CREATING A SELF-REFLECTION WALKING ROUTE TO IMPROVE STUDENT WELLBEING

BACHELOR OF SCIENCE THESIS CREATIVE TECHNOLOGY

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Abstract

In the past decade, there seemed to be an increased focus on students' mental health, both in the media and in universities. A University of Twente (UT) research from 2019 concluded that a third of their student respondents showed mild symptoms of depression, anxiety, or both. Studies seem to call even more urgently for strategies to support young people's mental health and wellbeing. This study aims to provide a solution to this decreased mental wellbeing of students.

Implementing personal self-reflection could be a possible solution. Self-reflection can help students to improve their wellbeing by becoming aware of thoughts, feelings, and behavior. However, students are not yet aware of the possibilities of self-reflection or do not know how to start using it.

The challenge of this study is to develop a system and to design and implement this system in a way that introduces and supports suitable proven personal self-reflection techniques to students through which they will be guided towards a perceived improvement in their wellbeing.

Through ideation and specification, the focus of the project shifted to what appeared to be most important when introducing self-reflection to students: sparking the interest of students in self-reflection and subsequently retaining their motivation to keep practicing self-reflection. A solution might be the self-reflection walk: A walking route on the campus of UT that incorporates signs with QR-codes that link to self-reflection prompts on a web page. Four different types of self-reflection methods were integrated in this prototype of the self-reflection walk. 80% of the students' interest were sparked by the system and all users expressed willingness to use the system again.

The realized prototype is a great starting point for actually implementing the self-reflection walking route. The results show that the self-reflection walk succeeded in sparking the interest of students in self-reflection methods.

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Abbreviations

SWIP	Student Wellbeing Project
UT	University of Twente
WHO	World Health Organization
RQ	Research question
BSA	Binding Study Advice
SUS	System Sustainability Scale
FR	functional requirement
NFR	non-functional requirement

1 Introduction

In this chapter the context of the current status of the student wellbeing and personal self-reflection is shown. Firstly, an introduction is be given regarding the necessity of this project. Additionally, to prevent confusion about the viewpoints present in this project, it is important to have a clear definition of personal self-reflection techniques and mental health and wellbeing. The research questions are be stated and explained, and the chapter is wrapped up with an outline of this report.

1.1 Context and Relevance

A University of Twente (UT) research (2019) [1] concluded that a third of their student respondents showed mild symptoms of depression, anxiety, or both. This number is higher than in other student populations in comparable studies [2]. Annet de Kiewit, the project leader of Student Wellbeing Project (SWIP) of UT and study advisor at UT, acknowledges the hectic study life of student nowadays: “Their busy lives, also due to social media and a higher standard of living, is a problem for students” [3]. Some groups of students are at risk of experiencing even more mental health issues: “Females, international students, students who identify as LGBT and students who reported illness or disability that decreased their ability to study” [1, p. 4].

Due to the Covid-19 regulations [4] in the Netherlands, there have been changes in higher education, lifestyle, and social relationships over the past one and a half years. There was no physical education for months, the study progress of some students has been delayed, the quality of online education was substandard, and the financial impact is significant [5]. These changes have decreased the perceived levels of well-being of students even more. Next to that, it is observed that students who priorly suffered from depression are experiencing even greater stress and anxiety during this lockdown [6]. Access to care for depression, anxiety, and other mental illnesses is often hampered by social stigma and affordability. This is of particular concern for vulnerable populations, such as students. Additionally, not only do depression and anxiety lead to mental struggles, but some physical symptoms are also related to mental problems, for example, somatic syndromes [7] and bad sleep quality [8]. Students at UT experienced significantly more somatic symptoms during Covid-19, with the most frequently occurring symptom being: “feeling tired or having low energy, trouble sleeping, headaches, and back pain” [2, p. 3].

In the past decade, there seemed to be an increased focus on students’ mental health, both in the media and in universities. The student wellbeing crisis is increasingly acknowledged and has only intensified with the Covid-19 crisis. Studies seem to call even more urgently for strategies to support young people’s mental health and wellbeing [2], [6], [9]. Combined, this states the need for strategies to improve student wellbeing, making this project highly relevant.

Personal self-reflection could be a solution to reduce (some of) the aforementioned symptoms. Personal self-reflection is self-reflection related to personal life, about bout someone’s identity and desires. Research has shown supportive evidence for self-reflection accompanied by valuable insights [10], as will be elaborated on in section 2.1. Practicing self-reflection can lead to insights in the moment of practicing, but could also contribute to an improvement in the ability to reflect. This report is about designing a system that includes the use of personal self-reflection, which can guide students towards an improvement of their wellbeing. By practicing self-reflection, it is possible to notice symptoms of depression and anxiety earlier on and partially prevent these symptoms.

Unfortunately, many students are not aware of the possibilities of practicing self-reflection or are not familiar with existing techniques to practice self-reflection. A self-reflection system could help to introduce students to self-reflection techniques. Such a system could give students the possibility to get acquainted with self-reflection techniques and could additionally support the development of necessary self-reflection skills.

Students' mental health is an essential part of student wellbeing. Although, some students perceive a stigma on mental health [11]. In an interview, Annet de Kiewit indicated that students indicate they do indeed perceive this stigma, which is described in section 2.3.1. Students can feel a sense of social isolation associated with the stigma of mental illness and are often unwilling to seek help because of this perceived stigma. This stigma causes this by two kinds of harm: It diminishes self-esteem and robs people of social opportunities [12]. Additionally, social stigma is positively associated with psychological distress [13]. This means that the presence of the stigma around mental health itself contributes to the psychological problems that are observed. Aside from presenting possibilities to help students improve their wellbeing using personal self-reflection techniques, this study will also raise awareness for the topic of student wellbeing and students' mental health, and contribute to open conversations about how we feel, and ultimately contribute to the de-stigmatization of mental health.

Technology opens new possibilities of accessing personal self-reflection techniques at any time and place. Technology will be explored as possible applications to serve not only as provider of but also introducer to personal self-reflection techniques.

This project is developed for a client, the Student Wellbeing Project (SWIP) at UT [14]. In 2018, the wider topic of student wellbeing was introduced within universities and UT decided at that point to integrate a wider student wellbeing plan: the SWIP project. The goals of this project are to increase the accessibility of information about student wellbeing and to increase the mental health support available to UT students [15]. This project aims to contribute to both goals, and therefore the SWIP fits well as a client.

1.2 Personal Self-Reflection

In this section, it will be explained why personal-focused self-reflection is the main focus of this project. The author will tell a personal experience.

Eva Lahuis: "In 2018 I started Creative Technology at UT. During my first year, I discovered the concept of bullet journaling. Bullet journaling, also known as BuJo, is originally a method of personal organization developed by the designer Ryder Carroll [16]. At first, I started using bullet journaling as the intended 'planner' method in my studies, but it let me discover multiple self-reflection techniques over time. Over two years, I discovered these techniques gradually and practiced them for a few days, weeks or even months. A list of the techniques I discovered is displayed in Table 1.1 (the techniques relevant to this project are explained in more detail in later chapters).

Table 1.1: A list with (personal) self-reflection techniques

(personal) Self-reflection techniques	
• journaling • asking reflective questions • habit and mood tracking • grading days • time tracking • goal setting and evaluation • favorites lists • gratitude practice • mindfulness	• coming up with challenges and keeping track of the progress • meditating • daily, weekly, and yearly reflections • analyzing habit patterns • choice reflection • scrapbooking • energy levels • labeling activities

I wanted to learn more about these techniques and I started to watch videos and read books that included one or multiple topics. I noticed a powerful shared characteristic of most of these techniques: they guide you to self-reflection or are self-reflection techniques themselves. However, I noticed during my

studies that very few students practice one or more of these self-reflection techniques in their personal life. With this project, I want to increase awareness about the relevance of using self-reflection techniques. An additional personal motivation that led to the proposal and execution of this project is the present stigma surrounding mental health, as discussed in section 1.1. I want to contribute to open conversations about how we feel and about our mental health, and in this way contribute to the destigmatization of mental health."

1.3 Definitions

To ensure correct understanding of components of this study and the way they are presented, the definitions of personal self-reflection techniques and mental health are given in this section.

1.3.1 Included Personal Self-Reflection Techniques

Self-reflection techniques are most often researched and applied in educational or work-related situations. In this study, the focus is on practicing self-reflection techniques targeted at the personal life of the students. The following definition from Dewey (1910) of self-reflection has been used for over a century:

> *"Active, persistent, and careful consideration of any belief or supposed form of knowledge in light of the grounds that support it, and the further conclusions to which it tends, constitutes reflective thought."* [17, p. 6]

As Dewey's definition highlights, reflection requires active engagement with our feelings, thoughts, and experiences to conclude our actions, thoughts, character, and, ultimately, foster self-knowledge [18]. In this study personal self-reflection techniques will be understood as:

> *Activities where students collect and reflect on personal data (feelings, thoughts, and/or experiences) to gain a better understanding of themselves and their capabilities, character, feelings, or motivations and can foster changes in behavior and/or thoughts* [19].

1.3.2 Mental Health and Wellbeing

The World Health Organization (WHO) has defined mental health in 2004 as:

> *"Mental health is described as a state of well-being in which every individual realizes his or her own potential, can cope with the normal stresses of life, can work productively and fruitfully, and is able to make a contribution to her or his community."* [20, p. 10]

But Galderisi et al. have proposed a new definition of mental health in 2015:

> *"Mental health is a dynamic state of internal equilibrium which enables individuals to use their abilities in harmony with universal values of society. Basic cognitive and social skills; ability to recognize, express and modulate one's own emotions, as well as empathize with others; flexibility and ability to cope with adverse life events and function in social roles; and harmonious relationship between body and mind represent important components of mental health which contribute, to varying degrees, to the state of internal equilibrium."* [21, p. 1]

WHO's definition of mental health identifies positive feelings and positive functioning as key factors for mental health, which raises several concerns and lends itself to potential misunderstandings. On the other hand, the definition from Galderisi et al. [21] is in favor of an inclusive approach and as close as possible to human life experience: "… which is sometimes joyful, and at other times sad or disgusting or frightening; sometimes satisfactory, and at other times challenging or unsatisfactory" [21, p. 2]. This proposed definition is also more compatible with this study because it suggests that "… recovery after an illness is seen as a process aimed to attain a fulfilled and valued life by building on the functions spared by the illness" [21, p. 3]. This is why the definition of Galderisi et al. [21] for mental health is used in this research.

The difficulty of defining wellbeing is widely described. Although the definition of WHO lacks in bearing relation to the struggles of real people in an imperfect world, their definition of wellbeing plays a crucial role in the definition of health: “Health is a state of complete physical, mental and social well-being and not merely the absence of disease or infirmity” [22, p. 1]. An often-used short textual definition of wellbeing includes: “The appraisals individuals make about the quality of their lives” [23, p. 1]. This definition is almost similar to the WHO’s definition of mental health.

In 2012, Dodge et al. [24] proposes a new visual definition of wellbeing after reviewing existing definitions. This new definition is displayed in Figure 1.1, and includes this definition of wellbeing: the balance between psychological, social, and physical resources and challenges. Additionally, it illustrates the connection between the different parts of wellbeing: psychological, social, and physical wellbeing. As can be seen, this definition of wellbeing resembles Galderisi et al.’s [21] definition of mental health.

Figure 1.1: Definition of wellbeing, as illustrated in [24, Fig. 4]

The definitions of mental health and wellbeing are closely related. In this project, the terms mental health and wellbeing will be used interchangeably.

1.4 Challenges

There is not yet a system focusing on UT students which introduces and/or provides personal self-reflection techniques to these students, while there might be more concerns about their wellbeing than ever before. This leads to formulating the main challenge of this thesis, which is to develop a chosen type of system and to design and implement this system in a way that introduces and supports suitable proven personal reflection techniques to students through which they will be guided towards a perceived improvement in their wellbeing.

Some challenges might come up when designing a certain system. First of all, students often have a busy lifestyle including (full-time) studying, possibly a side job, being active in an association, attending sports, and an (active) social life. This means the possible usage of this system is limited by the available time of students. It will be a challenge to show students that this system deserves priority.

The second challenge is the choice of a suitable and effective format for the system. The format of the system should make it possible to reach students but also support the presentation of the personal reflection techniques.

Thirdly, the system should motivate students to use the system regularly to increase the possible benefits of practicing self-reflection techniques.

A fourth aspect that might also influence the choice of a suitable system, is determining the exact user group of the system and reaching this group. For example, the number of previous experiences with self-reflection techniques of the user group will influence the design and implementation of the system.

A fifth critical aspect is the added value of this new system. There are existing systems and applications with a focus on one or multiple self-reflection techniques. These systems will influence the design of this system, based on good or bad features and design elements already used. This is discussed in section 2.4.

The sixth aspect is that the system is not meant to be and should not give the impression that it is a replacement for professional health care. If this would be the case, the consequences might be severe as dealing with mental health issues can potentially be very risky and cause adverse effects if not conducted properly.

Lastly, some students, or the people in their environment, might still think of working on mental health as a taboo and may feel disinterest to use the system. However, developing this system will contribute to the acceptance and promotion of the importance of mental healthcare.

1.5 Research Questions

To specify the above-mentioned challenges two research questions (RQs) have been formulated. The first RQ focuses on gaining insight into personal self-reflection techniques and the current state of the art of personal self-reflection applications. This RQ is also supported by two sub-questions.

- RQ1: How can proven personal self-reflection techniques be introduced and provided to students such that they are guided towards a perceived improvement of their wellbeing?
    - RQ1.1: What are relevant proven personal self-reflection techniques that can be implemented to guide students towards an improvement of their wellbeing?
    - RQ1.2: How can a self-perceived improvement in the mental health of students be measured?

The goal of RQ1 is to gain insight into proven self-reflection techniques focused on the personal life of the students. The practiced self-reflection will let the students focus on themselves and their wellbeing. Additionally, the goal is to gain insight into how these techniques can be introduced and provided to students so they are guided towards a perceived improvement in their wellbeing. For this, sound knowledge about proven self-reflection techniques and their current applications is necessary to make a well-founded choice for certain techniques in a later stage of the system development. This is formulated in the first sub-question. The second sub-question contributes to measuring the effects of the designed system and may help giving feedback on it.

The second research question builds upon the first and focuses on the system that will be created as the final product.

- RQ2: How should a personal self-reflection system be designed and implemented to introduce and support usage of self-reflection techniques?
    - RQ2.1: Which format(s) should be chosen for the system to spark the interest of students in self-reflection?
    - RQ2.2: How can students be motivated to use (the) self-reflection (system) regularly?
    - RQ2.3: Which group of students is the actual potential user group of this system?

The goal of RQ2 is to cause impact by contributing to the improvement of perceived wellbeing from students through the design and implementation of a system. The first sub-question is about contributing to the choice for the type of system is designed. The system should spark the interest of students in self-reflection, so that students will be motivated to continue to use the system and/or self-reflection techniques. Furthermore, the second sub-question is about reaching students and stimulating them to use the system regularly, which is often a prerequisite for self-reflection techniques to contribute to an improvement in wellbeing, more about this is explained in section 2.1. The third sub-question is formulated to investigate and specify the actual user group that is targeted to benefit from the results of this project.

1.6 Report Outline

The structure of the rest of the report will be described here. The first part of this report focuses on introductory topics. It incorporates chapter 1, an introduction about the relevance, the goal, and the corresponding research questions. Chapter 2, includes background research and state-of-the-art research that explores related and similar applications. This second chapter aims to gain background information, which can be used in the ideation phase and which may contribute to answering RQ1 and its sub-questions.

The second part of the report focuses on the development of the self-reflection system. It starts with chapter 3, which includes the methods and techniques used in the development of the system. Next is chapter 4, which includes the ideation phase. This chapter includes the first ideas and the first iteration of the requirements from a user's point of view. These are taken to the next chapter, the specification, where the ideas and the requirements are developed further. The realization of the self-reflection system is described in chapter 6 and includes the components and the functionalities of the self-reflection system. In chapter 7, the final prototype is evaluated using a functional test, a user test, an expert test, and a non-functional test. Finally, in chapter 8 the conclusions is given, the research questions are answered and recommendations for future work are made.

2 Background Research

This chapter includes the background research conducted for this project about personal self-reflection techniques, the current relationship between students and these techniques, and a state-of-the-art of existing (personal) self-reflection applications. This background research will partly answer RQ1, RQ1.1, and RQ1.2.

The order of this chapter is as follows: First, the research of scientific literature is presented which provides insights into how students can practice self-reflection techniques so they perceive an improvement in their mental health. Secondly, the most important findings of the conducted survey ‘What activities make you feel good?’ are presented. This questionnaire helped identify what activities students currently perform to make them feel good. In the questionnaire, some activities are mentioned that include personal self-reflection techniques. The familiarity with and interest in these techniques are discussed. Thirdly, findings from an interview with Lea Berkemeier, who assisted in the SWIP, are discussed. Finally, different applications which include personal self-reflection will be discussed.

2.1 Literature Research

The literature research is conducted to show how personal self-reflection techniques can be employed to improve mental health. Therefore, the goal of this research is to gather knowledge and insight into the factors that influence the performance of the personal self-reflection techniques regarding mental health improvement. The research is meant to point out different important factors which are of influence when students are introduced to and practicing personal self-reflection.

This literature research starts with the selection of relevant self-reflection techniques. To gather enough knowledge and insight into the to-be-chosen self-reflection techniques but at the same time stay within the time constraint of this project, four techniques were picked to be researched. As a starting point, the established list with self-reflection techniques in section 1.2 is used. The main selection criterium for the techniques isthe identified number of articles in May 2021 in the database search of Scopus [25]. The techniques are first explored with queries in the Scopus search, of which the most representable one is chosen. During the whole search process, the Scopus settings were not adjusted, which the [26] Scopus database research. The resulting number of articles can indicate the popularity of the technique and the possible availability of relevant research.

First of all, the techniques are entered in Scopus one by one. Some techniques are removed from the list because they are too vague or do not get matching results: ‘time tracking’; ‘goal setting and evaluation’; ‘favorites lists’; ‘coming up with challenges and keeping track of the progress’; ‘choice reflection’; ‘energy levels’; and ‘labeling activities’. Secondly, three techniques are removed from the list because of their low number of database results: ‘analyzing habit patterns’ (6 results); ‘daily reflection’ OR ‘monthly reflection’ OR yearly reflection (58 results), ‘scrapbooks OR scrapbooking’ (144 results). From the six remaining techniques, four techniques are selected for this background research.

‘Mindfulness’ and ‘meditation' are removed from the list for multiple reasons: there is already a lot of attention and research for these techniques in the last years (in the Scopus database ‘mindfulness’ returns 19.190 document results and ‘meditation’ 17.759). Besides, these techniques are different from the other four techniques. ‘Journaling’ (1457 results); ‘gratitude practice’ (648 results); ‘habit tracking’ (966 results) and ‘mood tracking’ (766 results) are often practiced together, for example in Bullet Journaling[16]. These final four personal self-reflection techniques are investigated.

The used definition for personal self-reflection is described in section 1.3. Finally, a conclusion is drawn based on the gathered information.

2.1.1 Personal Self-Reflection Techniques

Journaling
Journaling, also called creative writing, is a personal self-reflection technique that can improve mental health. This type of writing can be a powerful means of expression: Bolton [27, p. 1] describes that creative writing allows the writer for "exploration of cognitive, emotional and spiritual areas otherwise not accessible. The very act of creativity – of making something on the page which wasn't there before - tends to increase self-confidence, feelings of self-worth, and motivation for life." Journaling often includes writing stories, poetry, metaphors, fiction, journals, and memoirs. Cooper [28] researched two models of creative (physical) writing for people with depression. Cooper [28] demonstrates the benefits of the first model: increased self-knowledge and increased distance from painful emotions. This model included a six-session course on Using Writing as Therapy (UWaT). Cooper's [28] second model was called Creative Writing (CW) and included a 2 ½ hour weekly creative writing session without specific protocol. After six weeks, a comparison between a pre and post questionnaire showed an increase in enjoyment and in sense of belonging, which can both be seen as an increase in mental health.

Another research, by Haertl and Ero-Phillips [29], also supports the potential of journaling to improve mental health. This research shows the power of (physical) written expression in "perspective taking, enhanced understanding of the self and others, the spiritual nature of writing, and the promotion of health and healing" [29, p. 1]. An important characteristic of these outcomes is the long-term effect. These mental health benefits from Haertl and Ero-Phillips [29] were found in twelve interviews with individuals who engaged in personal writing for a minimum of three years. The effects of journaling on the short term, are thus still uncertain.

The effectiveness of journaling can vary on the presence of guidance by a professional and the practice frequency. The first model researched by Cooper [28], UWaT, consists of a weekly journaling session guided and observed by a therapist. Despite its effectiveness in improving mental health, it might be challenging when it is required to integrate the guidance of a therapist in the personal self-reflection application. However, the second creative writing model researched by Cooper [28] also shows mental health improvements without the integration of a therapist. Thus, it seems not necessary to integrate the guidance of a therapist in the application. Unfortunately, [29] did not include results about the journaling frequency of the participants. However, from both Cooper models [28] the conclusion can be drawn that creative writing can lead to benefits by practicing it weekly, which is an interesting finding. It might implicate that it is not necessary to journal daily, which might contribute to the decision of integrating journaling into the application. In short, journaling seems to be an effective personal self-reflection technique because of the power to improve mental health in the short and long term when practised weekly.

Gratitude Practice
Gratitude practice is a second personal self-reflection technique that can improve mental health. Gratitude practice can be explained as counting and focusing on blessings, rather than burdens: blessings being the aspects of life to be grateful for and burdens being the complaints about life [30]. Emmons, McCullough [30], and Froh [31] demonstrate that writing about blessings, daily, reliably produces higher levels of positive affect. This means that gratitude practice can contribute to improving mental health: Since low levels of positive affect are correlated with anxiety and depression, this personal self-reflection technique reduces anxiety and depression [32].

The practice frequency is one of the three factors that influence the effectiveness of gratitude practice. Emmons and McCullough [30] compared two studies which include writing about the aspects of life being grateful for, in which the first study focused on daily practice and the second one on weekly practice. This research demonstrates that through gratitude practice on daily basis, higher levels of pleasant affects are more pronounced. Froh [31] applied another practice frequency in the study, between daily and weekly: the participants took part in five gratitude sessions in two weeks. Because the studies [30], [31] use other measurement variables and techniques, it is difficult to compare the gratitude practice frequency between these studies. However, it can be summarized that that daily gratitude practice is preferred by Emmons and McCullough [30], but mental health improvement is also achieved when practiced every other day or weekly.

Next to the practice frequency, two other aspects influence the effectiveness of gratitude practice: the choice to integrate the guidance from a professional or not and the mental state of the participant before starting gratitude practice. A challenge that might come up while designing the personal self-reflection application might be the choice of guidance method for the techniques. In Froh's [31] study, the gratitude practice sessions are accompanied by an instructor. As stated before, the requirement of integrating the guidance from a professional in the application would be challenging. However, both studies of Emmons and McCullough [30] show that the participants practiced gratitude without guidance. Since this also leads to mental health improvement, the integration of a professional does not seem a prerequisite. The last aspect that influences the effectiveness in improving mental health originates from Froh's study [31]. The author shows that youth that is low in positive affect reported greater gratitude and increased positive affect after the gratitude sessions, and also at the two-month follow-up. As Froh [18, p.1] states: "People high in positive affect may have reached an 'emotional ceiling' and, thus, are less susceptible to experiencing gains in well-being." Thus, a limit of gratitude practice seems to be a high level of positive affect at the start of practicing, because these people are less prone to experience gains in mental health.

Habit Tracking

Habit tracking is a third personal self-reflection technique that can improve mental health. Abtahi et al. [33] describe habit tracking as self-tracking, which enables the user to record and analyze their personal data. Habit tracking can be done both manually and by the use of sensors, for example in a smartwatch. Examples of habits tracked manually are exercising, pain, water drinking, and food consumption. Sensory inputs could be step count, sleep, and weight. Habit tracking is mostly done individually, without an external instructor [33], [34]. Bentley et al. [34] show the power of habit tracking in supporting an increase in self-understanding that leads to focused behavior changes. Additionally, this study [34] demonstrates a significant improvement in participant's mood by practicing habit tracking. Although Abtahi et al. [33] did not target their research specifically on the effects on mental health, both digital and physical tracking were compared.

The application format, a digital tool or physical tracking, is one of the three factors that influence the effectiveness of habit tracking. In a study by Bentley et al. [34], a mobile application was used to track habits, while in the study of Abtahi et al. [33], bullet journaling was analyzed to practice habits. To clarify, the definition of bullet journaling is given: The definition of bullet journaling used by Abtahi et al. is retrieved from the website [16] of the designer Ryder Carrol: "Bullet Journaling (BuJo) is a freeform, analog logging system for organizing tasks, events, and notes, designed to facilitate a productive and reflective lifestyle." Abtahi et al. [33] demonstrate that physical habit tracking in a bullet journal is a productive creative outlet, where the slow pace gives more time to tackle mental health challenges and helps to reflect on hard to quantify data, such as observations and

pain level. On the other hand, a big concern of the bullet journalists was the increased chance of losing their data, which risk is lower using digital tools [33].

Another limitation was found by Abtahi et al.: “Physical trackers are not commonly used for long-term retrospective reflection” [33, p. 15]. Besides, some interviewees use a digital tool next to a physical bullet journal. The most important reason for this is the notifications on mobile phones [33]. After tracking information in a digital tool, the data is copied to the bullet journal. A final limitation, the mobile application from Bentley et al. [34] did benefit from the identified connections that were displayed in this application. An example could be the correlation between experienced pain and the amount of sleep, the displayed observation could then be: ‘You have less pain on days when you sleep more.’ A bullet journal is often an empty notebook, sometimes including some templates [33]. The limitation of these notebooks in comparison with a mobile application is the absence of technology. Connections between habits should be made by bullet journalists themselves, which means an extra step needs to be taken before actually making changes. Therefore, all the benefits and limitations of physical habit tracking together seem to advise against implementing habit tracking in a bullet journal.

Next to the choice of application format, the second aspect that influences the effectiveness of habit tracking is the practice frequency. The participants in the study from Bentley et al. [34] were expected and motivated to track their habits every day, and often used the application more than one time a day. Although Abtahi et al. [33] did not look into the practiced frequency of the bullet journalists, it can be assumed the bullet journalists tracked their habits every day because all the (filled in) trackers were asking for daily input. It can be concluded that daily is the preferred practice frequency for habit tracking. The time it takes per day is depending on the number of habits that are tracked. In [33] it took the participants an average of three minutes and in [34] the practice time was not mentioned.

The last aspect that influences the effectiveness of habit tracking is the inclusion of notifications. Bentley et al. [34, p. 23] highlight the importance of making changes: the mood improvement seemed to be in some parts explained by “understanding the correlations between food, sleep, activity, and mood over time and making changes that contributed to being in a better mood.” Next to tracking habits, it seems to be a prerequisite to get insight into these habits and accordingly make changes to contribute to being in a better mood. Important factors in this highlight by Bentley et al. [34, p. 23] were reminders and other notifications: “…reminders and other notifications were necessary to increase engagement to a point where enough data would be provided such that observations would be statistically significant and remain significant over time.” When deciding to integrate habit tracking, it is recommended that a trigger is implemented, for example in the form of a notification.

Mood Tracking

Mood tracking is a fourth personal self-reflection technique that can improve mental health. Mood tracking can be described as mood recording, where a person records their mood to identify patterns. Mood tracking is sometimes included in the previously discussed personal self-reflection technique, namely habit tracking. Mood tracking has multiple similarities with habit tracking, but the most important difference is the simplicity: it takes a lot less time and effort than habit tracking and is still a reflection technique that can be practiced to increase mental health [35]. Additionally, mood tracking leads to mental health improvement in slightly different ways. Thach [36] performed a study on mobile applications focused on mental health improvement, whereof a part of these applications had the option to track mood. Thach [36] shows that users from these mood-tracking applications felt more self-conscious and happy. Additionally, these users thought their life was more organized, their mood was more under control and they could sometimes avoid the sense of loneliness [36]. Another study by

Ferrario et al. [35], had other outcome factors, which also lead to an improvement in mental health. They demonstrate that practicing mood tracking via a mobile application can provide relief in anxiety management, through bringing relief, reflection and distraction.

Two of the three aspects that influence the effectiveness of mood tracking are the practice frequency and the inclusion of notifications. While habit tracking has a daily preferred practice frequency, mood tracking has a preferred practice frequency of multiple times a day. Torkamaan and Ziegler [37] show the requirement of using a two-daily mood tracker, to capture specific mood states. These specific mood states increase the ability to reflect, in contrast to weekly measures that only capture an overall mood. Additionally in a study from Ferrario et al. [35], the participants were even encouraged to enter their mood multiple times a day, into the selected application, because multiple mood recordings per day would increase the reflection level of the user. Another important factor highlighted by Ferrario et al. [35] is the addition of notifications to a mood tracking application. There should be a trigger implemented in this application for the user to be reminded about registering their mood, comparable to habit tracking. Torkamaan and Ziegler [37] also implemented these notifications into their mood tracking application. A third important aspect for users of mood tracking is seeing correlations, which is necessary to make changes in life. Ferrario et al. [35, p. 1] highlight two reflection methods: “We stress the importance of sense-making present to the interaction, in addition to shared and delayed reflection.” When choosing to integrate mood tracking in the application, there should be searched for methods to support this insight in correlations of the users.

A final aspect influencing the effectiveness of mood tracking is the number of questions asked to determine the mood of a participant. Torkamaan and Ziegler [37] show that the total number of questions participants had to answer about their mood, were independent of the dropouts from the study. Since more questions per mood entry increase the amount of data and therefore the ability to reflect, it is recommended to increase the number of questions when integrating mood tracking in the application.

2.1.2 Conclusion

The goal of this literature research was to get insight into how personal self-reflection techniques can be employed to improve mental health. At first, the choice was made for four personal self-reflection techniques. The techniques that are covered in this study are journaling, gratitude practice, habit tracking, and mood tracking.

The first personal self-reflection technique covered in this study is journaling, also called creative writing, which is an effective technique to improve mental health. An important characteristic of journaling is the long-term effect. Journaling is a self-reflection technique that is sometimes accompanied by a professional, however, it seems unnecessary to integrate the guidance of a therapist in the application. Journaling seems to be effective in improving mental wellbeing when practiced at least weekly.

The second personal self-reflection technique covered in this study is gratitude practice. Gratitude practice can be explained as counting and focusing on the aspects of life to be grateful for, in contrast to the complaints about life, and is an effective technique to improve mental health. The recommended practice frequency is daily, but mental health improvement can also be achieved to a lesser extent when this technique is practiced every other day or weekly. Gratitude practice is a self-reflection technique that is sometimes accompanied by a professional, however, this is not a prerequisite. A final important aspect to take into account is the level of positive affect of the students that will use the application because people with a high level of positive affect are less likely to experience gains in mental health. It is recommended to conduct further research on the level of positive affect of students when integrating gratitude practice in the self-reflection system.

The third personal self-reflection technique covered in this study is habit tracking. Habit tracking can be described as self-tracking, which enables the user to record and analyze their personal data, and is an effective technique to improve mental health. The recommended practice frequency is daily. A choice that should be made when integrating habit tracking in an application, is the format of the application. Considering the benefits and limitations, it is recommended to use a digital tool instead of a physical tracker for habit tracking. The last recommendation is to integrate a trigger, like a notification, when implementing habit tracking. This seems to be a prerequisite to get insight into habits and accordingly make life changes.

The last personal self-reflection technique covered in this study is mood tracking. Mood tracking can be described as mood recording, where a person records his/her mood to identify patterns, and is an effective technique to improve mental health. It is recommended to practice mood tracking at least once a day, but preferred is even multiple times a day, to increase the ability to reflect. It is important to integrate a trigger, like a notification, when employing mood tracking. This is necessary to increase insight and making life changes accordingly, which is shared with habit tracking. A final aspect is a recommendation of using a higher number of questions to assess the user's mood. This increased number of questions will increase the ability to reflect while there is no correlation with more dropouts.

All four techniques could be employed in the personal self-reflection system. Choosing one or multiple of these techniques will be done in later phases of the project. To summarize, important characteristics to consider when implementing self-reflection techniques are:

- Repetition: it is important to repeat practicing self-reflection techniques.
- Frequency: effective practice frequencies can differ per technique, weekly or daily, or in between them are common.
- Triggers: it is helpful to integrate an external trigger like a notification on a smart device.
- Short or long term effect: these can differ per self-reflection technique, some techniques may guide to a mental health improvement in the short term, other techniques additionally work in the long term.
- Guidance of professional: this guidance could be beneficial for the self-reflection users, but could also make the system more complicated.
- Format: the system could (partly) be digital or on paper.
- The accuracy: the number of self-reflective prompts or questions answered matters. Answering more prompts or questions lead to a better assessment of the current situation but additionally takes more time.

2.2 Questionnaire

In this section, the results and conclusions of the questionnaire 'What activities make you feel good?' are given. This questionnaire was distributed to gather information about the current situation of students.

2.2.1 Results

This questionnaire "was created to get insight into the current mental health situation of the students. This questionnaire provides information about the current situation of activities performed by students to make them feel good, including some personal self-reflection techniques. Additionally, it provides insight into the attitude of students towards mental health, both in activities to improve mental health and the current status of mental health and education. The most important findings of the questionnaire will be summarized in this section. Appendix A includes the full questionnaire.

This questionnaire is completed by 43 students, aged between 17 and 26, 58% female and 41% male. The respondents are all studying at a higher education institution in the Netherlands, of which 61% study at the University of Twente, and most of them (53% of the total respondents) are studying Creative

Technology. The majority of them is studying for three years (42%) or five years (23%), but on the whole it varies from one till seven years. 95% of the respondents are originated from the Netherlands and live in the Netherlands, and most of the respondents live in a student home with housemates.

One of the important findings of the questionnaire is the fact that most personal self-reflection techniques are never practiced by the majority of the respondents (Figure 2.1). This complies with the finding that students might not be familiar with these techniques, or do not know how to start implementing them.

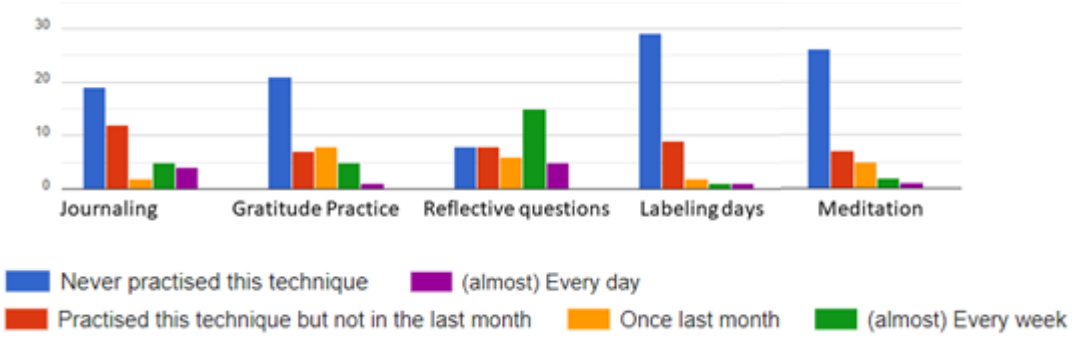


Figure 2.1: Questionnaire: practice or participation frequency of activities

Another important finding of the questionnaire is the lack of education about mental health while the importance is stated, see Figure 2.2 and Figure 2.3. 72% of the respondents think the amount of education about their mental health in their study career is too low while 93% of the respondents reported that including the topic of mental health in education is somewhat (54%) or very (40%) important.

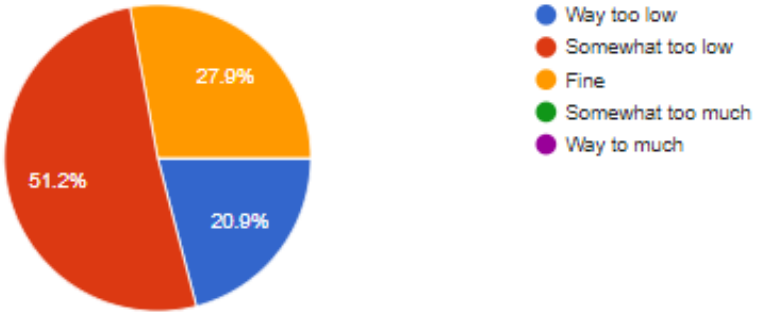


Figure 2.2: Questionnaire: Amount of education about Mental Health

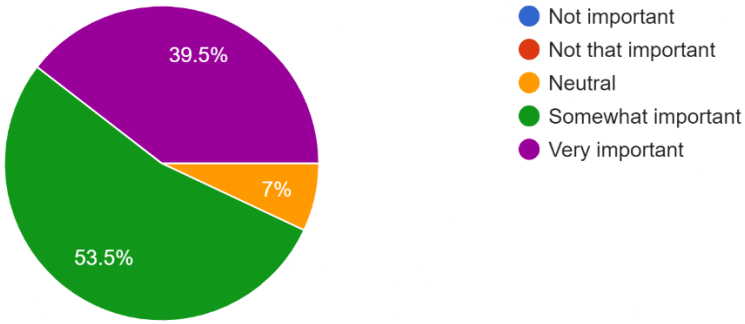


Figure 2.3: Questionnaire: Importance of including the topic of mental health in education

Additionally, a lot of students never participated in activities that included the topic of mental health, which can be seen in Figure 2.4.

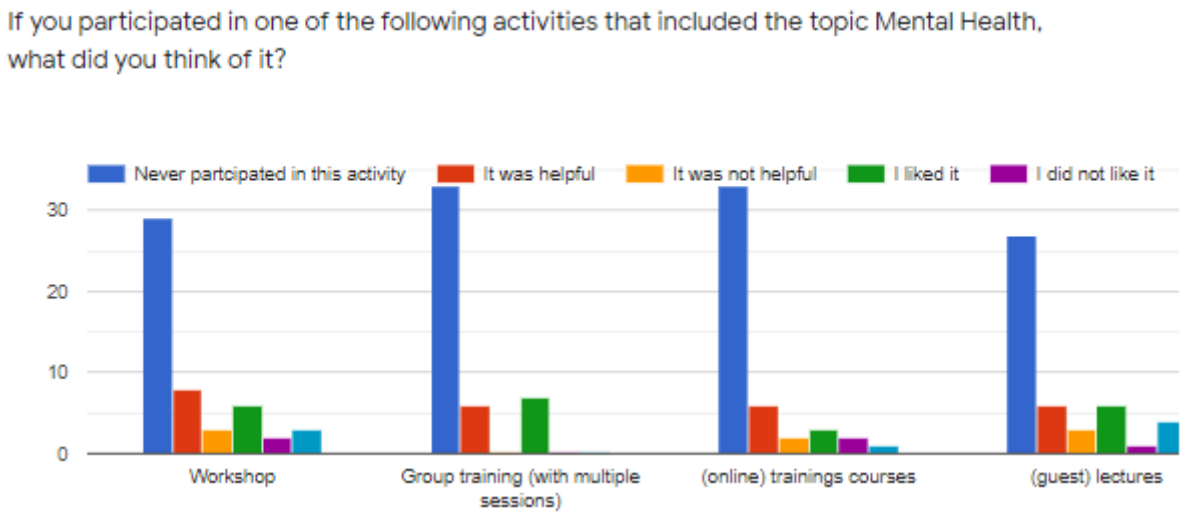


Figure 2.4: Questionnaire: Activities that included Mental Health

One question of the questionnaire asked: 'When does a new activity grasp your interest?' This question was often answered by 'a recommendation from a friend'. It seems that recommendations from friends about certain activities or grouping with friends during activities can be very powerful. Students highly value the opinion of friends or people they know.

> *"However, when studying becomes more serious focus on well-being can cause extra frustration, thus should become optional (yet normalized), especially since everyone's needs are different and people should be trusted to decide this for themselves."*
>
> *"I think it should be something voluntary … but it should be presented to you by your education."*
>
> *"I think it is important to include to the topic, but it should definitely not feel forced."*

These are some quotes from the answers to the question: "Do you have remarks about including the topic Mental Health in education?" It seems to be important to the students that a certain activity (to improve their mental health) should not be obligatory but free to choose. Freedom seems to be an important aspect to students regarding the choice when and if they want to be educated about certain mental health topics or not.

Other important findings of the questionnaire are:

- Most popular activities (to feel good) of students (practiced (almost) every day): watching films/series, listen to music, using social media, walking
- On average, half of the respondents is not interested in doing personal self-reflection activities. However, as mentioned before, most students never practiced or tried out these techniques. As found in literature in section 1.1, this result could (partly) be explained by the lack of awareness of the possibilities of practicing self-reflection or by the lack of familiarity with self-reflection techniques.
- An activity that was entered as being a missing activity that makes one feel good involves food: 'cooking' or 'eating good food' was entered by 21% of the respondents.
- On average, 70% of the respondents never participated in group activities that included the topic of mental health. From the respondents who did participate in these group activities, the conclusion can be drawn that a group training with multiple sessions is most liked and/or helpful.
- Important mental health topics for everyone: 86% of the respondents reported everyone should learn about their general wellbeing (in or outside education). 77% of the respondents reported

everyone should learn about 'How to get the help you need?' and 72% of the respondents reported everyone should learn about 'Types of mental issues'.

- 84% of the respondents reported that the topic of mental health should also be included in education, however, these respondents also think it is the student's responsibility to learn about mental health outside of education too.

For the complete overview of the results of the questionnaire, see Appendix A.

2.2.2 Conclusion

In this section, the important findings of the questionnaire are concluded. First of all, most students never practiced self-reflection techniques before, and might thus not be familiar with the techniques or are not motivated to use the self-reflection techniques. Most of the respondents reported that including the topic of mental health in education is somewhat (54%) or very (40%) important. On the other hand, most of the respondents think the amount of education about their mental health in their study career is too low. Most of the respondents never participated in activities that included the topic of mental health. Recommendations and feedback from friends and fellow students play an important role in getting interested in an activity.

2.3 Interviews

This section includes the results of two interviews conducted. First, the interview with the client, Annet de Kiewit, is included. The second interview is with Lea Berkemeier, who did a master Psychology at the University of Twente and works as a positive psychologist for the Student Wellbeing Project. These interviews are conducted to increase knowledge about the client and positive psychology.

2.3.1 Interview with Annet de Kiewit

Annet de Kiewit is study advisor of Mechanical Engineering at UT and project leader of the Student Wellbeing Project (SWIP), the client of this project. In 2018, the wider topic of student wellbeing was introduced within universities. UT decided at that point to integrate the functional impairment plan with a wider student wellbeing plan because the needs of students seemed more outspoken.

The founding of SWIP was accompanied by research [2] on mental wellbeing and substance use. One of the main findings of this research is that students do have many problems but not many students seek help. One question asked the students about whom they go to for help when experiencing mental health issues. The vast majority of the students go to their friends. Most students do have a strong social network where they can relate in case they have problems. The SWIP is trying to facilitate this current and maybe nature behavior of students of searching help with friends, and to start designing a system to professionalize students helping students.

There is some evidence that mental health issues have increased among students, but in the past, not much research was done. Annet de Kiewit said the number of students telling her they have mental problems increased the past year. However, according to her, it is the question of whether there are more problems or more students are talking about their problems.

Students indicate they do perceive stigma surrounding mental health. However, several years ago Annet did not meet students with panic attacks coming to her, but now she has several per year, and still, students say it is taboo to talk about mental health.

The discussion regarding teaching students about mental health is often about whether these should be integrated into the curriculum or be extracurricular. Annet de Kiewit thinks it's up to an organization like a university to think on how they can equip the future generation so that it's linked to education, so it cannot be fully individual an extracurricular

2.3.2 Interview with Lea Berkemeier

Lea Berkemeier did a master Psychology at the University of Twente and works as a positive psychologist for the Student Wellbeing Project. A textual record from the interview can be found in Appendix B, although this is in dutch. Lea just started with the research of creating a course that aims to increase the sense of belonging and decrease the fear of missing out (FOMO). The definition of FOMO is: “fear of not being included in something (such as an interesting or enjoyable activity) that others are experiencing” [38]. Thus, FOMO is the feeling that you can get when you are not present at a fun activity and includes experiencing anxiety.

Findings of the interview:

- Almost all students experience stress, however, the causes can be very different.
- Some students do think their mental problems are not big enough to ask help for. Other students think nobody else is experiencing the problems they are struggling with.
- The most vulnerable group for mental problems is the first year students. However, this group is very busy settling in their (often) very different new life. Therefore, students in module 4 of the first year, or early second-year students could be a good target group.
- Students like a combination of online and offline activities.
- Use a pre and post questionnaire to measure the effect of the application. These questionnaires could focus on measuring certain variables, such as FOMO or sense of belonging. Choose certain variables to measure an improvement in mental health.
- The stigma on mental health is probably more present in technical education. Because there is a lack of focus on mental health in technical education, there might be also a decreased focus on the topic outside of education.

The most important finding from this interview is that students do not know how to cope with mental problems. Students often recognize when they have mental problems, but do not know how to cope with them. They often try to flee from it or try to ignore the problems. Distraction is not the same as coping with mental problems. It could help to teach students different coping strategies.

2.4 State of the Art

In this section, a state-of-the-art of existing (personal) self-reflection applications is described. This state-of-the-art analysis is conducted to determine what applications already exist and determine the strengths and weaknesses of these applications.

2.4.1 Mobile Self-Reflection Applications

This section includes existing reflection applications. These applications are mobile applications (some of them are extended with a web application) that integrate one or multiple personal self-reflection techniques.

The applications were installed on a smartphone by the researcher, and used with the recommended frequency, which is displayed in Table 1.1. The applications were tested for a minimum of one week. Three applications are described and displayed in this section, the other applications can be found in Appendix C.

One of the applications is Ommetje, which is displayed in Figure 1.1. Ommetje, translated as (take a) stroll, is developed by Erik Schreder, a professor in neuropsychology. After taking a stroll, a fact about your mind will pop up in the application. The goal of the application is to make walking more fun and thereby keep your mind more healthy.

Figure 2.5: Application A: Ommetje [39]

Another application is the Loop Habit Tracker application, which is displayed in Figure 2.6. This application is suitable to track all your habits. In this application, you can enter your own habits. With daily reminders and insightful statistics, you can track and maintain these habits.

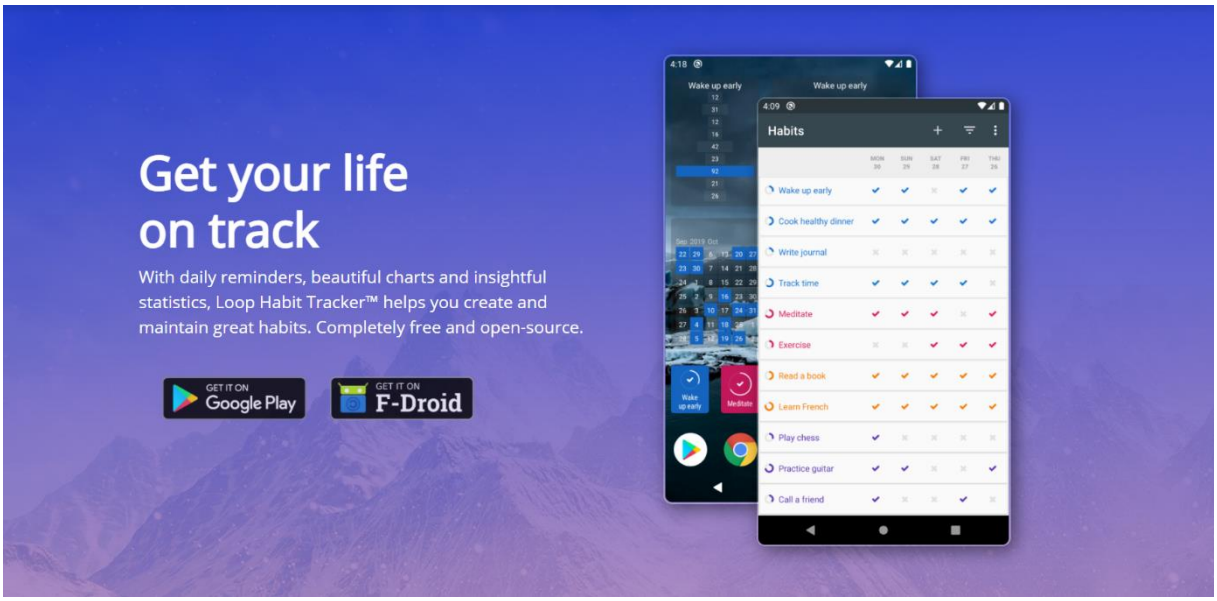


Figure 2.6: Application D: Loop Habit Tracker [40]

A third application is Salut, displayed in Figure 2.7. The Salut application allows one to measure their health. The application uses a combination of habit tracking and journaling to keep track of one's mental and physical health. By filling in some questions at the first usage of the application, some habits and questions are provided to the user.

Figure 2.7: Application G: Salut [41]

In Table 2.1, eleven applications are included which are graded with seven different features. The lowest grades applications are highlighted in orange and the best scoring applications are highlighted in green. The first one is the Google Play Store rating. This rating is copied from the Google Play Store. The other scores (the time to navigate, the settings options, the motivation, and the looks) are determined by the researcher after usage the application as described before. The second feature is which types of (personal self-) reflection are integrated into the application. The third feature of the application is the time it takes to navigate. A lower score means it takes much time to navigate the application.

The fourth feature included the options in settings. A good score means the application can be configured to personal preferences. This gives the user a lot of freedom. The fifth feature is the (practice) frequency. This is the frequency in which the application should be used, recommended by the application itself. The sixth feature is motivation. Applications that score low on motivation tend to punish the user for not opening or filling in the reflection tasks, the grades are an interpretation of the researcher. The final feature is the design of the interface of the application; a nice-looking interface got a higher grade.

During the search for applications to test, it became clear that there are a lot of (mobile) self-reflection applications already. However, these applications focus on practicing one or multiple reflection techniques, as designed by the creator of the application. Often it includes no integration of connecting with friends and no inclusion of a professional. Additionally, these applications usually do not introduce people to (different) self-reflection techniques so they can decide what works for them.

All the applications do not score well on motivation. The applications tend to punish users for not using the application as frequently as intended by the maker, instead of incentivizing them for opening the application. An application that is being known for its positivity when opening an application is Duolingo [42], this is however not a self-reflection application but an application to learn languages. Additionally, the freedom in the applications is often not existing or limited. To benefit from and to like practicing personal self-reflection, freedom and personal preferences are important. This does not agree with the tested applications.

Table 2.1: Matrix with eleven self-reflection applications

	APP/ features	Google Playstore Rating 0-5	Reflection types	Time to navi-gate 0-5	Setting options 0-5	Moti-vation 0-5	Looks 0-5	(practice) frequency
A	Ommetje Lopen [43]	3.0	informative prompt after walking	3	2	3	2.5	When walking
B	Atom [44]	4.9	meditations	3	2	3	3.5	Every day
C	Intellect [45]	4.8	journal, mood tracking	0.5	4.5	2.5	3.5	Every day
D	Loop Habit Tracker [46]	4.7	habit tracking	4	3	3	3.5	Every day
E	Level up Life [47]	4.0	habit tracking, mood tracking	2.5	3.5	1.5	2	Every day
F	Moodflow [48]	4.6	journal, habit tracking, mood tracking	2	4.5	2.5	1.5	Every day
G	Salut [49]	3.3	habit tracking, journal,	1.5	2.5	3	3	Every day
H	Youper [50]	4.5	questions, mood tracking, journal	5	3	3	2	Every day dag
I	Diarium [51]	4.7	journal, mood tracking	3	4.5	2.5	2	Every day
J	Ate [52]	- N/A (early access)	food, pictures of every meal	2.5	2	2	2	Every time eating
K	Fastic [53]	4.7	food, intermitted fasting	0.5	2	1	1.5	Two times a day

2.4.2 Conclusion

In this section, the conclusions from the state-of-the-art, self-reflection applications, the analysis will be given. A lot of self-reflection applications already exist, of which only eleven applications were analyzed.

However, multiple limitations of the applications were found. All applications score low on motivation because they tend to punish the user for not using the application as frequently as intended by the maker, instead of positively rewarding the user when using the system. Additionally, the applications lack in including connections (and therefore motivation) with friends (or other people). Some applications

lack freedom, and cannot be configured to personal needs. Next to this, most of the applications lack in inclusion of the guidance of a professional.

The two most important limitations are the lack of introduction to self-reflection and the motivational aspect. The applications lack in introducing the users to different techniques so they can decide what works for them. Additionally, the applications lack the motivational aspect. The applications seem to not sufficiently motivate users enough to actually keep using the self-reflection techniques regularly.

2.5 Conclusion

In this section, the conclusion from the background research is provided. Through literature research, the conducted questionnaire, conducted interviews, and the state-of-the-art analysis of self-reflection applications, a clear image is created. First, RQ1 and its sub-RQs will be partly answered, and secondly, some important findings will be described.

> **RQ1.1**: *What are relevant proven personal self-reflection techniques that can be implemented to guide students towards an improvement of their wellbeing?*

Journaling, gratitude practice, habit tracking, and mood tracking are relevant personal self-reflection techniques, according to the Scopus database assessment. From the literature research can be concluded that these four self-reflection techniques can contribute to an improvement in wellbeing of students.

Mindfulness and (mindful) mediations could additionally be relevant according to the Scopus database assessment but were not added to the literature research because of time constraints.

> **RQ1.2**: *How can a self-perceived improvement in the mental health of students be measured?*

According to Lea Berkemeier, it can be difficult to measure a self-perceived improvement in the mental health of students. It is common to use a pre and post questionnaire to measure the effectiveness of the system. These questionnaires could focus on measuring certain variables, such as FOMO or sense of belonging. More research should be done about which variables should be chosen to measure an improvement in mental health through using self-reflection.

> **RQ1**: *How can proven personal self-reflection techniques be introduced and provided to students such that they are guided towards a perceived improvement of their wellbeing?*

According to the literature research, it is important to consider the following characteristics when self-reflections are introduced and provided: repetition, practice frequency, triggers, short or long term effect, the guidance of a professional, format, and accuracy. Important factors to integrate into the self-reflection system for students are the connection with friends, a combination of online and offline activities.

Next to the partial answers to the research questions, some important findings for the development of the self-reflection system are found in the background research. The first findings include the potential target group: students in module four of the first year and module five and six of the second year. Secondly, the existing applications seem to miss out on the motivational aspect. RQ2.2 focuses on motivating students, this seems to be an important feature to focus on during the further development of the self-reflection system.

3 Methods and Techniques

This chapter includes the chosen methods and techniques that are used during this research. The choices for certain methods and techniques are additionally motivated.

3.1 Creative Technology Design Process

This research follows the Creative Technology Design Process as proposed by Mader and Eggink [54], and is shown in Figure 3.1.

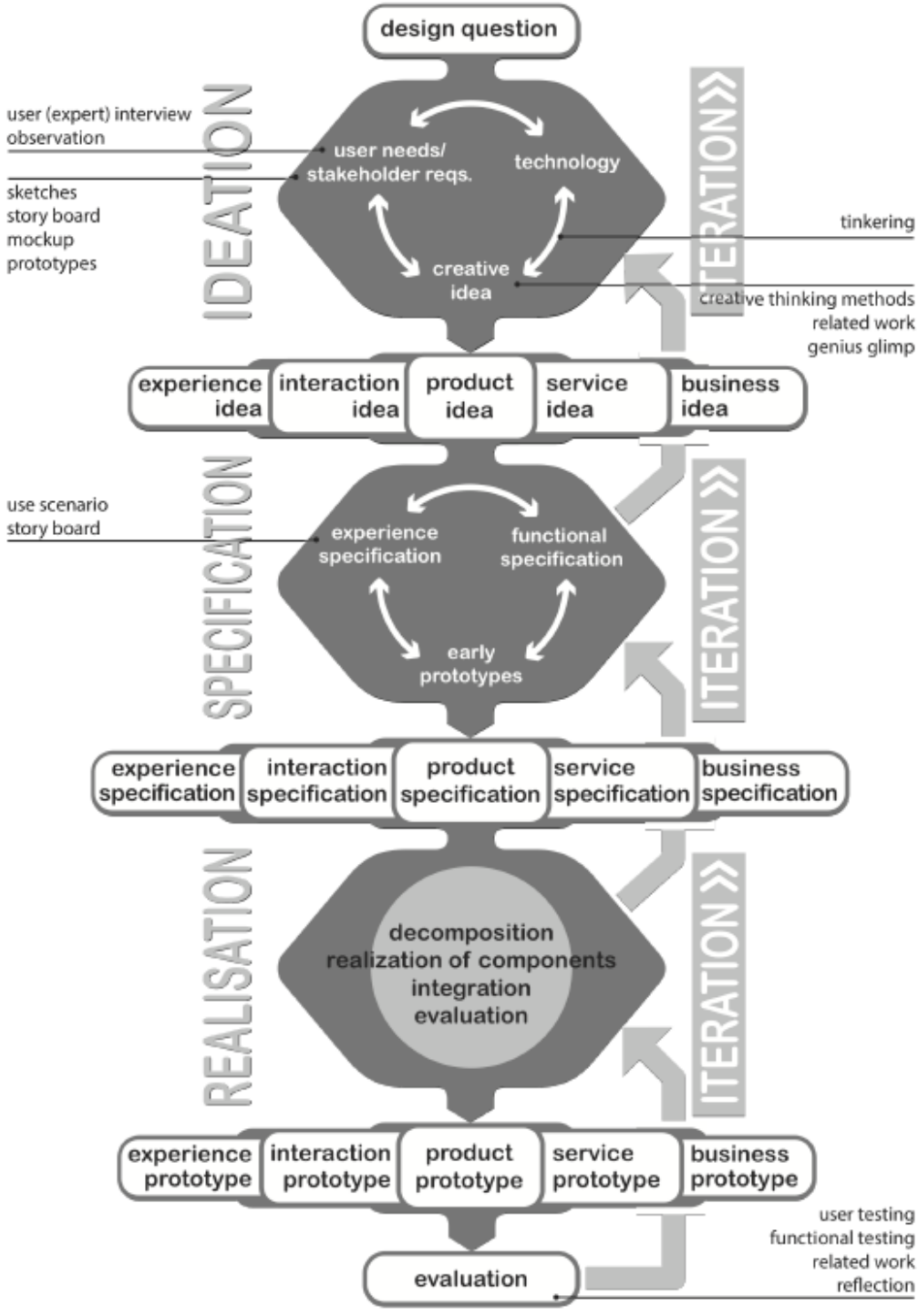


Figure 3.1: Creative Technology Design Process [54]

This process is defined by four phases: ideation, specification, realization and evaluation. For each of these phases, the characteristics and goals are described below. An important feature of the Creative Technology Design Process, is that it includes spiral models. This means that in the ideation and specification phases, iteration is required to ensure a reflective and transformative design process.

3.1.1 Ideation Phase

The goal of the ideation phase is to elaborate on the project idea and set up the project requirements. Additionally, "ideas on experience, interaction, as well as a service and business model are also part of the result" [54, p. 4]. As previously described, the spiral model in this phase revolves around coming up with a creative idea, identifying user needs and stakeholder requirements and determining what technology could be used. For the latter, Mader and Eggink state that "technology can be a starting point or motivating force in the ideation phase" [54, p. 4]. This is also referred to as 'tinkering', the process of taking existing technology and coming up with novel applications for that technology [54].

3.1.2 Specification Phase

The specification phase is characterized by the large amount of prototypes that are made. Those prototypes are meant to be discarded, improved or merged into other prototypes, and often address only small aspects of the overall product. Moreover, the various prototypes serve as iterations to establish the functional and experience specification. Ultimately, the specification results in a final set of requirements that should be integrated in the realization phase [54].

3.1.3 Realization Phase

In the realization phase, the requirements from the specification phase are realized. It describes how the various components of the application are created and implemented, but also highlights design considerations that are made within the realization phase [54].

3.1.4 Evaluation Phase

The evaluation phase describes how the final prototype from the realization phase is evaluated. In this project, this includes a functional test, but also an expert test and a non-functional test. Moreover, the user testing is carried out in this phase. Ultimately, the goal is to find out "whether all the original requirements identified in the ideation phase are met" [54, p. 5]. In the end, the evaluation phase helps assess to what extent the project succeeded in achieving its own goals and requirements.

3.2 Stakeholder analysis

To make sure all the relevant stakeholders are consulted during this project, the relevant stakeholders should be determined and analyzed. For this stakeholder analysis, the approach of Sharp et al. [55] is used in section 4.1.

> Sharp et al. [55] point out a key reference for the definition of a stakeholder:
>
> *A stakeholder in an organization is (by definition) any group or individual who can affect or is affected by the achievement of the organization's objectives*. [27, p.46]

This means a stakeholder is a person, people, group or organization that has a direct or indirect influence on the development of the system. Sharp et al. [55] identify four stakeholder roles for better identification purposes. These four stakeholder roles and a brief explanation are given:

- **Users** will interact with the system or will use the products of the system.
- **Developers** are responsible for creating the system.
- **Legislators** produce guidelines for the system that will affect the development and/or operation of the system.
- **Decision-makers** are part of decision-making structures during the development of the system.

In this project, the stakeholders will be identified and grouped into the above-mentioned categories of which an overview will be given in a table. Secondly, the stakeholders will be ranked on interest in and influence on the project with a score between 1-10. These scores will be used to create an influence-versus-interest matrix, as described in detail by Eden and Ackermann [57]. In this matrix, the stakeholders are mapped according to the four quadrants, as is shown in Figure 3.2. Finally, some additional notes are made about the goal and the motivation of the stakeholders.

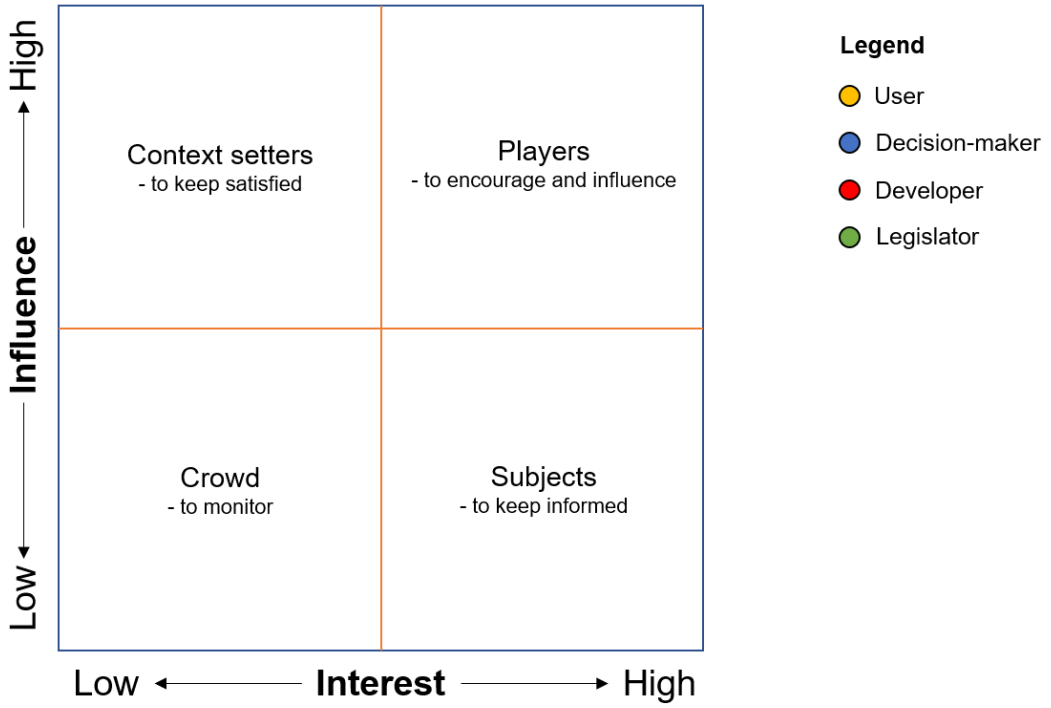


Figure 3.2: Stakeholder influence-interest matrix as described by Eden and Ackermann [57]

3.3 Brainstorm sessions

To generate new viewpoints and ideas for the system, brainstorm sessions are conducted. First, an individual brainstorm session is held to prepare for the other brainstorm sessions withs students and group of students. After this, individual brainstorm sessions are held to find out what students are interested in and what gives them motivation to do something.

Two different types of group brainstorm sessions are held. First, one open group brainstorm session is conductd early on the project, this to gather information about the current student view on self-reflection applications. The next group brainstorm is conducted with students and with mentors from the course professional development of Creative Technology. To facilitate this brainstorm, one main question will be formulated as basis of the brainstorm. Such a question will lead to answers and ideas from the particiapnts.

3.4 iPACT

During the requirements process of this project, the iPACT Scenario-Based Methodology [58] is used. This is done in the ideation phase, that is described in section 3.1. These scenarios are used to view the project from different perspectives. In the ideation phase, the iPACT analysis [58] is used to describe the concept from the user's point of view.

The iPACT analysis [58] can be helpful when designing a system as it helps to clarify of the project from the user's perspective and is able to give a good indication of the user requirements. iPACT stands for intention, People, Activities, Context, and Technologies. This analysis gives a detailed overview of why

someone would use the system, who would use it, what they would do with it, where and how they would use it, and the technology required to do so. The iPACT analysis is used in section 4.3.

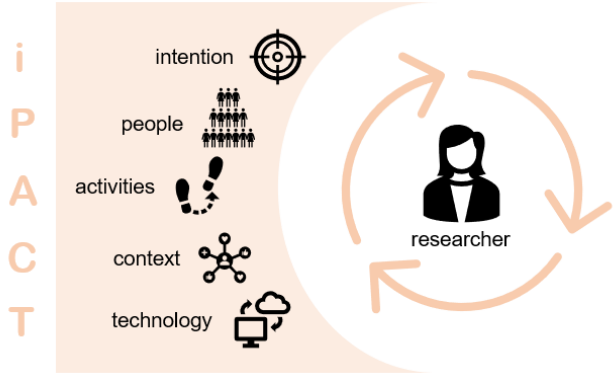


Figure 3.3: iPACT

3.5 Requirements

During this project, the requirements of the system are prioritized using the MoSCoW [59] method. Furthermore, the requirements are categorized as either being functional or non-functional requirements. The requirements are iterated during the project. In the ideation phase, the first iteration is done and in the specification, the second iteration is done. The requirements are also used in the evaluation phase to test the functionality of the system.

3.5.1 MoSCoW Method

The MoSCoW [59] method is used to prioritize the requirements. It is necessary to know the difference between important and less important requirements to know in which order the requirements should be implemented in the system. Every requirement is categorized in one of the MoSCoW categories:

- **Must have**: the minimal requirements of the system.
- **Should have**: the important but not vital requirements of the system.
- **Could have**: the wanted but less important requirements of the system.
- **Won't have:** the requirements that are not viable for the time frame of the system development.

3.5.2 Functional and Non-Functional

Requirements are often classified as functional (FR) and non-functional (NFR) requirements [60]. FRs specify what the system should do and NFRs specify how the system works. This means that the FRs are related to the functionality of the system, whereas the NFRs is related to the performance and usability of the system.

3.6 Evaluation

The prototype developed in the realization phase is evaluated. The goal of the evaluation is to determine the effectiveness and usability of the system and to contribute to answering the RQs. The prototype is evaluated in four steps. First, the functional requirement test is done. Secondly, the user test is executed. Thirdly, an expert test is done, and finally, the non-functional test is done. During the functional test, it is tested whether the prototype meets the beforehand determined requirements. During the user and the expert test, participants from the target group and the expert test the prototype of the system. During the non-functional requirement test, the results of the user and expert tests are used.

3.6.1 Functional Test

During the functional test, it is checked whether the developed prototype meets the functional requirements set-up at the end of the specification phase. The functional test needs to be done before the user and expert test. This is necessary to ensure that the prototype meets all of the 'Must have' requirements. The functional evaluation is done by the researcher. Additionally, it is determined which 'Should have' and 'Could have' requirements are met.

3.6.2 User Test

First, the participants of the user test use the prototype of the system. The evaluation is divided into two parts. First, a Google Form is distributed among the participants. This form included some demographic questions, the System Usability Scale (SUS) [61], and a short questionnaire. The demographic questions are asked to show the characteristics of the participants, but also to identify possible similarities and differences between two or more characteristics. The SUS is performed to assess the usability of the system, and the short questionnaire is to gather some quantitative data about the performance of the system.

The SUS is a way to assess the usability of a system: "A simple, ten-item scale giving a global view of subjective assessments of usability" [61, p. 3]. This SUS method includes ten statements with a Likert scale about different aspects of system usability. The user test participants rate the statements from one to five. The ten statements are:

1. I think that I would like to use this system frequently.
2. I found the system unnecessarily complex.
3. I thought the system was easy to use.
4. I think that I would need the support of a technical person to be able to use this system.
5. I found the various functions in this system were well integrated.
6. I thought there was too much inconsistency in this system.
7. I would imagine that most people would learn to use this system very quickly.
8. I found the system very cumbersome to use.
9. I felt very confident using the system.
10. I needed to learn a lot of things before I could get going with the system

The SUS results are analyzed by calculating the SUS rating. To calculate the SUS rating, the score contributions from each item are summed. The contribution of the odd statements is the scale position minus 1. The contribution of the even statements is 5 minus the scale position. The sum is multiplied by 2.5 to obtain the overall value of the SUS, which is always a score ranging between 0 to 100. In an empirical evaluation of the SUS by Bangor et al. [62] a recommendation is made as to how the SUS rating can be interpreted (Figure 3.4).

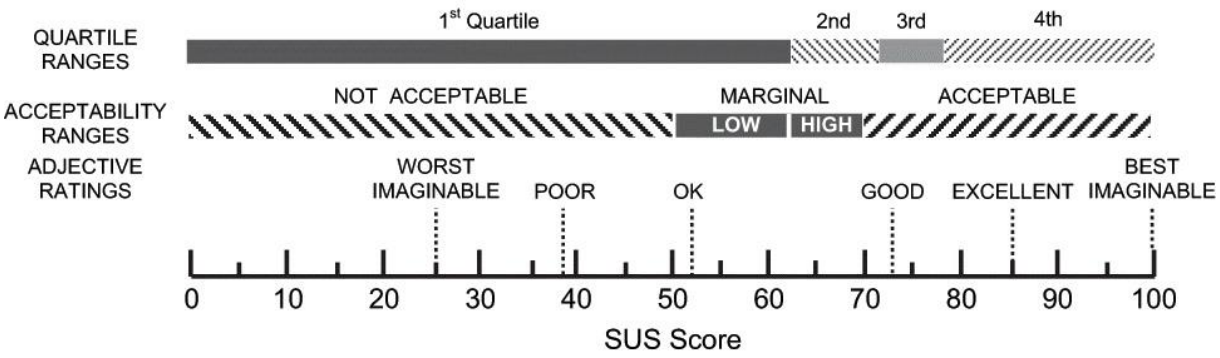


Figure 3.4: A comparison of the quartile ranges, acceptability ranges, and the adjective ratings of the final SUS rating, as illustrated in [62, Fig. 13]

3.6.3 Expert Test

During the expert test, the expert will test the prototype of the system, similar to the participants of the user test. After testing the prototype of the system, the expert will be interviewed about the performance and the usability of the system.

3.6.4 Non-Functional Test

During the non-functional test, it is checked whether the developed prototype meets the non-functional requirements set-up at the end of the specification phase. The prototype has to meet all of the ‘Must have’ requirements (section 3.6.1). Furthermore, it is determined which ‘Should have’ and ‘Could have’ requirements are met. The non-functional test is done by the researcher.

4 Ideation

This chapter will include the generation and conceptualization from the user's perspective. The background research from chapter 2 is used as the basis for this chapter. The goal of this chapter is to gather relevant information and shape ideas about the self-reflection system. The chapter includes an analysis of the stakeholders, the results of brainstorm sessions with different stakeholders, an iPACT analysis, and the first iteration of the requirements of the self-reflection system.

4.1 Stakeholder Analysis

In this section, the stakeholders of this project are identified and assessed on influence on and interest in this project, as described in section 3.2. First, the approach of Sharp et al. [55] is used to analyze the stakeholders, whereof an overview is given in Table 4.1.

Table 4.1: Overview of stakeholders including influence on and interest in this project

	Stakeholder	Role(s)	Influence	Interest
A	University Students (or Creative Technology Students)	User	8	8
B	Student Wellbeing project (SWIP) of the University of Twente - Annet de Kiewit as head of SWIP	User	8	7
C	Researcher Eva Lahuis	Developer/ Decision-maker	10	10
D	Supervisor: Erik Faber	Decision-maker	8	8
E	Critical observer: Karen Slotman	Decision-maker	7	7
F	Educational Specialist: Babs Ernst	Decision-maker	6	6
G	The Creative Technology program - partly represented by Erik Faber	Decision-maker	5	6
B	Student Wellbeing project (SWIP) of the University of Twente - Annet de Kiewit as head of SWIP	Decision-maker	8	7
I	Technology Enhanced Learning and Teaching (TELT) [63] with contact via Karen Slotman	Decision-maker	6	3
J	The General Data Protection Regulation (GDPR) for people in the European Union (EU)?	Legislator	8	1
K	Government of the Netherlands (especially the COVID-19 pandemic policy)	Legislator	9	1

The stakeholders are rated on a scale of 1 to 10. Their influence and interest are approached by the researcher, where a higher rating corresponds to more influence or interest. The stakeholders are explained according to their corresponding category or categories:

Users: The main users of the application are university students. They are of high interest because the application will guide these students towards an improvement in their mental health. Additionally, they are of high influence because they are the main users of the application. The Student Wellbeing project (SWIP) of the University of Twente, with Annet de Kiewit as project leader, is the client of this project. Being the client and their possible future deployment of the project result, the SWIP has a high influence on this project. Additionally, the SWIP shares the goal of this project to improve the mental health of their University of Twente students, thus their interest is also high.

Developers: The developer of this application is mainly the researcher and author of this thesis, Eva Lahuis. The influence and interest of the developer are high because she shaped and carried through the project. Decisions will be influenced by the users, decision-makers, and legislators, but the researcher is making the final decisions.

Decision-makers: The decision-makers are the researcher, the client (SWIP), the supervisor from Creative Technology Erik Faber, the critical observer Karen Slotman and educational specialist Babs Ernst. The most important decision-maker of this project is the researcher. Therefore, her influence and interest are high. The supervisor and the critical observer are interested in the correct finalization of the project, so their interest in the project is high. Furthermore, they have a high influence on project management and content. Educational specialist Babs Ernst is additionally a decision-maker but has a lower influence on and interest in the project. The TELT team is another decision-maker and is consulted about this project. Their interest is low, but their influence medium. Lastly, the SWIP is an important decision-maker because it is the client of this project. The interest is high because of the shared goal of the client and this project and the influence is high because the project needs to satisfy their requirements.

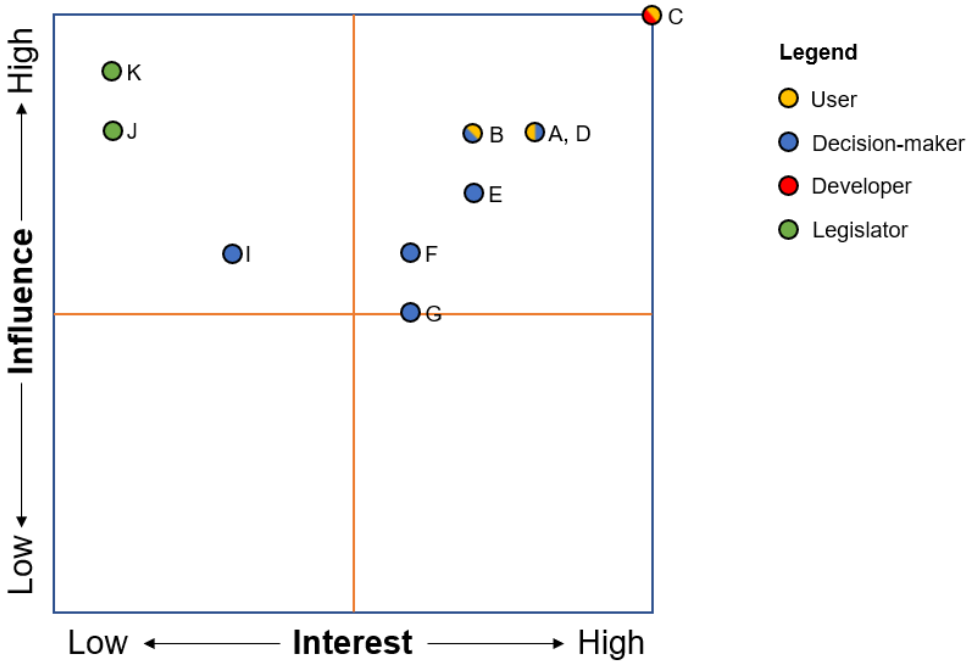


Figure 4.1: Implemented stakeholder influence-interest matrix [57] *(labels in this figure correspond to labels in Table 4.1)*

Legislators: The government of the Netherlands will have a high influence on the project, because of the (changing) COVID-19 measures. These measures limit the possibilities to meet stakeholders or to

test the project result in real life. When the self-reflection system will include being a mobile/web application with, the General Data Protect Regulation from the European Union is important and will influence the project.

The influence and interest scores from the stakeholders shown in Table 4.1 are used to create a stakeholder influence-interest matrix, as described by Eden and Ackermann [57]. This matrix is shown in Figure 4.1.

4.2 Peer Support

In this section, the definition of peer support used in this project is given. Peer support is also called peer connection. The importance of peer support was discovered in background research (chapter 2). Before exploring the different options of integrating peer support into the self-reflection system, it is necessary to have a clear definition of the concept. MacNeil [64] defined peer support as following:

> "Peer support has been defined by the fact that people who have like experiences can better relate and can consequently offer more authentic empathy and validation." [64]

Relating, and offering empathy and validation can be powerful motivator [64], as was also concluded from the research that accompanied the founding of SWIP [1] and from the distributed questionnaire (discussed in section 2.2). However, when developing a peer support system for professional mental health help, many challenges are involved according to Repper and Carter [65]. Although the self-reflection system developed in this project is not a professional mental health help system, this should be made very clear to the stakeholders.

4.3 iPACT analysis

In this section, the self-reflection system is explained according to the iPACT analysis. This iPACT method is described in section 3.4 and describes the system from the user's point of view.

4.3.1 Intention

The intention of the system towards the user is to introduce and give the means to practice self-reflection techniques, in order to guide the user towards an improvement of their mental health. Additionally, the intention is to spark the interest of the students in self-reflection techniques. This means that the students will notice the possible positive effects of practicing self-reflection techniques and will possibly enjoy practicing the self-reflection techniques. Next to this, the intention is to motivate the students to practice the self-reflection techniques regularly, so that students are guided towards experiencing the self-reflection benefits that can occur after regular usage.

4.3.2 People

The people are the users who will interact with the system. The people that are going to use this self-reflection application are students. These are students who do not intend to use the application as a replacement for professional help but as complementary mental health support tool. The following criteria are used to establish the personas, who are used to describe the people.

- University of Twente students
- First or second-year students
- No or medium experience with self-reflection techniques
- Motivated to grow their self-reflection skills or learn about their mental health/mind/self-reflection skills

Personas

Astrid is a 19-year-old Industrial Engineering and Management student at the University of Twente. She finished her first year of her bachelor's and will soon start with the second year of her bachelor. During the first year of studies, it took her much time and energy to get used to her new life as a student, including a

new place of residence because of her moving from her parents to a student home. Now and then, she sees people on Instagram who are working in their bullet journal including journaling, habit tracking, and more self-reflective activities. Sometimes, she would like to have the time to keep a bullet journal herself and being creative like these people. At the beginning of her second study year, a friend from a student association sends her a link to this self-reflection system. They discuss and decide to try the self-reflection application individually but keep each other updated about their progress every week via a meeting or a call because this is suggested by the self-reflection system.

Pepijn is a 20-year-old Industrial Business Administration student at the University of Twente. He is currently doing module 4 of his study, and just obtained his binding recommendation rule (BSA). He still lives at his parent's house in Almelo, but he is planning to move to a studio in Enschede sometime next year. He wanted to focus on obtaining his BSA before moving out. Via an invitation sent by email, he joined the Student Wellbeing Canvas environment. In this Canvas environment, he sees the self-reflection system including some example experiences (recognizable problems and fitting benefits from the self-reflection system). He never worked with self-reflection techniques before, but he recognizes himself in one of the example stories about self-reflection. He sees the self-reflection application is free of charge and decides to try the self-reflective group course that uses the application as guidance.

Sterre is a 21-year-old Creative Technology student at the University of Twente. She is currently in the second year of her study, almost starting with module 6. Since she got recommendations about the self-reflection system from a fellow student who used the self-reflection system as the basis for their professional development challenge, she is interested in coming up with a challenge that includes exploring this self-reflection system for the Creative Technology course professional development. She discusses this with her mentor and they agree upon a challenge that includes some research, using the application, and updating her mentor about the process every few weeks.

4.3.3 Activities

The self-reflection application can be used daily/weekly as a tool to make an acquaintance with self-reflection techniques and/or practice self-reflection techniques. This so the users are guided towards a mental health improvement.

The application will:

- present self-reflective questions
- introduce and give the option to practice one or more self-reflection technique(s)
- give an easy possibility to reflect on earlier entered questions or answers

4.3.4 Context

The target group of the application is for now first and second year bacherlor’s students and the main focus is the personal life of these students. So the context will be mainly in a personal setting, but because the self-reflective system will be widely applicable, the guidance or meetings around the personal usage of the application may be in an education setting or additionally in a personal setting, with peers or friends.

4.3.5 Technologies

The self-reflection system will include a mobile/web application that shows an interface which allows for practicing self-reflection technique(s).

Input
The mobile/web application will receive input in the entry boxes of the application.

Output

The application will show user statistics to the user. These statistics can include usage streaks, but also overviews of answers to different questions, to promote self-reflection on previous entries.

4.4 Individual brainstorm

In this section, the results of the individual brainstorm are discussed. During the individual brainstorm, the important components of the self-reflection system were determined: the format, the self-reflection techniques, and peer connection options. To prepare for the other brainstorm sessions, options for these different components were gathered. These options are presented in the following lists:

Formats for the system: workshop, web/mobile application, podcast, forum, (mentor) group (sessions), workbook, manuals, videos.

Self-reflection techniques: journaling, asking reflective questions, habit and mood tracking, grading days, time tracking, goal setting and evaluation, favorites lists, gratitude practice, mindfulness, coming up with challenges and keeping track of the progress, meditating, daily, weekly, and yearly reflections, analyzing habit patterns, choice reflection, scrapbooking, energy levels, labeling activities.

Options for peer connection: friends, family, fellow students, mentors, student counselors, chat, meetings, activities.

Additionally, together with the supervisor, an overview is made of the current key aspects of the self-reflection system, this is displayed in Figure 4.2 (the orginial brainstorm photo is displayed in Appendix D-1). The users are placed in the center of the key aspects: the student(s). The goals of the system are to guide the students towards mental health improvement, to motivate regular usage of self-reflection, and to spark the interest of students in self-reflection. The first key aspect is to provide students with enough self-reflection tools, to motivate them to start working with the techniques. The second key aspect is to contribute to the awareness of self-reflection techniques. The system should convince the users of the possibilities of self-reflection. The third key aspect is to focus on the personal life and personal preferences of the students. This self-reflection should be related to personal life, to someone's identity and desires. The fourth key aspect of the system is peer connections, as explained in section 4.2. The last key aspect is that the system should be complementary to professional mental help and that the system should not be a replacement thereof.

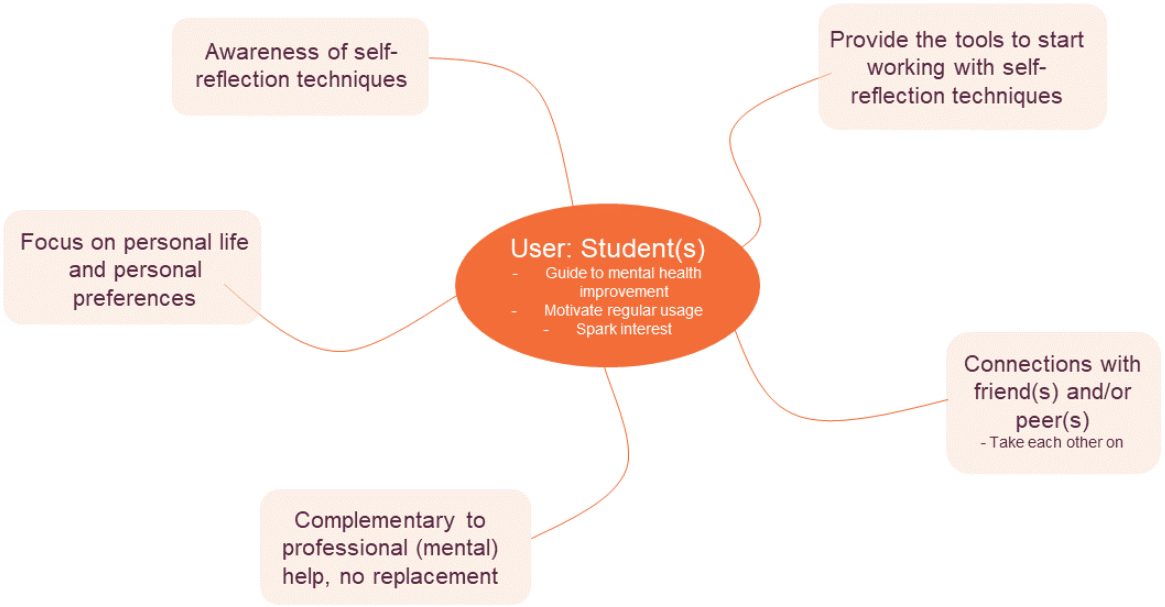


Figure 4.2: Key elements of the self-reflection system in the Ideation phase, see Appendix D-1 for the original photo

4.5 Individual Student Brainstorm

The goal of this individual brainstorm session was to find out what students are interested in and what gives them motivation to do something. This information could be useful in determining how to spark interest in self-reflection techniques.

The first student that participated in the brainstorm session was a 20-year-old female. She explained that she feels motivated when she puts time and effort into something that is good for her. She compares it to the situation that when you create something, the end result is most important. She mentions that motivation can also come from doing something together, and provides the example of her getting motivation to go to the fitness center if she is doing it together with a friend. Another important aspect to keeping motivated, is being confronted with the subject, for example by seeing someone else on social media going through the same struggle.

She explains that most of her interests come from seeing other people do something, or when something that has long been on her mind gets triggered somehow.

The second student that participated was a 23-year-old male. He finds himself being motivated to finish things, and provides a scenario as illustration: If you have a glass of water and a bottle of water on your desk, which is empty sooner? According to him, the answer is the glass, as it is in human nature to finish things (and a bottle can be closed, thus regarded as 'finished'). Completion is therefore an important driver for him, but he also mentions that an end result to be proud of and recognition of others are motivating him to keep going. His interests usually originate from a need and therefore cause him to have an intrinsic motivation.

In conclusion, a sense of doing something that is good for you, intrinsic motivation, the urge to complete things, support from a friend and being confronted are good drivers for motivation. Interest can be sparked by others, interesting topics and individual needs.

4.6 Group Brainstorm Sessions

There were three brainstorm sessions planned. One open brainstorm session with students early on in the execution of the project to gather information about the current student view on self-reflection (applications). A second brainstorm session with other students using the brainstorming technique explained in section 3.3 to brainstorm, but also to test this brainstorming technique for the third brainstorm session. The third brainstorm session was scheduled to be with three mentors from the course professional development in the study Creative Technology. The reason to brainstorm with mentors is because they are close to students in terms of guidance.

4.6.1 First Brainstorm Session

The first brainstorm was executed with three students and the researcher, at the 29th of April 2021. All three students being Creative Technology students and working on their graduation project. Two students had little experience with self-reflection techniques and one student had slightly more experience than the other two. The central question of this brainstorm session was: 'How can we present self-reflection to as many students as possible?' The results of this brainstorm session are displayed in Appendix D-2.

4.6.2 Second Brainstorm Session

A second group brainstorm was executed with two students about the contents and realization of the self-reflection system, at the 10th of May 2021. Both students are Creative Technology students. One with no experience in practicing self-reflection techniques and one with little experience in practicing self-

reflection techniques. The complete results of this brainstorm can be found in Appendix D-3. From this brainstorm session, six preliminary ideas for the self-reflection system were formulated:

Idea 1: Combination of workshop and an application
• Workshop about self-reflection techniques with an introduction of the application.
• Self-reflection application includes peer connection.

Idea 2: Combination of an application and peer support meetings.
• Self-reflection application.
• Offline meetings with peer(s) for support.

Idea 3: Combination of a workbook and an application.
• Self-reflection workbook to fill in.
• Application to scan workbook and share with peer(s) for support.

Idea 4: Combination of an application and support meetings
• Affirmation application with selfie cam and prompts.
• Offline meeting with peer(s) to write more personal affirmations.

Idea 5: Combination of drinking cups with QR-codes and an application.
• Self-reflection questions printed on drinking cups with QR codes (to use with friends/party).
• Scanning the QR code leads to the self-reflection application.

Idea 6: Combination of a community and an application.
• Self-reflection community/student association with reflection meetings.
• Application to support the self-reflection usage

After this brainstorm session, feedback was asked about the brainstorm session itself. This feedback is progressed before the third brainstorm session. A complete overview of the feedback can be found in Appendix D-4.

4.6.3 Third Brainstorm Session

The third brainstorm session was canceled on short notice. It was canceled because the position of mentor, in the eyes of UT's mental health counselor, was not an appropriate position to shed light on this delicate subject. Instead of the brainstorm session with the mentors, another brainstorm session was conducted together with the same students as the previous group brainstorm session. This brainstorm session was conducted on the 19th of May 2021. The results of this brainstorm session are displayed in a mindmap in Figure 4.3, although this is partly in dutch (the original figure is displayed in Appendix D-4). Unfortunately, the mindmap partly in dutch. This mindmap is explained in section 4.7.

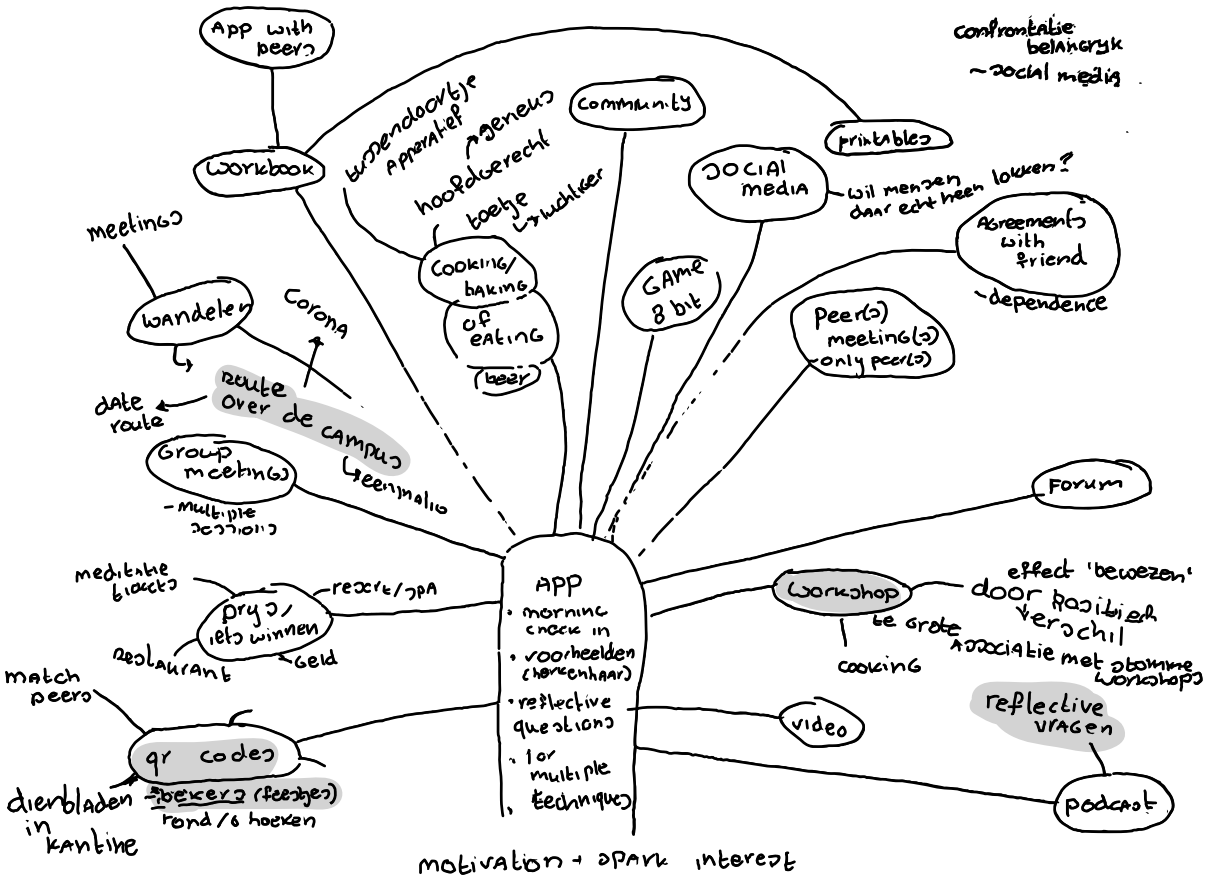


Figure 4.3: Mindmap with ideas as results from third group brainstorm session, although this is partly in dutch.

4.7 Idea selection

In this section, the idea selection after the brainstorm sessions is described. During the third group brainstorm session, a mindmap with all the ideas was generated, which is displayed in Figure 4.3. our potential ideas were selected from this mindmap.

The basis of the idea for the self-reflection system included a self-reflection application. To this basis, a sub-sytem could be connected which focuses on motivating regular usage and sparking an interest in self-reflection. The first idea for this sub-system included a walking route on the campus of UT. During this walking route, self-reflection techniques would be integrated. It might be possible to integrate the web/mobile application in the walk itself. During the walking route, self-reflective prompts and questions could be showed to the user to reflect on. This idea would be suitable during the corona pandemic, because of walking outside and at possible distance of the fellow walker. A limitation could be the one-time experience of the walk.

The second idea for the sub-sytem includes drinking cups with QR-codes. Self-reflective questions or prompts could be printed on the cups, together with a QR-code. The cups could be used during parties and meetings, and the self-reflective questions and prompts could be discussed together with other people. By scanning the QR codes, the basis self-reflection application could pop up on the screen of the user. This idea would not be suitable during the corona pandemic, because physical parties and meetings are not possible. Additionally, the questions and the prompts on the cups might become boring after multiple usages.

The third idea for the sub-system includes a workshop. This workshop could introduce some self-reflection techniques to students, including a practical work session. The basis application could be introduced to the students after this workshop or the application could already be used during the

workshop. However, a workshop has a bad reputation among students (concluded from the experience of the researcher). Additionally, the content of the workshop should be correct and professional, so it might be necessary to integrate the help of a professionalist in self-reflection, which will be difficult in the period of the project.

The fourth idea is a podcast about self-reflection. This podcast would include multiple episodes where students get interviewed about practicing self-reflection. This podcast could be added to the basis web/mobile application, but also to the known podcast applications in order to advertise the application to students. This podcast will be very accessible to students and could give a representative idea of using self-reflection themselves. However, such a podcast does not focus on regular usages of the system and also not on sparking the interest of students.

One idea seemed to have the most potential and was chosen to build the self-reflection system on. This idea included the possibilities of peer support and additionally, walking as physical activity, which was one the favorite acitivities from students. This was found in the conducted questionnaire about activities to make you feel good. This idea is the self-reflective walking route on the campus of UT. The web/mobile application is the basis of the idea, the walking route will focus on spark interest and motivate regular usage.

4.8 Requirements 1st iteration

The list of requirements to be taken into the specification phase is made and organized according to the MoSCoW method, which is explained in section 3.5. Functional requirements and non-functional requirements are labeled as such. This list of requirements is displayed in Table 4.2.

Table 4.2: System requirements 1st iteration, organized according to the MoSCoW method

No.	MoSCoW	FR or NFR	Requirement
1	Must have	FR	The system must **introduce** one or more self-reflection techniques to the user: the 'tools' of the self-reflection techniques must be given to them.
2		NFR	The system must focus on **sparking the interest** of the user.
3			The system must motivate **regular usage** of self-reflection techniques.
4			The system must clarify that it is **complementary to professional help**, and not a replacement.
5			The system must be experienced as **useful**, meaning that the user must feel supported to successfully use the self-reflection techniques during participating.
6			The system must be experienced as an **added value** to the life of the student: the student should experience changes.
7			The system should **retain the interest** of the user, for multiple usages.
8	Should have	FR	The self-reflection integrated into the system should focus on the **personal life** of the student.
9			The system should **not push** usage too much.
10			Usage of the system should be **rewarded**.
11		NFR	The system should contribute to the **awareness** of the relevance of using self-reflection techniques.

12			The user should have full **freedom** in choosing to (not) participate (the system should not be used obligatory).

13	Could have	FR	The system could have integrated **peer collaboration** to motivate the use of the system.
14			The system could be used in the course **professional development** of Creative Technology.
15		NFR	The system could be **adopted** by the Student Wellbeing Project.

-	Won't have		-

5 Specification

The focus in this chapter is on the functionalities of the system, to show how the system will interact with the user. In this phase, the design choices are made regarding the development of the envisioned system. Results from chapters 2 and 4 will be used as the basis for this phase.

5.1 TELT meeting

In this section, the meeting with the TELT team is described. The TELT [63] team from the UT is the technology-enhanced learning and teaching team. E-learning and applications are also included in their expertise. The idea of creating a self-reflective application was discussed with this team.

During the meeting with the TELT team, difficulty in making an application arose. First, it was recommended to schedule a meeting with a GDPR specialist, about the general data protection regulations. This will be necessary when processing personal data, as in the self-reflection application. However, one of the members offered the possibility to contact him for technical questions about this.

One suggestion that was made, included testing the self-reflection application in mentor groups from Applied Mathematics. This UT study assigns mentor groups to all first-year students, so these already existing groups could be used in user tests.

One important aspect that was pointed out is the usages of recognizable examples. Users of the self-reflection application should see the possibilities of using the application. This can be done by adding stories about recognizable situations to the application or the subsystem. Another important aspect is safety and security. When entering sensitive information about personal feelings, thoughts, and experiences, these should be handled with care and kept safe.

A recommendation was to follow the eHealth [66] course. In this UT course, the design, application, implementation, and evaluation of eHealth are included. However, this course has a duration of 6 weeks with a weekly study load of three hours.

5.2 Client Evaluation

In this section, the chosen idea of the ideation is evaluated with the client. This idea contains a web/mobile self-reflection application as the basis of the system, and a self-reflective walking route on the campus of the UT as a sub-system. This evaluation was performed in an online meeting with the client, Annet de Kiewit.

The client reacts positive to the self-reflection walking route idea, therefore preference is given to this subsystem. Due to the time constraint of the project, the client would like to focus on developing the walking route as this would be more valuable to know how to correctly implement. It should be tested how long the route should be; where the route should be; how many self-reflection assignments should be included; if you should walk alone or together; what the physical environment must look like and what the right start and end point is.

A benefit from the self-reflection walking route is the enlarged target group. The focus can shift from module 4 first-year and module 5 and 6 second-year to the total student population, and additionally the employees of the university.

5.3 User scenario

In this section, a user scenario is described. This user scenario illistrates how the current system could be used. In this example is included how both mentor and mentee can benefit from the system.

Rooney is a 59-year-old professor at the University of Twente for the study Creative Technology. Apart from teaching, he is also a mentor to several students. His primary task is guiding students through

their study, helping them out when necessary. Recently, the self-reflection walk was introduced at the UT. Yesterday, he had his first meeting of the year with one of his mentees. With the self-reflection walk in mind, Rooney suggested to go for a walk to get to know each other better. He explains the existence and goal of the self-reflection walk to the student, who gets excited. Once they get to the start of the route, they read the sign and instructions and scan the first QR-code: “What are you proud of?” shows up at Rooney’s screen. While walking, he asks if he can go first, and then explains that he is very proud of his son who recently got a new job. Then, the student takes his turn and explains that he is very proud of the first bit of programming he learnt recently. He explains that he liked it so much, that he went out of his way to add more features and functionalities to his first program. Rooney laughs: “Sounds like you will have a great time in this study!” The student laughs, and then observes the next sign: “I wonder what the next question will be!”

5.4 Final Idea

In this section, the final idea for the self-reflection system is described. Till this point the idea of the system included a self-reflection application and a self-reflection walking route. In this section is explained that the self-reflection application is not developed further then sketches and that the project continued with the self-reflection walking route.

5.4.1 Self-Reflection Application

Together with the client the decision was made to focus on the self-reflection walking route and to drop the idea of a self-reflection application. However, earlier in the process sketches were made of the self-reflection application, which can be seen in Appendix E. In Figure 5.1, one of these sketches is depicted. This sketch shows how the user would interact with the application and what screens are included.

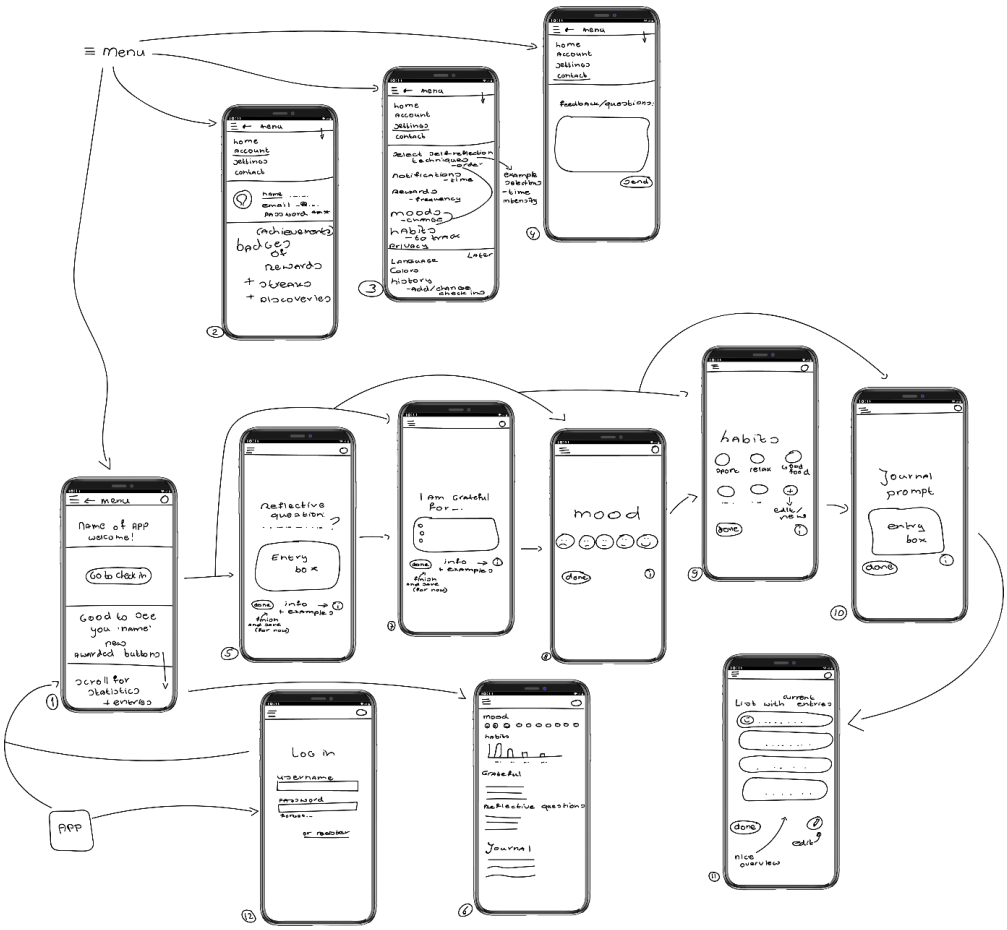


Figure 5.1: User flow self-reflection application

5.4.2 Self-Reflection Walking Route

The final idea that was picked is the reflection walk. Basically, this idea entails a walking route through a quiet and calming environment, with the addition of signs along the route that display QR-codes. At the start of the route, a larger sign is located that displays an informative poster. Here, the user is able to scan the first QR-code and start the reflection walk (Figure 5.2). Even though it seems contradictory, the reflection walk is also suitable for multiple people walking together; the goal of sparking interest in self-reflection techniques would still be achieved when people walk the route together. This was already expected because of earlier research (section 4.2Peer Support), and in the user test evaluation this proved true.

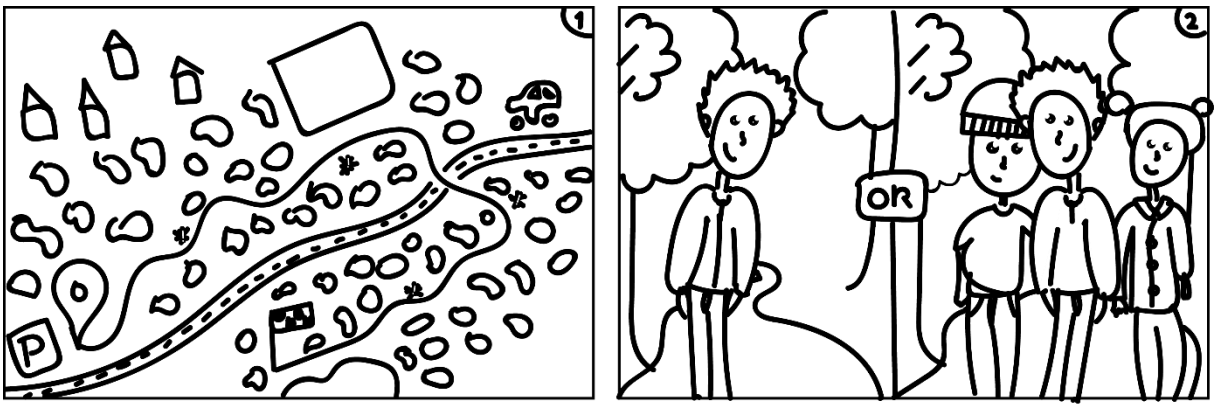


Figure 5.2: Part 1 reflection walk storyboard: (1) restful reflective route on campus including placed signs; (2) users can use the system along or together with others

At first, the idea was to let users sign up for an account at the first sign such that data during the walk could be tracked, but in the final implementation this was left out as it was not possible to achieve within the scope of this project. On the positive side, this had the advantage that users would not need to bother with signing up and could quickly get on their way.

Prior to the realization, the intention was to just randomize the type of prompt for each sign as well, but this would reduce the effect of having a different QR-code each time (as the user could then simply refresh the page each time they encounter a sign). Therefore, the decision was made to have each QR-code link to a different type of prompt. The QR-codes along the route (Figure 5.2) would thus all lead to a different type of prompt when scanned (Figure 5.3), one of which initially was intended to be an informative podcast. However, there were no suitable podcast for such a short duration, so this idea was not implemented. Instead, informative prompts were selected (Appendix F). The other three types of prompts are reflective questions, actions, or mindful prompts.

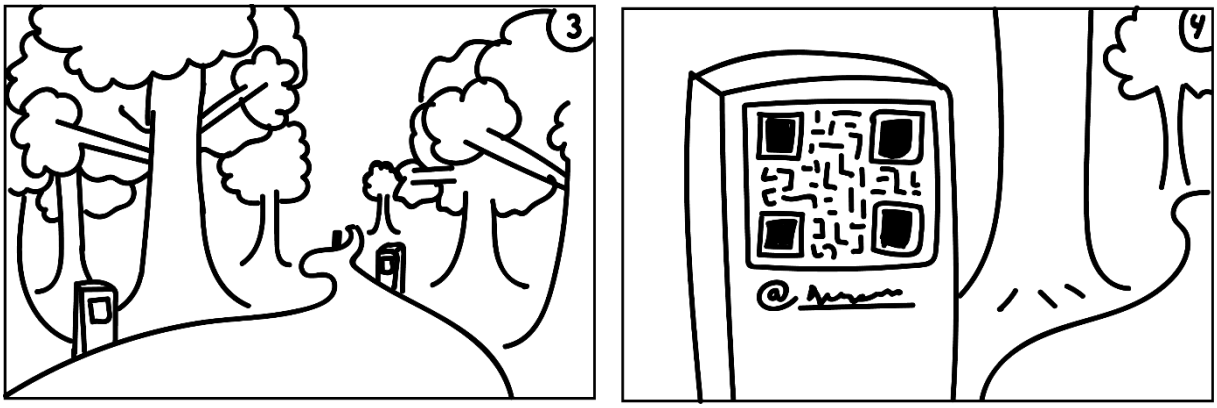


Figure 5.3: Part 2 reflection walk storyboard: (3) front view of the walking route; (4) sign with QR-code standing along the route

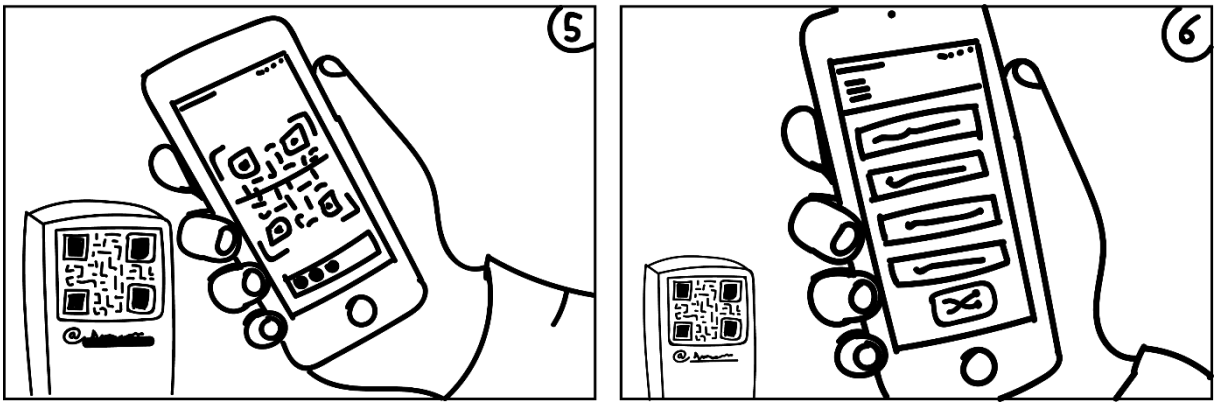


Figure 5.4: Part 3 reflection walk storyboard: (6) scanning the QR-code from the sign; (7) the selection menu on the smartphone from the user

The sign at the end of the route links to an overview page containing links to all the different types of prompts (Figure 5.4). At the final sign, the suggestion is made to save this page so that it could be used on future walks at different locations where there are no QR-signs available to scan.

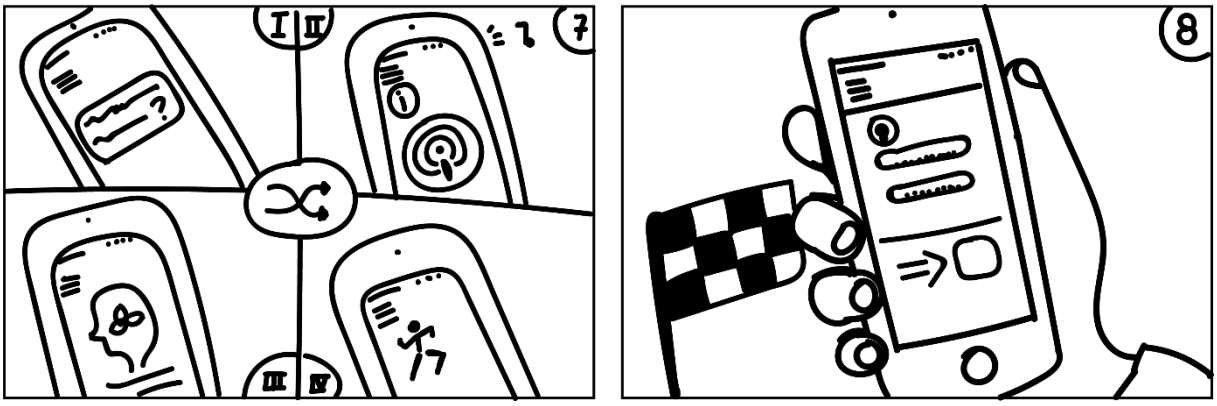


Figure 5.5: Part 4 reflection walk storyboard: (7) the four options to select in the selection menu (I = a reflective question; II = information, for example, a podcast; III = mindful observation; IV = an action; or 'surprise me'); (8) the QR-code on the sign indicating the end of the reflection walk directs to the web/mobile application

Initially, the goal was to make the reflection walk part of the self-reflection application. This application could then support students in maintaining their self-reflection habits, as it would be unlikely that they would take the self-reflection walk every day. An important aspect would be that the overall feel and look of the self-reflection walk would resemble the appearance of the self-reflection application. However, as described in the previous section, the idea of a self-reflection application was not implemented in this project.

5.5 Requirements 2nd iteration

The list of requirements to be taken to the realization phase is made and organized according to the MoSCoW method, which is explained in section 3.5. Functional requirements and non-functional requirements are labeled as such. This list of final requirements is displayed in Table 5.1.

Table 5.1: System requirements 2nd iteration, organized according to the MoSCoW method

No.	MoSCoW	FR or NFR	Requirement
1	Must have	FR	The system must **introduce** one or more self-reflection techniques to the users: the 'tools' of the self-reflection techniques must be given to them.
2			The system must be (partly) an **online** system (such as a web/mobile application)
3			The system must be (deployable as) part of a **bigger system,** including an afterthought; a mobile self-reflection application, an informative email, etc.
4			The system must provide enough information so the user can (partly) use the system **autonomously**.
5		NFR	The system must focus on **sparking the interest** of the user in self-reflection.
6			The system must motivate **regular usage** of self-reflection techniques.
7			The system must clarify it is **explicitly complementary** to professional mental health help, and not a replacement.
8			The system must be experienced as **useful**, meaning that the user must feel supported to successfully use the self-reflection techniques during participating.
9			The system must be experienced as **easy to understand** by the user.
10			The system should **retain the interest** of the user, for multiple usages.
11			The system must provide an environment where the users feel **safe and secure**.
12	Should have	FR	The self-reflection integrated into the system should focus on the **personal life** of the student.
13			The system should have integrated **peer collaboration** to motivate the use of the system.
14			It should be possible to (partly) use the system **individually** and (partly) in a **group setting**.
15		NFR	The system should contribute to the **awareness** of the relevance of using self-reflection techniques.
16			Using the system should give **satisfaction**.
17			The user should **experience changes** after using the system, in physical activity, in conversation, and/or self-reflection knowledge.
18			The user should have full **freedom** in choosing to (not) participate (the system should not be used obligatory).
19			The system should be **widely applicable:** personal life, studies, and work-life.
20	Could have	FR	The system could have the ability to **set goals** when starting with the system and to motivate self-reflection on it, to evaluate their planning and actual usage of the system.

21			The system could be integrated into education and/or student counseling.
22			The **target group** of the system could be **expanded** with all students and employees of the University of Twente.
23			The system could be a **hybrid** system: the system could combine offline and online activities.
24		NFR	The system could be **adopted by** the Student Wellbeing Project.

25	Won't have	NFR	The system is **not a professional application** focussing on professional (mental) help.
26			The system won't include **information** on different mental issues and/or **coping suggestions**

6 Realization

This chapter describes the process of the development and realization of the prototype of the self-reflection system. An in-depth description of the components of the self-reflection system is given, after which the final prototype will be shown.

6.1 Self-reflection Walking Route

The prototype of the self-reflection walking route consists of multiple components, as was described in section 5.3 including the final idea. The components of this self-reflection walking route are discussed one by one in this chapter, but it is important to keep in mind the various components were developed in an iterative process.

6.1.1 Self-reflection Prompts

The first component of the self-reflection walking route includes the self-reflection prompts and questions. These prompts and questions are integrated into the web page and will pop up when a user of the self-reflection walking route will scan a QR-code that is displayed on a sign. The complete list of self-reflection prompts and questions integrated into the prototype can be found in Appendix F.

Together with the supervisor, the importance of integrating self-reflective prompts and questions for different personal preferences was discussed. Integrating personal learning preferences into the system was pointed out. Additionally, as discussed in previous chapters, people can have personal preferences for certain self-reflection techniques. To integrate both aspects into the self-reflection system, it was chosen to select self-reflection techniques matching with learning domains. For the learning domains, the taxonomy of Bloom [67] was incorporated. According to Bloom's taxonomy [67], there are three types of learning which include thinking, feeling and, the combination of sensing, and moving. These belong in the following domains, respectively: cognitive, affective, and sensorimotor. The cognitive domain is for remembering, thinking, and knowledge, the affective domain for growth in feelings or emotions, and the sensorimotor domain for manual and physical skills.

The types of learning were connected to similar self-reflection techniques. First, feeling was connected to self-reflective questions. This type of question lets one feel their mind or body. The second type of learning, thinking, was connected to an informative prompt. This type of prompt gives one information related to self-reflection and is sometimes complemented with questions, to let the user think about. The third learning domain is sensorimotor, this domain includes two learning types: sensing and moving. The learning type sensing was connected to mindful prompts. These types of prompts let the user focus on their senses. The last learning type, moving, is connected to reflective actions. These actions let you reflect on movements, so the body is focusing on a physical activity during this action.

6.1.2 Web page

The second component of the self-reflection walking route is the web page. When the QR-codes are scanned by the users, a web page pops up on the smartphone of the user. The goal of this web page is to show a prompt or question to the user, so the user can reflect on it during walking. Both to lower the time spent on building the web page and to guarantee a professional design, the help of a web developer was asked: Joshua van der Meer [68]. The web page is hosted on the website of the author and can be visited using the following link: http://evajoanne.nl/reflectionwalk/index.php.

The web page basically consists of two different pages: one that provides an overview of the different types of self-reflection prompts (Figure 6.2a), and one that actually shows the prompt to the user (Figure 6.2b). First, sketches where made of these pages, these are shown in Figure 6.1. When a QR-code is scanned, the user will open a webpage that redirects to this second page. To ensure that each QR-code provides a different type of prompt, which are described in section 6.1.1, the web address in the QR-code

has a so-called ‘hash’-value. Such a hash value is the part in a URL that follows the ‘#’. The QR-code that redirects to a reflective question, for example, would become https://evajoanne.nl/reflectionwalk/prompt.php#**reflective**.

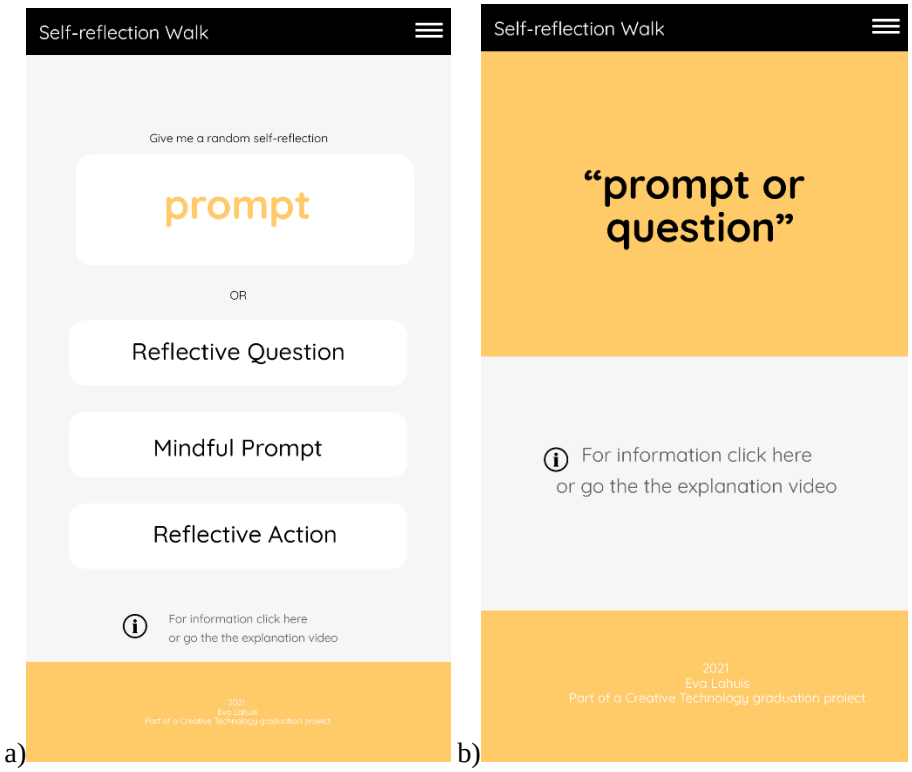


Figure 6.1: Sketch of the web page, (a) overview of the different types of self-reflection prompts, (b)showing prompt

Previously, when discussing the prompts it would be mentioned that these were stored in a database. However, in the final prototype the decision was made to simply include the prompts in a JavaScript-array. Based on the hash-value from the URL, the prompts belonging to that type could be retrieved from the array. Within these remaining prompts, a random number was generated to ensure that each time a page is loaded, a random prompt shows up. Of course, it could occur that a user would get the same prompt twice, but given the large amount of prompts added to the array, this chance was fairly low. Moreover, in the user test the participants would only see one prompt of each self-reflection type anyway.

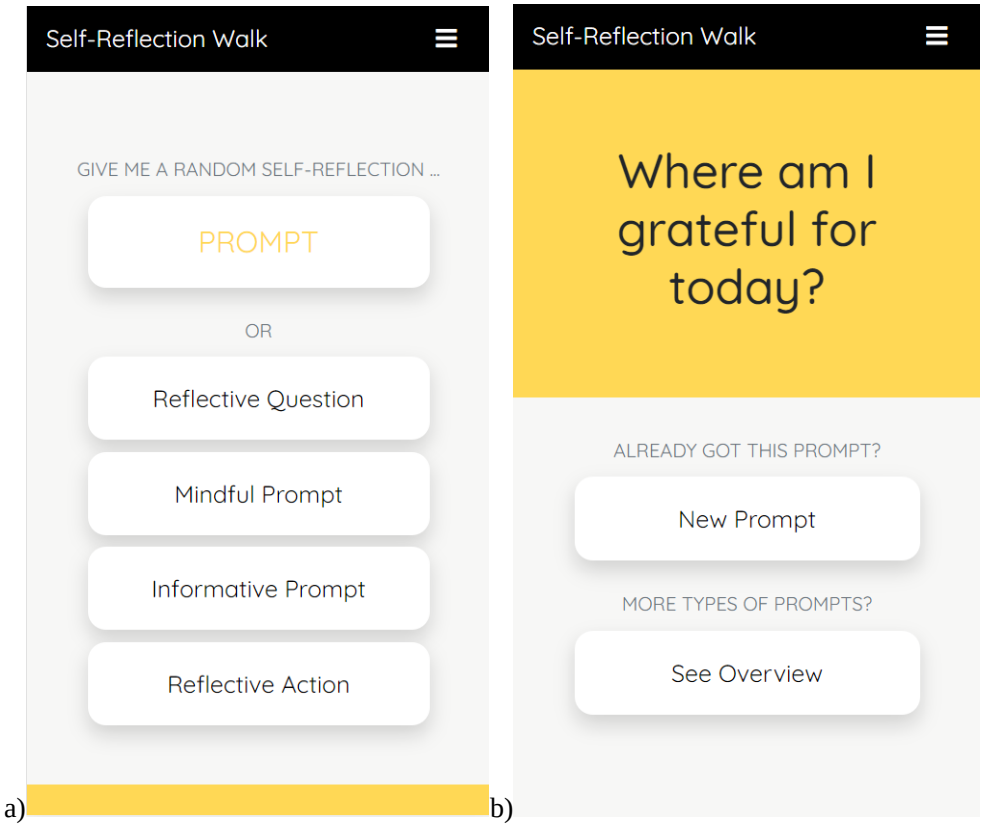
The following code demonstrates how the hash value is retrieved from the URL, and is used in combination with a randomly generated number to get a random prompt:

```
function setPrompt() {
  var hash = window.location.hash.substr(1);
  var prompts = PROMPTS[hash];
  var promptContainer = document.getElementById("prompt");
  var prompt = prompts[randomInteger(0, prompts.length-1)];

  promptContainer.innerHTML = prompt;
}

function randomInteger(min, max) {
  return Math.floor(Math.random() * (max - min + 1)) + min;
}
```

As stated before, the overview page provides links to all types of prompts, but also offers the option to let the system also randomly decide the type of prompt. In the user test, the final sign of the route would link to this page, with the suggestion to bookmark the page so that it could be used on future walks at a different location.



a) b)

Figure 6.2: Screenshots from the web page, (a) overview of the different types of self-reflection prompts, (b)showing prompt

6.1.3 Route

The route is the actual place where the prototype of the self-reflection walking route will be tested. The first decision that was made was to place the route on the campus of UT. This was decided with the intent to stay as close as possible to the potential users, the client, and students of UT. Additionally, the campus offers multiple walking route options. These options will be discussed later on in this section.

It was decided to give the preference to an outside, green scenery; a route that is surrounded by nature. In a study by Bratman et al. [69], the power of walking in nature was found: walking in nature yields measurable benefits and may reduce the risk of depression. Even though the participants from [69] walked for 90 minutes, which is a lot longer than this self-reflection walking route, it could have (partly) the same effect on shorter durations.

Next, the length of the route had to be decided. To increase the possible usage of the self-reflection walking route, it should be possible to walk the route in the lunchbreak of the University of Twente. The lunch break lasts from 12:45 to 13:45 [70], but this includes getting lunch, going from the previous study location to the start of the walking route, and going from the end of the walking route to a new study location. This led to a preferred walking route of around 25-30 minutes.

It is important to make the prototype as close to the real system as possible. However, it was decided to reduce the length of the walking route for the prototype to 10-15 minute, in order to reduce the time burden on the participants of the user test.

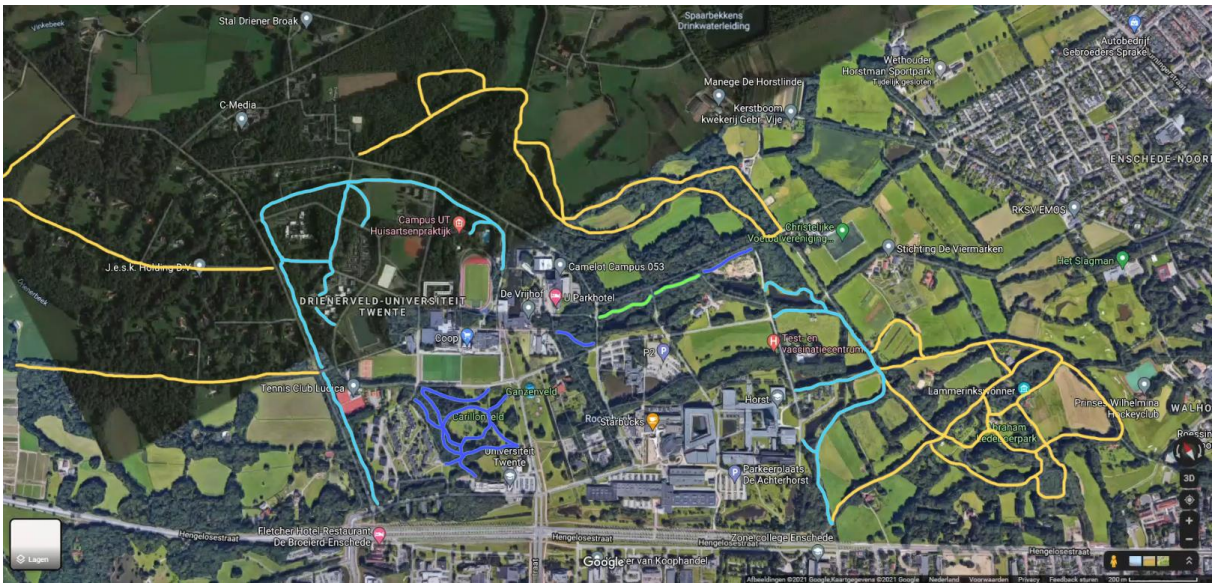


Figure 6.3: Optional walking paths for the self-reflection walking route. First, the yellow routes were declined because they are not located on the campus of the University of Twente. The chosen route is indicated with green. Image retrieved from Google Maps [71]

The route needed to be chosen. First, the possible walking routes were collected, of which an overview is displayed in Figure 6.3. The indicated walking routes are on (or close to) the campus of the University of Twente and are in a green environment, without too much disturbance from bicycles and cars. From this overview, a 10-15 minute walking route had to be chosen. Because there were still a lot of options left, it was decided to limit the route to the actual campus of the University of Twente [72]. The routes indicated with yellow in Figure 6.3 were declined. Still, a lot of route options were left, so it was decided to inspect the two most central route options physically on campus. These are indicated with dark blue and green in Figure 6.3. The route at the Carillonveld, the most left dark blue route, was dropped because of the large number of bikers passing through. Finally, the route indicated with green in Figure 6.3 was chosen because of the green scenery, the peaceful environment without many bicycles and cars, and the central location on the campus.

In Figure 6.3, it can be seen that the chosen route, indicated with green, could have been extended by the surrounding route parts, indicated with dark blue. It takes only 6 minutes to walk the chosen route, but the time it takes to read the poster and scan the signs will add up to these 6 minutes. The author timed herself walking the route, including reading the poster and scanning the signs. In total, this included 11 minutes. However, this is still an indication, it was expected that the participants of the user test might need some more time to read the poster and to scan the signs because it is new to them.

6.1.4 Poster

In this section, the development of the poster is described. Users of the self-reflection walking route should be able to know how it works, even if they have not heard of this route before encountering the start of the walking route. This is why was decided to place an informative poster at the starting point of the route. Before starting to sketch the poster, it was decided which information was needed on the poster:

- The title of the walking route;
- Description of how to walk the route, in steps;
- Map of the route;
- QR-code to get started, directing to a reflective question.

In section 5.4, a storyboard of the self-reflection walking route is displayed and explained. This storyboard is used as the basis for the description of how to walk the route. The steps are visually and

textually presented on the poster. In Figure 6.4, a draft version of the poster is displayed. During the process of making the draft poster, it was not yet decided what the actual route would be. Therefore, the map on the draft poster is not yet correct.

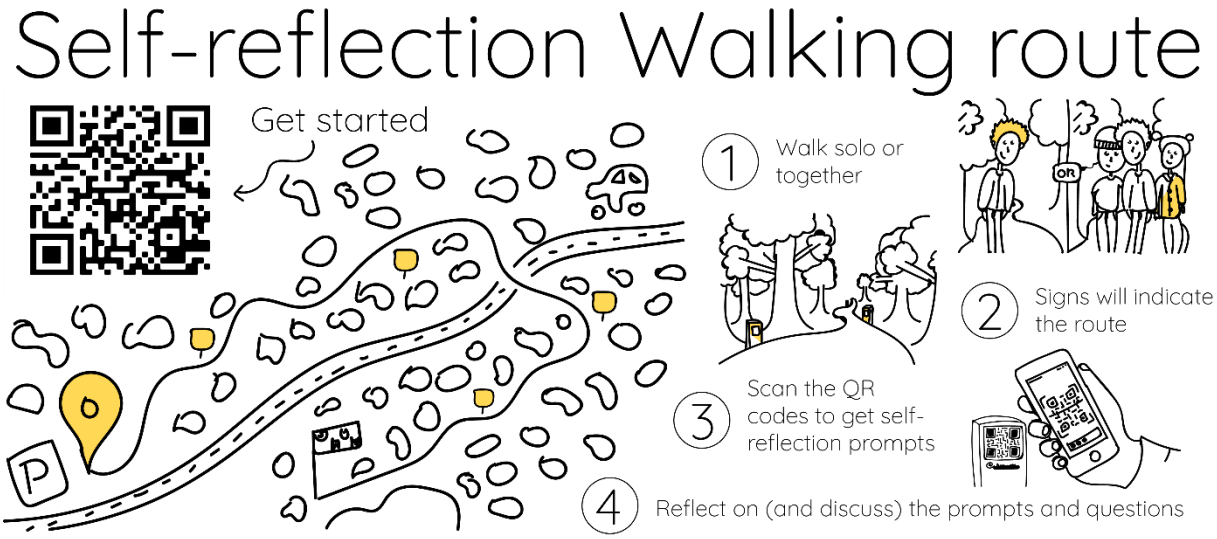


Figure 6.4: Draft version of the Self-Reflection Walking Route Poster

This draft poster was showed to the client, together with the storyboard. There were no remarks about the poster, so a final version of the poster was made. This final poster is displayed in Figure 6.5. This final poster was printed on A3 size, and attached to the poster sign.

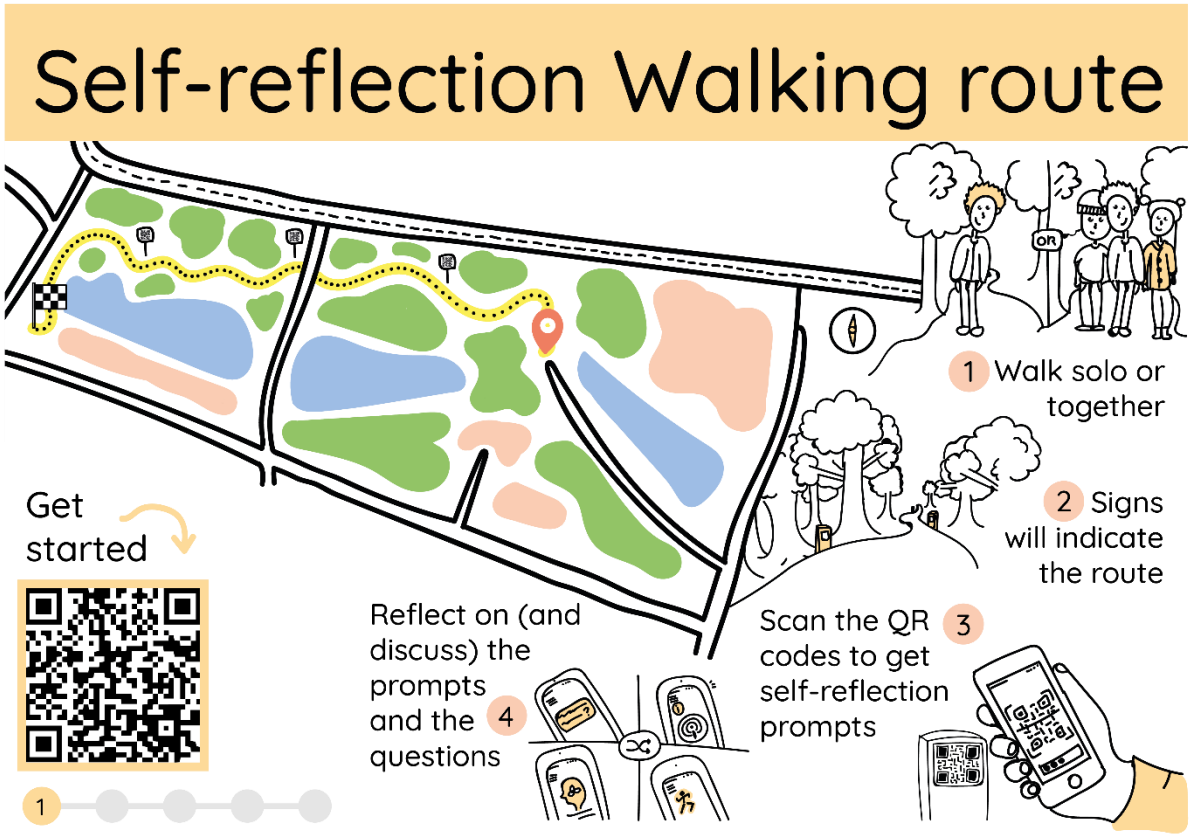


Figure 6.5: Final version of the Self-refleciton Walking Route start poster

6.1.5 QR-code signs

In this section the development of the signs with QR-codes is described. The goal of the QR-code signs is to show the QR-code to the users of the self-reflection walking route. The signs should be high enough to scan the QR-code easily and the QR-code should be big enough to scan. In total, four signs were needed: three signs to direct to a self-reflection prompt and one sign to indicate the end of the route.

First, the height of the sign was determined. The sign should be high enough for the users to scan the QR-code easily. After testing to scan QR codes from a 70 cm table, it was concluded that around 70 cm should be a good height. First a quick sketch was made of the sign, and after this, the sign was fabricated with residue wood.

Figure 6.6: Sketch of the QR-code sign (left), wooden QR-code sign (right)

After this, only the QR-codes needed to be made and printed. The QR-codes were made using a QR-code generator [73]. First, the signs only displayed the QR-code, but after the feedback from the first thee participants of the user test, a progress bar was added, as can be seen in Figure 6.7. The explanation of the two intermediate changes during the user test can be found in section 7.1.2.

Figure 6.7: QR-code from sign number 4 directing to a mindful prompt

Four QR-code signs were needed. The first QR-code on the poster directs to a reflective question. The second, the third and the fourth QR-code, all on a sign, direct respectively to an informative prompt, a mindful prompt and a reflective action. A fourth sign was necessary to indicate the end of the walking route, and includes a QR-code directing to the overview page of the self-reflection walk web page. The print of this final sign is displayed in Figure 6.8.

Figure 6.8: QR-code from the final sign directing to the overview page of the web page

6.2 Final prototype

In this section, the final prototype of the self-reflection walking route that was used for testing is described. The actions involved in using this prototype are also included. Pictures are made of the prototype to illustrate the included activities.

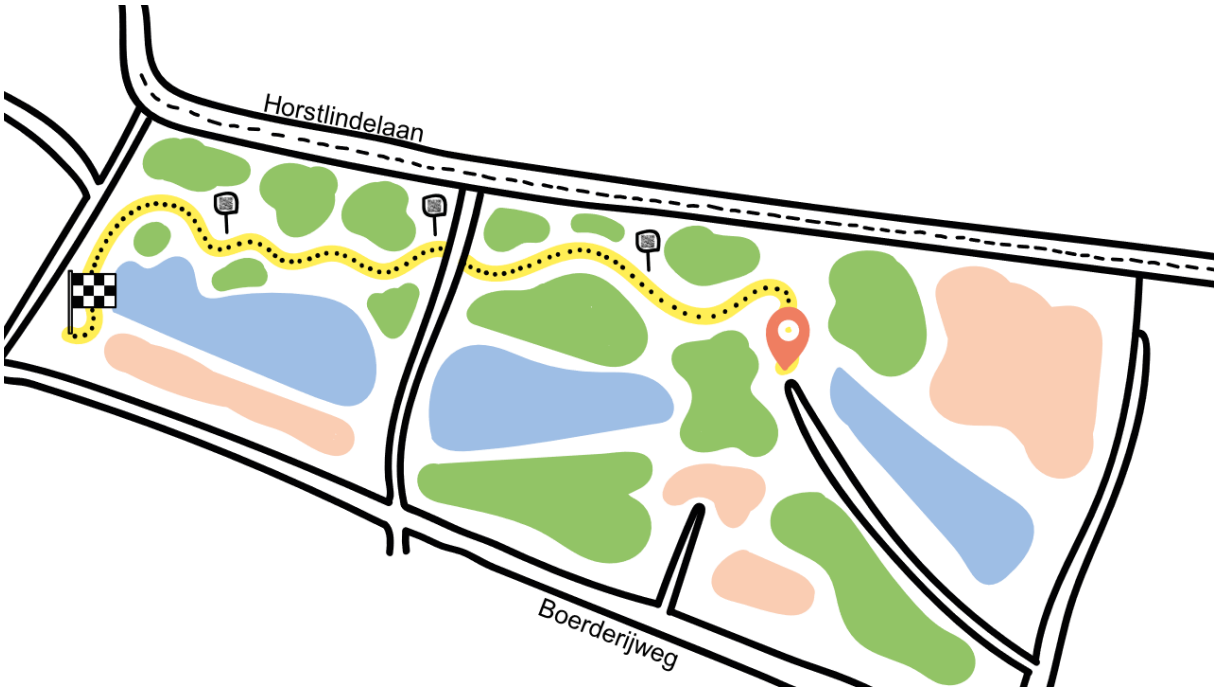


Figure 6.9: Map displayed on the poster

First, the user(s) (solo or together with someone) has to go to the starting point of the route, bringing their smartphone. At this starting point, an informative poster can be found. The starting point of the route is displayed in Figure 6.10.

Figure 6.10: Final prototype: the starting point of the route

Next, the informative poster including the explanation of how the walking route works can be read by the user (Figure 6.11). Optionally, the user can skip this step if the user is already familiar with the workings of the walking route.

Figure 6.11: Final prototype: reading the informative poster

The user can start walking the route by scanning the QR-code on the informative poster, as displayed in Figure 6.12.

Figure 6.12: Final prototype: scanning the start QR-code

The first reflective question will pop up on the smartphone of the user. An example of a reflective question on the web page is displayed in Figure 6.13.

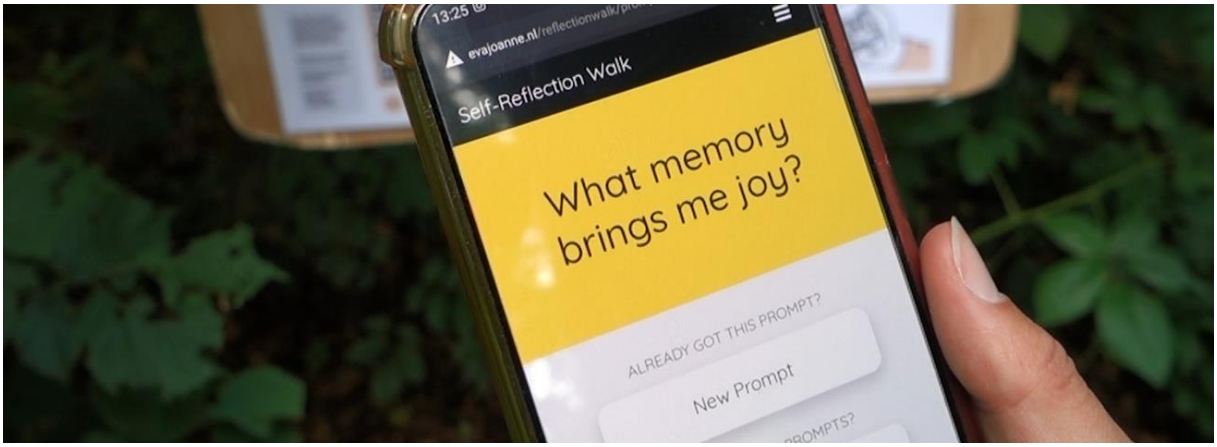


Figure 6.13: Final prototype: example of reflective question

The next step is to start walking, as can be seen in Figure 6.14. While walking the user can reflect on the question or prompt that was displayed on their smartphone.

Figure 6.14: Final prototype: reflecting on a question and walking

The user will walk until a sign with a new QR-code is encountered. These signs are placed along the walking route. The user will scan the new QR-code, as can be seen in Figure 6.15.

Figure 6.15: Final prototype: scanning a QR-code on a sign

Next, the user will continue walking till a new sign with a QR-code is encountered. This process repeats itself till the end of the walking route is reached, as can be seen in Figure 6.16.

Figure 6.16: Final prototype: the end of the walking route

Scanning the last QR-code will lead to the overview page with the different types of self-reflection questions and prompts, this is displayed in Figure 6.17. On the last sign, the suggestion is made to save the overview web page as a bookmark to possibly access later on.

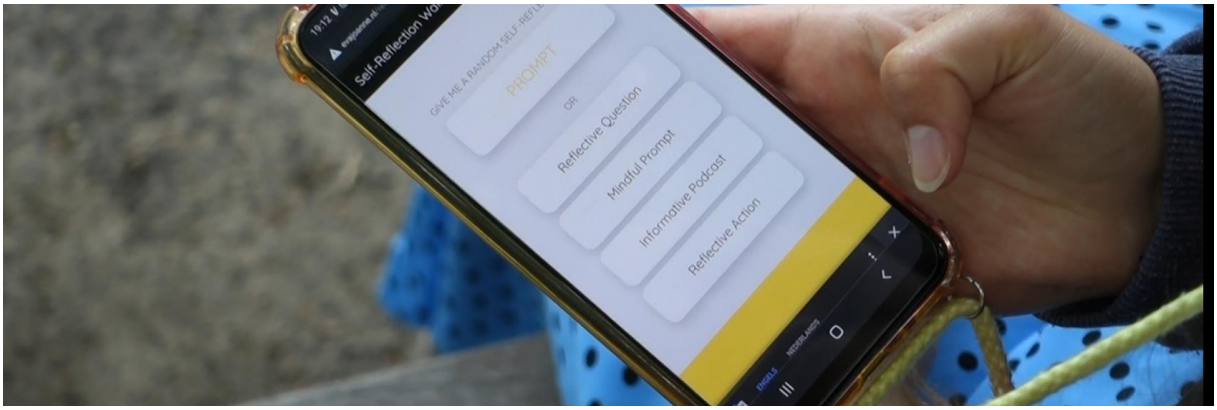


Figure 6.17: Final prototype: overview web page including different types of self-reflection

7 Evaluation

This chapter discusses the steps taken to evaluate the system from a functional point of view, a user's point of view, and an expert's point of view. It includes the evaluation of the final self-reflection walking route prototype, as described in chapter 6. The evaluation includes the functional, user, expert, and non-functional evaluation of the prototype.

The order of this chapter is as follows: First, the test procedures are described. After this, the results of the functional, user, expert, and non-functional tests are displayed and discussed.

7.1 Test Procedures

The evaluation of the self-reflection walking route prototype exists of four parts. First, the procedure of the functional test, secondly the user test, thirdly the expert test, and finally, the non-functional test.

7.1.1 Functional Test

During the functional test, the final prototype of the self-reflection walking route is assessed by comparing the results to the proposed functional requirements in section 5.5. Each proposed requirement is assessed to whether the requirement was fulfilled. The requirements are indicated with either 'Yes' (completely fulfilled), 'Yes, but' (partially fulfilled), 'No, but' (not fulfilled with a remark), or 'No' (not fulfilled). This functional test is concluded with an explanation of the assessment.

7.1.2 User Test

To increase the comparability of the qualitative and quantitative data gathered in the user test, the test procedure was extensively described beforehand, to ensure that every participant in the user test has the same experience and the information given to them is consistent.

Table 7.1: Planning for the user and expert test of the self-reflection walk.

Saturday the 19th of June 2021	**Tuesday** the 22nd of June 2021	**Wednesday** the 23rd of June 2021	**Thursday** the 24th of June 2021	**Friday** the 25th of June 2021
10:30-11:30	13:30-14:30	16:30-17:30	12:14-13:45	12:15-13:15
Participant 1	Participant 4	Participant 9	Expert 1st meeting	Expert 2nd meeting
11:30-12:30	16:00-17:00	19:00-20:00		
Participants 2 and 3	Participants 5 and 6	Participant 10		
	17:00-18:00			
	Participants 7 and 8			
	18:00-19:00			
	Participant 8			

In previous phases of the project, the target group of the system was still first-year module 4 students and second-year module 5 and 6 students. During those previous phases, this group was already contacted via WhatsApp with the possibility to sign-up for this user test. After the change of course of the project, the possible target group of the system expanded, and also second and third-year students were approached. The students who were interested were sent a Google Form including the information brochure and

informed consent, as displayed in Appendix H. With the respondents who agreed with the informed consent, a time slot of one hour was planned somewhere between the 19th and 24th of June 2021. The user test (and expert test) planning can be found in This chapter discusses the steps taken to evaluate the system from a functional point of view, a user's point of view, and an expert's point of view. It includes the evaluation of the final self-reflection walking route prototype, as described in chapter 6. The evaluation includes the functional, user, expert, and non-functional evaluation of the prototype.

The order of this chapter is as follows: First, the test procedures are described. After this, the results of the functional, user, expert, and non-functional tests are displayed and discussed.

7.2 Test Procedures

The evaluation of the self-reflection walking route prototype exists of four parts. First, the procedure of the functional test, secondly the user test, thirdly the expert test, and finally, the non-functional test.

7.2.1 Functional Test

During the functional test, the final prototype of the self-reflection walking route is assessed by comparing the results to the proposed functional requirements in section 5.5. Each proposed requirement is assessed to whether the requirement was fulfilled. The requirements are indicated with either 'Yes' (completely fulfilled), 'Yes, but' (partially fulfilled), 'No, but' (not fulfilled with a remark), or 'No' (not fulfilled). This functional test is concluded with an explanation of the assessment.

7.2.2 User Test

To increase the comparability of the qualitative and quantitative data gathered in the user test, the test procedure was extensively described beforehand, to ensure that every participant in the user test has the same experience and the information given to them is consistent.

Table 7.1.

The goal was to gather at least five participants. According to Virzi [74], five users will approximately find 80% of the usability flaws. More participants could lead to more insights, but due to the time constraint of this project, a maximum of around twelve participants was possible. Eventually, eleven participants were scheduled, but one participant canceled last minute, so ten participants participated in this user test.

Prior to each day of user testing, the researcher placed the signs with the poster and the QR-codes at the chosen walking route. The participants were sent a screenshot and asked to meet the researcher at the starting point of the walking route, as is indicated with a red cross in Figure 7.1. After the arrival of the participant(s), the least possible information was given to them. The participants were asked to start walking the route and provided with the explanation that the researcher would follow them at a safe distance to do some observations and to be available for urgent questions. After walking the route, the participant(s) and the researcher would sit together. During the first part of the evaluation, the participant was asked to fill in a Google Form. The questions (and results) are displayed in Appendix I-1, I-2, and I-3. This Google Form consists of some demographic questions, the System Usability Scale (SUS) questions and a short questionnaire, respectively. More information about the SUS is provided in section 3.6.

Figure 7.1: Informative screenshot of the self-reflection walking route for the participants of the user test. Image retrieved from Google Maps [71]

Subsequently, the participants were interviewed, these questions (and results) are displayed in Appendix I-4. After the user tests, the participants were thanked. After the user tests were done for the day, the researcher removed the signs with the poster and the QR-codes and stored them at a safe place.

After the first user test day, the 19th of June, with three participants, two minor changes were made to the prototype. To increase the comparability and the reliability of the user evaluation, it is important to keep the procedure of the user test and the prototype the same. However, two small factors appeared to be distractive in the process of the user test, so they were changed:

- Adding progress bar to the QR code signs. For illustration, an example is visible in Figure 7.2.
- Formulated a question in the evaluation form different. From: "With whom would you like to walk this route again?" to 'Would you like to walk this route again, if so, with whom?"

Figure 7.2: Example of the progress bar added to the poster and the QR-signs

7.2.3 Expert Test

At the end of the project, the final prototype of the self-reflection walking route was evaluated with an expert: Educational Specialist Babs Ernst, who works as an e-learning specialist for the faculty EEMCS at the UT. The test procedure was almost the same as in section 7.1.2, the only difference being that the expert was not asked to fill in the Google Form, only the interview was done.

7.2.4 Non-Functional Test

During the non-functional test, the final prototype of the self-reflection walking route is assessed by comparing the results to the proposed non-functional requirements in section 5.5. Each proposed requirement is assessed to whether the requirement was fulfilled. For this assessment, the results from the user and the expert test are used. The requirements are indicated either with 'Yes' (completely fulfilled), 'Yes, but' (partially fulfilled), 'No, but' (not fulfilled with a remark), or 'No' (not fulfilled). This non-functional test is concluded with an explanation of the assessment.

7.3 Functional Test

In this section, the final prototype of the self-reflection walking route is assessed by comparing the result to the proposed functional requirements from section 5.5. In Table 7.2, the final functional requirements are displayed again, combined with an indication as to whether the requirement was fulfilled.

Table 7.2: Functional requirement assessment

No.	MoSCoW	FR	Requirement	Fulfilled

1	Must have	FR	The system must **introduce** one or more self-reflection techniques to the users: the 'tools' of the self-reflection techniques must be given to them.	Yes
2			The system must be (partly) an **online** system (such as a web/mobile application)	Yes
3			The system must be (deployable as) part of a **bigger system,** including an afterthought; a mobile self-reflection application, an informative email, etc.	Yes, but
4			The system must provide enough information so the user can (partly) use the system **autonomously**.	Yes

12	Should have	FR	The self-reflection integrated into the system should focus on the **personal life** of the student.	Yes
13			The system should have integrated **peer collaboration** to motivate the use of the system.	Yes, but
14			It should be possible to (partly) use the system **individually** and (partly) in a **group setting**.	Yes

20	Could have	FR	The system could have the ability to **set goals** when starting with the system and to motivate self-reflection on it, to evaluate their planning and actual usage of the system.	No
21			The system could be **integrated in education** and/or student counseling.	No, but
22			The **target group** of the system could be **expanded** with all students and employees of the University of Twente.	Yes
23			The system could be a **hybrid** system: the system could combine offline and online activities.	Yes

25	Won't have	FR	-

As illustrated in Table 7.2, all the functional 'Must Have' requirements have been fulfilled, although one has a remark. FR1 is fulfilled, since the system introduces four different types of self-reflection to the user, and the 'tools' to practice the techniques are integrated into the web page of the system. FR2 is fulfilled as the system is partly an online system because of the implementation of the web page. FR3 is not completely fulfilled, the self-reflection walking route is deployable as part of a bigger system, but this is not yet the case. The system can serve as part of a bigger system by, for example, including a reference to this bigger system in the final sign of the route. FR4 is fulfilled because te system provides all the information about how it works to the user.

Much like the 'Must Have'-requirement, all but one of the 'Should Have' requirements have been completely fulfilled, and one has a remark. FR12 is fulfilled; the self-reflection prompts and questions mainly focus on the personal life of the students. FR13 is fulfilled, since peer connection is added to the system as it allows the walking route to be walked together. However, the walking route can also be walked alone, so the choice for the integration of the peer connection lays partly with the user. FR14 is fulfilled as it is possible to use the system individually, together, or even in a group.

Not all the functional ‘Could Have’ requirements have been fulfilled. FR20 is not fulfilled: It is not possible to set goals when starting the system, nor is it possible to reflect on them. However, this could still be added to the system, for example on the web page as a pre and post-entry form, or as an external workbook. FR21 is not fulfilled since the system is not integrated into education or student counseling. However, the system is already suitable to do this, for instance in the case of a a mentor/study counselor and a student using it together. FR22 is fulfilled as the possible user group of the system includes all students and employees from the UT. FR23 is also fulfilled because the system is a hybrid system: It combines an online web page with an offline walking route.

7.4 User Test

The user test was conducted as described in section 7.1.2. In this section, the results from the user test are discussed. First, the results of the System Usability Scale are discussed, then the results of the short questionnaire, and finally, the interview results.

The user test had in total ten participants (71% male and 28% female). Their age was between 19 and 25, with an average age of 21 years old. The participants were all studying at the UT, of which 70% studied Creative Technology. 90% of the participants originated from the Netherlands, and 10% originated from an EU country.

7.4.1 System Usability Scale

In this section, the results of the SUS, as explained in section 3.6.2, are discussed. After collecting the results from the ten participants, the final SUS rating of the system was calculated. The results of the ten SUS statements and the calculation of the final SUS rating can be seen in Appendix I-2. A final SUS score of 88.75 of the system was found. This can be classified as ‘acceptable’ according to the acceptability range or as ‘excellent’ according to the adjective ratings from Bangor et al. [62], as can be seen in Figure 3.4. The lowest individual score was 80 and the highest individual score was 100. According to Bangor et al., the SUS “…should not be used in isolation to make a judgment about the “goodness” of a given product” [62, p. 19], but it can be concluded that the system with a final SUS rating of 88.75 seems to score very well on usability.

7.4.2 Evaluation Questionnaire

In this section, the results of the short questionnaire are discussed. The total questionnaire and the results can be found in Appendix I-3.

One of the questions that was asked, included whether the participants would like to walk the route again and, if so, with whom. The participants could select multiple options, or add a custom option. The result is displayed in Figure 7.3. Not one participant answered: ‘No’ to this question, so all participants would like to walk the route again. The most popular answer being: ‘Yes, together with a friend’, and the second most popular answer being: ‘Yes, alone’.

Next, it was asked to grade different aspects from the self-reflection system: the web page, the time it takes to walk the route, the content of the self-reflection prompts, the scenery, and the overall system; the self-reflection walking route. The lowest grade is given to the time it takes to walk the route. This aspect is graded with an average of 7.1, with the lowest grade being a 4 and the highest being a 10.

The other average grades of the aforementioned aspects were all higher than 8. This illustrates that these aspects were all positively regarded. The web page is graded with an average of 8.4, with the lowest grade being a 7 and the highest grade being a 10. The content of the self-reflection prompts is graded with an average of 8.1, with the lowest grade being a 4 and the highest grade being a 10.

The highest grade is given to the scenery. This aspect is graded with an average of 8.6, with the lowest grade being a 7 and the highest grade being a 10. The overall system is graded with an average of

8.5, with the lowest grade being a 7, and the highest being a 10. This illustrates a high appreciation of the system.

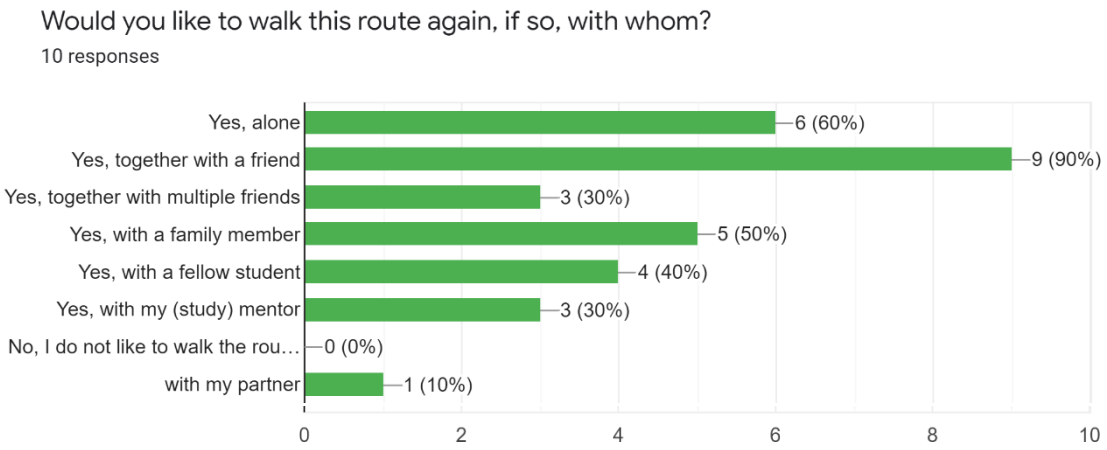


Figure 7.3: Evaluation questionnaire: Would you like to walk this route again, if so, with whom?

One other important finding of this evaluation questionnaire is: 70% of the students had not heard of the Student Wellbeing Project before testing the self-reflection walking route.

7.4.3 Interview Results

In this section, the results of the interviews conducted after testing the self-reflection walking route are discussed. All the interview questions and the results can be found in Appendix I-4.

The first question from the interview had the goal to start the conversation with the participant(s) and included the question about the overall impression of the self-reflection walking route. However, six participants agreed on wanting a longer route; the route was generally regarded as being too short.

The second question from the interview asked the question why the participants would want to walk the self-reflection walking route again. The most frequently mentioned reason, given by 4 of the 10 participants, was the value of walking together with someone. Other aspects include the walking and the scenery.

The third question from the interview asked the participants whether there were enough instructions to walk the route autonomously. Nine out of ten participants answered ‘yes’ to this question. However, the first three participants added a remark about the QR-code signs. This is the reason that after the first three participants a progress bar was added to the signs with QR-codes. This is also explained in section 7.1.2.

The fourth question from the interview was asked to see whether the participants, who could sign-up themselves for the user test, were already familiar and enthusiastic about self-reflection. However, seven out of the ten participants did not practice self-reflection in their personal life. The other three participants have occasionally practiced self-reflection. The fourth question from the interview additionally included the question of what the participants thought about the self-reflection prompts. Four of the ten participants mentioned they liked the variety in the self-reflection prompts. Two participants said they would like to have deeper questions, and one participant did not like the mindful prompts. The other three participants were content with the prompts.

To the question whether the interest of the students was sparked in self-reflection techniques, eight of the ten participants answered ‘yes’. The participants were asked which aspects of the system led to sparking their interest: Seven of the ten participants said ‘walking’, so the physical activity itself was

important. Five participants additionally mentioned the self-reflection prompts, three participants mentioned peer connection and three participants mentioned the scenery.

Nine of ten participants answered ‘yes’ to the question whether the participants thought this self-reflection walking route could be part of a bigger system. However, two participants mentioned the walking route as being most powerful. After this, three examples were mentioned as being a bigger system: sending an informative email, directing to a self-reflection application, or using the web page at another walking location without the QR-code signs. The bigger system that has the lowest potential might be the informative email. Five participants said ‘No’ to the email and three participants ‘Maybe’. Three participants said ‘Yes’ to the application and five participants answered ‘Maybe’. The web page might have the highest potential al being a bigger system because six participants said ‘Yes’ to using the web page and two participants said ‘Maybe’. However, these bigger systems were not built and tested by the participants so the reliability of these findings can be questioned.

When asked for improvements, the following suggestions were mentioned multiple times:

- Increase the length of the route, and thereby increase the time it takes to walk the route (mentioned by seven participants;
- Increase the distance between the signs, especially for the users who are walking together (mentioned by three participants);
- Pick another location for the route with no road to cross during the walk and no car road next to the route (mentioned by three participants);
- Change the QR-code signs, some suggestions are:
    - Not having to scan a QR-code every sign, giving the final sign a different layout, deleting the signs (mentioned by three participants);
    - Introduce a different option in the system for walking along and together (mentioned by one participant).

Some new ideas for the system were suggested by the participants when they were asked for additional comments:

- Give users the possibility to add new prompts and questions. Of course, this should be moderated.
- Give the web page an option to receive prompts/questions in intervals while walking. This way, the web page can be used when walking another route without the QR-code signs.

Lastly, the researcher made an important observation during the user tests. The chosen route for the prototype was not as suitable as was expected for the self-reflection walking route. The route appeared to be a mountain bike route where mountain bikers were passing by at high speed. Additionally, it was observed that the start and the end of the route might be too far from each other. The participants often arrived by bicycle at the start of the route, so after walking the route they had to walk back to their bicycles. It would be more convenient to have the start and the end of the walking route closer together, or even have it become a full circle when possible.

7.5 Expert Test

In this section, the results of the interview conducted after the expert test of the self-reflection walking route are discussed. All the interview questions and the results can be found in Appendix I-5. As described in section 7.2.3, educational specialist Babs Ernst tested the self-reflection walking route.

The first impression of the walking was positive to the expert. She felt relaxed and liked the calming route, surrounded by nature. She wanted to walk the route again, but if the route would stay the same, she would possibly be not that interested anymore after a few walks. She suggested a different route on the campus of the UT, where also variety could be added to the length of the route. This route was

shown to the researcher during the second expert meeting by walking a large part of the route, this suggested route can be seen in Figure 7.4

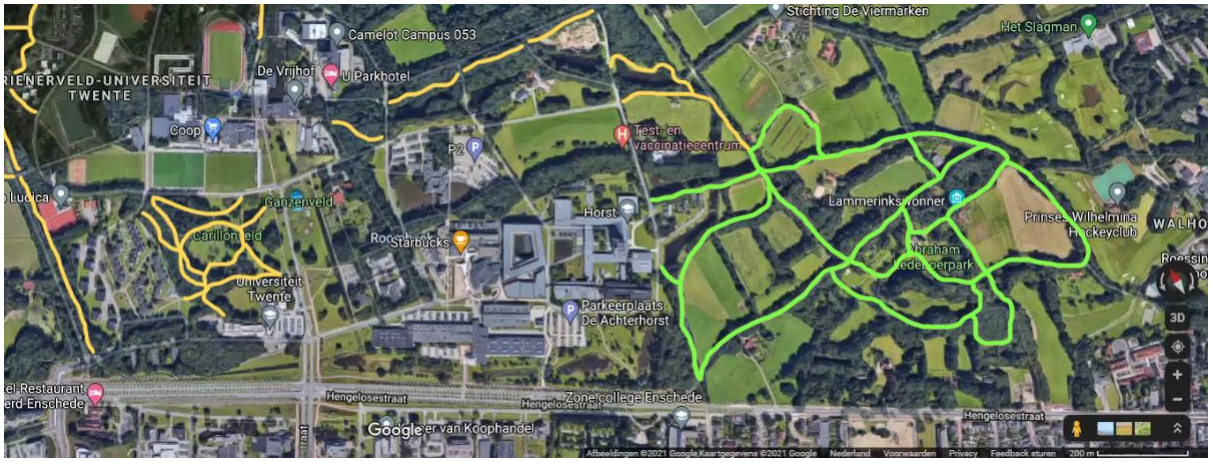


Figure 7.4: Suggested route by the expert (indicated with green), Image retrieved from Google Maps [71]

According to the expert, the current starting point was hard to find. But the poster, the signs, and the web page were clear. She commented on the second prompt she got during the walk. This was an informative prompt and was difficult to understand at first, but appeared to be the most appreciated prompt. She advised against showing the name of the type of prompt/question next to the popped-up prompt/question. An average person does not have a clear idea about the contents of reflective questions and the other types of prompts. However, there could be made a different option in the web page between walking the route for the first time, and another walk. When a person would walk the route for the first time, it is a good thing to introduce them to all the different types.

The expert does not practice self-reflection regularly, but sometimes she does practice mindfulness. The system sparked her interest in self-reflection: the walking route lead to positive feelings about self-reflection and it made her feel calm. According to the expert, the system should still be tested as part of a bigger system. She says the QR-code signs are a nice reminder to scan for a new prompt, so she does not want to use the web page at another location. An email, sent after a week, could be an option to remind people of the self-reflection (walking route). An application could be an option, it would be nice to have a very positive self-reflection application.

According to the expert, two improvements should be made. First, relocation the route to the suggested route in Figure 7.4. Secondly, change the QR-code sign frequency for walking alone and walking together by color-coding the QR-code signs. People who walk together might need a double amount of time to discuss the prompts and questions. An aspect that should not be changed is the untitled QR-code signs. Do not add the name of the types of prompts or questions next to them, this will only distract the users.

According to the expert, QR-codes could be a limitation of the system. Here on the campus of the UT, everyone might understand what they are and how they work, but other people might not understand. An additional limitation could be the interest of beta-orientated people. Maybe they need a lot more time to think about a self-reflection prompt, or they will answer too fast.

7.6 Non-Functional Test

In this section, the final prototype of the self-reflection walking route is assessed by comparing the result to the proposed non-functional requirements from section 5.5. For this assessment, the results of the user and expert test are used. The assessment of the non-functional requirements can be seen in Table 7.3.

Table 7.3: Non-functional requirements assessment

No.	MoSCoW	NFR	Requirement	Fulfilled
5	Must have	NFR	The system must focus on **sparking the interest** of the user in self-reflection.	Yes, but
6			The system must motivate **regular usage** of self-reflection techniques.	Yes, but
7			The system must make clear it is **explicitly complementary** to professional mental health help, and not a replacement.	Yes
8			The system must be experienced as **useful**, meaning that the user must feel supported to successfully use the self-reflection techniques during participating.	Yes
9			The system must be experienced as **easy to understand** by the user.	Yes
10			The system should **retain the interest** of the user, for multiple usages.	Yes, but
11			The system must be an environment where the users feel **safe and secure**.	Yes, but
15	Should have	NFR	The system should contribute to the **awareness** of the relevance of using self-reflection techniques.	Yes
16			Using the system should give **satisfaction**.	Yes, but
17			The user should **experience changes** after using the system, in physical activity, in conversation and/or self-reflection knowledge.	Yes, but
18			The user should have full **freedom** in choosing to (not) participate (the system should not be used obligatory).	Yes
19			The system should be **widely applicable:** personal life, studies and work life.	Yes, but
24	Could have	NFR	The system could be **adopted by** the Student Wellbeing Project.	No, but
25	Won't have	NFR	The system is **not a professional application** focussing on professional (mental) help.	Yes
26			The system won't include **information** on different mental issues and/or **coping suggestions**	Yes

As can be seen in the non-functional requirements assessments, all the non-functional 'Must Have' requirements have been fulfilled, but four with a remark. NFR5 is partly fulfilled, eight out of the ten participants of the user test said their interest was sparked in self-reflection. However, two participants disagreed with this, so not all users might spark their interest in self-reflection when using the system. NFR6 is partly fulfilled since the system is suitable for users to use multiple times and regularly, and all the participants in the user test want to use the system again. However, the system has no specific feature to actively motivate the user to use self-reflection regularly. NFR7 is fulfilled; the system does not include any suggestions to professional mental health and it does not lead to associations with professional mental health to the user. NFR9 is fulfilled as nine of the ten participants in the user test found the system easy to understand. NFR10 is partly fulfilled: All ten participants in the user test said they would like to use the system again. However, multiple usages are not tested, so this is still uncertain. NFR10 seems to be

fulfilled, none of the participants indicated feeling not safe or secure. However, no explicit question is asked about this to the participants.

All the functional ‘Should Have’ requirements have been fulfilled, but three with a remark. NFR15 is fulfilled since the system contributes to the awareness of self-reflection techniques. The system introduces self-reflection to students and five of the ten students mentioned self-reflection itself as a powerful aspect of the system. NFR16 seems to be fulfilled, as most of the participants appeared to be satisfied after using the system. However, no specific question about this was asked to the participants. NFR17 is partly fulfilled, seven of the ten participants did not use self-reflection before and five of them had their interest in self-reflection sparked. However, no specific questions were asked about actually feeling changes. NFR18 is fulfilled: The users have the freedom to choose whether to use the system or not. NFR19 is partly fulfilled; the system is widely applicable and suitable to also use in studies and work life, but is only tested in the personal life of the student. To know if the system works in studies and/or work life, this should be tested.

The only non-functional ‘Could have’ requirement NFR24 is not fulfilled. The system is not yet adopted by the SWIP, but this could be possible in the future. The two non-functional ‘Won’t have’ requirements NFR25 and NFR26 are both fulfilled. The system is not a professional help application and also does not include information on different mental issues and/or coping suggestions.

7.7 Discussion

In this section, the test procedures, the tests themselves, and their results are discussed. The discussion will include some factors which played a role during the evaluation which influenced the reliability of the evaluation.

Apart from the SUS score, no scientific results can be attached to the outcomes of the user test. The results should be treated as mere feedback, and serve as indication of the strengths and weaknesses of the self-reflection walking route.

As explained in section 0, the length of the prototype route was shortened in comparison to the actually preferred length of the route to reduce the time burden on the participants. One of the main recommendations of the user and expert tests is to increase the length of the walking route. It could be that a longer walking route would have influenced the results of the user and the expert test.

In the user test, only ten users participated. This amount of responses does not lead to statistically significant results. More participants could have lead to more significant evaluation results. Additionally, it can be doubted to which extent the group with participants is representable for the whole student population of UT. In comparison to the UT figures of 2019 used in [2], the proportion of non-Dutch students were underrepresented. Additionally, seven of the ten participants study Creative Technology. This also means that the participants were on average younger, and master students were also underrepresented.

Furthermore, the first three participants were friends of the researcher. This could have influenced the results of the evaluation, for example when friends would be more enthusiastic about the prototype (or even more critical) because they know the one who created it. However, from the results of the evaluation, no outstanding different results could be found for the first three participants.

Participants could sign-up themselves for the user test. This could lead to a less representative user group than when selecting participants randomly. It was expected that the participants who signed up themselves might have an interest in self-reflection already. However, it resulted from the user test that seven of the ten participants do not practice self-reflection in their personal life, and the other three participants sometimes. From these results, it can not be concluded that the participants had an increased interest in self-reflection before sign-up for the user test.

During the user test, some participants tested the route by walking alone and some participants tested the route by walking together. Participants 2 and 3 and participants 5 and 6 tested the route together. The user test interviews were additionally conducted together with both participants and the researcher. These participants who were interviewed could have influenced each other's results, and be therefore less reliable. Although, through discussing the answers to the questions, new ideas could have originated.

During the user test, two minor changes were made to the user test and prototype. A progress bar was added to the QR code signs and one question was formulated differently in the evaluation questionnaire. To keep the results of a user reliable, the test procedure and the prototype must be as consistent as possible. It was still chosen to implement these two minor changes because they seemed to influence the experience of the participants. However, especially adding the progress bar to the QR-code signs might have led to a slightly different experience.

The participants (probably) got different prompts and questions from the database during the test. This could have influenced the answers to the interview question about the content of the self-reflection prompts.

In the SUS test, one statement led to questions for the participants. In this statement, the word ‘cumbersome’ was included, and multiple participants did not understand this word. This could have influenced the answers to this question, and thereby the final SUS rating.

In the user test interview, the question about the self-reflection route as part of a bigger system was asked. The participants were told about three examples: an informative email, directing to a self-reflection application, or using the web page at another walking location without the QR-code signs. However, none of these examples were built or tested by the participants, so the results of this question can be questioned.

7.8 Conclusion

In this section, the important findings of the evaluation are concluded. These findings are concluded from the functional test, user tests, expert test, and non-functional test.

All ‘Must have’ functional and non-functional requirements are fulfilled. Therefore, the system is functioning as required and envisioned. However, according to the functional and non-functional tests, there are possibilities for improvement in the system. First, the system could be part of a bigger system, but the bigger system should still be chosen and this should be tested. These bigger systems could be integrated into education or student counseling, or the system could be adopted by the SWIP. 70% of the students did not know the SWIP before testing the self-reflection walking route. A possibility could be to connect the SWIP to the system. Additional options for a bigger system include a further development of the web page or implementing a self-reflection application. An informative email is discouraged. Secondly, it is not yet possible to set goals when starting the system, nor is it possible to reflect on goals.

Although the system has no specific feature to actively motivate the user to use it regularly, all the participants indicated they want to walk the route again. Nine of the ten participants would like to walk the route again with a friend, and six of the ten would like to walk the route again by themselves. However, multiple usages are not tested.

Ten students participated in the user test. The users and the expert reacted quite positively after testing the system. Eight out of ten participants had their interest in self-reflection sparked. According to the users and the expert, strengths of the system include: the peer connection, the scenery surrounding the route, the physical activity involved and the self-reflection prompts and questions.

The system was rated with a SUS score of 88.74. This score suggests that the usability of the self-reflection walking route is good. Furthermore, the components of the system were graded. The scenery received the highest grade during the user test, an 8.6. The time it takes to walk the route got the lowest

grade, a 7.1. The web page got an 8.4, the content of the self-reflection prompts an 8.1 and the overall system was graded with an 8.5. This illustrates a high appreciation of the system.

Some important possibilities for improvements were mentioned during these tests. First of all, the length of the self-reflection walking route prototype might be too short, seven out of ten participants indicated they would have liked to walk and reflect longer. Secondly, the distance between the QR signs is too short when two users are walking together.

Moreover, the prototype tests led to some interesting ideas from the participants and the expert. First, an option to suggest new prompts to the database could be added to the web page. Secondly, the web page could give an option to receive the prompts and questions in an interval, while walking another route without QR-code signs. Thirdly, a better location for the self-reflection walking route was suggested, which can be seen in Figure 7.4. This new route seems suitable for the system. It is still close to educational buildings and it is possible to add variety to the length of the route and therefore to increase the length of the route. There will be less disturbance from mountain bikers. Fourthly, the frequency of the QR-code signs could be adjusted for walking alone or together with someone. This could be done by color coding these signs: every sign can be scanned when walking alone and every other sign can be scanned when walking together.

8 Conclusion & Future Work

In this chapter, the conclusions and the recommendations for future work are given. The conclusions will be given by answering the RQs and the sub-RQs, stated in section 1.5. Then, recommendations will be given for future research and further development of the system.

8.1 Conclusions

In this section, the RQs and the corresponding sub-questions will be answered. First, the sub-RQs will be answered which will help to formulate the answer on the main RQs. The answers are based on the background research, the brainstorms, the interviews, and most importantly, on the evaluations.

> **RQ1.1**: *What are relevant proven personal self-reflection techniques that can be implemented to guide students towards an improvement of their wellbeing?*

Journaling, gratitude practice, habit tracking, and mood tracking are relevant personal self-reflection techniques, according to the Scopus database assessment. From the literature research can be concluded that these four self-reflection techniques can contribute to an improvement in wellbeing of students. Mindfulness and (mindful) mediations could additionally be relevant according to the Scopus database assessment, but were not added to the literature research because of time constraints. The four implemented self-reflection techniques in the self-reflection system are: reflective questions, mindful prompts, informative prompts and reflective actions. These techniques are relevant for people with different preferent learing styles. However, these self-reflection techniques specifically are not yet substantiated by literature research.

> **RQ1.2**: *How can a self-perceived improvement in the mental health of students be measured?*

It can be difficult to measure a self-perceived improvement in the mental health of students. Furthermore, this question can not be quantified for the final prototype of the system. In retrospect, the questions should have been formulated differently. The goal of this question was to establish how to evaluate the self-reflection system, but eventually, the system was mainly assessed on performance and usability.

> **RQ1**: *How can proven personal self-reflection techniques be introduced and provided to students such that they are guided towards a perceived improvement of their wellbeing?*

According to the literature research, it is important to consider the characteristics of the self-reflection techniques. Two important aspects to focus on when introducing and providing self-reflection techniques to students, are to spark their interest in self-reflection and to motivate regular usage of self-reflection. In RQ2.1 and RQ2.2 there will be a focus on how this can be achieved.

> **RQ2.1**: *Which format(s) should be chosen for the system to spark the interest of students in self-reflection?*

To spark the interest of students in self-reflection, the decision was made to create a self-reflection walking route. Key features of the system that contribute to spark the interest of students include: peer connection, a green scenery surrounding the route, the physical activity involved and a variety of self-reflection prompts and questions

> **RQ2.2**: *How can students be motivated to use (the) self-reflection (system) regularly?*

There is no active feature integrated in the self-reflection walking route which motivates the user to use the system regularly. However, the system has a high potential to be used again. Key factors for this are: peer connection, walking and the scenery.

> **RQ2.3**: *Which group of students is the actual potential user group of this system?*

Students in module four of the first year and module five and six of the second year of the UT could possibly benefit the most from a self-reflection system. However, the self-reflection walking route is suitable for all students at the UT and additionally for employees of the UT.

RQ2: *How should a personal self-reflection system be designed and implemented to introduce and support usage of self-reflection techniques?*

The goal of this research was to develop a chosen type of system and to design and implement this system in a way that introduces and supports suitable proven personal reflection techniques to students through which they will be guided towards a perceived improvement in their wellbeing. The developed system includes a self-reflection walking route. The components of this system are self-reflection prompts, a web page, the route, the QR-code signs and the poster.

All tests from the evaluation phase were succesfully caried out. The self-reflection walking route seems to effectively introduce self-reflection techniques to students. A considerable number of students had their interest in self-reflection techniques sparked after using this system. About the continuation of the usage of self-reflection techniques, no conclusions can be drawn. In conclusion, the system has potential to be part of a bigger system, in which the supportive usages of self-reflection could be incorporated.

8.2 Recommendations for Future Work

In this section, the recommendations for future work are discussed. Based on the background research and the evaluation, some recommendations can be made about future research to improve and implement the self-reflection walking route.

In the current background research, four self-reflection techniques were researched. The self-reflection integrated into the system, however, is not completely covered in the literature research. More research could be done about these integrated techniques. Additionally, it is recommended to do more research about systems similar to the self-reflection walking route. The current state-of-the-art focuses mainly on smartphone applications. Research could be done about comparable walking routes or applications implementing prompts and questions. It is additionally recommended to research how to motivate the target group to use self-reflection techniques regularly. Although it was concluded that all user test participants wanted to use the system again, the system does not yet include a feature to actively motivate the user to use self-reflection regularly.

Some improvements could be made to the system. First of all, it is recommended to increase the number of prompts and questions. The database with prompts and questions used for the prototype is limited, so this database can be extended. Secondly, it is suggested to relocate the route. Recommend is the suggested route by the expert in Figure 7.4. to add variety to the length of the route and therefore give the possibility to increase the length of the route. Thirdly, it is suggested to change the frequency of the QR-code signs for walking the route alone or together with someone. This could be done by color coding these signs: every sign can be scanned when walking alone and every other sign can be scanned when walking together.

After improving the system, it is recommended to test the system again with a more representable larger number of participants. Next to students testing alone or together, groups of students could also be used to test the system. Additionally, the system could be tested by (a) student(s) and a mentor, for example from Creative Technology, and by a student and a student counselor. Lastly, the system could be tested by employees of UT.

There are some other extensive improvement that could be made to the system. One of these is adding the posibility to create an account on the web page. Users could

Another option includes the research of using the system as part of a bigger system. The system could be adjusted to be part of a bigger system, and this could again be evaluated with new tests. Some

suggestions for bigger systems will be given. First, the system could be adopted by the SWIP to introduce the existence of this project to students. Secondly, the sketched self-reflection application, discussed in 5.4.1, could actually be designed and implemented as a bigger system. Thirdly, the web page itself could be extended. The web page has the potential to be used as stand-alone application, during walking a route at another location. The web page could give an option to receive the prompts and questions in an interval while walking another route without QR-code signs.

Another possibility is to use the system in the course Professional Development from Creative Technology. The system could be used as an introduction to self-reflection, where after the students can be taught more about self-reflection. Goal setting could additionally be integrated into the system. The user could state goals when starting the system and can be motivated to reflect on them after usage of the system. This could be added to the system, for example on the web page as a pre and post-entry form, or as an external workbook.

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Appendices

A Appendix: Questionnaire

This section includes the questionnaire and the responses to this questionnaire: “What activities make you feel good?”, distributed in among students in March 2021. There were 43 valid responses: 43 of the 44 students answered “yes” to “Do you wish to participate?” and completed the questionnaire. This means n = 43.

What activities make you feel good?

The goal of this questionnaire is to find out what activities make you feel good, and in which activities you are interested. Additionally, some questions are about your opinion regarding the inclusion of mental health in education.

I will use this data to look at the current opinion of students on personal reflection techniques, activities performed to feel good, and the current mental health coverage in education. The data that will be collected is anonymous and the data will be carefully stored till the end of the graduation project, till July 2021, and destroyed whenever the interest of the research allows for this. The data will be analyzed and I will report my findings in my thesis.

The target audience of this questionnaire is students, so if you are not a student you can unfortunately not participate in this questionnaire.

Thank you in advance for participating!

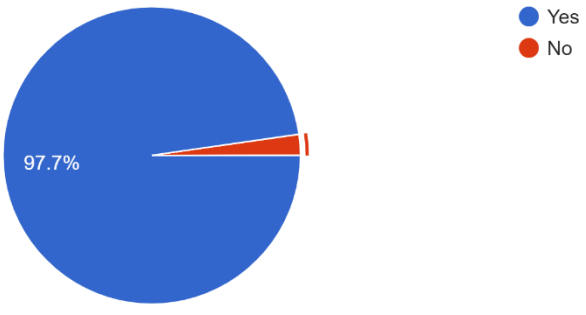
Informed Consent

This informed consent includes your permission to use your data from this questionnaire for my graduation project:

‘I hereby declare that I have been informed in a manner which is clear to me about the nature and method of the research as described on the previous page. I agree with my own free will to participate in this research. I reserve the right to withdraw this consent without the need to give any reason and I am aware that I may withdraw from the experiment at any time. If my research results are to be used in scientific publications or made public in any other manner, then they will be made completely anonymous. If I request further information about the research, now or in the future, I may contact e.j.lahuis@student.utwente.nl. If you have any complaints about this research, please direct them to the secretary of the Ethics Committee of the Faculty of Electrical Engineering, Mathematics and Computer Science at the University of Twente, P.O. Box 217, 7500 AE Enschede (NL), email: ethicscommittee-cis@utwente.nl).

Do you wish to participate?

44 responses



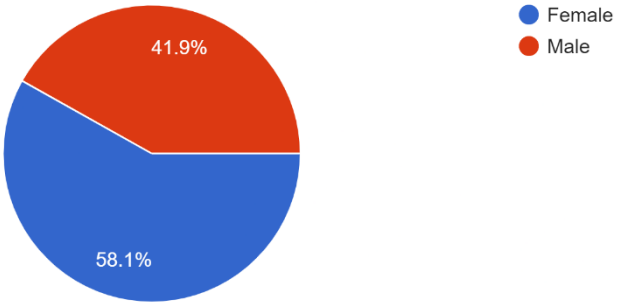
First some simple questions

These questions are meant to gather some characteristics.

Question 1

What is your gender?

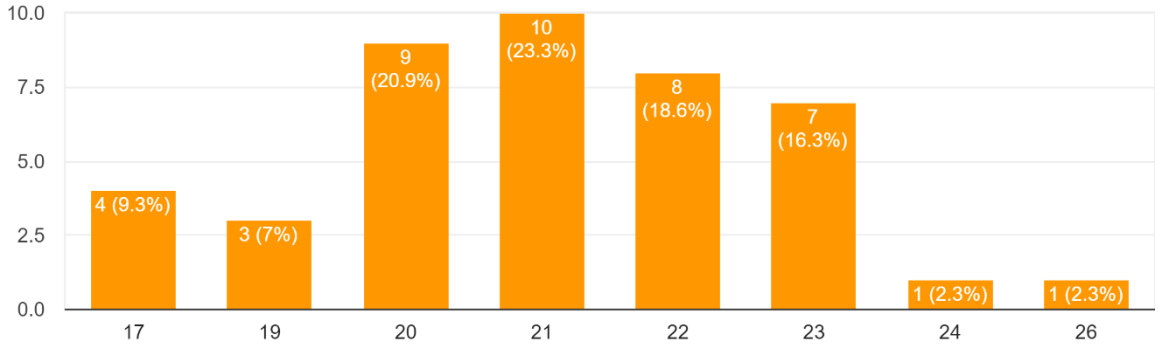
43 responses



Question 2

What is your age (in full years)?

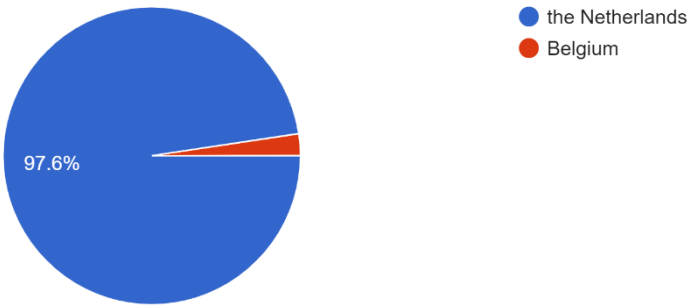
43 responses



Question 3

What is your country of origin?

42 responses



Question 4

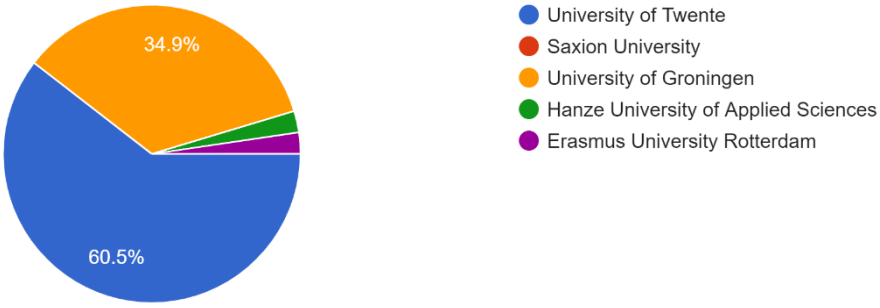
What is your current housing situation and location (country)?

43 responses

Question 5

Which institution are you studying at?

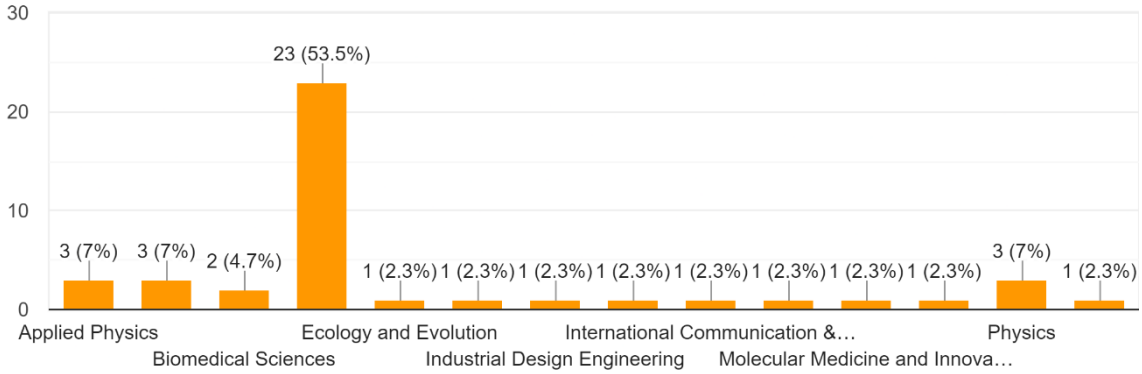
43 responses



Question 6

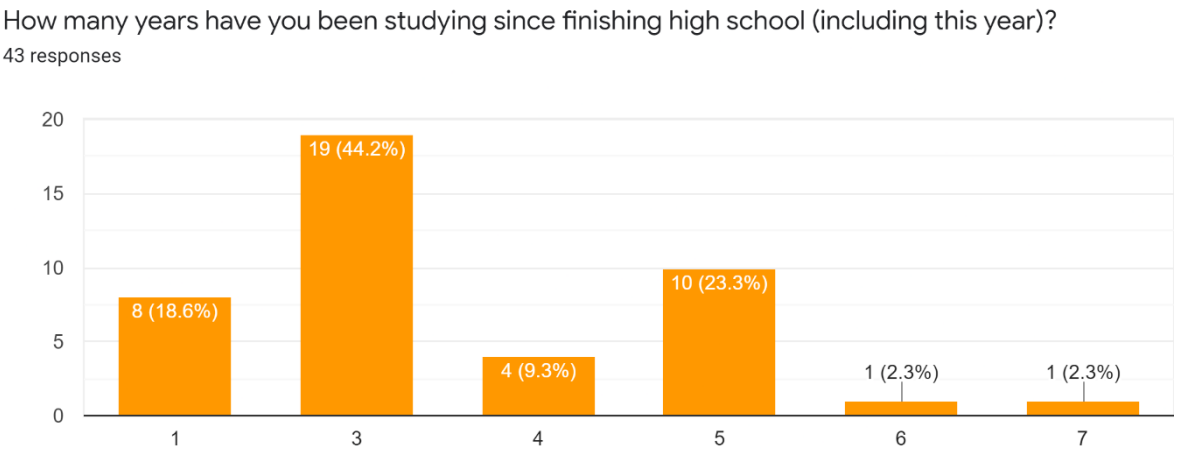
What is the name of your studies?

43 responses



Overview of responses (including count and percentage): 3 (7%) *Applied Physics*; 3 (7%) *Astronomy*; 2 (4.7%) *Biomedical Sciences*; 23 (53.5%) *Creative Technology*; 1 (2.3%) *Ecology and Evolution*; 1 (2.3%) *Human Resource Management*; 1 (2.3%) *Industrial Design Engineering*; 1 (2.3%) *Interaction Technology*; 1 (2.3%) *International Communication & Media*; 1 (2.3%) *Mathematics and Physics*; 1 (2.3%) *Molecular Medicine and Innovative Treatment*; 1 (2.3%) *Philosophy*; 3 (7%) *Physics*; 1 (2.3%) *Science Education and Comunication.*

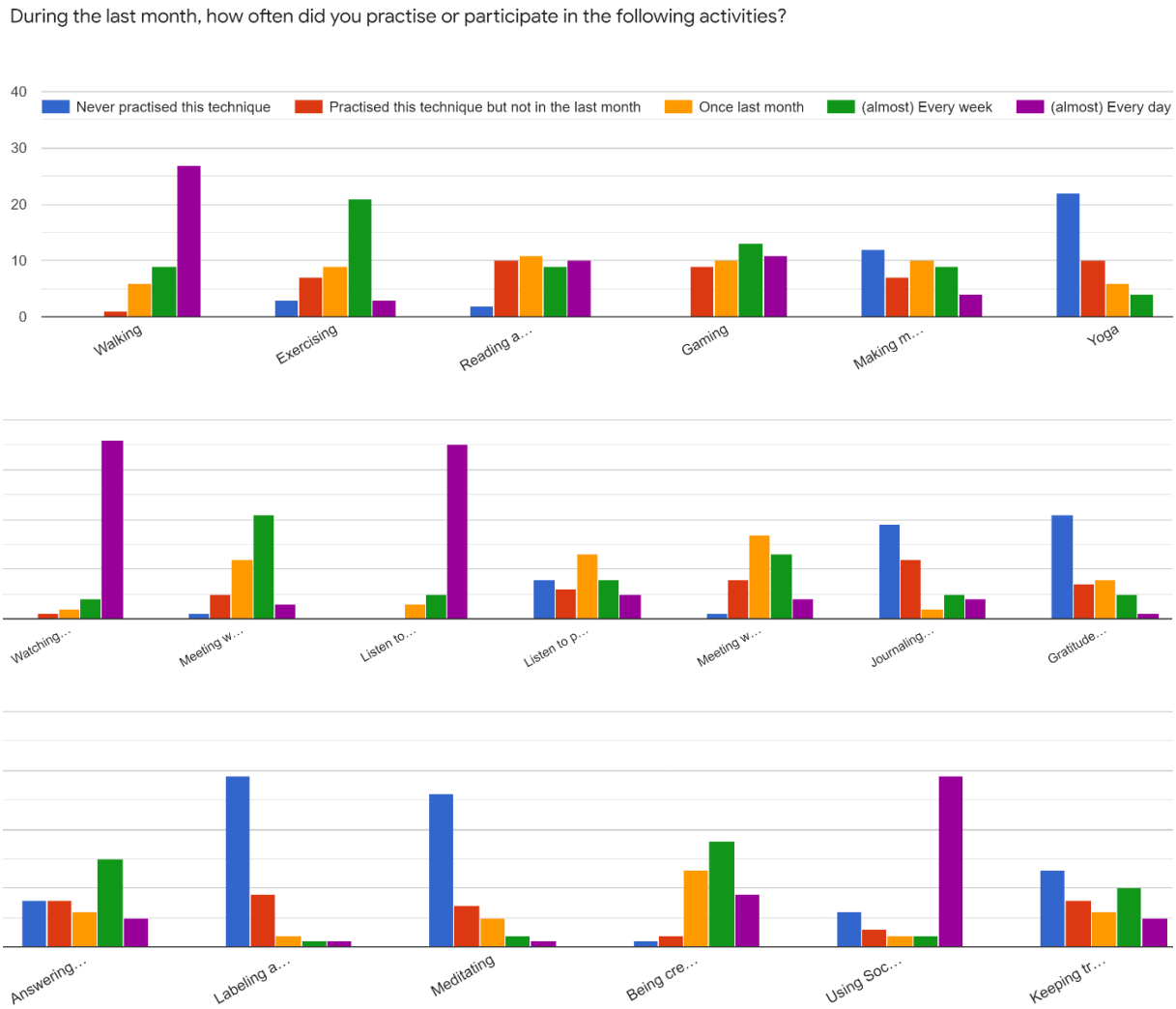
Question 7



Activities that make you feel good – I

In the next question, some sample activities are given that could make people feel good. Please select the best answer from the choices provided.

Question 8



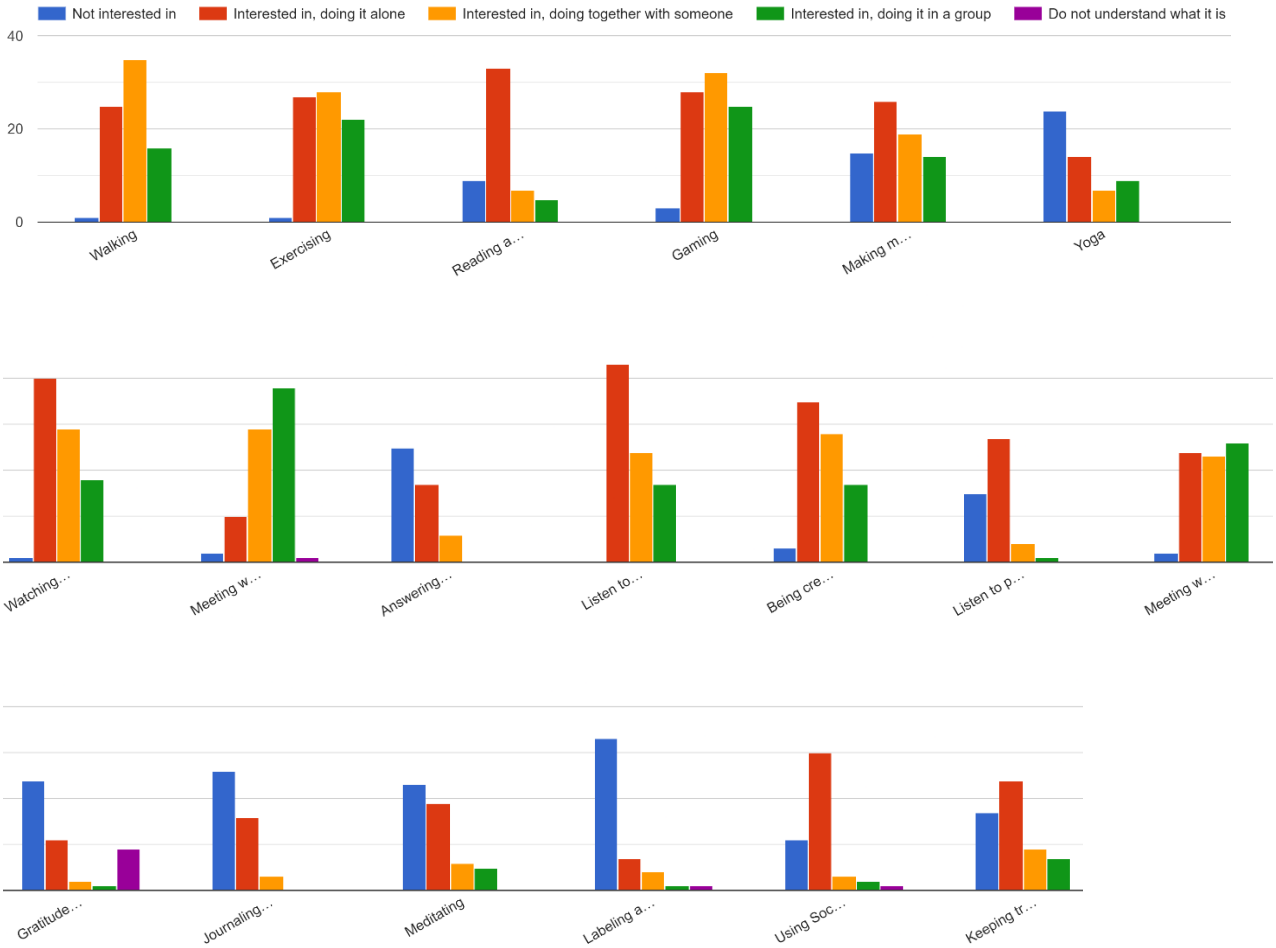
Answer options, from left to right respectively: Walking; Exercising; Reading a book; Gaming; Making music; Yoga; Watching a video or film (for example on Netflix, YouTube, etc); Meeting with friends; Listen to music; Listen to podcasts; Meeting with family; Journaling (writing about feelings, thoughts, and/or experiences); Gratitude practise; Answering reflective questions (for example: 'How do I feel today?' 'What would make today great?'); Labeling activities or days with a grade/color/smiley; Meditating; Being creative (for example painting, writing, programming, etc); Using Social Media; Keeping track of habits (for example water intake, exercising, etc.).

Activities that make you feel good – II

In the next question, some sample activities are given that could make people feel good.

Question 9

Which activities are you interested in, and would you like to do it alone and/or together and/or to participate in a group?



Answer options, from left to right respectively: Walking; Exercising; Reading a book; Gaming; Making music; Yoga; Watching a video or film (for example on Netflix, YouTube, etc); Meeting with friends; Listen to music; Listen to podcasts; Meeting with family; Journaling (writing about feelings, thoughts, and/or experiences); Gratitude practise; Answering reflective questions (for example: 'How do I feel today?' 'What would make today great?'); Labeling activities or days with a grade/color/smiley; Meditating; Being creative (for example painting, writing, programming, etc); Using Social Media; Keeping track of habits (for example water intake, exercising, etc.).

Activities that make you feel good – III

Question 10

In the previous questions we asked you about some activities that make you feel good (also see the picture below), if you think activities were missing, please write them down here:

Overview of responses: *Cooking, eating, tidying (house or room), running errands, eating out/drinking something in the city centre; Cooking, baking, (online) shopping, interior design, tidying up; Cooking and cleaning; Cooking, thrift shopping, talking, sex, puzzles, performances; (Video) calling; (Video) calling; Cooking; cooking/baking; Sleep; Cooking; (1) Playing with pets/petting them, (2) baking stuff (cookies, etc), (3) working in the garden/caring for plants; Eating good food; Partying; Having dinner together; Baking; Doing puzzles; Eating, solving puzzles, committee work; Cooking; Cuddling; Nothing missing; Drinking.*

Question 11

When does an new activity grasp your interest?

Overview of responses: *If my friends like to do it; when it is a little bit adventurous or other people enjoy it very much; If friends tell me that it is fun/worth it; If friends tell me that it is fun/worth it; When I'm introduced to it through a friend for example; If it makes me feel happy and/or motivated; If its fun and its relatibely easy to do; Either when I see someone else doing it or when I find out it exist (Idont really understand what you mean with this question); Really depends on the activity; If I enjoy the activity and I feel better afterwards; If it is out of the box, is accessible (or if I can do it alone so people don't see me fail), and not too time-consuming initially (but I have the freedom to make it time-consuming ;D); when after completing it, I want to do it again as soon as possible; I don't know, just as it goes or as I tried it and it felt good, or if someone makes a random suggestion which feels great or exciting; When its fun.*

Mental Health in Education – I

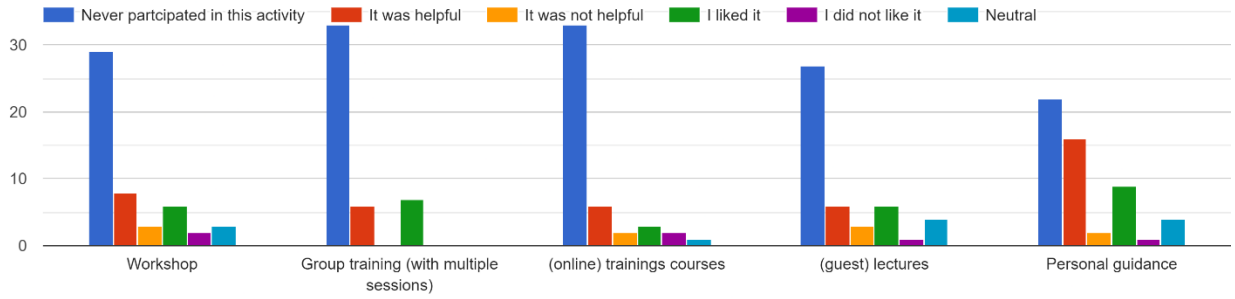
Sometimes people need help or need to learn about their mental health, to feel good (again).

Learning about mental health allows us to understand (our own and other's) behaviors, thoughts, and emotions, and how this will affect relationships, self-esteem, and productivity. It also promotes empathy for other people and improves the way we communicate with other people. Furthermore, we know better how to help people who are suffering from PTSD, depression, anxiety, among others.

Examples of including Mental Health in education: workshops, (online) training courses or (guest) lectures, that are for example including one or more of the following aspects: how to focus on your studies, (handling) stress, (coping with) anxiety, learning mindful skills, self-image, study encouragement, etc.

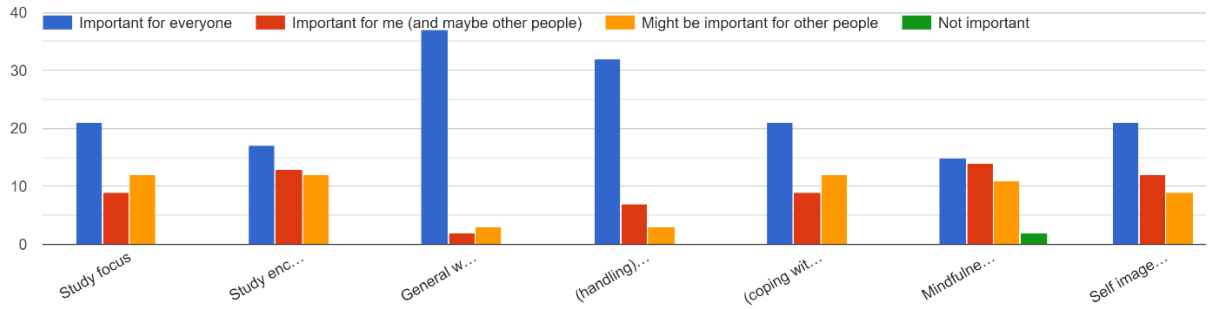
Question 11

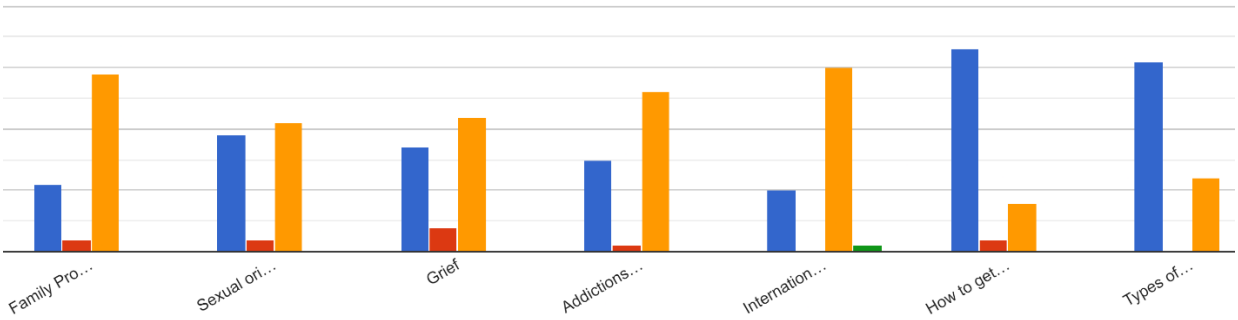
If you participated in one of the following activities that included the topic Mental Health, what did you think of it?



Question 12

How important do you think it is to learn about the following Mental Health topics? (this could be in or outside education)





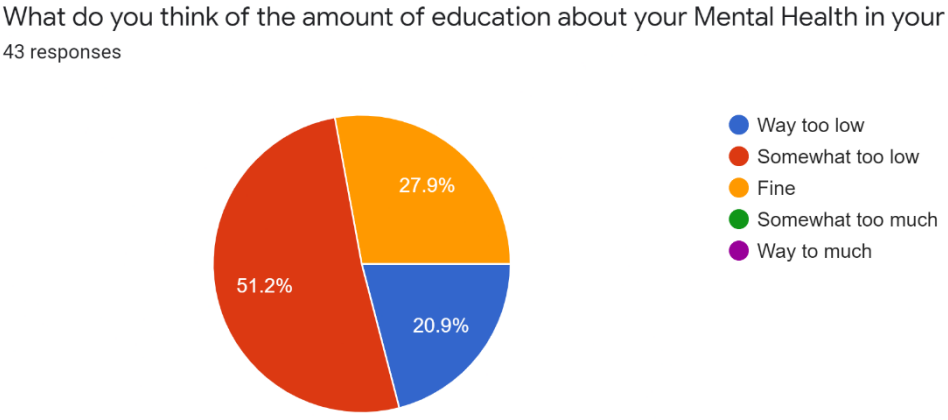
Answer options, from left to right respectively: Study focus; Study encouragement; General wellbeing; (handling) Stress; (coping with) Anxiety; Mindfulness skills (teaching the mind to focus on the present moment); Self image (improvement); Family Problems; Sexual orientation and gender identity; Grief; Addictions (Alcohol etc.); International student support; How to get the help you need?; Types of mental issues.

Mental Health in education – II

Question 13

Overview of responses (including percentage): 83.7% *Yes, but the topic Mental Health should also be included in education*; 4.7% *Yes, it is mainly your own responsibility to educate yourself about your mental health*; 2.3% *No, it is mainly the responisbility of education organizations to learn it's students about mental health*; 2.3% *No, it is mainly the responisbility of education organizations to learn it's students about mental health since they are the ones causing it to happen*; 2.3% *I think it should already have been tought in highschool or at least made a beginning*; 2.3% *It's the responsibility of parents and schools for children and teenagers to create a healthy basis. From a later age on (16/18/20+) it becomes your own responsibility, but resources should be easily available*; 2.3% *Yes, but the topic Mental Health should be accessible in education (non-mandatory).*

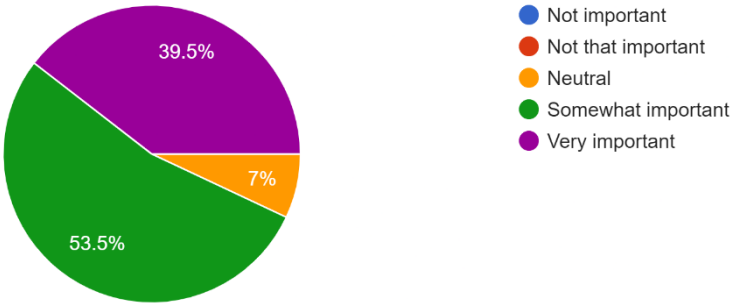
Question 14



Question 15

Do you think it is important to include the topic mental health in education?

43 responses



Question 16

Do you have remarks about including the topic Mental Health in eductation?

Overview of responses:

I know where to get/ask for help for certain problems. I have not been taught how to recognise these problems in myself or others.

This is already important in primary school, not just in University.

I think mental health should be addressed as soon as possible. Preferably already in high school

Should especially be implemented and normalized for younger (underaged) students. However, when studying becomes more serious focus on well-being can cause extra frustration, thus should become optional (yet normalized), especially since everyone's needs are different and people should be trusted to decide this for themselves

Students should be able to choose in what way the topic is taught to them, I think that would be the most helpful.

It's being mentioned right now in University but truly performing education and taking mental health in consideration is not yet done. Things are very slowly taking off but I wish things were moving faster to change the mindset of society quicker for all of our mental health.

I think it should be something voluntary you do but it should be presented to you by your education. I think at CreaTe there are possibilities however I personally never attend them...

Mental health should be talked about in elementary and high school. Afterwards people should be aware of the fact that they can get help but do not necessarily have lectures about it with your study program. (could be extra sessions in design lab for interested people)

It tends to be in such a general form that its not tartgeted towards student bit its more so the university can say they did smtg about mental health. Its so so important to involve students

I think it is important to include to the topic, but it should definitely not feel forced. The people who need it the most will not come looking for it (hence it should be included), but are often also scared to get help (for example because they feel weak for doing so), so it should be treated really carefully. Next to that, CreaTe's study association Proto organised some mental health lunch lectures/workshops last year, also in cooperation with the study. I thought those were really nice (I believe they were given by a mental health expert). They were of course not mandatory, but visited by and appreciated by many.

B Appendix: Interview with Lea Berkemeier

26 March 2021 – Via Microsoft Teams, the interview is (partly) in Dutch.

Lea Berkemeijer werkt aan een canvas cursus voor het wellbeing project. Dit wordt een cursus van een aantal weken om Sense of beloninging en FOMO te verbeteren.

Lea berkemeijer heeft studenten geinterview naar aanleiding van de cursus die ze willen maken. Waar hebben studenten behoefte aan? Het bleek dat alle studenten uit deze interviews stress ervaart. De oorzaken van deze stress verschillen per student. Voor sommige mensen gaat het meer over persoonlijke problemen, sociale problemen, studie problemen, studenten of omgeving met een te hoge verwachting, FOMO en psychologische problemen.

Grote ontdekking van dit interview: studenten weten niet hoe ze met stress moeten omgaan. Veel studenten denken dat ze niet om hulp mogen vragen (het is maar een beetje stress). Studenten voelen zich overwelhmed, taken uit te stellen. Ze weten dat er een probleem is (te veel stress) maar bijna niemand heeft een goeie copingsstrategie. Vaak wordt er afleiding gezocht van de stress, ipv er mee te copen.

Requirements voor het programma: laagdrempelig en ze moeten niet het gevoel krijgen dat het programma te veel stress op gaat leveren.

Thema's: why did I choose to study, How are you doing (wat beinvloed welbevinden en waarom is het belangrijk om jezelf te ondersteunen), staying resilient in stressful times, what am I not missing out (reflectie: is het belagnrijk om overal bij te zijn), give yourself a break (minder kritisch met jezel te zijn en meer compasionate, pauzes nodig), supporting each other (voel jezelf connected met familie en vrienden, sense van beloningness)

Combinatie van online (hoorcolleges) en offline (tutorials).

Vaak is er wel inzicht van studenten dat ze stress hebben, maar ze hebben dus niet echt een copingstrategy. Masterstudenten weten dit nu soms wel, maar als ze terugkijken was dat aan het begin van de studententijd niet zo. Niet elke copingstrategy werkt voor iedereen. Ze moeten dus vinden welke copingstrategy bij hun werkt. Het is meer het probleem dat studenten nog aan het zoek zijn naar een copingstrategy die bij hun past, dan dat ze het helemaal niet weten.

De verwachting van studenten is vaak heel hoog. Dat het in 1 keer allemaal goed moet gaan.

De meest kwetsbare groep is eerstejaars. Het is allemaal nieuw, er komt opeens heel veel dingen samen en je moet heel veel regelen. Maar eerstejaars hebben ook wel heel veel te doen al. Dus hebben ze wel tijd om nog een extra interventie naast hun studie te doen? Misschien is het tweedejaars studenten wel een betere doelgroep en is de toegevoegde waarde dan ook groter.

De cursus is gericht op iedereen maar de eerste jaars psychologie studenten gaan dit testen in de vierde module.

Hoe gaan studenten ervaren dat ze zich beter voelen? (hier stuurde ze 2 documenten: 1 van die twee is een masterscriptie over een interventie om stress te verlagen bij studenten. Prototype ontwikkeld en laten testen door studenten) Lea zou zelf goed bedenken waar je op wil focussen. Welbevinden is te groot. Ze gaat zelf focussen op sense of belongingness of FOMO. Geef een vragenlijst aan de studeten voor en na gebruik/deelnamen van de applicatie/cursus. Al bij een kleine verbetering zie je dat het geholpen heeft. Er zijn ook measurements voor stress of copingsstrategien.

Hoe ga ik meten of het werkt wat ik ga maken? Pre en post questionnaire en die vergelijken.

Studenten bereiken: mail, tijdens hoorcolleges.

Bij de interviews zaten een paar studenten van technische studies, en die waren ook geinteresseerd in dit onderwerp, maar daar is dus niet heel veel info over. Technische studenten kunnen moeilijker bereikbaar zijn voor dit onderwerp, maar het is erg persoonlijk. Er hangt toch een soort van stigma op dit onderwerp bij technische studenten. “Ik heb toch geen psyschishe ziekte, dus waarom zou ik dit moeten doen.” Maar ze leren hier ook niet over in hun studieprogramma, dus ze zijn ook heel erg op andere dingen gericht. Lea raad aan om niet op 1 studieprogramma te focussen maar op meerdere.

C Appendix: State-of-the-Art Applications

In this appendix, eight self-reflection applications are displayed including a short description.

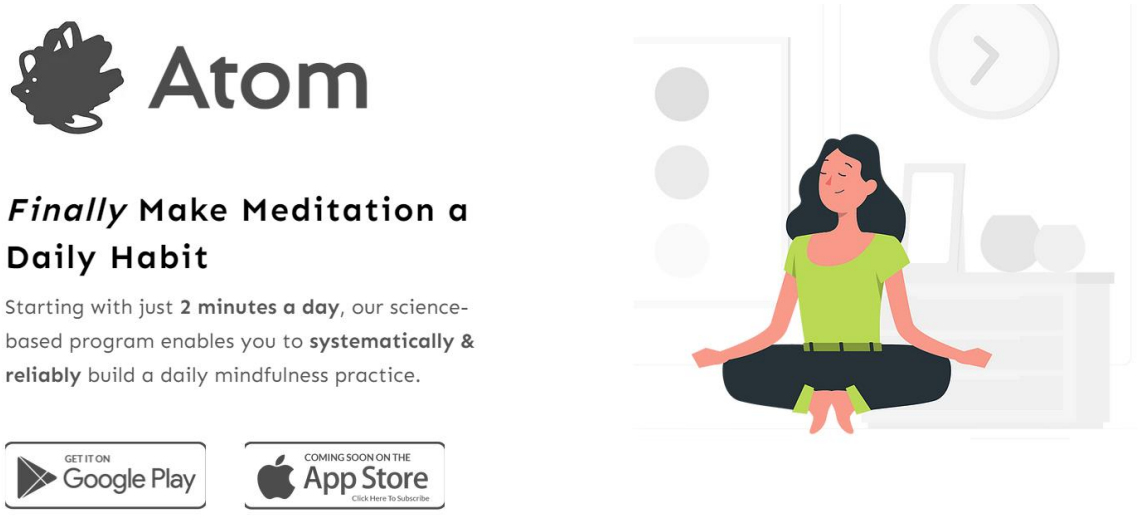


Figure C.1: Application B: Atom [44]

In Figure C.1, the application Atom is displayed. Atom includes the self-reflection techniques mindful meditation and habit tracking of this meditation. The application can help by developing mindfulness as a daily habit.

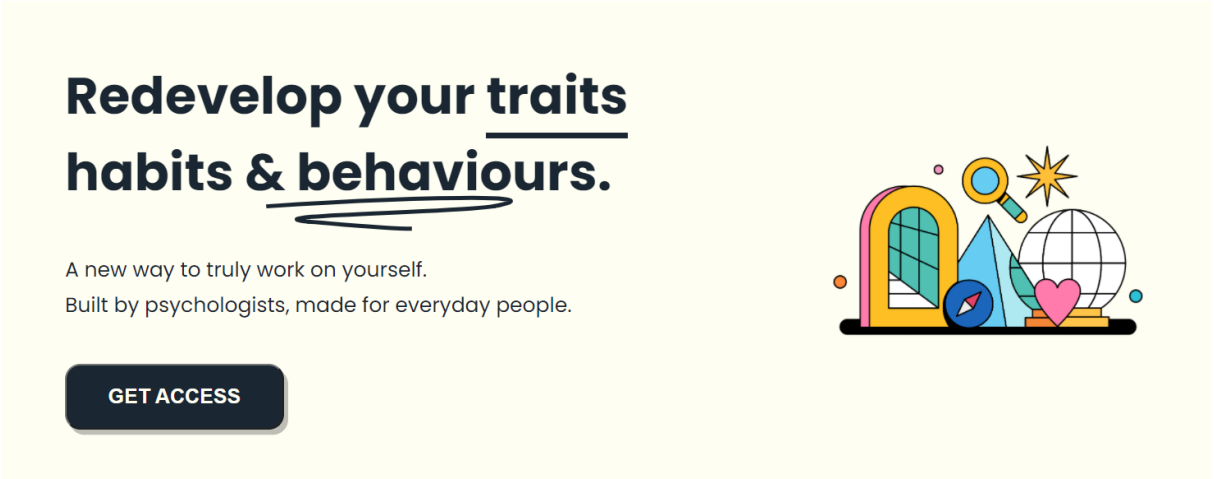


Figure C.2: Application C: Intellect [45]

In Figure C.2, the application Intellect is displayed. Intellect includes a combination of journaling and mood tracking. The journal feature is guided by the integration of reflective questions. These integrated questions focus on personal behaviors, relationships, and work habits.

Figure C.3: Application E: Level up Life [47]

In Figure C.3, the application Level up Life is displayed. These applications integrated habit and mood tracking in a game-like environment to motivate the user. Tracked habits or moods are achievements, and just like in some games, badges can be obtained.

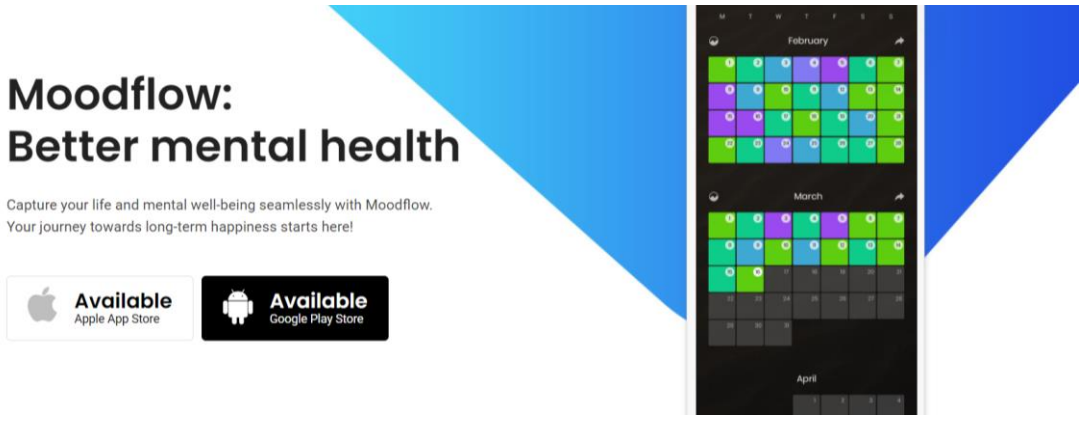


Figure C.4: Application F: Moodflow [48]

In Figure C.4, the application Moodflow is displayed. This application mainly focuses on journaling and mood tracking, but habit tracking and gratitude practice are also included. Moodflow is a clean and simple application.

Figure C.5: Application H: Youper [50]

In Figure C.5, the application Youper is displayed. Youper uses reflective questions to indicate your current mental health status. Mood tracking and journaling are additionally integrated.

Figure C.6: Application I: Diarium [51]

In Figure C.6, the application Diarum is displayed. In Diarium, journaling and mood tracking are integrated. Diarium is a diary but then digital. Photos can be added to the journal entries and this application can sync with your social media accounts.

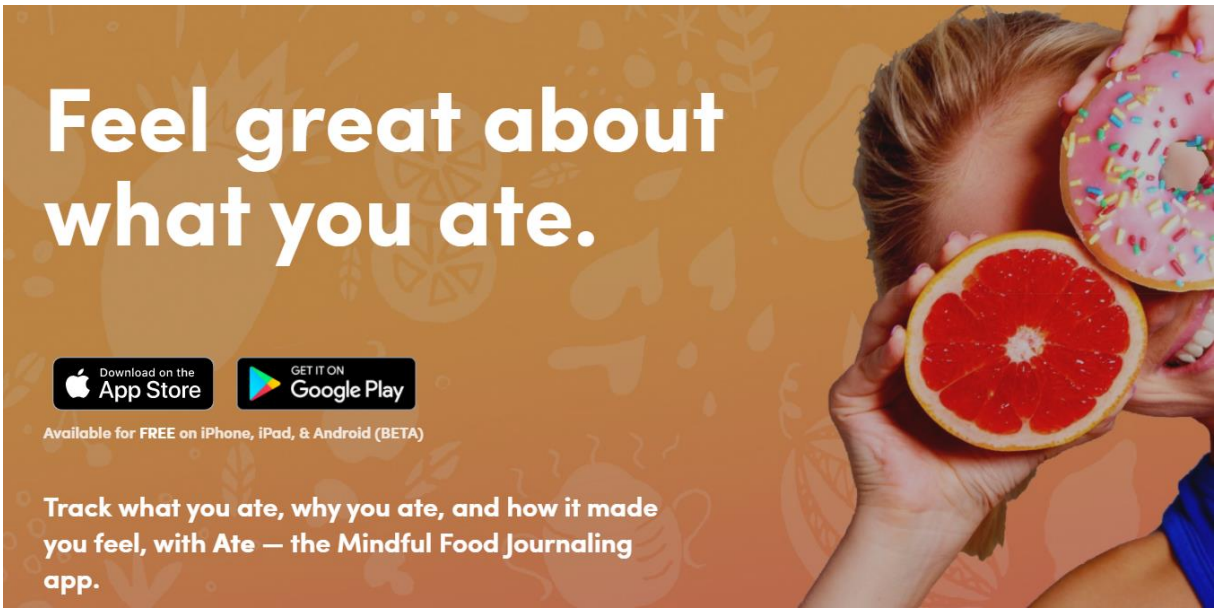


Figure C.7: Application J: Ate [52]

In Figure C.7, the application Ate is displayed. Ate is about food and every meal you eat. In this application, you can reflect on your eating habits. After every mail, habits can be tracked and questions about the meal are asked. After multiple entries, the application displays statistics.

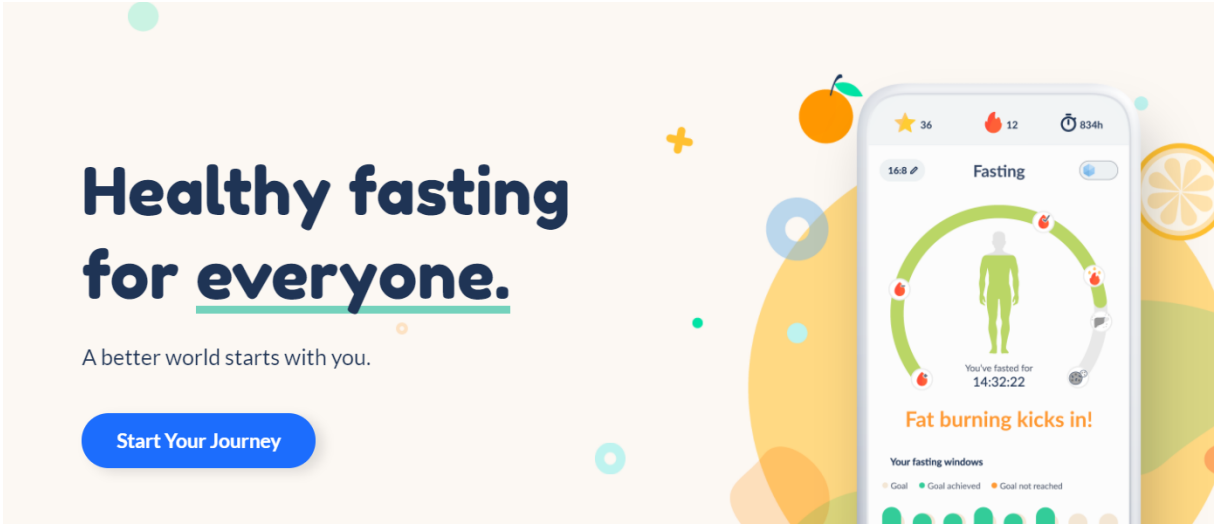
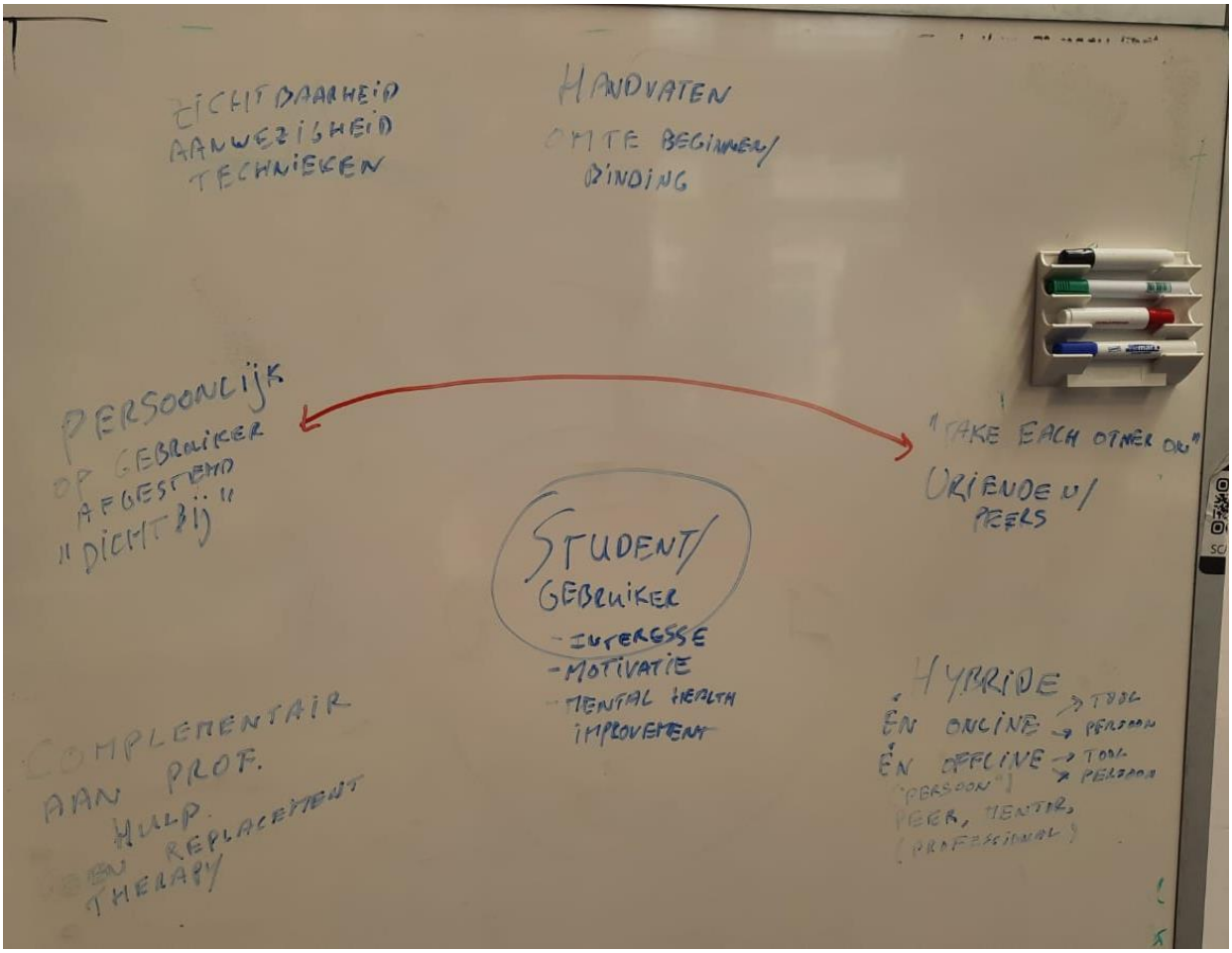


Figure C.8: Application K: Fastic [53]

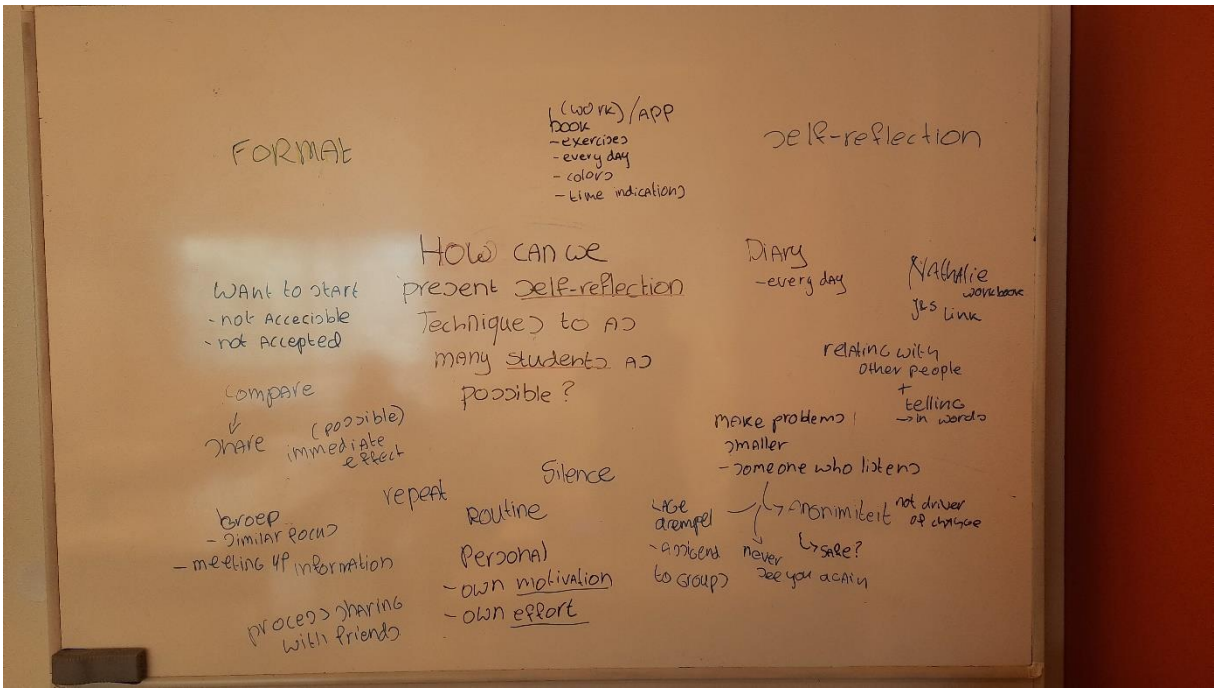
In Figure C.8, the application Fastic is displayed. In Fastic, fasting habits and food-related habits can be tracked. The application has included predefined habits and questions.

D Appendix: Brainstorm sessions

D-1: Brainstorm with supervisor



D-2: First Group Brainstorm Session



D-3: Second Group Brainstorm Session

Brainstorm planning

This brainstorm session was executed on 10 May 2021, with two fellow Creative Technology students and the author as brainstorm facilitator.

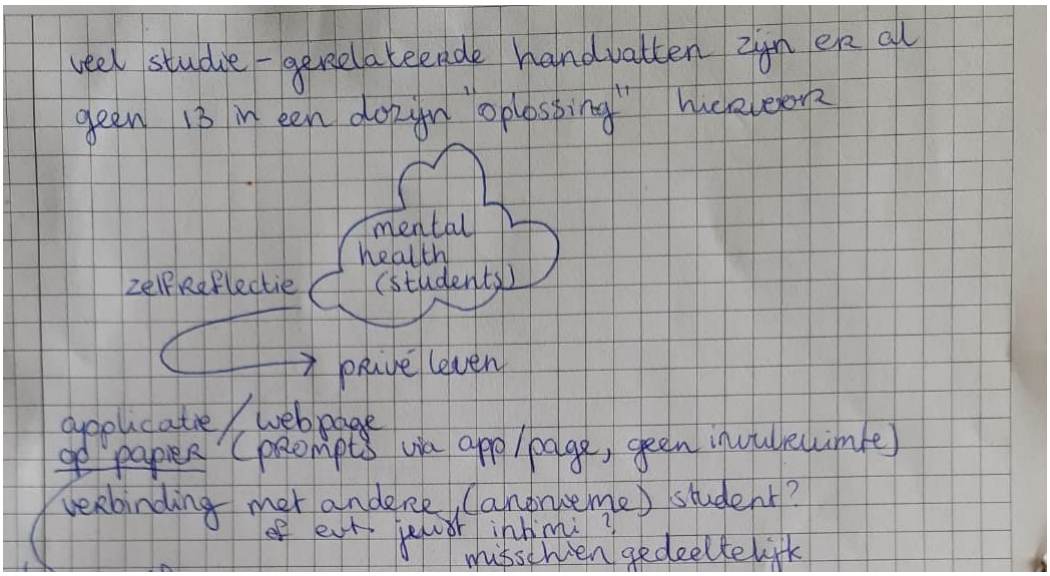
Brainstorm facilitator: “Thank you for participating in this brainstorm session. In this brainstorm, the user will be the central point: the student. In this project, a system is developed that uses self-reflection to guide these students towards mental health improvement.”

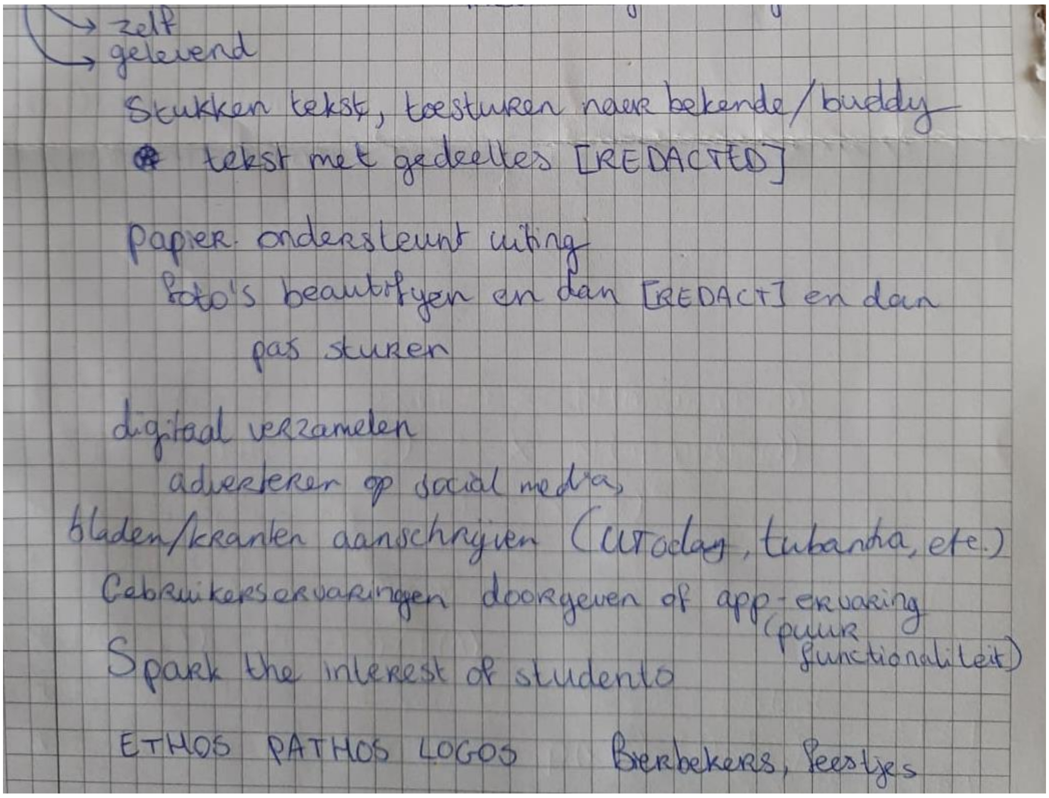
Both participants get a notebook and a pen. They are asked to take notes: they can write down their answers to the questions asked by the brainstorm facilitator. The brainstorm method explained in section 3.3 is used.

Brainstorm questions

- Question 1a: Which formats could a personal self-reflection application have?
- Question 1b: about a Hybrid system (offline and online) How can we combine online and offline tooling to experience the benefits of both using tools, learning methods and/or mentoring?
- Question 2: about friends/peers: ‘take each other on’: How can we integrate the power of friends or peers in a self-reflection application? (important: self-reflection is focused on the personal life of the student)
- Question 3a: about increasing visibility and presence of existing self-reflection techniques: How can we increase visibility and presence of the existing self-reflection techniques?
- Question 3b: What is important when giving students ‘handvaten’ to practice self-reflection?
- Question 4: about spark the interest of students: How can a self-reflection application spark the interest of students?
- Question 5: about motivating regular use: How can students be motivated to use the self-reflection techniques on a regular basis?’
- Question 6: Which self-reflection techniques seem interesting?
- Question 7: What has to be taken into account when focusing on personal life topics with the application?
- Question 8: What are important themes or topics to cover? (love, mind, body, soul, play)

Brainstorm results



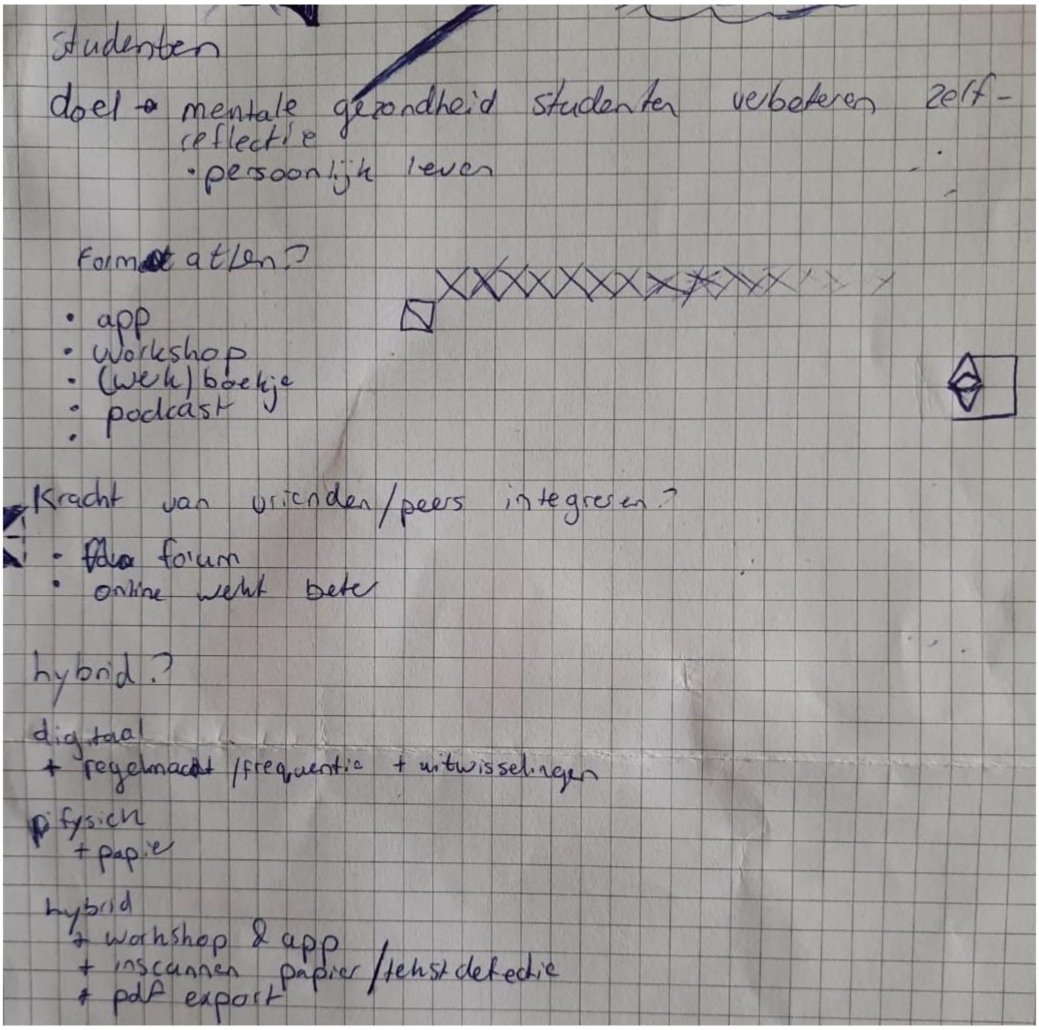


zelf
gelevend
Stukken tekst, toesturen naar bekende/buddy
tekst met gedeeltes [REDACTED]

papier ondersteunt uiting
foto's beautifyen en dan [REDACT] en dan
pas sturen

digitaal verzamelen
adverteren op social media,
bladen/kranten aanschrijven (UToday, tubantia, etc.)
Gebruikerservaringen doorgeven of app-ervaring (puur functionaliteit)
Spark the interest of students

ETHOS PATHOS LOGOS Bierbekers, feestjes



studenten
doel → mentale gezondheid studenten verbeteren zelf-reflectie
· persoonlijk leven

Format aten?
· app
· workshop
· (werk)boekje
· podcast

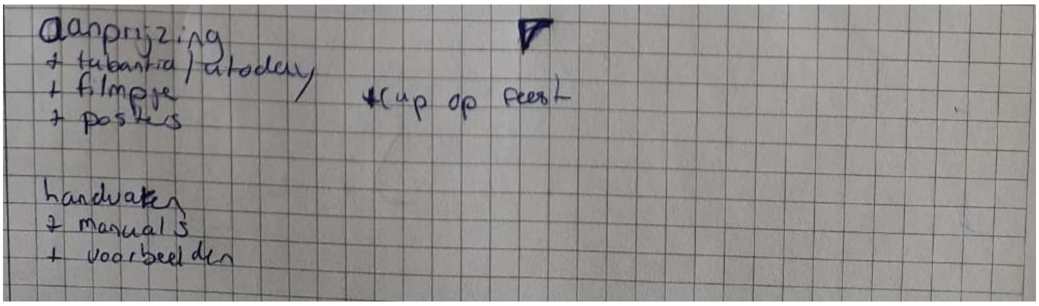
Kracht van vrienden/peers integreren?
· forum
· online werkt beter

hybrid?

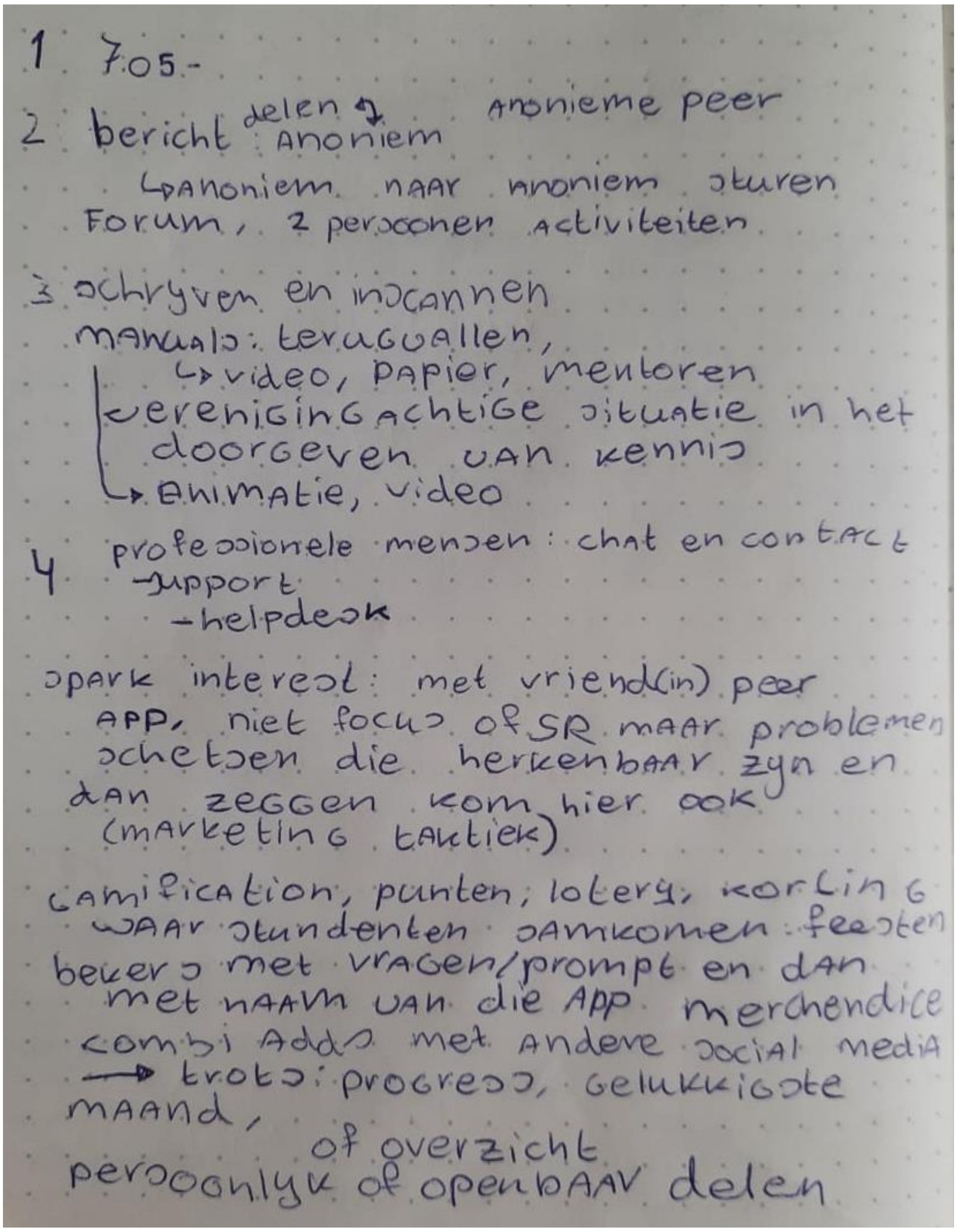
digitaal
+ regelmaat/frequentie + uitwisselingen

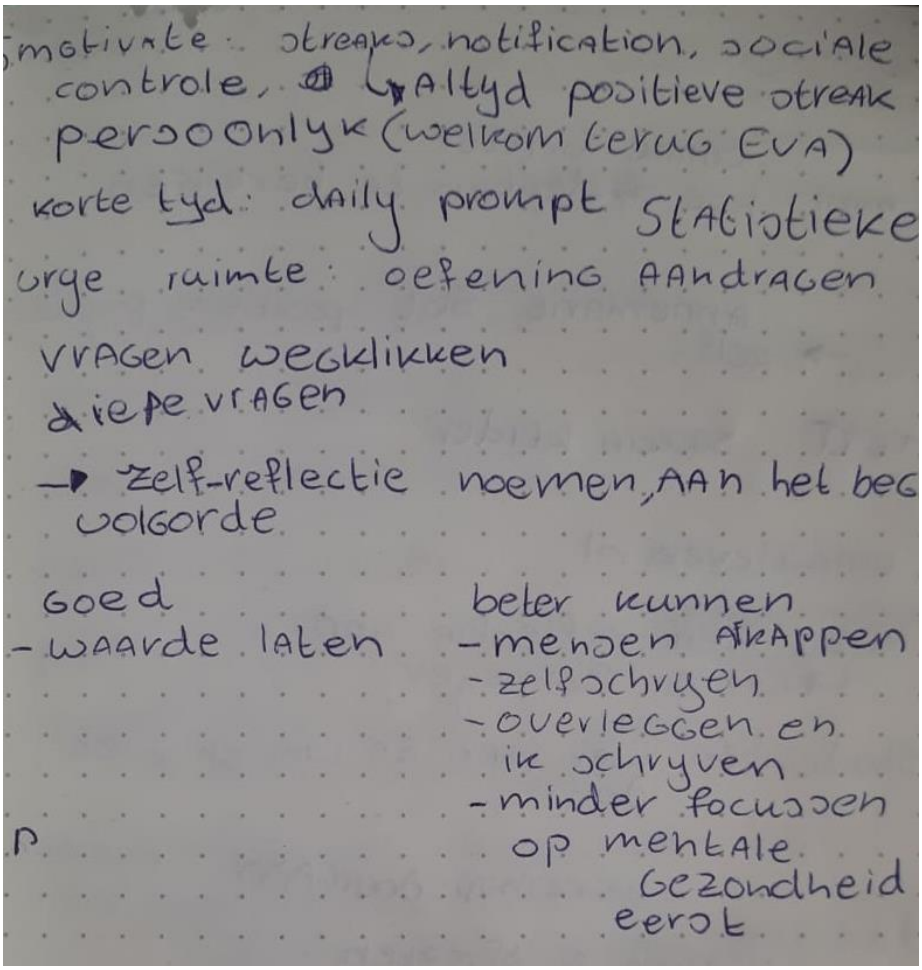
fysiek
+ papier

hybrid
+ workshop & app
+ inscannen papier/tekst detectie
+ pdf export


aanprijzing
+ tubantia / utoday
+ filmpje
+ posters
+ cup op feest

handvaten
+ manuals
+ voorbeelden


1 7.05 -
2 bericht delen anoniem anonieme peer
↳ anoniem naar anoniem sturen
Forum, 2 personen activiteiten
3 schrijven en inscannen
manuals: terugvallen,
↳ video, papier, mentoren
verenigingachtige situatie in het doorgeven van kennis
↳ animatie, video
4 professionele mensen: chat en contact
- support
- helpdesk
spark interest: met vriend(in) peer app, niet focus of SR maar problemen schetsen die herkenbaar zijn en dan zeggen kom hier ook (marketing taktiek)
gamification, punten, lotery, korting
waar studenten samkomen feesten
bekers met vragen/prompt en dan met naam van die app merchendice
combi adds met andere social media
→ trots: progress, gelukkigste maand,
persoonlijk of openbaar delen of overzicht


motivatie: streaks, notification, sociale
controle, altyd positieve streak
persoonlyk (welkom terug EVA)
korte tyd: daily prompt statistieke
urge ruimte: oefening aandragen
vragen wegklikken
diepe vragen
→ zelf-reflectie noemen, aan het beg
volgorde
goed
- waarde laten
beter kunnen
- menjen afkappen
- zelfschryen
- overleggen en
ik schryven
- minder focussen
op mentale
gezondheid
eerst

D-4: Feedback on brainstorm session

After this brainstorm session the brainstorm facilitaro asked for feedback. First was asked about the tops (what went well) , then about tips (what could be improved).

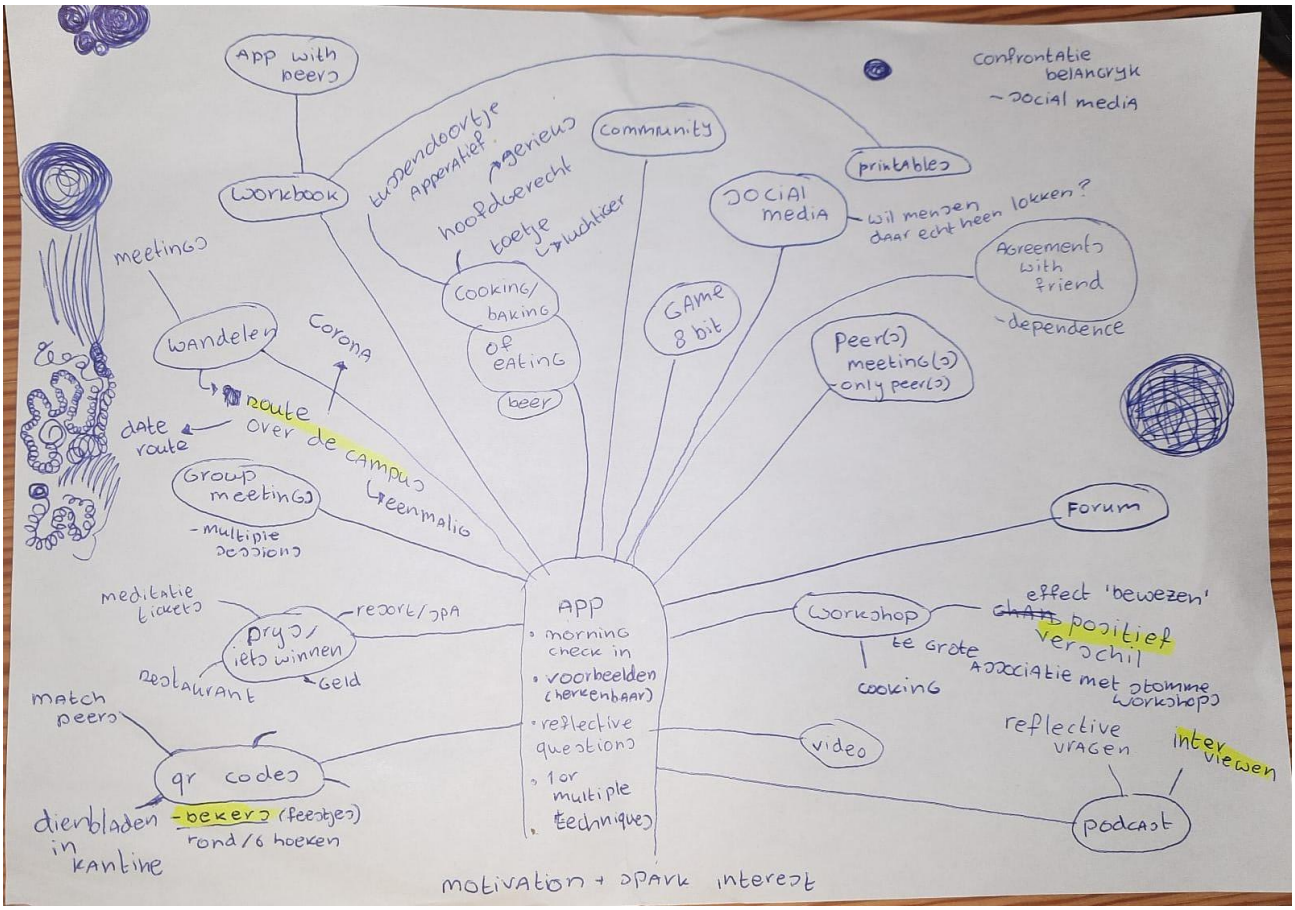
Tops

- The explaination of the brainstorm method is clear.
- The order of the brainstorm questions is good.
- The brainstorm session is well organized.
- The brainstorm participants feel respected and comfortable.
- The brainstorm participants feel they added value to the brainstorm session.

Tips

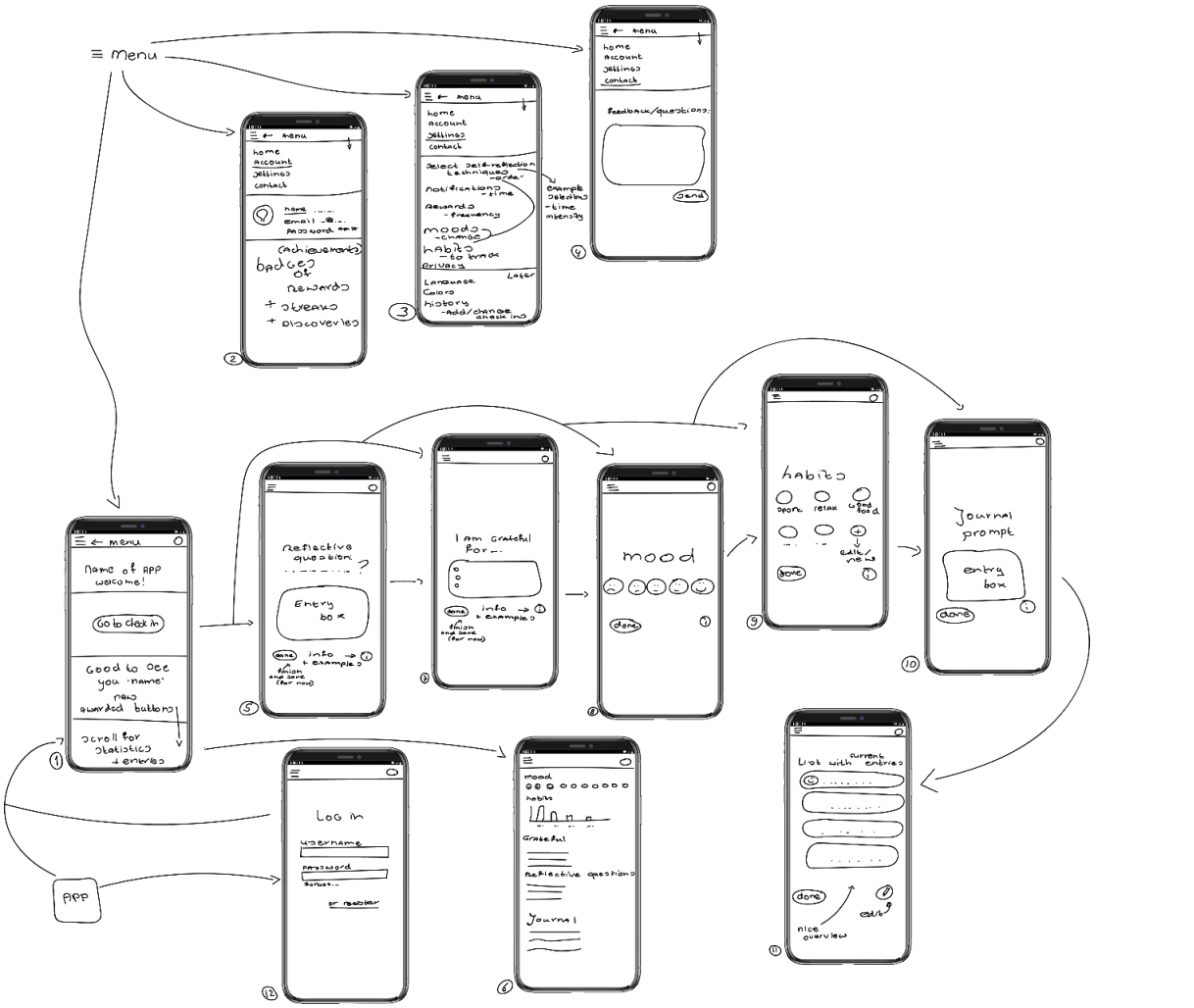
- The focus on mental health improvement in the explanation can limit the creativity of the participants. A suggestion is to focus more on the self-reflection (techniques) and less on mental health in the explanation of the brainstorm session at the beginning.
- The brainstorm participants feel limited by the large writing amount. They were instructed to write their thoughts down, but they would like to write less and talk more. The brainstorm facillitator could make notes instead, or the conversation could be recorded.
- The brainstorm facillator should notice when a participant is not writing notes, and should ask to resume note-taking.
- The brainstorm facillitator should interrupt when participants are speaking too long.
- The brainstorm facillitator should beter keep track of time per question.

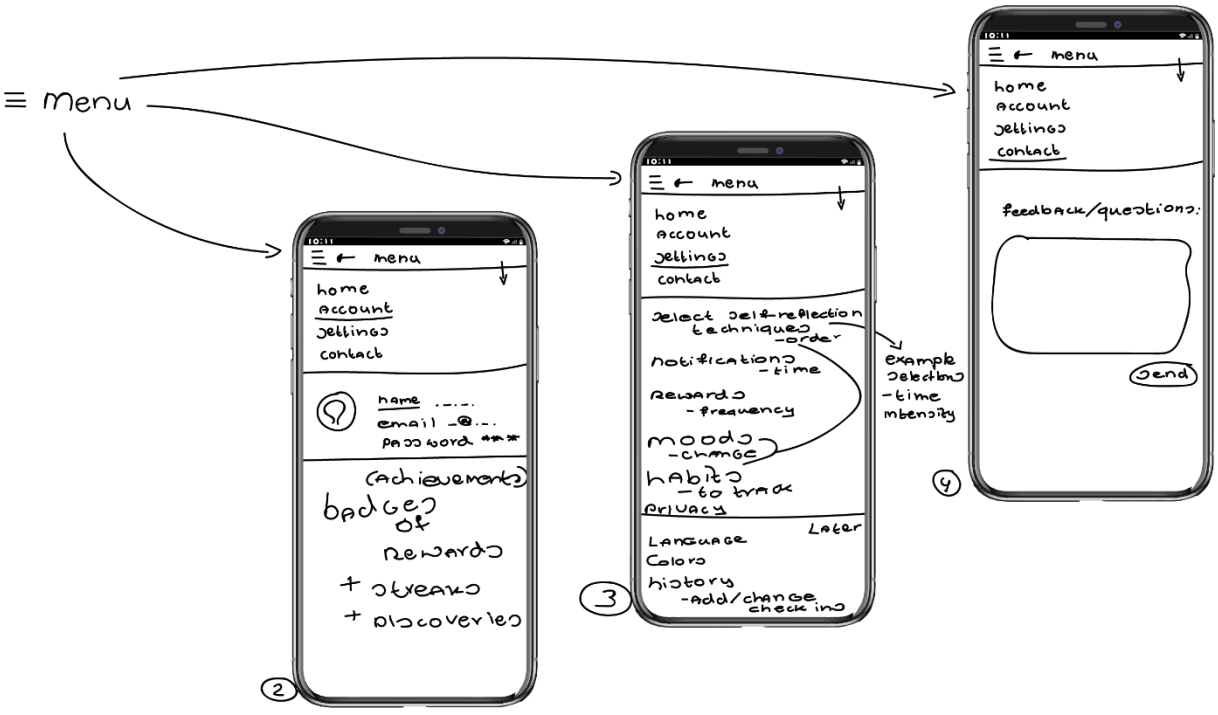
D-5: Third Group Brainstorm Session

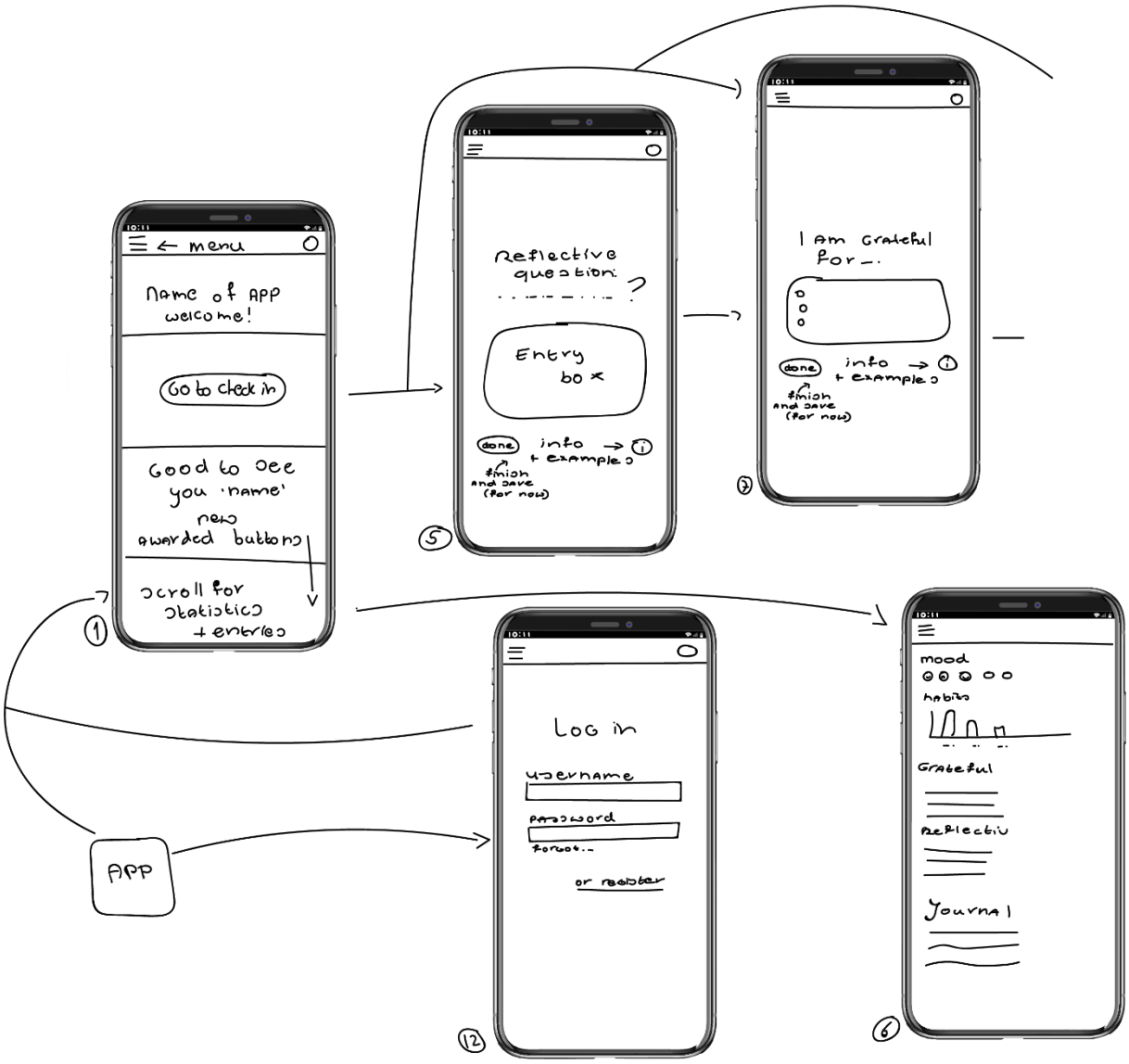


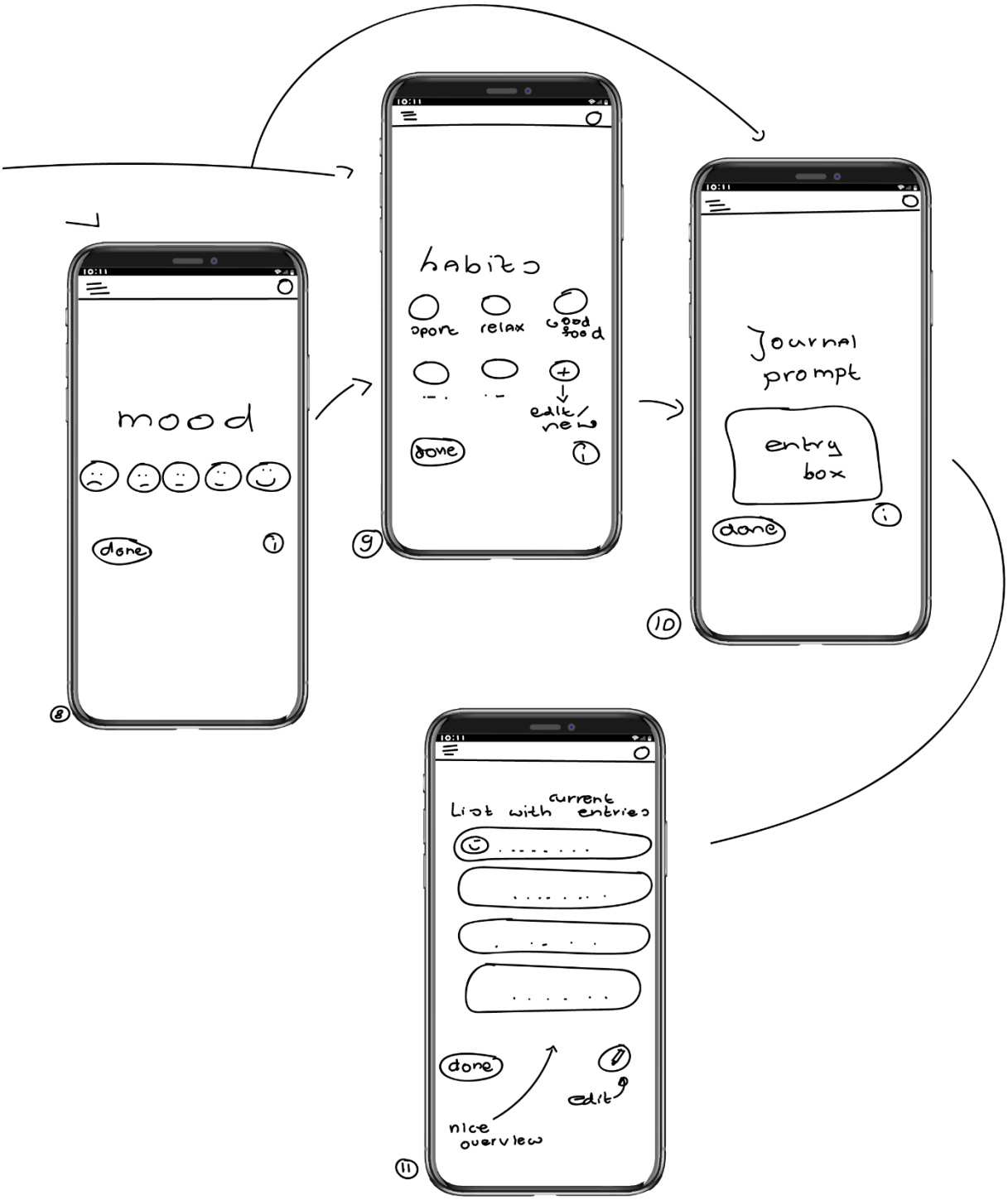
E Appendix: Self-reflection application sketches

First, an overview of the sketches is give. After this, some zoomed in parts of the sketch are repeated.






menu
Name of APP
welcome!
Go to check in
Good to see you 'name'
new awarded buttons
scroll for statistics + entries
1
Reflective question: ?
Entry box
done
info
+ examples
finish and save (for now)
5
I am grateful for_.
done
info
+ examples
finish and save (for now)
7
APP
Log in
username
password
forgot..
or register
12
mood
habits
Grateful
Reflecti
Journal
6


mood
done
habits
sport
relax
good food
edit/ new
done
Journal prompt
entry box
done
List with current entries
done
edit
nice overview

F Appendix: Self-reflection prompts and questions

Reflective Questions

- What would make today great?
- How do you really feel today?
- Do you prefer a clean or chaotic environment?
- What was the last situation that made you laugh?
- What was a special moment today?
- What activity required a lot of energy today?
- What activity yielded energy today?
- What do I worry about for next year?
- Where am I grateful for today?
- Who is someone that inspires me?
- What makes me feel alive?
- What choice or decision feels most authentic to me right now?
- How would I describe the relationship I have with myself?
- When do I feel most like ‘me’?
- If I was sure to succeed, what project or course of study would I begin tomorrow?
- What expectations of ‘normal’ am I letting go of today?
- What was something beautiful I saw today?
- What memory brings me joy?
- Who are the people that support me in this life?
- How would I feel without fear?
- How can I express my feeling without hurting anyone?
- What am I proud of?
- How do I reward myself when I achieve a goal?
- Who suffers when I am upset?

Mindful pompts

- How many different birds do you hear?
- Can you distinguish different shades of green in the trees?
- What different material can you spot in the walking path?
- Which different smells can you distinguish?
- Focus on your walking pace, how does your body move while walking?
- If your look around you, what captures your attention?
- Focus on your breathing, how does it feel to focus on your breathing?
- Look around you, can you discover some insects?
- Try to feel which temperature it is, can you feel warmth or coolness?
- Focus on the wind, is there a breeze or is the air still?
- Focus on your walking body, which sensations do you notice in your body?
- Where are you right now: do you want to be here more often?
- Continue walking for a few minutes, focusing on the very particular experience of your
- foot making contact with the ground.
- How does this walk make you feel: calm, excited, or neutral?
- In which part of your body do you feel the most right now? Try to focus on that part of your body.
- What can you feel? Is your hair tickling the back of your neck or your shoes rubbing against your heels?
- What can you taste? Are the flavors of your last meal still sitting on your tongue?

Informative prompts

- Mindfulness is the basic human ability to be fully present, aware of where you are and what you are doing. Are you fully present right now?
- Mindfulness is the basic human ability to be not overly reactive or overwhelmed by what is going on around us. Were you overwhelmed today?
- When you meditate you venture into the workings of your mind, like your thoughts. How are you thinking right now?
- Reflective questions can let you think about who you are and what you want out of life. Do you ever think about life this way?
- Reflective questions can help you identify your strengths and weaknesses. Can you name some strengths?
- Reflective actions can help you to experience something new. When was the last time you really did something new?
- It can be necessary to use your body differently than normal for a reflection action. How do you use your body?
- Mindfulness can help you to discover your surroundings. Do you ever really pay attention to your surroundings?
- Practicing self-reflection can make people feel better. What does make you feel better?
- Sometimes people will look at you when you will perform a reflective action, like standing still with your eyes closed. How would you feel about this?
- Mindfulness can sometimes get you out of the future. Were you thinking about the things you still have to do today?
- Mindfulness can sometimes help you to get out of the past. Are you worrying sometimes about things that have happened?

Reflective actions

- Stand still for a moment and close your eyes: listen to all the sounds around you.
- Focus on your posture and try to walk upright.
- Try to form a smile on your face while walking.
- Walk with your arms behind your back for a while. How does this make you feel?
- Can you spot 5 different types of leaves?
- Try to walk slaloming over the walking path instead of straight.
- While walking, try to look at the sky, what do you see?
- Point with your finger at three things in your surroundings that look beautiful.
- Try to make small steps while walking.
- Can you spot 5 different types of trees?
- Touch a tree, and feel its structure.
- While walking, try to look at the ground, what do you see?
- Try to find a loose branch and use it as a walking stick.
- Move your arms and hands in the direction of your legs and feet while walking.
- Walk with your arms crossed for a while. How does this make you feel?

G Appendix: Web page code

G-1: Code of the Overview Page

```
<!DOCTYPE html>
<html lang="en">
<head>
  <title>Reflection Walk</title>
  <meta charset="utf-8">
  <meta name="viewport" content="width=device-width, initial-scale=1">
  <link rel="stylesheet"
href="https://maxcdn.bootstrapcdn.com/bootstrap/4.5.2/css/bootstrap.min.css">
  <script
src="https://ajax.googleapis.com/ajax/libs/jquery/3.5.1/jquery.min.js"></script>
  <script
src="https://cdnjs.cloudflare.com/ajax/libs/popper.js/1.16.0/umd/popper.min.js"></s
cript>
  <script
src="https://maxcdn.bootstrapcdn.com/bootstrap/4.5.2/js/bootstrap.min.js"></script>
  <link rel="preconnect" href="https://fonts.gstatic.com">
  <link
href="https://fonts.googleapis.com/css2?family=Quicksand:wght@300;400;500;600;700&d
isplay=swap" rel="stylesheet">
  <script src="https://kit.fontawesome.com/2fe85a6aca.js"
crossorigin="anonymous"></script>

  <style>
        /* normal style */
        .btn-primary {
                width: 80%;
                min-height: 60px;
                margin-top: 10px;
                padding: 20px;
                background-color: white;
                border: none;
                color: black;
                border-radius: 15px;
                font-size: 20px;

        }

        /* hover style */
        .btn-primary:hover {
                background-color: #FFD855;
                transition: 0.3s;
        }

        /* activated style */
        .btn-primary:not(:disabled):not(.disabled).active, .btn-
primary:not(:disabled):not(.disabled):active, .show>.btn-primary.dropdown-toggle,
.btn-primary:focus, .btn-primary.focus {
                background-color: #FFD855;
        }

        body {
                background-color: #F7F7F6;
                font-family: 'Quicksand', sans-serif;
        }

        .special {
                font-size: 25px;
                color: #FFD855;
        }

        .special:hover {
                color: white;
        }
```

```
        .navbar-dark .navbar-toggler {
                border: none;
                color: white;
        }

        .navbar-dark{
                background-color: black !important;
        }

  </style>

</head>
<body>

<nav class="navbar navbar-expand-md bg-dark navbar-dark">
  <a class="navbar-brand" href="#">Self-Reflection Walk</a>
  <button class="navbar-toggler" type="button" data-toggle="collapse" data-
target="#collapsibleNavbar">
    <i class="fas fa-bars"></i>
  </button>
  <div class="collapse navbar-collapse" id="collapsibleNavbar">
    <ul class="navbar-nav">
      <li class="nav-item">
        <a class="nav-link" href="#">Info</a>
      </li>
    </ul>
  </div>
</nav>

<div class="container" >
  <div class="row">
    <div class="col-sm-12 text-center">
        <p class='text-muted' style='padding-top: 70px; margin-bottom: 0px;'>
                GIVE ME A RANDOM SELF-REFLECTION ...
        </p>

        <a href='prompt.php#surprise'><button type="button" class="btn btn-primary
shadow special">PROMPT</button></a><br>
        <br>
        <span class='text-muted'>OR</span>
        <br>
        <a href='prompt.php#reflective'><button type="button" class="btn btn-
primary shadow"><!--<i class="fas fa-brain"></i>-->Reflective
Question</button></a><br>
        <a href='prompt.php#mindful'><button type="button" class="btn btn-primary
shadow"><!--<i class="fas fa-spa"></i>-->Mindful Prompt</button></a><br>
        <a href='prompt.php#info'><button type="button" class="btn btn-primary
shadow"><!--<i class="fas fa-microphone-alt"></i>-->Informative
Prompt</button></a><br>
        <a href='prompt.php#action'><button type="button" class="btn btn-primary
shadow"><!--<i class="fas fa-exclamation"></i>-->
        Reflective Action</button></a><br>
    </div>
  </div>
</div>


<!--footer-->
<div class='jumbotron' style='background-color: #FFD855 ; height: 30vh; text-align:
center; margin-bottom: 0px; margin-top: 50px; border-radius: 0px;'>
        <h3 style='color: #4c4c4c; font-size: 10px; margin-top:60px;' >&copy;
2021<br/>
        Eva Lahuis<br/>
        Part of a Creative Technology graduation project
        </h3>
</div>
</body>
</html>
```

G-2: Code of the Prompt Page

```
<!DOCTYPE html>
<html lang="en">
<head>
  <title>Reflection Walk</title>
  <meta charset="utf-8">
  <meta name="viewport" content="width=device-width, initial-scale=1">
  <link rel="stylesheet"
href="https://maxcdn.bootstrapcdn.com/bootstrap/4.5.2/css/bootstrap.min.css">
  <script
src="https://ajax.googleapis.com/ajax/libs/jquery/3.5.1/jquery.min.js"></script>
  <script
src="https://cdnjs.cloudflare.com/ajax/libs/popper.js/1.16.0/umd/popper.min.js"></s
cript>
  <script
src="https://maxcdn.bootstrapcdn.com/bootstrap/4.5.2/js/bootstrap.min.js"></script>
  <link rel="preconnect" href="https://fonts.gstatic.com">
  <link
href="https://fonts.googleapis.com/css2?family=Quicksand:wght@300;400;500;600;700&d
isplay=swap" rel="stylesheet">
  <script src="https://kit.fontawesome.com/2fe85a6aca.js"
crossorigin="anonymous"></script>


  <style>
        /* normal style */
        .btn-primary {
                width: 80%;
                min-height: 60px;
                margin-top: 10px;
                padding: 20px;
                background-color: white;
                border: none;
                color: black;
                border-radius: 15px;
                font-size: 20px;

        }

        /* hover style */
        .btn-primary:hover {
                background-color: #FFD855;
                transition: 0.3s;
        }

        /* activated style */
        .btn-primary:not(:disabled):not(.disabled).active, .btn-
primary:not(:disabled):not(.disabled):active, .show>.btn-primary.dropdown-toggle,
.btn-primary:focus, .btn-primary.focus {
                background-color: #FFD855;
        }

        body {
                background-color: #F7F7F6;
                font-family: 'Quicksand', sans-serif;
        }

        .jumbotron {
                border-radius: 0px;
                background-color: #FFD855;
                padding: 60px;
        }

        .navbar-dark .navbar-toggler {
                border: none;
```

```
                color: white;
        }

        .navbar-dark{
                background-color: black !important;
        }

        .h1{
                font-size: 100px;
        }
  </style>

</head>
<body>

<nav class="navbar navbar-expand-md bg-dark navbar-dark">
  <a class="navbar-brand" href="#">Self-Reflection Walk</a>
  <button class="navbar-toggler" type="button" data-toggle="collapse" data-
target="#collapsibleNavbar">
    <i class="fas fa-bars"></i>
  </button>
  <div class="collapse navbar-collapse" id="collapsibleNavbar">
    <ul class="navbar-nav">
      <li class="nav-item">
        <a class="nav-link" href="#">Info</a>
      </li>
    </ul>
  </div>
</nav>

<div class="jumbotron text-center">
  <h1 id='prompt'></h1>
</div>

<div class='container'>
        <div class='row'>
                <div class='col-sm-12 text-center'>
                        <p class='text-muted' style='margin-bottom: 0px;'>
                        ALREADY GOT THIS PROMPT?
                        </p>
                        <button type="button" onclick='window.location.reload()'
class="btn btn-primary shadow">New Prompt</button><br><br>
                        <p class='text-muted' style='margin-bottom: 0px;'>
                        MORE TYPES OF PROMPTS?
                        </p>
                        <a href='index.php'><button class='btn btn-primary
shadow'>See Overview</button></a>
                </div>
        </div>
</div>

<script>

window.onload = function() {
  setPrompt();
};

PROMPTS = {
        "surprise":["What would make today great?","How do you really feel
today?","Do you prefer a clean or chaotic environment?","What was the last
situation that made you laugh?","What was a special moment today?","What activity
required a lot of energy today?","What activity yielded energy today?","What do I
worry about for next year?","Where am I grateful for today?","Who is someone that
inspires me?","What makes me feel alive?","What choice or decision feels most
authentic to me right now?","How would I describe the relationship I have with
myself?","When do I feel most like me’?","If I was sure to succeed, what project
or course of study would I begin tomorrow?","What expectations of normal’ am I
letting go of today?","What was something beautiful I saw today?","What memory
```

brings me joy?","Who are the people that support me in this life?","How would I feel without fear?","How can I express my feeling without hurting anyone?","What am I proud of?","How do I reward myself when I achieve a goal?","Who suffers when I am upset?","How many different birds do you hear?","Can you distinguish different shades of green in the trees?","What different material can you spot in the walking path?","Which different smells can you distinguish?","Focus on your walking pace, how does your body move while walking?","If your look around you, what captures your attention?","Focus on your breathing, how does it feel to focus on your breathing?","Look around you, can you discover some insects?","Try to feel which temperature it is, can you feel warmth or coolness?","Focus on the wind, is there a breeze or is the air still?","Focus on your walking body, which sensations do you notice in your body?","Where are you right now: do you want to be here more often?","Continue walking for a few minutes, focusing on the very particular experience of your foot making contact with the ground.","How does this walk make you feel: calm, excited, or neutral?","In which part of your body do you feel the most right now? Try to focus on that part of your body.","What can you feel? Is your hair tickling the back of your neck or your shoes rubbing against your heels?","What can you taste? Are the flavors of your last meal still sitting on your tongue?","Stand still for a moment and close your eyes: listen to all the sounds around you.","Focus on your posture and try to walk upright.", "Try to form a smile on your face while walking.", "Find 5 different types of leaves."],
  "reflective": ["What would make today great?","How do you really feel today?","Do you prefer a clean or chaotic environment?","What was the last situation that made you laugh?","What was a special moment today?","What activity required a lot of energy today?","What activity yielded energy today?","What do I worry about for next year?","Where am I grateful for today?","Who is someone that inspires me?","What makes me feel alive?","What choice or decision feels most authentic to me right now?","How would I describe the relationship I have with myself?","When do I feel most like ❍me’?","If I was sure to succeed, what project or course of study would I begin tomorrow?","What expectations of ❍normal’ am I letting go of today?","What was something beautiful I saw today?","What memory brings me joy?","Who are the people that support me in this life?","How would I feel without fear?","How can I express my feeling without hurting anyone?","What am I proud of?","How do I reward myself when I achieve a goal?","Who suffers when I am upset?"],
  "mindful":["How many different birds do you hear?","Can you distinguish different shades of green in the trees?","What different material can you spot in the walking path?","Which different smells can you distinguish?","Focus on your walking pace, how does your body move while walking?","If your look around you, what captures your attention?","Focus on your breathing, how does it feel to focus on your breathing?","Look around you, can you discover some insects?","Try to feel which temperature it is, can you feel warmth or coolness?","Focus on the wind, is there a breeze or is the air still?","Focus on your walking body, which sensations do you notice in your body?","Where are you right now: do you want to be here more often?","Continue walking for a few minutes, focusing on the very particular experience of your foot making contact with the ground.","How does this walk make you feel: calm, excited, or neutral?","In which part of your body do you feel the most right now? Try to focus on that part of your body.","What can you feel? Is your hair tickling the back of your neck or your shoes rubbing against your heels?","What can you taste? Are the flavors of your last meal still sitting on your tongue?"
 ],
 "info":["Mindfulness is the basic human ability to be fully present, aware of where you are and what you are doing. Are you fully present right now?","Mindfulness is the basic human ability to be not overly reactive or overwhelmed by what is going on around us. Were you overwhelmed today?","When you meditate you venture into the workings of your mind, like your thoughts. How are you thinking right now?","Reflective questions can let you think about who you are and what you want out of life. Do you ever think about life this way?", "Reflective questions can help you identify your strengths and weaknesses. Can you name some strengths?","Reflective actions can help you to experience something new. When was the last time you really did something new?","It can be necessary to use your body differently than normal for a reflection action. How do you use your body?","Mindfulness can help you to discover your surroundings. Do you ever really pay attention to your surroundings?","Practicing self-reflection can make people feel better. What does make you feel better?","Sometimes people will look at you when you will perform a reflective action, like standing still with your eyes closed. How would you feel about this?","Mindfulness can sometimes get you out of

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the future. Were you thinking about the things you still have to do
today?","Mindfulness can sometimes help you to get out of the past. Are you
worrying sometimes about things that have happened?"],
  "action":  ["Stand still for a moment and close your eyes: listen to all the
sounds around you.","Focus on your posture and try to walk upright.","Try to form a
smile on your face while walking.","Walk with your arms behind your back for a
while. How does this make you feel?","Can you spot 5 different types of
leaves?","Try to walk slaloming over the walking path instead of straight.","While
walking, try to look at the sky, what do you see?","Point with your finger at three
things in your surroundings that look beautiful.","Try to make small steps while
walking.","Can you spot 5 different types of trees?","Touch a tree, and feel its
structure.","While walking, try to look at the ground, what do you see?","Try to
find a loose branch and use it as a walking stick.","Move your arms and hands in
the direction of your legs and feet while walking.","Walk with your arms crossed
for a while. How does this make you feel?"],
};

function setPrompt() {
  var hash = window.location.hash.substr(1);
  var prompts = PROMPTS[hash];
  var promptContainer = document.getElementById("prompt");
  var prompt = prompts[randomInteger(0, prompts.length-1)];

  promptContainer.innerHTML = prompt;
  console.log("called");

}

function randomInteger(min, max) {
  return Math.floor(Math.random() * (max - min + 1)) + min;
}

</script>


</body>
</html>
```

H Appendix: Information brochure and informed consent

H-1: Information brochure

Enschede

User test of a Self-Reflection walking route

What is this research project about?

In this letter, we would like to inform you about the research you have applied to participate in. The experiment will take place on the beforehand arranged date and time, between the 14th and the 25th June 2021, and will approximately take 30/45 minutes. The goal of this research is to test the prototype which is designed in a creative technology graduation project. This prototype includes a self-reflection system. You can withdraw at any time without having to give a reason.

What will participants be asked to do?

In this research, the participants will be asked to test a self-reflection route. This self- reflection walk is a beforehand planned route on the campus of the University of Twente, guided by signs with QR-code to scan. The participants will be asked to scan the QR-codes with their smartphones. The QR-codes will lead to the designed web page with a selection menu. This selection menu consists of 5 options to select: a reflective question, a mindful prompt, an action to perform, a link to an informative podcast, or surprise me (links to one of the before mentioned options randomly). Examples of this are: ‘Listen good, how many birds do you hear?’ or ‘How are you really feeling today?’. Some participants will walk the route alone, and some participants will walk the route together with a fellow student. The participants are asked to do the action or think about the answer(s) to the prompt and discuss this with the fellow student if walking together. During the test, the researcher (I, Eva Lahuis) will be present to make observations. The observations will include confirmations or deviations from the expected and intended use of the reflection walk.

After testing the self-reflection walk, questions will be asked about the functional aspects of the walking route. These questions will be focused on the user experience of the self-reflection walk and the interface from the signs and the web page with the selection menu. Additionally, a prototype from a more extensive (compared with the previously mentioned web page) web/mobile application is shown to the participants (this will be on a device belonging to the researcher), and questions are asked about this second prototype. The integrated self-reflection methods in this web/mobile application are reflective questions, mindful questions, journaling, gratitude practice, habit tracking, and mood tracking. Any advice offered during this user test should not be taken as professional advice regarding mental health. For professional mental health help, contact the SACC at the University of Twente to let experts help you find a suitable form of support.

During the user tests, please keep the corona guidelines of the Dutch government in mind. The researcher and the participants will keep a distance of 1.5m at all times. The reflection walk and asking the questions afterward will both preferably be outside in the open air. When a meeting must be inside a building, a mouth mask has to be worn when walking.

The data gathered during this user test will be used to evaluate the designed self- reflection system. The data will be collected anonymously. The collected data will be analyzed and I will report my findings in my thesis. The target audience of this questionnaire is students, so if you are not a student you can unfortunately not participate in this user test. Additionally, as a participant, you need to be able to follow a route on the campus of the University of Twente so if you are not able to follow this route (for example due to a physical restraint) you can unfortunately not participate in this user test.

H-2 Informed consent

‘I hereby declare that I have been informed in a manner which is clear to me about the nature and method of the research as described in the aforementioned information brochure. My questions have been answered to my satisfaction. I agree with my own free will to participate in this research. I reserve the right to withdraw this consent without the need to give any reason and I am aware that I may withdraw from the experiment at any time. My data will be collected anonymously. The collected data will be analyzed and reported in the thesis by the researcher. If I request further information about the research, now or in the future, I may contact the researcher Eva Lahuis (e.j.lahuis@student.utwente.nl) or the project supervisor Faber, Erik, dr.ir. (e.j.faber@utwente.nl) on behalf of Creative Technology (EEMSC).’

If you have any complaints about this research, please direct them to the secretary of the Ethics Committee of the Faculty of Electrical Engineering, Mathematics and Computer Science at the University of Twente, P.O. Box 217, 7500 AE Enschede (NL), email: ethicscommittee-cis@utwente.nl).

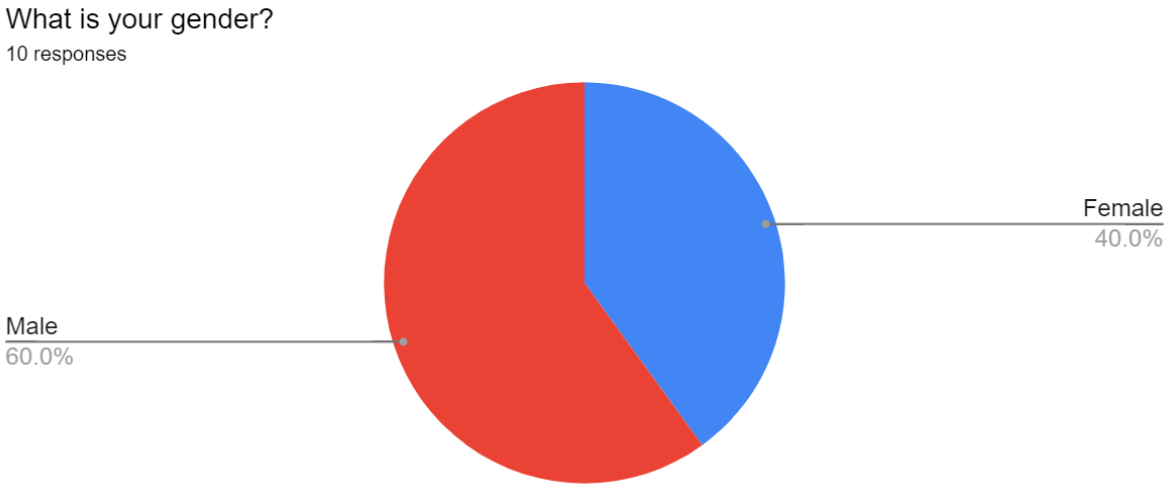
Do you wish to participate?

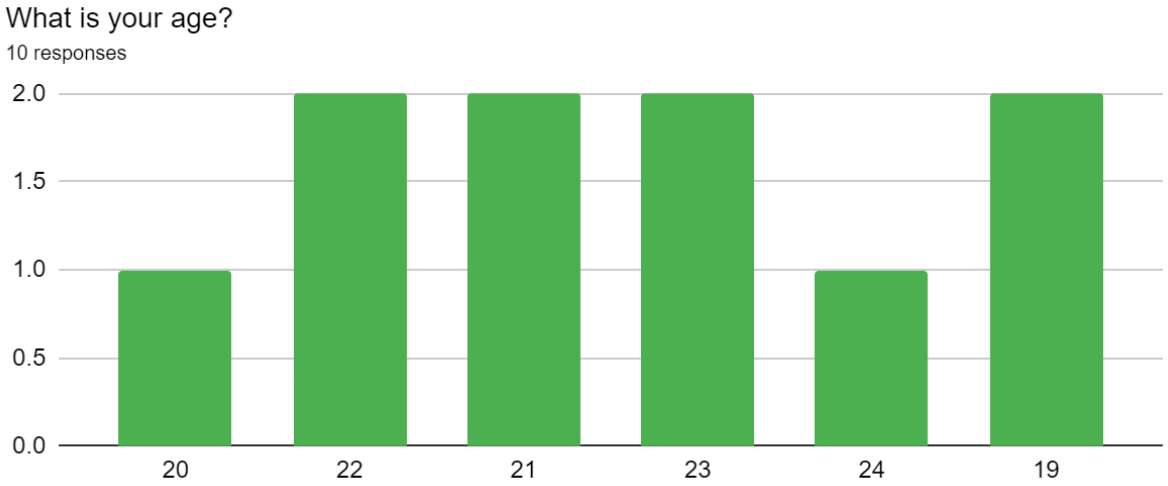
☐ Yes

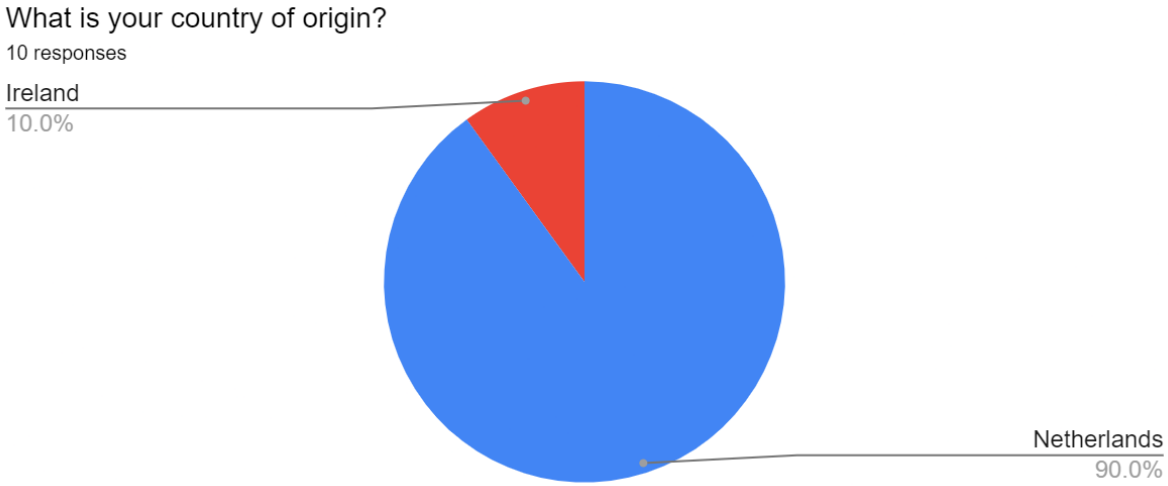
☐ No

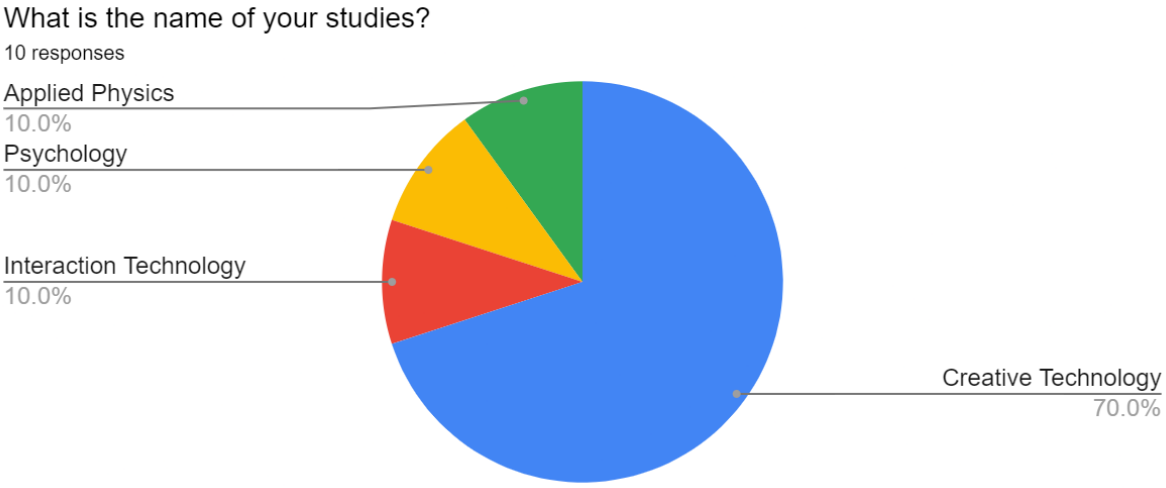
I Appendix: User Evaluation Self-reflection Walking Route

I-1: Demographic Questions





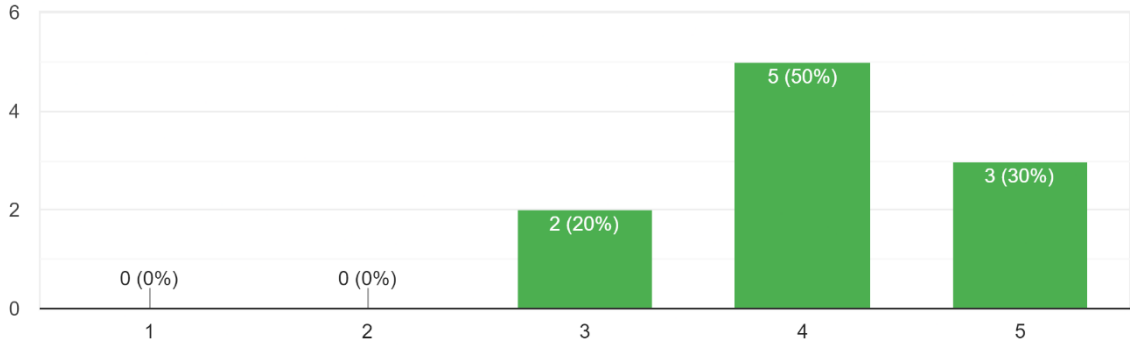



What is the name of your studies?
10 responses
Applied Physics
10.0%
Psychology
10.0%
Interaction Technology
10.0%
Creative Technology
70.0%

I-2: System Usability Scale

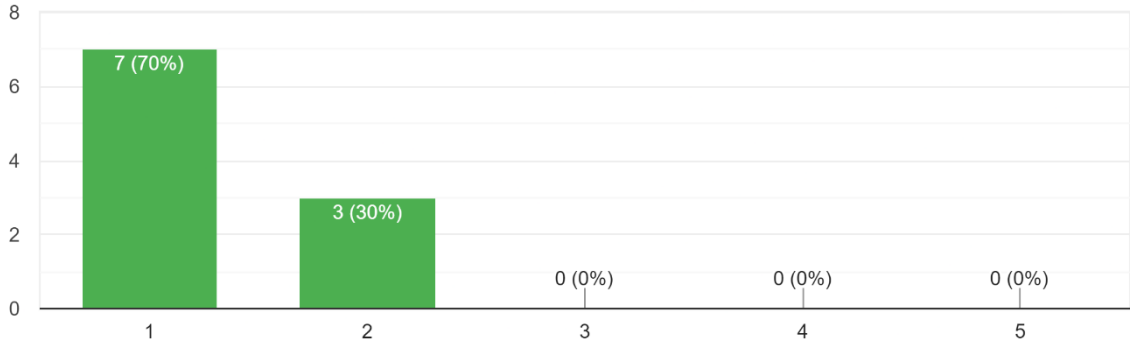
1. I think that I would like to use this system frequently.

10 responses



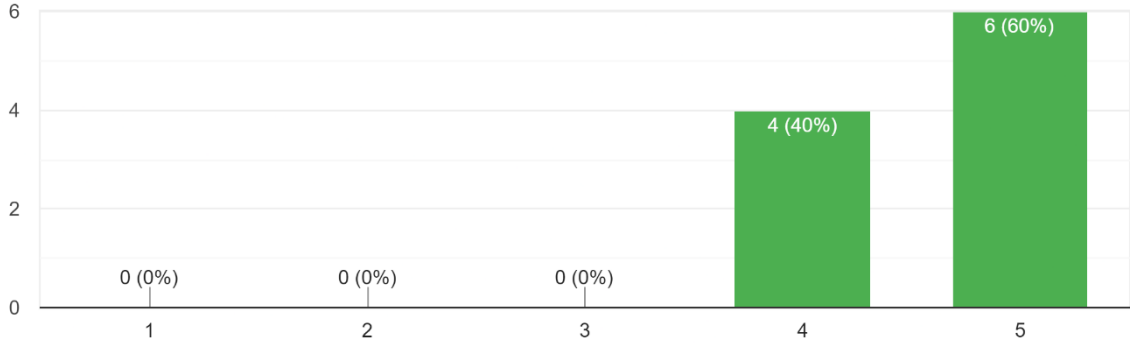
2. I found the system unnecessarily complex.

10 responses



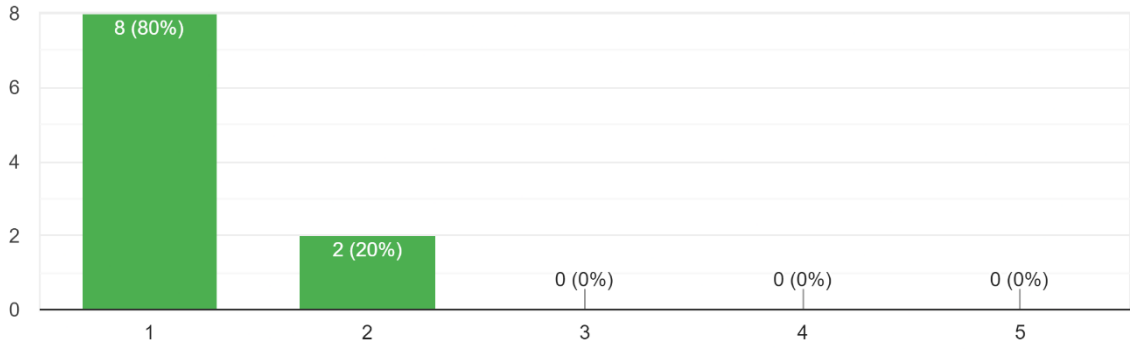
3. I thought the system was easy to use.

10 responses



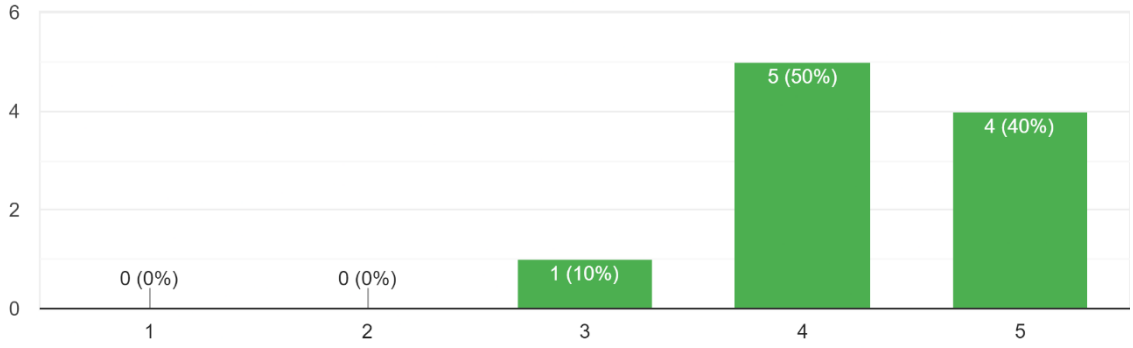
4. I think that I would need the support of a technical person to be able to use this system.

10 responses



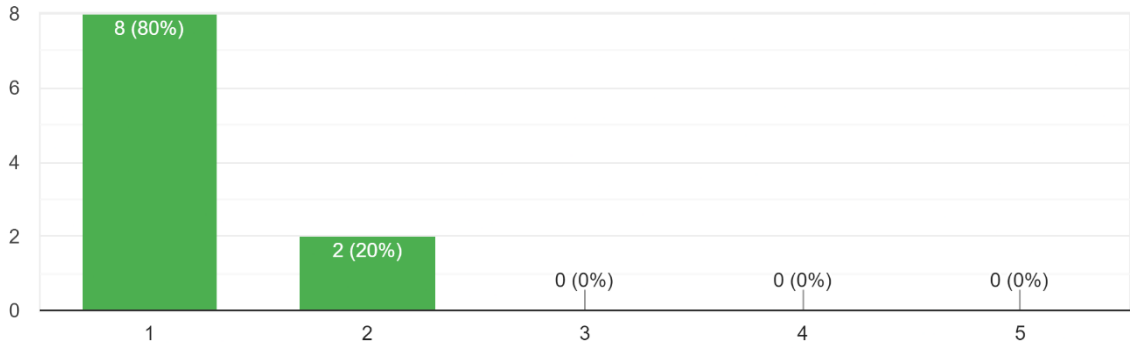
5. I found the various functions in this system were well integrated.

10 responses



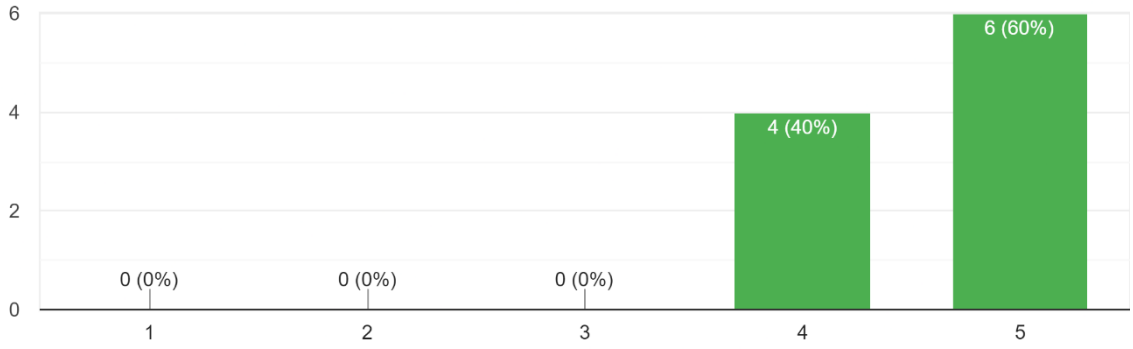
6. I thought there was too much inconsistency in this system.

10 responses



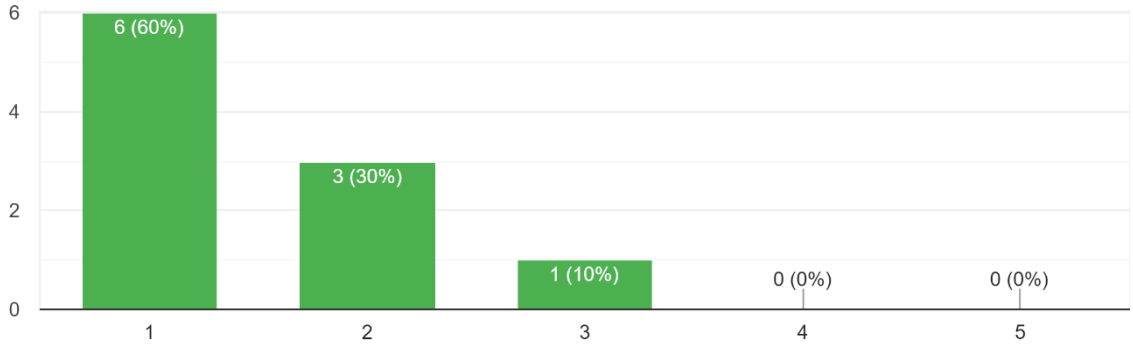
7. I would imagine that most people would learn to use this system very quickly.

10 responses



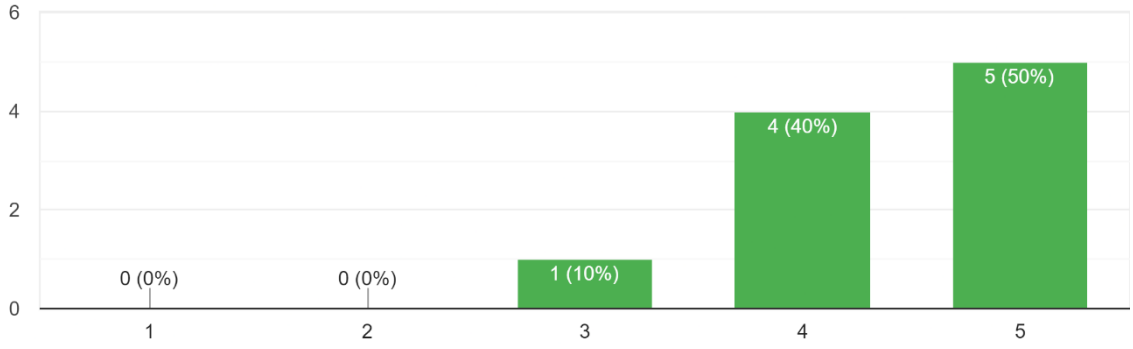
8. I found the system very cumbersome to use.

10 responses



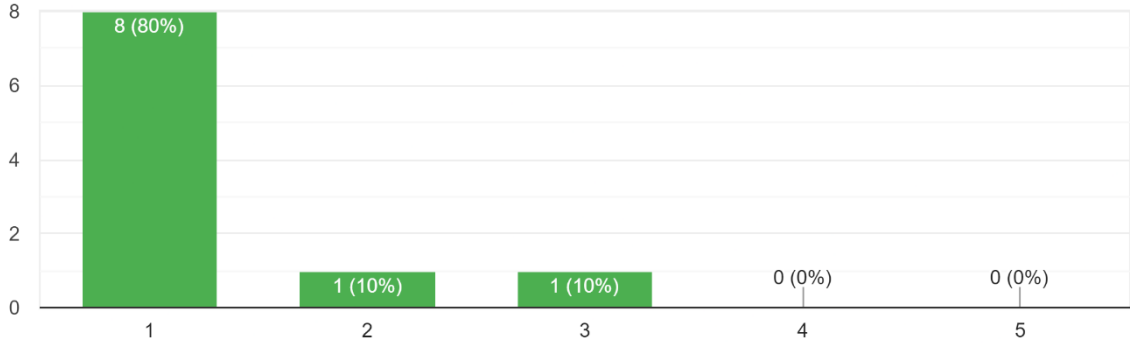
9. I felt very confident using the system.

10 responses



10.I needed to learn a lot of things before I could get going with this system.

10 responses



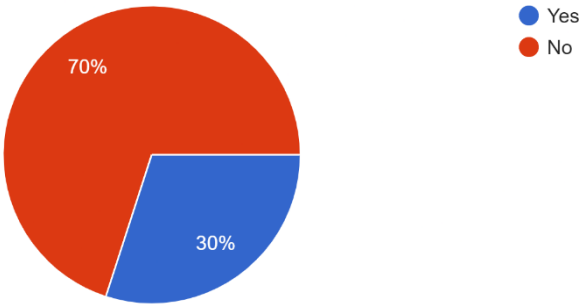
Question #	1	2	3	4	5	6	7	8	9	10				
	5	1	5	1	5	1	5	1	5	1	**20**	**20**	*40*	100
	3	1	4	1	4	1	5	1	4	1	**15**	**20**	*35*	87.5
	4	2	4	1	5	1	4	2	3	1	**15**	**18**	*33*	82.5
	3	2	4	1	4	1	4	3	5	1	**15**	**17**	*32*	80
	4	2	5	2	3	2	5	2	5	2	**17**	**15**	*32*	80
	5	1	4	1	4	1	5	2	5	3	**18**	**17**	*35*	87.5
	4	1	5	1	4	1	4	1	4	1	**16**	**20**	*36*	90
	5	1	5	1	5	1	5	1	5	1	**20**	**20**	*40*	100
	4	1	5	1	5	1	4	1	4	1	**17**	**20**	*37*	92.5
	4	1	5	2	4	2	5	1	4	1	**17**	**18**	*35*	87.5
	3.1	3.7	3.6	3.8	3.3	3.8	3.6	3.5	3.4	3.7	17	18.5	35.5	**88.75**
	1	2	3	4	5	6	7	8	9	10				

I-3: Evaluation Questionnaire

Question 1

Do you know the Student Wellbeing Project from the University of Twente?

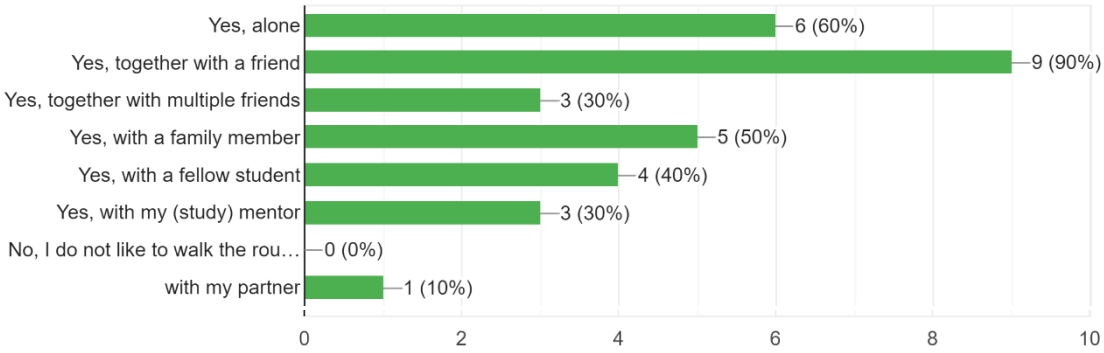
10 responses



Question 2

Would you like to walk this route again, if so, with whom?

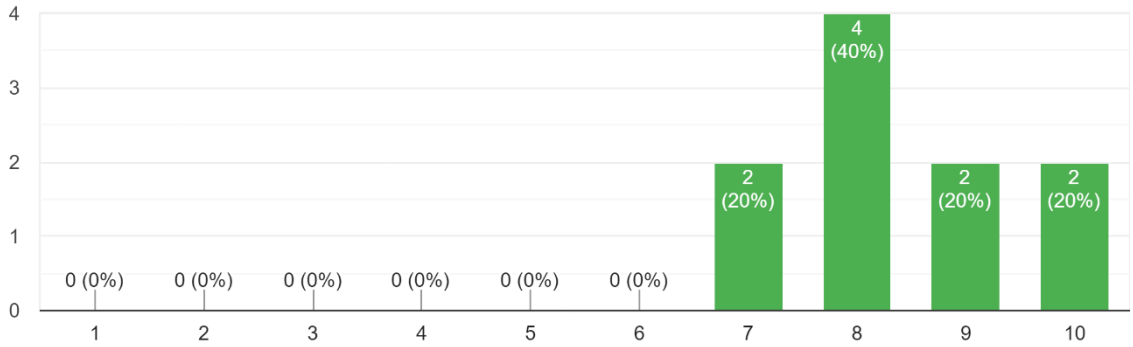
10 responses



Question 3

How would you grade the web page?

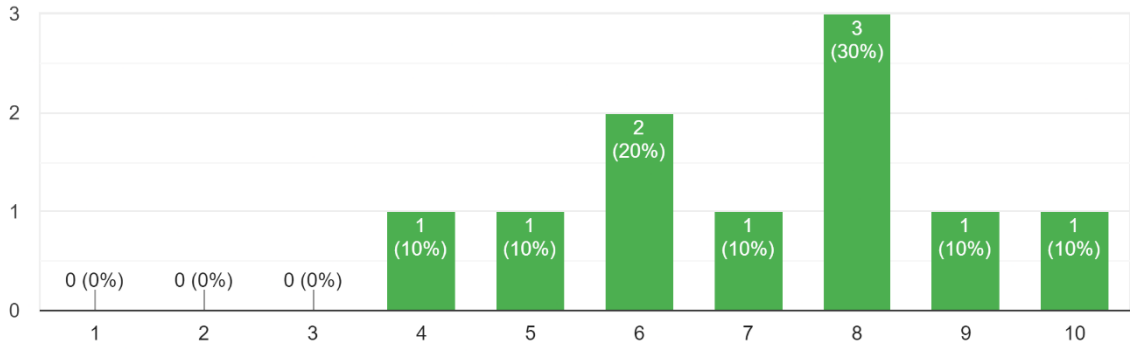
10 responses



Question 4

How would you grade the time it takes to walk the route?

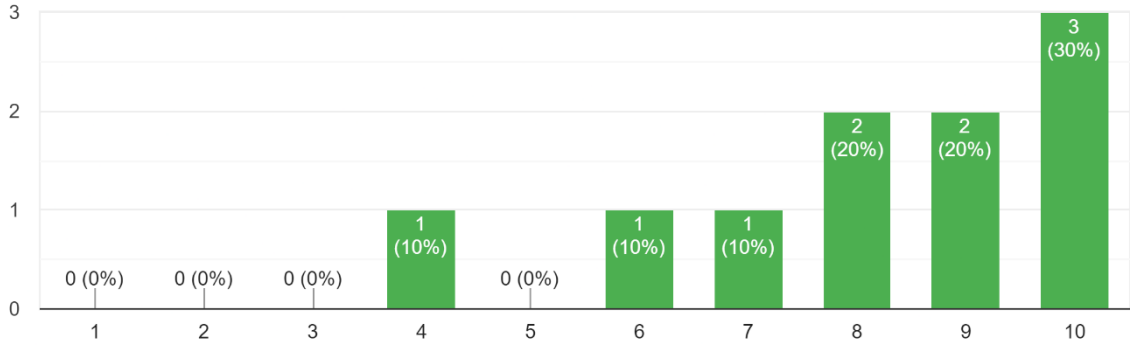
10 responses



Question 5

How would you grade the content of the self-reflection prompts?

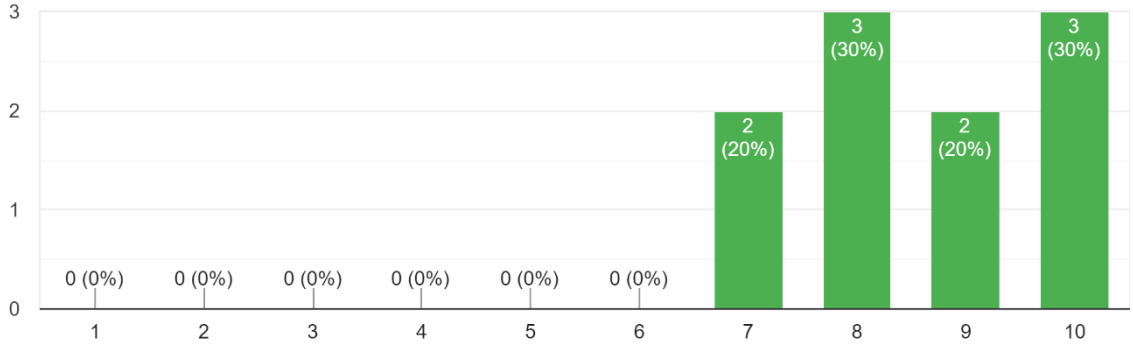
10 responses



Question 6

How would you grade the scenery of the walking route?

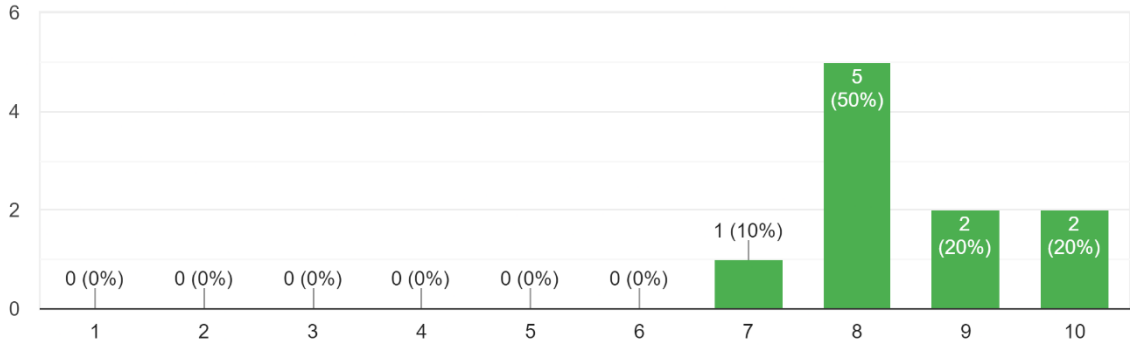
10 responses



Question 7

How would you grade the overall self-reflection walk system (including web page)?

10 responses



I-4: Interviews

The *No.* in the tables correspond to the number of a participant.

No.	Question 1. What was your overall impression of the self-reflection walk?
	Answers
1	Clearly, the signs are prototypes. But if the signs and posters were just as professional as the web page, the self-reflection walk would be amazing. The duration of the walk (10/15 minutes during the user test) is too short. 20/25 minutes would be better.
2	The questions worked in the sense they led to reflective thoughts and conversations. The start sign of the reflection walk was a bit confusing to me. Maybe an arrow could be added to give the right direction.
3	The time between the signs was too short. I wanted to think and discuss longer about the prompts and questions. But it could be about us, we both like to talk a lot and long. 25/30 minutes would be better. The route could be extended to the forest north of the campus (start at the pyramids from the Witbreuksweg.
4	Cool idea and nice experience. Nice walking route and fitting to think about things
5	I would have liked a longer walking route, something like 20 minutes. Sometimes the new sign worked contradictory and ended the nice conversation we were having.
6	The route was a bit short, and also the distance between the signs was a bit too short. It seemed to me like the distances between the signs differed.
7	The route was nice. Only crossing the route was confusing. Maybe crayons could be used to direct you to the next part of the route.
8	Walking the route made me feel calm, the view was good and it was nice to see the route be along the water
9	Nice. simple and clear, was nice to walk the route. Easy to find the route. Would be nice to have a longer walking route, between 20 and 30 minutes. Distance between the signs was okay, but when walking together, it might be too short.
10	Cool walking route! The webpage responded a bit weird on my phone. The mindful question was nice. The route could be longer, 20 minutes or so, and the distance between the signs is all right. Walking the route was really relaxing

No.	Question 2. Would you walk the self-reflection walking route again, and why and when?	
	Conclusions	**Answers**
1	**Yes**, also in the lunch break.	Yes. I would not like to walk this route by myself. I want to do walk this again with my best friend, my mother, or with a fellow student during the break. I would buy a sandwich at the Waaier in a lunch break and then walk this route.
2	**Yes**.	Yes possibly, alone or with a friend, because I liked the route.
3	**Yes**.	Yes, maybe with housemates with whom I walk more often on campus.
4	**Maybe**, but a different route closer to home.	Maybe, but not specifically this route as it is too far from my home. I would prefer to use the web page on my own walking route, close to home.
5	**Yes**, but together with someone to prevent distraction.	Yes, I would like to walk the route again, but together with someone. When I walk alone I will be quickly distracted.

6	**Yes**, together with someone is more valuable.	Yes, I would like to walk the route again, but not alone. The peer connection was really valuable to me. The reflection prompts lifted the conversation. We had a really nice conversation.
7	**Yes**, since I walk a lot.	Yes, I walk a lot, also with housemates. Would be nice to walk the route together with someone, or with more people.
8	**Yes**, alone to prevent distraction.	Yes, I would like to walk the route again but only alone. Otherwise, I will be distracted by the other person.
9	**Yes**, together to discuss the questions.	Yes, I would prefer to walk together with someone. I prefer to discuss the questions together with someone. I am more a doing person than a thinking person.
10	**Yes**, to get to know interesting facts about yourself and others.	Yes, with another person or more people, to get to know interesting facts about yourself and others.

No.	**Question 3. Did the provided instructions suffice to walk the reflection route autonomously?**	
	Conclusions	**Answers**
1	**Yes, but** there are some points for improvement.	Yes, the poster at the beginning of the walk includes enough information, yes. But there are some points for improvement: The signs with QR-codes however, could include a number. Example: sign 4 of the 5. Then it is more clear the sign is part of a route. The QR code signs should not include a title like 'self-reflection walk'. The signs without titles with QR codes are more likely to be scanned by people who walk by. When people will scan the QR code, they will see it is part of the self-reflection route on the web page.
2	**Yes, but** there are some points for improvement.	Yes, but it would be nice to add an arrow to the signs. Or logo, or color, or drawing, it should be more recognizable.
3	**Yes, but** there are some points for improvement.	Yes, but it could be more clear that the signs are part of the reflection route. Indicate the signs with color.
4	**Yes**, it was easy to understand.	Yes, it was easy to understand.
5	**Yes**, but there are some points for improvement.	Yes, it was clear to understand. Maybe it could be less clear. So it is more exciting to try and scan the QR code. The last sign was confusing, I was expecting another prompt but I went to the overview web page.
6	**No**, not completely.	The poster was not clear to me, but we started to scan the QR code and just walked. It was nice that some prompts are interpretable for own interpretation. I think it would be very different for me to walk the route alone or together.
7	**Yes**, clear.	Yes, there was enough information to know how it works.
8	**Yes**, very clear.	Yes, very clear.
9	**Yes**.	Yes, the poster was fine. The prompts give enough information, but once I doubted about a prompt.
10	**Yes**, enough instructions.	Yes, enough instructions.

No.	Question 4a. Do you practice self-reflection more often in your personal life?	
	Conclusions	**Answers**
1	**Yes**, sometimes.	Yes, sometimes. Mainly journaling and answering reflective questions, for example during No Nonsense November.
2	**Yes**, other techniques.	Yes, but not the techniques covered in this system. Praying is also a type of self-reflection.
3	**No**.	No, not really.
4	**No**.	No, I do not work with self-reflection techniques.
5	**No**.	No, I did not do anything with self-reflection before.
6	**No, but** heard about it.	Of course, I heard about self-reflection before, but I do not practice it regularly.
7	**No**.	Self-reflection, I heard about it, but I never practiced it.
8	**Yes**, sometimes other techniques.	I meditate sometimes, but further no self-reflection.
9	**No**.	I do not work with self-reflection techniques in my personal life.
10	**No**.	I do not practice self-reflection techniques.

No.	Question 4b. What did you think about the self-reflection prompts?	
	Conclusions	**Answers**
1	Does not like mindful prompts, big database is important.	Personally, I do not like the mindful prompts. I do not walk here to look around or at the walking path. I want to walk and discuss with someone. Maybe it is an idea to delete the mindful prompts and just at a reminder at the beginning sign to look around you and do mindful things (think about the forest, listen to birds, etc.) But it is important to have a large database with self-reflection prompts, otherwise, the prompts will only be repeated.
2	Good reflective prompts.	It led to reflective thoughts so it worked. One time we the web page did not reload when scanning the QR code, so I pushed the button: New Prompt.
3	Liked the prompts.	I liked the prompts. Where there different types of prompts? This was not really clear to me.
4	Would have liked more depth.	They were a bit superficial, could have more depth. But maybe I was just unlucky in the questions I got.
5	Liked the questions.	The questions were nice, I raised my awareness about myself and my environment.
6	Liked the variety, but the order could be different.	It was nice that the prompts were different. But the order could be different I think: pay attention to surroundings and action could be in the beginning and the deeper question later on. So there will be a build-up.
7	Liked variation.	Some questions were hard to answers. Only deep questions will be difficult, so variation is nice.
8	Liked variation.	Nice to have a variety in the types of self-reflection. I liked the deep questions especially. And it was nice when questions are still interpretable.
9	Liked variation.	The variety is nice. I had to think really good. I had to stand still and listen, this could be nice, but someone walked past me so this was difficult.

10	Liked the deeper questions.	Deeper questions are nice. I prefer the more deeper questions.

No.	Question 4c. What did you think was the goal of this self-reflection walking route?	
	Conclusions	**Answers**
1	*	*
2	*	*
3	*	*
4	*	*
5	Self-reflection.	I think it was the goal to feel more, here and now.
6	Physical activity outside.	I think the goal was to get people out of their houses. Because when you want to walk this route you have a goal to go outside and to walk and move.
7	*	*
8	Self-reflection and connection with nature.	I thought this walk was about thinking about life. I think the goal was to connect more with nature, to reflect on the inside but also the outside
9	Self-reflection.	I think the goal is to let you think about yourself and about what you want and to find peace.
10	Self-reflection.	I think the goal is to think about yourself.

* Researcher forgot to ask this question to participants 1,2,3,4,7.

No.	Question 5. Did the self-reflection walk spark your interest in self-reflection techniques, and why?	
	Conclusions	**Answers**
1	**Yes**, peer connection and walking are important.	Yes, it did. The combination of walking this route with a friend is amazing. The connection with someone is important to me.
2	**Yes**, peer connection, self-reflection and walking are important.	Yes, for me it did. I have the feeling I would like to use this web page with prompts more often when walking with friends, also at another location.
3	**No**, **but** maybe after improvements.	No, for me, the short time (the short distance between the signs) to discuss the prompts prevented me from this. But maybe if this would be fixed.
4	**No, but** I liked the self-reflection while walking.	Hmm not really, but I like reflecting on things while walking.
5	**Yes**, peer connection and walking are important.	Yes, but mainly in this walking route. I am not sure whether I want to use self-reflection later on. But I would like to walk this route again with friends.
6	**Yes**, the self-reflection, the scenery, and walking are important.	Yes, I found the self-reflection interesting. I would walk more if I knew this route was really available. It was nice to feel peaceful after walking through the forest.
7	**Yes**, the self-reflection, the scenery, and walking are important.	Yes, I did not practice self-reflection before but it was nice. It was also nice to walk in the peaceful forest.

8	**Yes**, the self-reflection and the scenery are important.	Yes, it sparked my interest in self-reflection. The scenery was really important factor for me. Walking the route made me feel calm, the view was good and it was nice to see the route be along the water.
9	**Yes**, the self-reflection and walking are important.	Yes, I would walk again to discover new prompts. I liked to walk. But I will not use it again in my personal life I think, not outside this walking route.
10	**Yes**, walking is important.	Yes, I would like to walk the route in the lunch break of the UT. I like to walk.

No.	**Question 6a. Do you think this self-reflection walk could be part of a bigger self-reflection system, and why?**	
	Conclusions	**Answers**
1	**Yes**, but main power in this route.	Yes, I would understand this walk is like a stepping stone to something bigger, including self-reflection. But I think most of the power of this system is included in the walk itself. Word of mouth will be very powerful in attracting people to this walking route, because everyone can just do this walk in their break.
2	**Yes**, **but** only for the web page.	Not really, but I want to use this web page more often. So this was a nice introduction to the web page with self-reflection.
3	**No**, the main power is in this route.	This route is an ideal situation. The route is beautiful, so the environment helps in making the reflection topics lighter to talk about.
4	**Yes**.	Yes, maybe as an introduction to an application or as part of a walking routine where you always use prompts to think about yourself.
5	**Yes**.	Yes.
6	**Yes**.	Yes.
7	**Yes**.	Yes.
8	**Yes**, want more information.	Yes, I would like some more information about self-reflection than this walking route provides.
9	**Yes**, want more information.	Yes, I would like some additional information.
10	**Yes**.	Yes.

No.	**Question 6b. Examples of such bigger systems could be: an application that offers the possibility to practice self-reflection daily; an option to enter your email after the walk to receive more information about the techniques encountered during the walk; using the web page at a different walking route. What do you think about these examples?**	
	Conclusions	**Answers**
1	**Yes**, application. **No**, email. **Yes**, web page.	A sign at the end of the route could direct to such application, yes I think that could work. I would personally not use the email option, that would be something I do not look at after the walk. A web page would be nice to use somewhere.
2	**Maybe**, application. **No**, email. **Yes**, web page.	The application could be, but only if it is like this web page. Email not. I would like to use the web page at another location when I go and walk with a friend!
3	**No**, application. **No**, email.	I would say this route should be your main goal because this walking route has the most potential to reach a lot of people. Application is

	No, web page.	maybe an option, but not for me. Also email and web page is not for me I think. But difficult to say when you cannot show examples.
4	**Maybe**, application. **Yes**, email. **Yes**, web page.	All three are good, but be careful that it does not become yet another app.
5	**Yes**, application. **No**, email. **Yes**, web page.	I am not sure about the email, but the web page or application is nice.
6	**Maybe**, application. **Yes**, email. **Maybe**, web page.	I would be interested in an informative email about self-reflection. I am not sure about an application, I need more information about this application to say something about it. The web page was nice, but not sure if I would use it somewhere else.
7	**No**, application. **No**, email. **No**, web page.	Yes, but for me, I would not use an application, then I have to download it. I would not read an email. This walking route makes self-reflection accessible, during this walk the web page is nice.
8	**Yes**, application. **Yes**, email. **Yes**, web page.	Yes, I would like an email, would be nice to receive some information about techniques in my email. Yes, an application would be nice: it should direct to different routes in Enschede. Using the web page during walking a different route would be nice.
9	**Maybe**, application. **Maybe**, email. **Yes**, web page.	Yes, I would like an email, but I could of course also forget it or not read it. The application sounds interesting, but I would not use it daily. Once in a few days maybe. I would like to use the web page tho on a different route. To talk deeper with someone.
10	**Maybe**, application. **Maybe**, email. **No**, web page.	Email maybe, I don't know if I would read it. Application, maybe I would use it. I would install it and try it after the walking route. Web page, I would not use it elsewhere, here the poster and the signs are a nice way to remember this walking route

No.	**Question 7. How would you improve the self-reflection walk?**	
	Conclusions	**Answers**
1	Improvements: upgrade signs, longer route	The signs must be waterproof. The walking distance between the two signs is too short. If you walk with two people, only one person had the time to talk about the prompt. The total distance of the walk is also short. 10 minutes longer would be better.
2	Improvements: delete signs, poster unclear add arrow, increase distance between signs	I do not need the signs, there were too close to each other. Only the web page is cool. I will also use the application in a different forest. The start sign of the reflection walk was a bit confusing to me. Maybe an arrow could be added to give the right direction.
3	Improvements: longer route, increase distance between signs	The time between the signs was too short. I wanted to think and discuss longer about the prompts and questions. But it could be about us, we both like to talk a lot and long. 25/30 minutes would be better. The route could be extended to the forest north of the campus (start at the pyramids from the Witbreuksweg.
4	Improvements: scanning the QR-code, do not repeat prompts	It was a little bit uncomfortable to scan the QR code every time again, as the page was still open: would be better if a button to open the scanner was also added. Furthermore, checking the prompts you had so they do not appear again.

5	Improvements: placement QR-codes, longer route	I would just place the signs with QR-codes all over the campus. Then you can decide the route you walk yourself. I would have liked a longer walking route, something like 20 minutes. Sometimes the new sign worked contradictory and ended the nice conversation we were having.
6	Improvements: longer route, increase distance between signs, difference walking alone or together	The route was a bit short, and also the distance between the signs was a bit too short. Make the route longer, 20 minutes. There could be made a difference in prompts for walking alone or walking together. Walking alone could be more about the environment, scenery, and doing activities. Walking together could be more about asking reflective questions.
7	Improvements: longer route, not crossing a road in the route	Making the route longer, about 30 minutes. The distance between the signs is right. When you scan a new sign, you forget about the previous sign. The route was nice. Only crossing the road was confusing. Maybe crayons could be used to direct you to the next part of the route.
8	No improvements	I would like to see more of the questions and more prompts. 10 minutes is fine, over 15 minutes will be too much. the distance between the signs is good.
9	Improvements: longer route, not next to car road, increase distance between signs when walking together	A longer route would be nice, and the route should not be next to a car road. Would be nice to have a longer walking route, between 20 and 30 minutes. Distance between the signs was okay, but when walking together, it might be too short.
10	Improvements: not crossing a road, longer route	Not having to cross a road. The route could be longer, 20 minutes or so, and the distance between the signs is all right.

No.	**Question 8. Do you have additional comments?** **Answers**
1	The first QR code did not work well. The route is so beautiful, with no cars and only nature. I really like this walking route.
2	No.
3	Maybe get rid of the signs and just give the QR code at the start of the walk. Then people can get a new prompt when they are ready for it.
4	Give the users the possibility to add new prompts. Of course, this should be moderated.
5	It will be a different experience walking alone or walking together.
6	Can we answer some more prompts on the way back?”
7	It would be nice to make an option to use the web page elsewhere, for example with countdown intervals.
8	The layout of the last sign should be different. I would like to use the web page somewhere else.
9	No.
10	No.

I-5: Expert interview

Question 1. What was your overall impression of the self-reflection walk?
I liked de walking route, it made me feel relaxed. The scenery was important during the walk. The calming route was nice. Pay attention to the ‘eikenprocessierups’.

Question 2. Would you walk the self-reflection walking route again, and why and when?
I would walk the route again, but if the route stays the same it will possibly not be that interesting for me anymore after a few walks. I liked walking the route alone, but I would also walk it together with someone.

Question 3. Did the provided instructions suffice to walk the reflection route autonomously?
The start point of the route is difficult to find. The poster and the signs are clear. Only the last sign was a bit hidden, but eventually, I found it.

Question 4a. Do you practice self-reflection more often in your personal life?
I do not practice self-reflection often, and not regularly. Sometimes mindfulness.

Question 4b. What did you think about the self-reflection prompts?
The prompts were nice. The second prompt I got (informative prompt) was most difficult to understand, but this was also the most valuable prompt. I would not give the option to choose from the four different techniques at the start of the route (so only one type of prompt/question during the walk). An average person does not have a clear idea about the contents of reflective questions and the other prompts. When a person would walk the route for the first time, it is a good thing to introduce them to all the different types. There could be made a different option in the web page between walking the route for the first time, and another walk.

Question 5. Did the self-reflection walk spark your interest in self-reflection techniques, and why?
Yes, it sparked interest, because I do not practice self-reflection often. But this self-reflection walking route leads to positive feelings about self-reflection, and additionally, it made me feel calm.

Question 6a. Do you think this self-reflection walk could be part of a bigger self-reflection system, and why?
Maybe, this should be tested.

Question 6b. Examples of such bigger systems could be: an application that offers the possibility to practice self-reflection daily; an option to enter your email after the walk to receive more information about the techniques encountered during the walk; using the web page at a different walking route. What do you think about these examples?
I would not use the web page in another route. The signs are nice, they remember me to scan them. Because of the signs, you can walk the route more passively. And email would maybe an option, after a week, to remember me about the self-reflection route. The application would be possibly an option. Would be nice to have a very positive Duolingo-like self-reflection application.

Question 7. How would you improve the self-reflection walk?
Add color codes to the signs: one color for walking solo and one color for walking together. People who will walk together might need a double amount of time to discuss the prompts and questions. Will other people then campus people get QR codes? maybe they do not understand.

Question 8. Do you have additional comments?
A limitation could be the interest of beta people. Maybe they need a lot more time to think about a self-reflection prompt. Or they will answer too fast. Do not place the name of the types of prompts next to the prompt. The attention of the walker will be deduced from the prompt/question. A route suggestion: the route behind the horst. A tip for your thesis: write discussion topics while writing the other chapters.