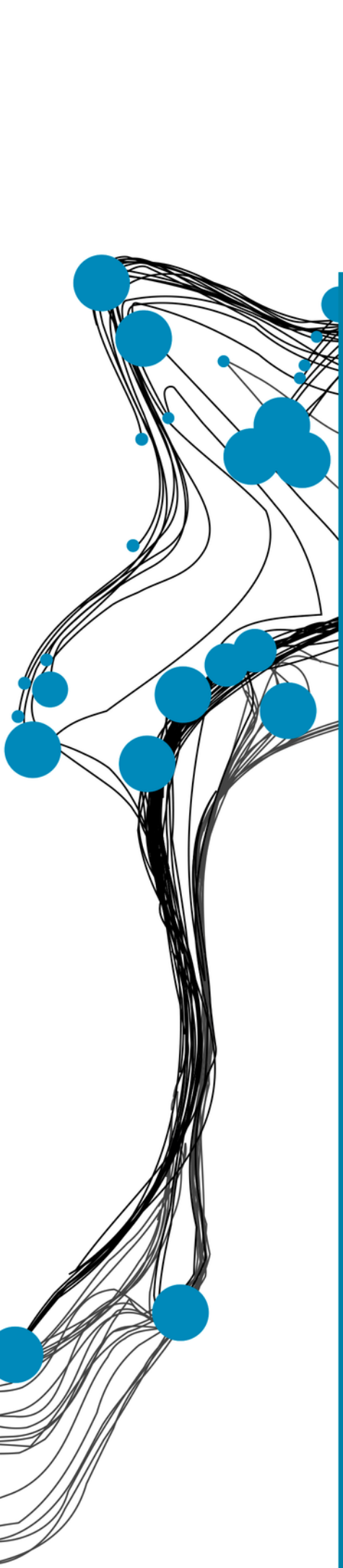

Lifestyle Counselling of People with Type 2 Diabetes and Low Health Literacy

Floor Lieverse

Bachelor Thesis,
Creative Technology

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Abstract

In The Netherlands, 1.2 million people suffer from diabetes mellitus, with nine out of ten suffering from type 2 diabetes mellitus (DM2). To reduce this disease's side effects, a healthy lifestyle is essential. Therefore, supporting lifestyle self-management programs are being developed. However, not all of these programs are understandable for everyone. In The Netherlands, one out of four has low health literacy, meaning they struggle to access, comprehend, and implement health-related information. Consequently, they face challenges in controlling their blood glucose levels. This thesis tries to tackle this problem by answering the following research question: *"How can a communication method be designed for a lifestyle self-management program for people who suffer from type 2 diabetes with low health literacy?"*.

To answer this question, background research, including literature research, state of the art and field research was conducted to gain an understanding of the problem. Thereafter, the Creative Technology Design Process, consisting of four phases, was followed in combination with a participatory design approach. In the ideation phase, a stakeholder analysis was conducted and the final concept was selected based on the results of the concept generation and a focus group. In the specification phase, functional and non-functional requirements were formulated. Additionally, the interaction and experience were investigated using an interaction diagram, personas and a design scenario. Also, behaviour change techniques (BCTs) were used to specify the content. In the realisation phase, the prototype was realised and an intermediate evaluation of the concept was conducted with three experts and a participant with low health literacy. Finally, the evaluation phase involved assessing the prototype's functionality and usability through tasks, questionnaires, and interviews with two participants with low health literacy and an expert.

Based on the four phases and inputs of experts and participants 'Het DiaBoek' was developed to initiate new behaviour regarding lifestyle, amongst people with DM2 and low health literacy. 'Het DiaBoek' is an interactive audiobook, which can read its contents out loud. These contents are designed by following communication strategies and address multiple aspects of DM2 and the importance of a healthy lifestyle. The final evaluation shows an overall positive response, with participants and experts acknowledging that the prototype is well-tailored to the needs of people with low health literacy. There is an overall consensus that the book is clear and easily understandable. However, there is still room for refinements. Future work could investigate improvements for the case (e.g., repositioning the buttons). Furthermore, it seems essential to conduct a longitudinal study with more participants who suffer from DM2 with low health literacy, to obtain more representative results.

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Chapter 1

Introduction

Diabetes is a chronic disease that has been around for over 3000 years. [1]. However, recently it is one of the most common chronic illnesses. Globally, in 2019 in total, 463 million people suffered from diabetes [2]. It is expected that the prevalence of diabetes will increase to 578 million people in 2030 and to 700 million people in 2045 [2]. From the total number of diabetes patients in 2019, 90 - 95% of them suffered from DM2 [3].

According to the Dutch DiabetesFonds, this illness is also prominent in The Netherlands. 1.2 million people suffer from diabetes in The Netherlands [4]. Nine out of ten people that suffer from diabetes suffer from DM2 [4]. DM2 is a combination of the malfunction of the hormone insulin and insulin resistance [5]. Insulin is the hormone that regulates the blood sugar level. Due to the malfunctioning of this hormone, too much sugar remains in one's blood, which causes physical complications like fatigue and reoccurring infections. When experiencing insulin resistance, cells in the human body are less sensitive to the hormone insulin. This insensitivity results in an elevated blood sugar level [6]. Physical complications that can occur with this phenomenon are loss of vision, dry mouth and fatigue in the short term. In the long term, this includes issues with both the vascular and nervous systems.

To reduce the effects of DM2, glycaemic control is necessary. Glycaemic control is defined as the control of blood glucose levels, which should be within a certain range for patients to minimize suffering from diabetes-related complications. Self-management activities are crucial for glycaemic control and thus also in the treatment of this disease [7]. There is no universal definition for self-management. However, Barlow et al. [7] define self-management as one's ability to manage symptoms, treatment, physical and psycho-social consequences and lifestyle changes when living with a chronic disease.

Self-management activities can entail many actions for DM2, like medication self-management and lifestyle self-management. Lifestyle plays an essential role in the management of DM2. Unhealthy dietary habits in combination with minimal physical exercise, can cause a distortion in the regulation of blood glucose levels [8]. Also, extreme stress and minimal sleep contribute to this effect. Therefore, it is crucial for DM2 patients to obtain and maintain a healthy lifestyle [8]. Nonetheless, many DM2 patients struggle to obtain and maintain this recommended healthy

lifestyle.

Luckily, there are supporting lifestyle self-management programs to obtain and maintain this healthy lifestyle. An example of such a program is the Beyond Good Intentions (BGI) educational program [9]. The program focuses on initiating and maintaining self-management activities [9]. Since digital technologies are prominent nowadays, digital lifestyle self-management programs are also upcoming. An example of a digital self-management program is the mobile application Diameter. This app provides insights into the user's movement, nutritional values and glucose values. The app teaches the users how lifestyle influences their glucose levels.

However, some of these lifestyle self-management programs do not fit the needs of all the users. In The Netherlands, 2.5 million people are illiterate [10]. Furthermore, in The Netherlands, one out of four has low health literacy [10]. Health literacy is defined as the capacity to obtain, process and understand information regarding one's health and the ability to make appropriate health decisions [11]. Generally, low health literacy is related to poor health outcomes and poor health decisions [11]. These findings also apply to people with low health literacy and DM2. Research indicates that people with low health literacy struggle with managing their diabetes and they are less successful in glycaemic control [12].

The aforementioned mentioned research, illustrates that to improve health outcomes and encourage a healthy lifestyle among people with DM2 and low health literacy, more accessible programs with easy-to-understand content are crucial. However, currently, there is a shortfall in lifestyle self-management programs that are specifically targeted at addressing this issue. Therefore, the purpose of this study is to tackle this challenge and develop an interactive and suitable communication method for a lifestyle self-management program which fits the needs of people with DM2 and low health literacy. For this project, there is a focus on lifestyle self-management, including nutrition and physical activity.

1.1 Research Questions

Based on the section above the following research question is formulated:

> *How can a communication method be designed for a lifestyle self-management program for people who suffer from type 2 diabetes with low health literacy?*

To answer this research question three sub-research questions are formulated:

- What lifestyle programs already exist that meet the needs and requirements of DM2 patients with low health literacy?
- Which delivery mode can be used in DM2 lifestyle self-management programs?
- To what extent is the designed prototype useful for people with DM2 and low health literacy to teach them about diabetes lifestyle self-management?

The first sub-research question is aimed at gaining knowledge about the existing lifestyle self-management programs. The second sub-research question is aimed at getting more insight into possible technologies that can play a role in the design of a lifestyle self-management program. The final sub-research question is aimed at evaluating the designed lifestyle program.

1.2 Outline

This report consists of nine chapters. Chapter 2 focuses more thoroughly on the background research. This includes literature research, state of the art and field research. The third chapter discusses the methods and techniques that were used during the design process. Next, Chapter 4 describes the ideation phase and the concept generation. Chapter 5 presents the final concept and it elaborately specifies this concept. Thereafter, Chapter 6 elaborates on the realization of this concept and how it has been created. Subsequently, Chapter 7 evaluates the designed product by means of a functional and usability evaluation. Chapter 8 discusses the research as a whole, including the strengths and limitations and future recommendations. Finally, Chapter 9 provides a conclusion to this research.

Chapter 2

Background Research

As a first step in the design process, a better understanding of the described problem is necessary. This background research aims at getting a better understanding of the problem and answering the first sub-research question: *"What lifestyle programs already exist that meet the needs and requirements of DM2 patients with low health literacy?"*. To answer this question, the first section summarises the findings of the literature research, which discusses the role of low health literacy in DM2. The next section addresses the state of the art of DM2 lifestyle self-management programs. The third section discusses insights from a previously conducted field study of Saxion students, who have conducted interviews with experts and patients. This section codes these results and discusses the findings. Finally, the last section provides an answer to the sub-research question formulated at the beginning of this chapter. Additionally, the conclusion formulates preliminary requirements for the design of a communication method for a lifestyle self-management program.

2.1 Literature Research

This section discusses the conducted literature research, which first identifies the role of self-management activities in DM2. Thereafter, this section defines low health literacy and discusses the consequences of low health literacy for DM2 patients. Finally, this section addresses the mobile application Diameter, on which this research is based.

2.1.1 DM2 and Self-Management

DM2 is caused by two factors. The first factor is the malfunctioning of insulin. Insulin is the hormone which regulates the blood sugars, also called glucose, in the human body. When one suffers from DM2, the hormone insulin is 'invisible' to the body, which causes distorted values for the blood sugars in the body [13]. The second factor is insulin resistance, in which the cells of the body do not respond properly to the insulin [5]. Ultimately, this leads to too much blood sugar in the blood. Due to these two factors, physical complications occur which include reoccurring wounds, infections, a deteriorating vision, fatigue and many more [14].

Several factors can contribute to the development of DM2. One of the most important causes of DM2 is genes; DM2 is hereditary. For example, it is known that for Asian Americans as well as Native Hawaiians this disease is more common in their families and bloodlines [15]. Another important and common cause of DM2 is an unhealthy lifestyle [15]. Being overweight and physically inactive are two important risk factors for this disease. Insulin resistance is common among people with obesity. Insulin resistance can lead to DM2 or prediabetes [15]. Also, the location of the fat plays a role in DM2. Belly fat, for example, is linked to insulin resistance and therefore also a risk for DM2. Other factors such as dietary habits, physical activity, stress and sleep all influence DM2 [8].

To reduce the side effects of these conditions glycaemic control is necessary. Glycaemic control is the optimal value of glucose in the blood of DM2 patients, and the ultimate goal for the patients is to have these values within a specific range. [16]. According to Fransen et al. self-management activities are essential for glycaemic control and also for the treatment of this illness [7].

According to Fransen et al., there is no universally agreed-upon definition for self-management [7]. However, Barlow et al. do use a definition for this term; the patient's ability to cope with a chronic disease and manage the symptoms, the physical and the psycho-social consequences that this chronic illness exposes them to [17]. In more recent research Fransen et al. agree with Barlow's definition [12]. Visscher et al. do not provide a definition of self-management, but they do state that there are two types of self-management. The first type of self-management activities focuses on lifestyle. The second type of self-management focuses on medication [18]. Taking the importance of lifestyle management for DM2 into account, this graduation project focuses on lifestyle self-management activities, specifically, activities regarding nutrition and physical activity.

2.1.2 Literacy

The National Centre for Education Statistics defines literacy as the degree to which individuals can use written information to fully function in society, to develop themselves and to achieve one's goals [19]. According to Nutbeam, there are three different types of literacy [20]. (1) Basic/functional literacy which refers to basic reading and writing skills to be able to function in ordinary situations. (2) Communicative/interactive literacy refers to more developed and advanced literary skills, which can be used to retrieve information from different media. One should also be able to apply the retrieved information in particular situations. (3) Critical literacy is the most advanced type of literacy. This type of literacy refers to the skill of critically analysing retrieved information and using this information in more complex situations [20]. To manage DM2 properly, at least the first two types of literacy are necessary and preferably the third type as well. Furthermore, there are different aspects one can be (il)literate on, like digital literacy, research literacy and health literacy.

Health Literacy

Individual health literacy is defined as the degree to which one can find, understand and use information to make health-related decisions for themselves and others [21]. Fransen et al. have based their definition of health literacy on the Institute of Medicine (IOM), which states the following; health literacy is defined as the degree to one's ability to obtain, process and understand information necessary to make appropriate health decisions [7]. Caruso et al. [22] their definition is broadly similar to a combination of both definitions. According to Caruso et al., health literacy is an essential element in the successful management of a chronic illness with positive health outcomes and a high quality of life [22].

Health Literacy in Diabetes Self-Management

According to Visscher et al. patients with low health literacy face problems with understanding provided information and implementing this information [18]. Visscher et al. state that people with low health literacy have trouble correctly understanding the information that is provided on prescription medication labels. Furthermore, Fransen et al. present that these people usually have less knowledge about their illness, they have less knowledge about self-management activities and generally, their health is poor. This leads to an ultimate statement that people with low health literacy are less likely to manage their chronic disease [7].

There are different aspects of health literacy: personal health literacy, organisational health literacy, and digital health literacy [23]. This graduation project mainly focuses on personal health literacy.

When looking at low health literacy in combination with DM2, Visscher et al. claim that low health literacy is relatively common for DM2 patients [18]. Research indicated that low health literacy is associated with low diabetes knowledge [24]. Other research indicates that low diabetes knowledge affects glycaemic control since this is related to diabetes knowledge and self-management activities [22]. Based on this, it can be stated that there is a relationship between low health literacy and the ability to self-manage DM2.

2.1.3 Communicating with People with DM2 and Low Heath Literacy

Even though lifestyle self-management programs are essential in the treatment of diabetes, not all lifestyle self-management programs are tailored to the needs of people with low health literacy. On the contrary, Visscher et al. state that most interventions are too difficult to comprehend for people with low health literacy [18]. Nonetheless, it is not known how self-management programs can be made better suited for DM2 patients with low health literacy. Therefore, it is important to understand effective communication strategies for people with low health literacy. This section discusses communication strategies for both written and oral communication.

Written Communication

Nowadays, written communication is an essential method to communicate effectively with people. Written communication is defined as an exchange of messages between two persons which makes use of written words [25]. Examples of written texts include e-mails, printed letters, text messages, websites and blog posts. This type of communication can also be used to communicate with patients. To communicate with patients different types of texts can be used, like printed flyers and website articles. However, most written texts are incomprehensible for people with low health literacy. Therefore, there are a few aspects of written communication that can be utilised to enhance effective communication with people with low health literacy.

One of these strategies is the usage of plain language [26], [27]. Plain language is similar to simplified language. According to Osborn et al. this means that medical jargon is removed from the text and replaced by colloquial language, which includes the use of more simple terms and words [26]. Kountz acknowledges this statement and even provides some examples for healthcare professionals to implement [28]. For example, instead of saying that DM2 is a chronic disease, one can say that DM2 is a disease that does not end. The word 'chronic', which can be difficult for people with low health literacy is replaced by a phrase that is used more frequently in colloquial language. Another example is replacing the term adverse effects with side effects. Also, the usage of short sentences that are not dense with information can make sentences more comprehensible for people with low health literacy [26].

Another recommendation to enhance communication with people with low health literacy is by organising ideas into units [26]. By organising similar ideas into units, the information is well-structured which is useful for people with low health literacy. Also, when information is provided about a process, this information should be well-structured and presented in the correct sequence. This helps people with low health literacy to better understand the subsequent information. In addition, when (a lot of) text is used, it is wise to divide the text into sections with headers and bullets. Using headers and bullets gives a better overview of the information and it makes the text less imposing, dense, overwhelming and cluttered [29].

Additionally, the inclusion of pictures makes written information more comprehensible [27], [28]. Given that the pictures are clear and have a clear caption, pictures can be very useful to illustrate the text next to them, making it easier for patients to understand the text. Research executed by Park and Zuniga illustrates this principle and states that pictures can be very useful for health education for people with low health literacy [30].

Finally, when handing out printed written information, the healthcare professional can underline key points in the handout [27]. Schwartzberg et al. have stated that printed information is an effective way of communicating with people with low health literacy. By underlining key points, the most important and essential information is highlighted. If they want to look back at it later, it still shows the most important information.

Oral Communication

Next to written communication, oral communication is used to communicate with others. Oral communication is defined as the process of conveying information to others by word of mouth [31]. However, understanding conversations correctly with healthcare professionals can be challenging for people with low health literacy. Therefore, there are a few aspects that healthcare professionals can focus on to make the spoken text more understandable for these people.

One of these aspects, as was mentioned in the section above, is the usage of plain language [26], [27]. In this case, plain language also includes the tone and pace one speaks with. Plain language means using colloquial language, which people with low health literacy use on an everyday basis [26]. Osborn et al. provide some points of attention for plain-spoken language. For example, avoid using words that can have multiple interpretations, this issue arises with words such as 'could' and 'might'. Instead, use more clear words such as 'will' or 'will not'. Furthermore, they recommend avoiding the use of common words in uncommon ways. Also, paying attention to culture and being culturally sensitive is important according to Osborn et al. [26]. Moreover, the pace one uses when speaking is important. For people with low health literacy, it is better to lower the conversational pace. This allows people with low health literacy to have more time to absorb the provided information [28].

Another recommendation for effective oral communication is writing out and reading instructions out loud [27]. With this method, the healthcare professional writes out specific instructions that are important for the patient. After this, the healthcare professional can read the instructions out loud. This allows the patient to see the written text and to hear the written text being repeated, this can give them more time to process the information[27].

Additionally, the teach-back method is used more frequently in the last couple of years [26]. This method checks if the patients have correctly understood the explanation of the healthcare professional [32]. This is done by asking the patient to re-explain the explanation of the healthcare professional. The explanation of the patient, using their own words and phrases, indicates if the explanation of the healthcare professional was interpreted correctly [32].

Moreover, Kountz recommends creating a trustful environment for the patients that makes them feel safe [28]. This environment can only be created with the effort of an entire team, which starts at the moment someone enters the building. A safe atmosphere encourages patients to ask questions if they do not fully understand something [28]. In the end, if the patients dare to pose their questions, they benefit enormously from this, since they can ask to clarify something if this is necessary.

Finally, bringing family along to healthcare appointments can be very useful for patients [27], [33]. In general, people with low health literacy think it is difficult to ask questions [33]. Having a family member present at the appointment may comfort them. Furthermore, if the patient is not able to ask any questions, the family member can step in and ask the questions for them. Additionally, having a family member present also allows for more knowledge that can be gathered. This allows the patient to fall back on their family member after the appointment since

the family member can help them remember what was discussed [33].

2.1.4 Diameter

Diameter is a mobile lifestyle counselling application that is developed for people with DM2. The main objective of the application is to enable the users to self-manage their DM2 by making well-informed choices concerning their lifestyle [34]. The app tries to achieve this goal by keeping track of the user's information and providing personalised feedback. Since the Diameter is the base for this research project, research is done on this application. To showcase how the application looks, screenshots are displayed in *figure 2.1.*

Functionalities of the Application

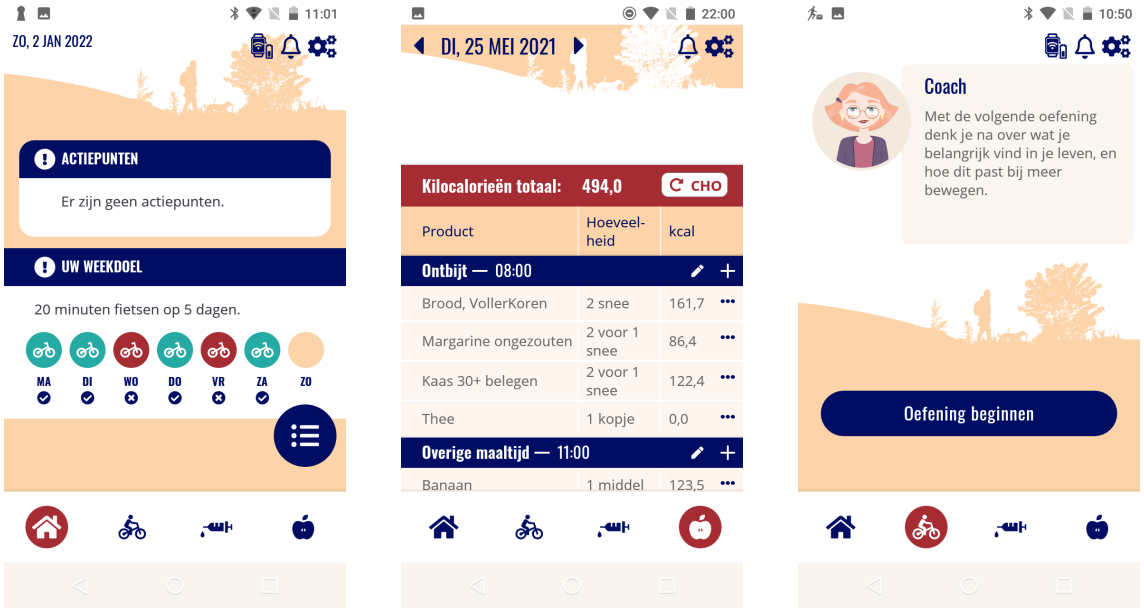
The app keeps track of three main aspects: glucose values, physical activity and food intake [35]. The app keeps track of the values of the blood sugars which can be measured by the use of an external sensor; the Freestyle Libre [36]. The values are updated every fifteen minutes, which gives interesting insights to the users. For physical activity, the external fitness watch FitBit [37] can be used to keep track of the step count. Other activities like cycling, can be filled in manually in the app. Lastly, the app contains a diary function to keep track of the food intake of the user. This nutrition diary is presented in *figure 2.1b.* With the insights on these three areas, the users get insights into their current habits and behaviour as well as learn how they can adjust their current habits to more healthy ones.

Furthermore, the app provides information and personal feedback, based on this the user can set personal goals [35]. A virtual coach is involved in discussing issues and tips regarding their behaviour. Twice a day a short message is sent to the user to advise them about their physical activity and food intake at that moment. This is visible in *figure 2.1c.* Furthermore, the app offers the user to make a weekly assignment with the virtual coach, which educates them about more healthy decisions and strategies to apply healthy habits in daily life. Finally, the user can set a personal weekly goal regarding physical activity or food intake. The application provides daily feedback on their progress towards achieving their goal.

Development of the Application

According to the developers of the app, the application has three unique aspects; it is theory-based, it is personal and it can be used for blended-care [35]. The theory-based application uses multiple behaviour change techniques. These techniques focus on three phases; the initiation phase to establish the intentions to create a healthy lifestyle, the action phase which is the actual behaviour to create the healthy lifestyle and the maintenance phase is about trying to maintain this lifestyle in the long term [38]. These behavioural aspects are implemented into the app by means of the app content. Furthermore, the app is personal, meaning that it gives personal feedback, tips and comments to each individual user. Finally, the app is created to use as blended care, meaning that it is supposed to be an addition

to regular diabetes care.



(a) Homepage (b) Food diary (c) Virtual coach

Figure 2.1: Screenshots of the Diameter

2.1.5 Preliminary Conclusion

Based on this literature research, it can be stated that a possible definition for self-management is one's ability to cope with a chronic disease and manage the symptoms, physical and psycho-social consequences that this chronic illness exposes them to. Lifestyle self-management activities are essential in the treatment of DM2. However, many lifestyle self-management programs are not tailored to the needs of people with low health literacy. People with low health literacy in general are less likely to successfully manage DM2. Therefore, it is important to communicate effectively with these people. For written communication the following suggestions are made in the literature to communicate effectively; use plain language, organise the main ideas in the text into units to make the text more well-structured, use appropriate pictures to illustrate the text and underline important information. For oral communication other suggestions were made; use plain text, write out and read the instructions out loud, use the teach-back method, create a trustful environment for the patients and involve a patient's family in their appointments with healthcare professionals. Finally, Diameter is a mobile application to track the lifestyle habits of users and gives personalised feedback based on the data.

2.2 State of the Art

There exist quite some tools that can help with the self-management of DM2. This section addresses the current state of the art of diabetes lifestyle self-management tools. For this state of the art three tools are included. The tools that are included address issues regarding DM2. The tools try to support the users in some way, but all in different manners. Also, literacy is taken into consideration for the selected programs.

2.2.1 NDF Toolkit

The NDF Toolkit is developed to provide healthcare providers with support and information about how to approach conversations about diabetes with patients. The toolkit is supposed to be a guideline for topics that can be discussed during appointments with their patients. Developed by the Nederlandse Diabetes Federatie (NDF) the kit is fully called the NDF Toolkit Person-Oriented Diabetes Care and Prevention, but in short, is referred to as the NDF Toolkit.

The toolkit consists of multiple rubrics that are related to diabetes. Some examples of rubrics are: 'My yearly diabetes check up', 'My check up about lifestyle', 'Diabetes and Ramadan' and 'Refresher courses and videos' [39]. All of these rubrics are developed by a group of experts, including Pharos, Amsterdam UMC and Wageningen University and Research.

In addition to this toolkit NDF also developed PratenPlaten. This is a map that can support healthcare providers while educating patients about DM2 [40]. PratenPlaten is specially developed for immigrant patients and patients with low health literacy.

My Yearly Diabetes Check Up

One of the rubrics of the NDF toolkit is called 'My yearly diabetes check up', this rubric consists of a series of communication methods [41]. The rubric includes a waiting room poster, a conversation card and a consulting room card. These three items are all designed in the same recognisable style with visual aspects to make them more understandable for patients.

The conversation card is meant to be sent to patients before the appointment. On the card, twenty-four subjects are presented by means of drawings. A picture of one side of the conversation card is shown in *figure 2.2*. The subjects are chosen in such a way that they can easily guide both the patients as well as the healthcare provider through the conversation. The patient is supposed to take a look at the card before the appointment, so they can already indicate subjects that they want to discuss during their consultation. Additionally, there are some questions on the cards that are supposed to trigger the patient to already think about these topics before their appointment.

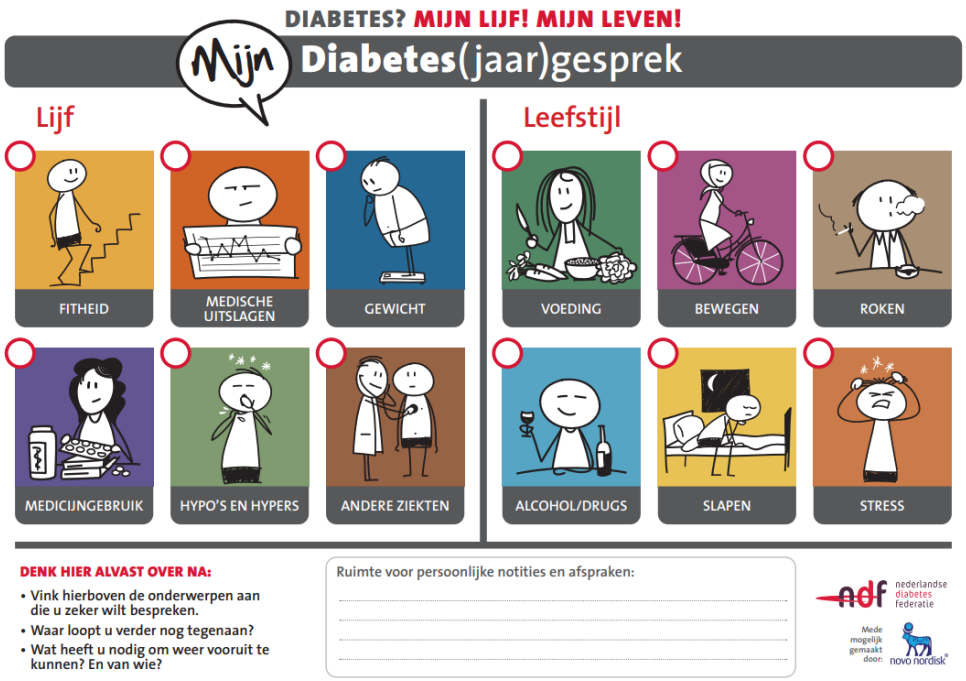


Figure 2.2: Conversation card

The waiting room poster is intended to be hung up in the waiting room. On this poster, the twenty-four subjects are displayed again, to remind the patients of the subjects that they have already seen on their conversation card [41]. The developers of the kit think that this triggers the patients to think about their own conversation card that they filled in, it encourages them to come in the right head space. Furthermore, the layout and visual aspects are similar to the conversation card, in this way, it creates an entity of items. The poster is displayed in *figure 2.3*.

The last aspect of this rubric is the consulting room card. The healthcare provider is supposed to position this card on the table as the patients walk in [41]. The card is supposed to remind the patient of the conversation card that they read and filled in. The consulting room card is similar in layout to the conversation card, however, it does have some open-ended questions added to it. These questions are meant to encourage the patient to think and it provides guidance through the conversation with the healthcare provider. The card helps in such a way that the most important issues and aspects for the patients are discussed. Additionally, it can also help to make the patient aware of several aspects of DM2.

PratenPlaten

PratenPlaten is aimed at supporting healthcare providers during DM2 checkups with patients. The PratenPlaten provides substance to conversations with patients. As already briefly mentioned, this tool was developed for immigrant patients and patients with low health literacy. Therefore, the tool uses simple and plain language and visual support. This enhances effective communication with the patients.

Figure 2.3: Waiting room poster

PratenPlaten consists of five chapters, which each tackle different aspects of DM2. The first chapter is about what diabetes is. A picture of one of the pages of this chapter is displayed in *figure 2.4*. Furthermore, the second chapter is about medication for diabetes. The third chapter is about creating a healthy lifestyle. Additionally, more information about nutrition is provided in chapter four. Finally, in chapter five meals are discussed. Turkish, Moroccan, Hindi and Dutch meals are discussed to make it as personalised as possible [42].

1.2 **Wat is diabetes?** - Risico's op diabetes

Sommige mensen krijgen wel diabetes en andere mensen niet.

De volgende risico's spelen een rol bij het krijgen diabetes:
1. Lengte en gewicht
U hebt meer kans om diabetes te krijgen als u te dik bent

2. Buikomvang
Het vet rond uw buik zegt ook iets over de kans op diabetes.
Bij meer vet heeft u meer kans op diabetes

3. Beweging
Als u te weinig beweegt per dag, heeft u meer kans op diabetes

4. Hoge bloeddruk
Als u een te hoge bloeddruk hebt, heeft u meer kans op klachten van uw diabetes.
Daarom is de combinatie van diabetes en hoge bloeddruk gevaarlijk

Aan deze vier risico's kunt u zelf iets doen. Dit is belangrijk als u nog geen diabetes heeft, maar óók als u wel diabetes heeft!

Aan de volgende risico's kunt u zelf niets doen:
5. Leeftijd
Hoe ouder u bent, hoe meer kans op diabetes u heeft

6. Erfelijkheid
Als diabetes in uw familie zit, dan heeft u ook meer kans om diabetes te krijgen.
Bijvoorbeeld als uw moeder en broer ook diabetes hebben

7. Zwangerschapsdiabetes of verhoging van glucose tijdens ziekte
Als u al eerder tijdens een zwangerschap teveel suiker in het bloed had, heeft u meer kans op diabetes

PratenPlaten over diabetes

Figure 2.4: PratenPlaten chapter 1, What is diabetes?

2.2.2 PRIDE Toolkit

The Partnership to Improve Diabetes Education (PRIDE) Toolkit, is developed to support and guide diabetes educators in their explanations. The toolkit consists of 30 low health literacy education modules.

Functionalities of the Modules

The modules of the toolkit are divided into twelve groups; general information about DM2, blood glucose monitoring, nutrition information, oral DM2 medication, insulin and exenatide (injectable DM2 medication), lifestyle management and behaviour change, foot care, cardiovascular risk factors, coping with stress and depression, oral health, women's health and men's health [43]. According to Wolff et al., these are the most important topics that should be discussed.

Despite the fact that each module tackles different subjects, all the modules have the same structure. First, the module starts with a title page that poses a question to the users. To illustrate, the module about blood pressure is called "Why should I care about blood pressure?" [43]. Wolff et al. state that this will engage the users more. In *figure 2.5* an example of a title and problem description is displayed. Thereafter, the module focuses on explaining and defining essential terms that are relevant to the theme of the module. This is followed by mentioning specific behaviour that helps regulate the issue. The final page of the module is used for shared goal setting. The users can write down their goal, which is followed by behavioural goals that can

help them to reach their goal [43]. The modules encourage communication between users and healthcare providers, for example by having a shared goal. An example of the shared goal-setting page is displayed in *figure 2.6*.

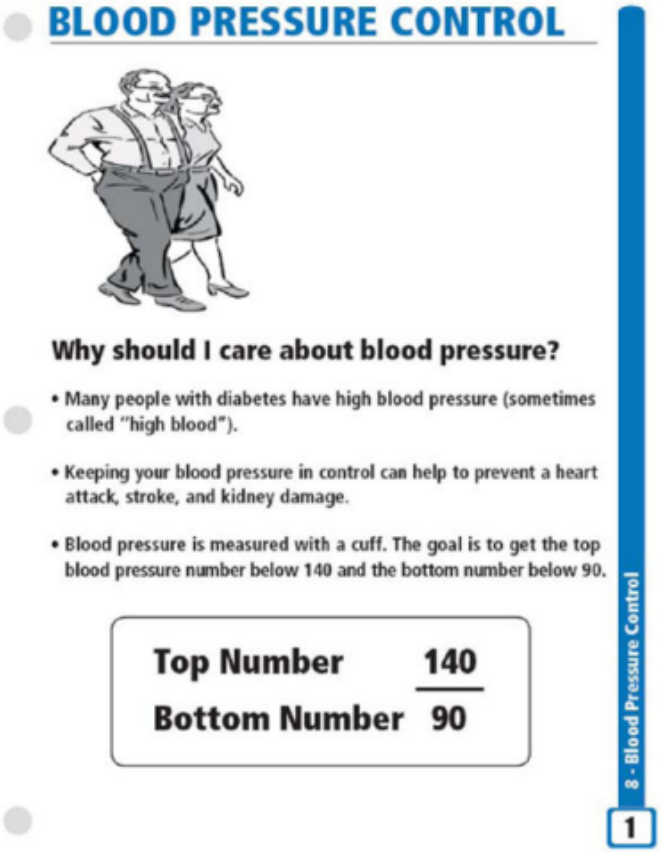


Figure 2.5: Title page and problem description blood pressure module

Low Health Literacy Guidelines

The modules were all designed by making use of the established literacy-based interventions. These interventions were suggested by the IOM and other literature [44]. By using plain language the developers of the kit try to convey the most important element of the modules. Furthermore, the developers used layout regulations, like using a lot of white space to avoid overwhelming the patients. "Simple line drawings" were used to clarify the text [43]. Additionally, traffic light colour codes were used and also icons to indicate the time of day [43]. Some of these aspects are presented in *figure 2.5* and *figure 2.6*.

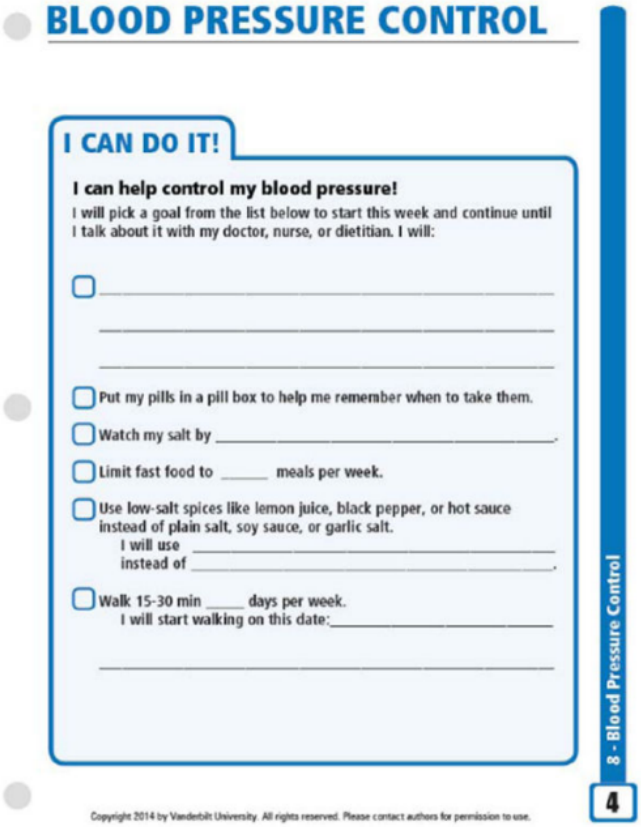


Figure 2.6: Shared goal setting page

2.2.3 Diabetes Island

Diabetes Island is a simulated three-dimensional (3D) world, aimed at educating users about DM2. The virtual world is created on the platform Second Life. Diabetes Island is a realistic type of world, in which users have an online presence and they can interact by means of avatars [45]. The avatars are virtual representations of the users. The users can interact with others and healthcare providers by means of text and voice chat.

Functionalities of the Virtual World

With their avatars, users can participate in ten educational sessions. Six sessions focus on topics related to nutrition and healthy dietary choices [45]. These six sessions are led by a real dietitian present as an avatar, who provides real-time feedback. To illustrate, the patient and the dietitian go to the supermarket together to do groceries. Together they read the packages of the food and together they make conscious healthy decisions. This interactive scenario is displayed in *figure 2.7*. Furthermore, there are two sessions about general information regarding DM2, which includes foot care. These sessions are led by a real diabetes educator present as an online avatar. Moreover, there is one session about physical activity led by

an exercise researcher present as an avatar. Finally, there is one more session about DM2 medication which is led by a pharmacist [45].

Despite the educational aspect of this program, there are also two entertaining aspects to keep users engaged. First of all, by attending the educational sessions and participating actively in these sessions, the users can earn points. With these points, they can buy new outfits and accessories in the shop [45]. Additionally, on a regular basis, social activities are organised in the virtual world, like parties, social gatherings and sports games. This is added to the virtual world, to motivate the patients to log in on the platform and make use of it on a regular basis [45].

Figure 2.7: Interactive scenario about reading labels of food products

Development of the Virtual World

To educate the patients effectively, professionals worked on the development of the platform, which they based on existing theories. The intervention was developed by a team consisting of an educator, physician, dietitian and psychologist. With the help of experts, the educational parts were realised into an actual platform. Additionally, the professionals used behaviour change techniques to achieve their goals. They specifically focused on the social cognitive theory, which guided their decisions throughout the process [46].

As mentioned above, Diabetes Island was developed on Second Life. This is an innovative platform, on which users can host their virtual worlds. Second Life makes use of advanced technologies which focus on social interactions as well as a unique real-life world weather system [47].

2.2.4 Comparison and Preliminary Conclusion

When comparing the three programs, a few aspects stand out. First, the PRIDE Toolkit and the NDF Toolkit specifically focus on low health literacy. Next, only Diabetes Island uses innovative digital technologies. Lastly, all the programs focus on educating the patients, while only Diabetes Island focuses on implementing the attained knowledge in real life.

First, both the PRIDE Toolkit and the NDF Toolkit make use of communication strategies aimed at people with low health literacy. The PRIDE toolkit was based

on and is the sequel to The Diabetes Literacy and Numeracy Education Toolkit (DLNET) [48]. The DLNET is developed using five communication strategies for communicating with people with low health literacy; (1) use simple language, (2) limit the information to the key points, (3) focus on the desired behaviour, (4) use pictures and (5) use colour codes [48]. As was mentioned in the section of the PRIDE Toolkit, this toolkit makes use of these guidelines [43]. This makes the toolkit accessible to people with low health literacy. When comparing these guidelines to the NDF Toolkit, this toolkit also used most of these recommended guidelines. The toolkit used visual aspects to make it easily comprehensible for the users. Furthermore, simple and plain language is used in the toolkit. On the other hand, Diabetes Island does not necessarily pay attention to this specific group of people with low health literacy[45]. Since this program does not focus on this, the program is not as effective for people with low health literacy [49]. Therefore, it can be concluded that including low health literacy communication strategies is essential.

Secondly, only Diabetes Island uses digital technologies. Diabetes Island is a virtual world, that is hosted on Second Life [45], an innovative platform on which users can host their virtual worlds [47]. This immersive virtual world is according to Ruggiero et al. very promising for the healthcare of DM2 [45]. Additionally, Nelson et al. state that digital health care has the potential to improve healthcare and the management of disease and with this improve the quality of life for the patients [50]. Diabetes Island makes use of behaviour change techniques. On the other hand, the PRIDE Toolkit does not mention anything about the possibility of using digital technologies for their toolkit and no behavioural techniques are used in the development of the kit [43]. This is also the case for the NDF toolkit. Based on the possibilities that digital technologies and the potential that literature sees in using these technologies, it can be concluded that using digital technologies in the design can be beneficial.

Thirdly, despite all the programs providing information about DM2, only Diabetes Island tries to educate the user on how to implement this information in their daily life. Diabetes Island creates real-life scenarios in the virtual world. In these scenarios, the experts accompany the patients to guide them through the decision-making process. The developers call these scenarios "interactive contextual learning opportunities" [43]. Adebiyi confirms that interactive scenarios help with effective learning, by stating that scenarios boost the learner's ability to think and act creatively for specific problems. Also, it helps by decision making, implementing the attained knowledge and facing the consequences of one's decisions [51]. Research by Seo et al. indicates that there is a relation between health literacy and decision-making, meaning that people with low health literacy have more difficulty with making health-related decisions [52]. Therefore, it can be concluded that having functionality in the product that teaches the patients how to implement the information in their daily life can be useful.

2.3 Interviews

A group of eight Saxion students worked on this topic before this graduation project, for which they created a lifestyle magazine [53]. To gain a better understanding of the target group, they conducted interviews with experts and patients. Since it is difficult to reach this target group, it was decided to use their interview transcripts for this research as well.

In total the group of Saxion students conducted 14 interviews. Seven persons with DM2 and low health literacy were interviewed. Two former low-literate people were interviewed. The demographic data of the (ex-)illiterates are displayed in the *table 2.1* down below. They also interviewed five experts; a diabetes nurse, a general practitioner, a pharmacy assistant, the coordinator Taalaanpak, which is a Dutch project for people to improve their Dutch skills, and a healthcare professional. For every interview, the students have provided transcripts that are used for this research.

Interviewee	**Gender**	**Age**
Person 1	Male	53
Person 2	Female	45
Person 3	Female	58
Person 4	Female	57
Person 5	Male	76
Person 6	Male	66
Person 7	Female	71
Person 8	Male	76
Person 9	Male	66

Table 2.1: Demographic information interviewees

The interview transcripts, that were used for this research, were coded according to the guidelines of the book Research Methods in Computer Methods Interaction [54]. They proposed to first read the entire text in order to fully understand what the qualitative data is about. Therefore, before starting with the actual coding, the researcher read all the interviews thoroughly. Thereafter, the coding categories also called the themes, could be identified, just as Lazar et al. proposed [54]. With the established themes, the interviews were read again. Based on the themes and according to the text sub-themes were identified. When a sentence, paragraph or word was relevant to a specific sub-theme, it was highlighted in the colour of the main theme. The coding was done in Adobe Acrobat Reader. In an Excel sheet, a coding scheme was created. Every time one of the sub-themes was encountered, one was added to the number of occurrences of this sub-theme. In this way, upon finishing the coding for all the interviews, the Excel sheet showed which sub-themes and which themes were the most present in the interviews. Based on the coding schemes conclusions could be made. The final coding schemes can be found in *Appendix A*.

2.3.1 Coding (Sub-)Themes

The next section discusses the seven main themes that were identified. Furthermore, the next paragraphs address the sub-themes and the most interesting insights.

For the theme 'diabetes type 2' seven sub-themes were identified. The most occurring sub-theme was about at what age diabetes occurs. According to the interviews, mostly older people (aged 60 - 80) suffer from DM2. However, nowadays youngsters are more likely to suffer from it as well, due to an unhealthy lifestyle. A quote by the diabetes nurse illustrated this: "In the neighbourhood, the age category is younger, it starts at 12 years old". Another sub-theme that reoccurred frequently was being overweight and suffering from diabetes. The experts imply that there is a relationship between the two. Also, therapy infidelity was one of the most common sub-themes for this theme. However, according to the pharmacy assistant that was interviewed, low literacy "makes no difference for the loyalty with which patient take their medication".

The second theme 'Communication strategies for low health literacy' counted thirteen sub-themes. The most occurring one by far was the sub-theme 'using pictures'. Not only the experts indicated that this is an effective way of communicating, but also patients with DM2 and low health literacy and former illiterates agreed with this: "A picture with a caption is very clear" (person 1). Furthermore, using movie clips to explain concepts and ideas was also well-received by people with low health literacy. There was, however a side note for this communication strategy, the conversational pace should be low. A recommendation from a former illiterate was to use animation videos in this case. Additionally, when using text, it was preferred to use short and easy sentences. This would make it easier for people with low health literacy to understand each sentence. Furthermore, when using written text having someone read the written text out loud could help a lot. Finally, when having a conversation having visual items supporting the spoken text also helped a lot to make it more clear for the patients: "It is very clear with the spoken text and the drawings" (person 1).

The third theme that was identified was 'low literacy', three aspects stood out for this theme. First of all, according to the experts, many people feel ashamed that they are illiterate. Therefore, many patients pretend that they can read. The second aspect, therefore, was about making up excuses to cover up the fact that they do not understand the text, like: "I forgot my glasses, can you read it to me" (Coordinator Taalaanpak). According to the general practitioner, "they are very busy with pretending that they are able to read". Lastly, another sub-theme was that low literacy is very personal, meaning that differs greatly per person. Potential products should therefore be able to be used by multiple people.

'Motivation' was the fourth theme that was identified. This theme did not have many surprising or relevant insights, other than that the environment people live in plays a big role in the motivation of a person. Furthermore, according to the experts, patients should have intrinsic motivation in order to get something done, like changing their lifestyle. If there is a lack of intrinsic motivation, it is difficult for the patients to make a change. Finally, the diabetes nurse mentioned motivational

interviewing as an interesting concept that could be helpful to motivate patients.

The fifth theme that was defined was 'lifestyle coaching'. The interviewed healthcare professional claimed that lifestyle counselling has a positive effect on this disease: "When this happens it works very effectively, even so effective that patients can quit using their medication". According to the healthcare professional, lifestyle counselling should mainly focus on physical activity and nutrition. However, night's sleep and stress could also be taken into consideration. Finally, the health carers that were interviewed indicated that they used no technology for lifestyle coaching.

'Product ideas' is the sixth category, which focused on characteristics that a potential product could have as well as potential product ideas. Most interviewees liked the idea of printed flyers. When presenting the idea of an app to the patients, the opinions were divided. Some were not fond of the idea of an app: "I don't use many apps, the content is often cluttered or it is difficult to understand" (person 3). Others preferred an app: "I think an app works because you can receive notifications that can help me remember that I still need to do something" (person 4). Other suggestions for characteristics of a product were the inclusion of a nutrition diary or the addition of explanatory videos.

The last theme that was identified is the theme 'issues patients encounter'. When explanations or products are not altered to the needs of people with low literacy, patients could face multiple issues. This theme identified the type of problems they encountered. One of the most common problems that people with low health literacy mentioned is the usage of difficult words, this made many written texts incomprehensible for them. One of the patients said the following: "The specific terms make it challenging. Usually, I can understand the general practitioner, however, the leaflets are difficult to comprehend" (person 8). Also, long texts are difficult to comprehend for the target group. Additionally, most patients are dependent on someone else for their information. Many of the patients indicated that family members help them to comprehend the information, however, this did mean that they are very dependent. For one of the former illiterates, this was also the case: "Medication or printed flyers that I could not read, were read out loud by my sister. (...) This was difficult for me since you're dependent on someone and you have to ask them about it constantly" (person 1). Another issue that was experienced by some of the patients with low health literacy was the use of technology. This was especially an issue for the elderly.

2.3.2 Preliminary Conclusion

Based on the coding of the interviews, it can be stated that DM2 mainly occurs at older ages, however, nowadays more youngsters also suffer from it. One of the causes is an unhealthy lifestyle and being overweight. Furthermore, experts stated that lifestyle counselling can be beneficial for patients. Besides, the experts said that there is no direct link between DM2 and low health literacy, however, some patients do have low health literacy. Some of the most common issues these patients experienced were difficult word use, long texts and being dependent on someone for information. Communication strategies could be used to communicate effectively with them, the patients and experts preferred using pictures to illustrate the text,

using movie clips to explain concepts, having text read out loud and the usage of short and easy sentences. When asked about what kind of product the patients preferred, the opinion about an app was divided. Another suggestion was printed flyers.

2.4 Conclusion and Preliminary Requirements

Based on the literature review, the state of the art and the field research a conclusion can be made, with which preliminary requirements can be formulated.

2.4.1 Conclusion

To answer the sub-research question posed at the start of this chapter it can be stated that first of all, the literature review indicates that there is a lack of self-management programs that are tailored to the needs of people with low health literacy. While, lifestyle management activities are essential for the management and treatment of the disease. Therefore, creating lifestyle self-management programs for people with low health literacy is essential. To communicate effectively it is recommended to make use of communication strategies that include; the usage of plain language, well-structured texts, usage of pictures, reading texts out loud, usage of the teach-back method and creating a trustful environment.

Moreover, in the state of the art review three programs, the NDF toolkit, PRIDE toolkit and Diabetes Island, were investigated and compared. This research also emphasises the need to create low-literate content, since this was not part of all the programs. However, there were some programs that are fit to the needs of people with low health literacy. So, to directly answer the sub-research question the PRIDE toolkit and the NDF Toolkit are existing lifestyle self-management programs for people with low health literacy. Furthermore, digital technologies can create opportunities for the usability of these programs. Moreover, using digital technologies in these programs can help the patients actually implement the attained knowledge about DM2 management.

Finally, the interviews voiced the opinion of participants with DM2 and low health literacy as well as those of experts. The interviews with experts showed that lifestyle counselling can be very effective. However, patients often experienced difficulty with understanding information which is necessary for their self-management. They especially experienced issues with difficult words and long texts. The interviews also showed communication strategies that were preferred by patients and experts; using pictures to illustrate the text, using videos, reading text out loud and using simple language. When asked about lifestyle programs in combination with technology, the opinions were divided. Especially elderly interviewees did not like the idea of using digital technologies. Also, what stood out is the fact that the experts indicated that low health literacy differs greatly per person, a customisable product would therefore be suitable.

A table that summarises all the communication strategies for people with low health literacy is presented in *Table 2.2*.

Category	#	**Strategy**
Written communication	1	Use plain language.
	2	Organise the main ideas in the text in unites.
	3	Use pictures.
	4	Underline important information.
	5	Put text underneath each other.
	6	Use pictograms.
	7	Use smileys in combination with corresponding colours.
	8	Draw out explanations.
Oral communication	9	Use plain language.
	10	Read instructions out loud.
	11	Write out instructions.
	12	Ability to record voice memos.
Interactivity	13	Use the teach-back method.
	14	Ask questions to the patients.
	15	Use (interactive) videos to illustrate concepts.
Environment	16	Create a trustworthy environment for the patients.
	17	Allow patients to bring family along to consultants.

Table 2.2: Summary of communication strategies for people with low health literacy

2.4.2 Preliminary Requirements

Based on the answer to the aforementioned sub-research question and the background research, a set of preliminary requirements can be identified. The following requirements are formulated:

- The prototype must make use of the communication strategies for people with low health literacy,
- If the prototype makes use of a digital technology, it should be an easily accessible one,
- The prototype could help people with low health literacy with implementing the information in their personal lives,
- The prototype could be customisable.

Chapter 3

Methods and Techniques

For this graduation project, the Creative Technology Design Process was used as the main method [55]. This process was developed by two professors of the bachelor Creative Technology, Mader and Eggink. The process consists of four phases: the ideation phase, the specification phase, the realisation phase and finally the evaluation phase. Each section below addresses a phase of this design process. Each of the chapters in this thesis is based on one of these phases. For detailed information about a specific phase, please refer to the corresponding chapter.

Each phase of the process commences as a divergent process and ends with a convergent phase. In a divergent phase, the design process is still wide open for numerous ideas. The purpose of this phase is to investigate the entire design space, various methods can be used for this [56]. After the divergent phase, there is a convergent phase present. This convergent phase is used to analyse all the ideas that were thought of in the divergent phase. The convergent phase is used to isolate only the useful ideas [56]. The process has spiral phases, in the ideation phase as well as the specification phase. These diverging, converging phases and spiral phases are visualised in the model of the Creative Technology Design Process, which is presented *figure 3.1*

3.1 Ideation

The first phase is the ideation phase [55]. This process commences with a design question. The ideation phase serves to gain more knowledge about the design question. Three aspects can be investigated to get a better understanding of this design question; user needs, technology and creative ideas. These aspects are spiral models, meaning that these aspects are iterative processes [55]. For this phase of the design process, a sub-research question is formulated: *"Which delivery mode can be used in DM2 lifestyle self-management programs?"*. The ideation phase attempts to answer this sub-research question by investigating the aspects described below.

The first aspect, user needs, can be researched through literature. Literature research simultaneously answered the first sub-research question that is formulated: *"What lifestyle programs already exist that meet the needs and requirements of DM2 patients with low health literacy?"*. To answer this question, a literature study was

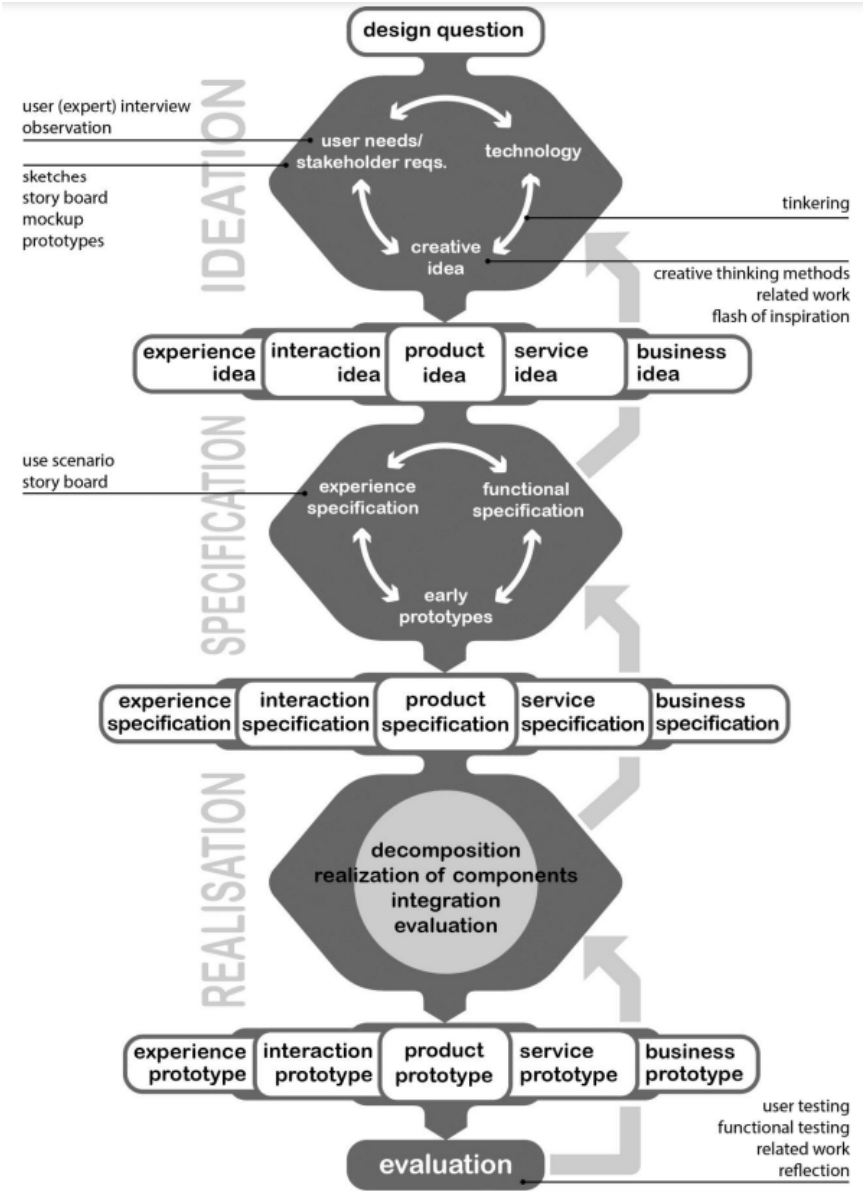


Figure 3.1: A Creative Technology Design Process

executed about diabetes, low health literacy and suitable communication strategies. Furthermore, field research was conducted to gain a better understanding of the target group. Regarding the field research, previously conducted interviews performed by Saxion students were used. These interview transcripts were thematically coded. Moreover, the stakeholders were investigated to gain a better understanding of who might be impacted by this project. For the stakeholder analysis, the technique of creating a power-interest grid was used [57].

The technology aspect was tackled by looking at the state of the art. The state of the art was described and compared to see possible drawbacks or useful strengths of the existing relevant products. Next to that, some tinkering was done in the ideation phase, to investigate what multiple technologies offer. This tinkering was

done by means of a brainstorming session.

The last aspect of this phase is creative ideas, which was tackled by using different brainstorming techniques. The first brainstorming session was based on four themes; low health literacy, DM2, lifestyle counselling and technology. A second brainstorming session was held, which built upon the technologies identified in the first session. For the second brainstorm, the lotus blossom brainstorming technique was used to come up with possible ideas for this graduation project [58]. Based on the lotus blossom, dot voting was used to identify the most interesting ideas [59]. These concepts were worked out with sketches. The results of the brainstorming sessions can be found in *Chapter 4.2*. Finally, five worked-out concepts were presented in a focus group with three experts. The experts voiced their opinion about the proposed concepts. Based on the outcome of this focus group and the entire ideation phase, preliminary requirements were formulated for the final concept.

3.2 Specification

The second phase is the specification phase, which is about specifying a final product. This phase also includes a spiral model for three aspects; early prototypes, functional specification and experience specification.

The aspect of early prototyping is characteristic of this phase. Mader and Eggink state that in this phase numerous prototypes should be created, to explore the entire design space [55]. The numerous prototypes should be evaluated and then improved or changed to new prototypes. The prototypes should focus on user experience and interaction. For this project, numerous prototypes have been developed as well.

Both the functional specification and experience specification evolve based on the results of the prototype tests. Based on the prototype tests, the results of the ideation phase and the results of the focus group one concept was selected and specified, with an ideal and realistic scenario.

The specifications can be divided into two categories; functional specification and experience specification. The functional specification described the prototype regarding the functioning of the prototype. Regarding this specification, functional requirements were formulated. These requirements were prioritised with the MoSCoW technique. Regarding the experience specification, non-functional requirements were formulated. To specify the experience more elaborately the technique of an interaction diagram was used. Moreover, two realistic personas were created to showcase the possible users of the prototype. Additionally, one of the personas was used in a design scenario, to specify and illustrate the interactions with this prototype.

During the specification, the content of the concept was specified. This content was partially based on phase-specific determinants. To address these determinants BCTs were selected. The selected BCTs were based on searched literature to link the selected determinants to the specific BCTs.

3.3 Realisation

The next phase is about realising the high-fidelity (hi-fi) prototype [55]. This phase focuses on realising and integrating all the components into one final product.

During the realisation phase an intermediate evaluation was conducted. During this evaluation, multiple experts were asked to participate. First of all, a design expert was asked to participate and to comment on the design of the specification. Additionally, a co-assistant participated to fact-check the content and thus the medical information of the book. Furthermore, a low health literacy expert participated to evaluate the design of the book and to ask him about his experiences. Lastly, a participant with low health literacy was asked to participate and voice his opinion about this concept. For the design expert, the low health literacy expert and the participant from the target group, the intermediate evaluation was shaped in the form of a semi-structured interview.

Based on the participants' input, specific design choices were made during the realisation phase. Including choices regarding the content and the style of the book. Thereafter, the practical aspects such as the case, electronics and the design of the book were realised. Ultimately this resulted in the final prototype.

3.4 Evaluation

The final phase of this design process is about evaluating the high fidelity (hi-fi) prototype. The following sub-research question for the evaluation phase was formulated: *"To what extent is the designed prototype useful for people with DM2 and low health literacy to teach them about diabetes lifestyle self-management?"*. The evaluation's purpose was to answer this sub-research question. To answer this question, two aspects were investigated: functional testing and user testing.

Functional testing verified whether the hi-fi prototype meets the specified functional requirements. The aim is to test the proper functioning of the prototype. To get an unbiased evaluation, an expert was recruited to execute the functional evaluation. The expert was recruited through the network of the supervisors. The procedure was as follows: the expert checked whether the prototype meets the functional requirements. When the requirement was met the expert noted down a '1'. If the requirement was not met, the expert noted down a '0'. With these results, the quantitative data resulted in a score, which ultimately resulted in a definition of the functionality of the prototype.

The usability evaluation was about evaluating the hi-fi prototype with potential users. The aim was to answer the research question about this phase, which focuses on the usability of the prototype. To investigate the usability, there was focused on three aspects: (1) subjective satisfaction, (2) appearance and (3) tailored to the target audience. The tasks and questions were formulated in such a way it addresses these aspects. Two participants were recruited by means of contacting various organisations which engage in projects related to low health literacy. People with low health literacy and with or without DM2 were included in the study. People

with DM2 without low health literacy were excluded. During the user evaluation, a participant was first asked to conduct five tasks. These tasks focused on getting a better understanding of how potential users interact with the prototype for the first time. Additionally, the tasks focused on checking whether the prototype is suited to the needs of the target group. Based on the experience with the prototype the participants were asked to fill in the System Usability Scale (SUS). Thereafter, a semi-structured interview followed to pose more thorough and elaborate questions. During the entirety of the evaluation, the participants were encouraged to use the thinking-out-loud protocol. The researcher took notes of the comments during the evaluation as well as the body language and facial expressions of the participants. The notes and the answers to the interview questions were thematically coded. Additionally, the scores of the SUS were calculated. A combination of these aspects ultimately determined the usability of the prototype.

Chapter 4

Ideation

This chapter discusses the ideation phase of this project. This ideation phase attempts to answer the second sub-research question: *"Which delivery mode can be used in DM2 lifestyle self-management programs?"*. To answer this question, the first section addresses the stakeholders that are influenced by this project, this is done by means of a power-interest grid. The stakeholders are placed in this grid to identify their role within this project. The next section discusses the concept generation, by means of discussing the techniques that are used for the generation as well as showcasing the outcomes of the brainstorming sessions. The section thereafter addresses the concepts that are created to explore the design space. Additionally, the next section showcases the lo-fi prototypes that are created for the concepts. These prototypes are evaluated by a focus group of experts. Next, the results of the lo-fi testing are discussed. Finally, the last section concludes this chapter with an answer to the second sub-research question and a list of preliminary requirements.

4.1 Stakeholder Analysis

This section discusses the stakeholders that play a role in (the development of) this project. The first subsection defines stakeholders. Thereafter, the primary and secondary stakeholders are identified. This section also presents the final power-interest grid.

4.1.1 What are Stakeholders?

Stakeholders are defined as persons, groups or organisations that are impacted by the result of a project, product or business [60]. Stakeholders might have an interest in the project, but not necessarily. They can affect the project both positively as well as negatively. Therefore, it is important to meet the requirements of these stakeholders, to keep them satisfied [60].

There are two types of stakeholders; primary and secondary stakeholders. Primary stakeholders are the people who are directly influenced by the project, they also play an important role within the concerning project, meaning that they can have a big impact on the project [61]. Secondary stakeholders, on the other hand,

are not directly influenced by a project, but they still have some influence on the project. Furthermore, it can be stated that they have no direct interest in the product [61].

Stakeholders can be organised in a power-interest grid. In this grid, four areas can be identified [62]:

- **High power - high interest**: These stakeholders have the biggest impact on the project, therefore they should be managed closely.
- **High power - low interest**: These stakeholders have high power, despite them having a low interest, they should be kept satisfied since they yield power.
- **Low power - high interest**: These stakeholders should be kept informed because they are very interested in the project. They can be helpful for the details of the project.
- **Low power - low interest**: These people have no real interest in the project, but they still should be monitored, since they still play a role in the project.

4.1.2 Primary and Secondary Stakeholders

For this project, the primary and secondary stakeholders can be identified as well.

Primary Stakeholders

The most obvious primary stakeholder, are the end users that will make use of the designed prototype. They are very important during the development phase of the prototype, as well as when the prototype is on the market, they are the ones who are supposed to use the prototype. So the prototype should definitely meet their requirements. This means that they have a high interest as well as a high power.

Another primary stakeholder is the investors. This is a graduation project, however, when this project is brought to the market investors play an important role. They invest money, which enables the company to develop the actual product. They have high power since they are the ones who invest money. Therefore, they should be kept satisfied.

The last primary stakeholder is the healthcare providers. This is a broad term but this includes all the healthcare providers that play a role in the treatment of DM2 are meant, so; diabetes nurses, dietitians, physicians, and general practitioners etc. The healthcare providers are not the ones who will be using the final product, however, they are the ones who are supposed to notice changes in the behaviour of the patients. This means, that they have low power, but they do have a high interest to see what influence the prototype has on the patients.

Secondary Stakeholders

Healthcare policymakers are one of the most important secondary stakeholders. Even though they have a lot of power with the rules and regulations that they are

setting, they only have little interest. But with their high power and thus influence, they are important to take into consideration.

Another interesting secondary stakeholder is the diabetes community. This community has little power but is very important for the product because they could be potentially interested in the product. It is, therefore, important to keep them informed about the product.

Furthermore, competitors are also secondary stakeholders. Even though this project is not aimed at making a profit, it is important to take the competitors into account and see how they tackle similar problems. A lot can be learned from looking at competitors. However, they do have little power and little interest in this project.

Finally, family is also an important secondary stakeholder. As mentioned, in *Chapter 2.3* many people with DM2 and low health literacy are dependent on their family for information. The family helps the patients out where necessary. Therefore, they are indirectly also influenced by this project. Ideally, the product that is to be designed would make the role of the family less important and would increase the user's autonomy. This means, that they have a high interest in this project, however, they only have little power.

4.1.3 Power-Interest Grid

Based on the information about the primary and secondary stakeholders for this project, a power-interest grid is created. This grid has been displayed in *figure 4.1.* In this grid, the red dots refer to the primary stakeholders and the blue dots represent the secondary stakeholders.

4.1.4 Preliminary Conclusion

To conclude, stakeholders are people or organisations that are impacted by the results of a project. There are two types of stakeholders, primary and secondary stakeholders. The primary stakeholders for this project are patients, investors and healthcare providers. The secondary stakeholders include healthcare policymakers, family, community and competitors. The prioritisation of the stakeholders can be done by means of a power-interest grid. For this project, this is done as well. The positions of the stakeholders according to the grid are as follows; first of all, patients should be closely managed. Furthermore, healthcare policymakers and investors should be kept satisfied. Next to that, healthcare providers, families and the diabetes community should be kept informed. Finally, competitors should be monitored with minimum effort.

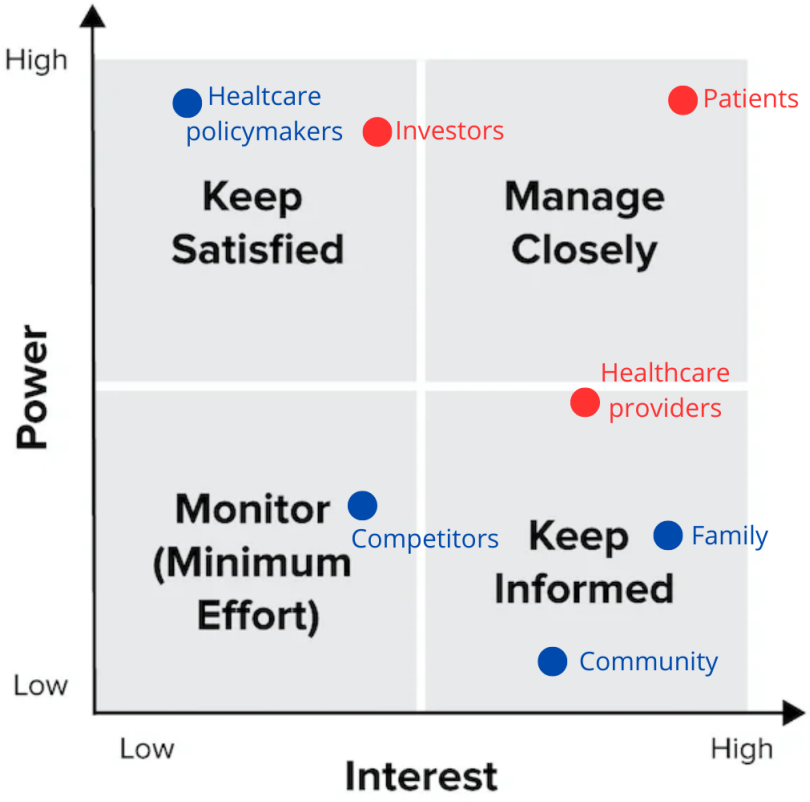


Figure 4.1: Filled in power-interest grid

4.2 Concept Generation

This section addresses the concept generation of the ideation phase. In this section the initial concepts are discussed, these concepts are based on the four preliminary requirements that were stated in *Chapter 2.4.1*. The results of the brainstorming sessions can be found in *Appendix B*.

4.2.1 Brainstorm Sessions

In total two brainstorming sessions were held to come up with ideas to tackle the problem statement. These sessions are addressed in the two sessions down below. The two brainstorming sessions took place in Miro, which is an online whiteboard space [63].

Brainstorm 1

For the first brainstorming session, a big mindmap was created with four main themes. The four themes were (1) low health literacy, (2) DM2, (3) Lifestyle counselling and (4) technologies. Mind mapping is a technique which is used to visualise how concepts and ideas are related to each other [64]. The aim, therefore, of this

brainstorming session was to come up with as many ideas as possible that were related to the four main themes. Therefore, it was not intended as a technique to come up with possible solutions, but rather to explore the available space. The results of this brainstorm can be found in *Appendix B.1*.

Brainstorm 2

Based on the results of the first brainstorming session, a new brainstorming session was held. The technologies that were thought of in the first brainstorming session formed the base of this brainstorming session. The technologies that were included in this brainstorming session were: phones, sensors, laptops, video, virtual reality, audio, augmented reality and wearables.

For this brainstorming session the lotus blossom technique was used. This technique is about basing ideas upon several central themes [58]. Usually, this technique is used in combination with a specific fixed grid, but in this case, this was not used, to encourage creative freedom. The technologies that are mentioned in the paragraph above were the central themes for this brainstorming session. On each theme, four minutes were spent thinking of ideas only for that specific central theme. After four minutes, the theme was concluded and the next four minutes started for the next theme. After having repeated this for all the themes, the brainstorming session was completed. The results of this brainstorming session can be found in *Appendix B.2*.

After this part of the brainstorming session, the dot voting technique was used to pick the researcher's personal favourite concepts. Dot voting is a technique that is used to indicate preferences during a brainstorm [59]. With this technique dots are placed on favourite ideas that came out of the brainstorm. Finally, the concept with the most number of dots is considered the 'favourite concept'. The dots that were placed can be seen in *Appendix B.2*.

The dots during the dot voting were placed at four ideas. The first idea is about an interactive book. The next idea is about an interactive lockscreen of a phone or laptop. The third concept is a smart keychain that can give personalised advice. The final idea is about creating interactive videos for the patients. These ideas are worked out more elaborately in the next section.

4.3 Concepts

The four favourite concepts, which are briefly discussed in the section above, are worked out more elaborately by using sketches and collages. The sections down below each discuss one of the four concepts.

4.3.1 Interactive Book

The interactive book is an idea about making a book or pamphlet that is interactive. It is anticipated that this increases the engagement of the users.

Initial sketches

To explore the design space of an interactive book a mood board was created. For the mood board, there was looked at different types of interactive books. This mood board can be found in *Appendix B.3*.

Based on the inspiration of the mood board a concept sketch was made to explore the design space. The sketch is displayed in *figure 4.2*. While discovering the design space another idea came up; a diabetes board.

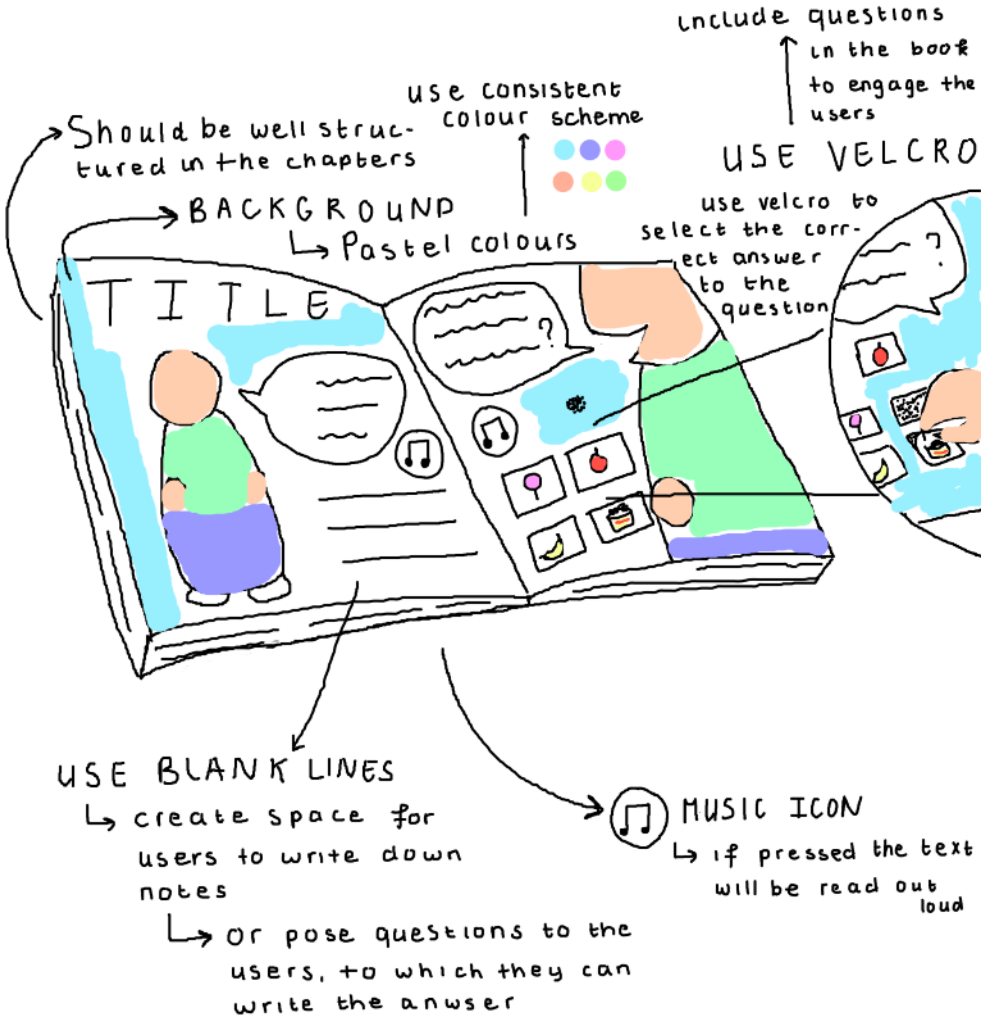


Figure 4.2: Concept sketch interactive book

Diabetes Board

The idea of a diabetes board is to have a board on which the users can indicate the time of day, how they are feeling, what type of food they have eaten and how much they have exercised. Based on their choices, the board can give personalised feedback and tips on how to proceed during the rest of the day. A concept sketch of this is displayed in *figure 4.3*. In *Appendix B.3* a sketch that explores multiple layouts is displayed as well. The first sketch that was made for this idea can be found there too.

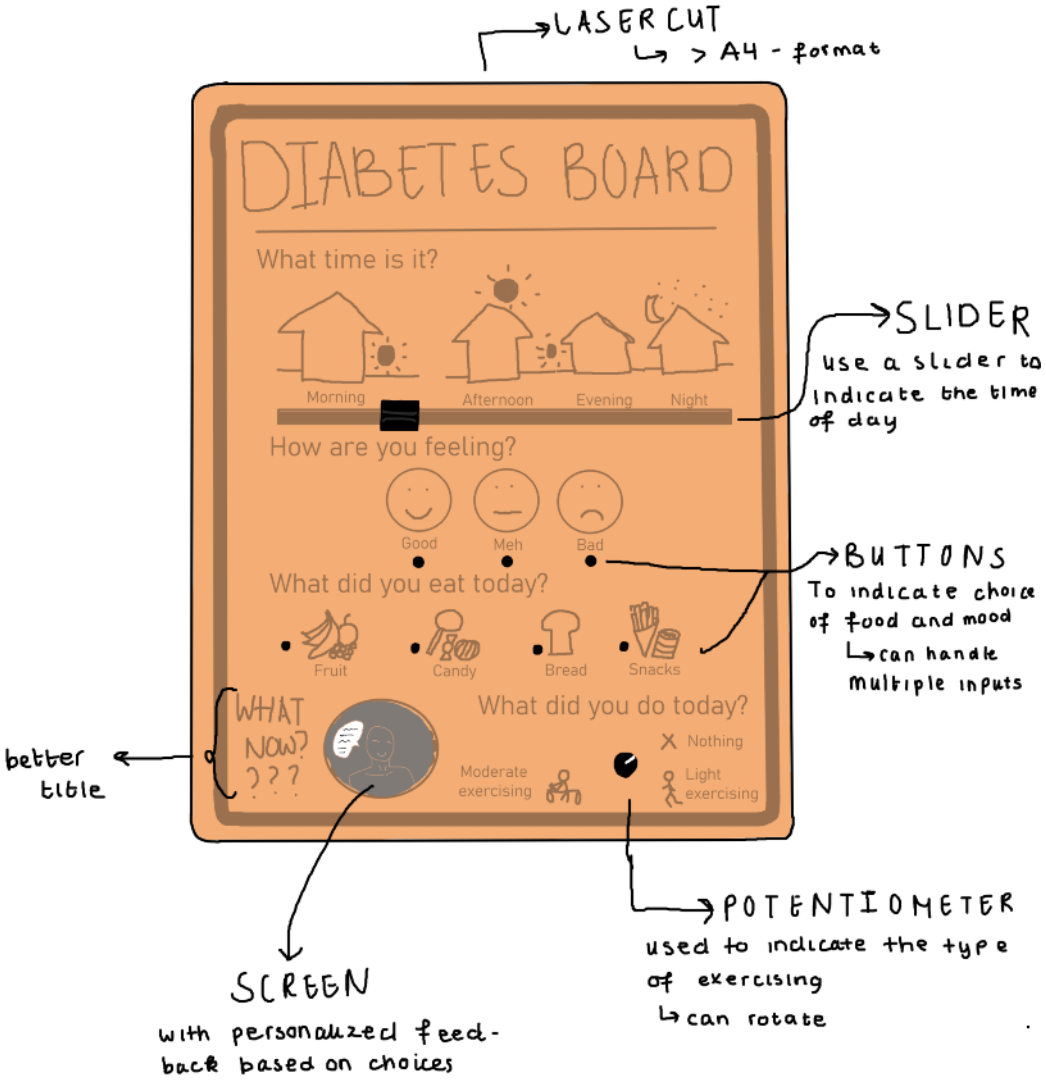


Figure 4.3: Concept sketch diabetes board

4.3.2 Smart Keychain

The concept of the smart keychain is meant to serve as an information provider for users. On the screen, the patients see an icon that represents a specific category, such as nutrition or physical exercise. If the patients press the select button, the keychain provides spoken advice based on the time of the day and their choice of category. To explore the design space for this concept, a mood board was created. *Appendix B.4* presents this mood board.

Based on the mood board and the concept, a concept sketch was made. This sketch is presented in *figure 4.4*. To ideate more on this concept, different shapes were explored. The sketches for this ideation can be found in *Appendix B.4*.

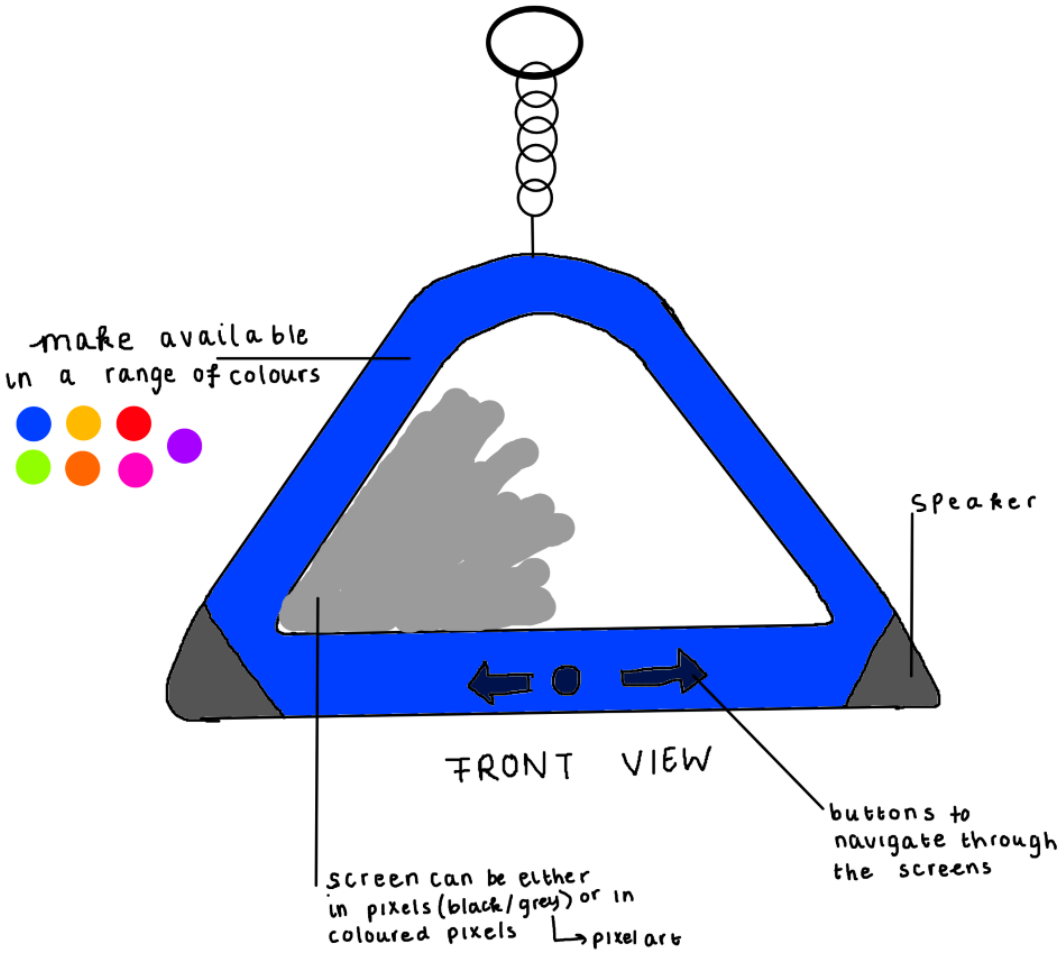


Figure 4.4: Concept sketch smart keychain

4.3.3 Interactive Video

The concept of the interactive video is about providing personal feedback based on the answers that the patients choose during the video. It can be a series of videos,

each tackling different aspects of diabetes. During the videos questions are posed to which the patients can answer one of the options. Based on their answer, the video continues in a specific direction. From the field research it can be concluded that animated videos are preferred by the interviewees, the videos in this case should therefore also be in an animated style.

In order to illustrate how this might look, a sketch was created. This sketch is displayed in *figure 4.5*. For these types of videos, a pre-made script should be made with possible outcomes of each possible answer. To illustrate and investigate in which directions such a script goes, a flowchart diagram was made. This flowchart can be found in *Appendix B.5*.

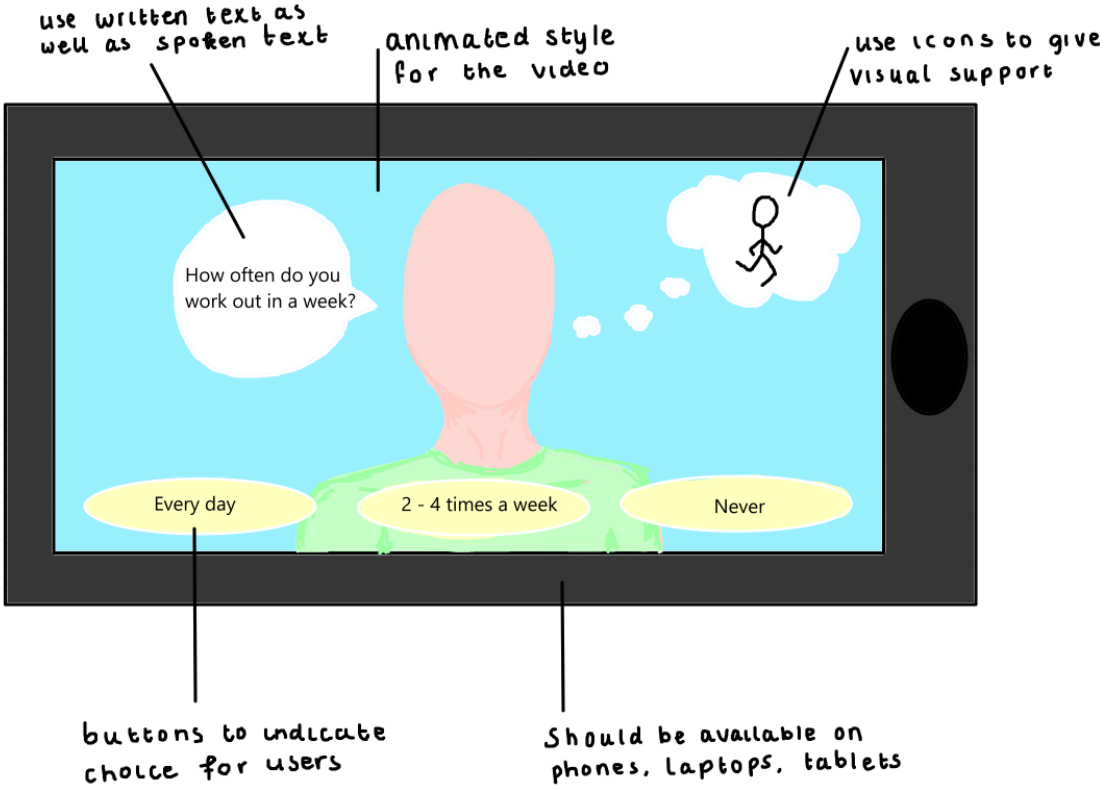


Figure 4.5: Concept of interactive video

4.3.4 Interactive Lockscreen

The final concept is an interactive lockscreen that can give advice based on the time of the day. Since almost everyone nowadays owns a smartphone, this concept is very accessible. When the patients look at their phone they will immediately see the changing background with feedback. This concept could also work for the backgrounds of laptops and tablets.

To elaborate on this concept some ideation was done. First, a mood board was made of lockscreens and relevant visual images. This mood board can be found in

Appendix B.6. Based on this mood board a concept sketch was created. This sketch can is presented in *figure 4.6*.

Figure 4.6: Concept of interactive lockscreen

4.4 Lo-Fi Prototypes

Besides making sketches and mood boards, the technique of prototyping was used to explore the design space. Lo-fi prototypes were created for the three physical products; the interactive book, the diabetes board and the smart keychain. The sections down below discuss the created prototypes for each concept.

4.4.1 Interactive Book

For the interactive book, a prototype was made to explore and showcase the possibilities. The prototype is a booklet that was crafted from paper. It shows what possible content could like look. Also, the visual aspects of the book are explored. The prototype is displayed in *figure 4.7*. Also, some prototyping was done, by means of looking at the possible size of the book. This can be found in *Appendix B.3*.

4.4.2 Diabetes Board

Also, for the diabetes board, a prototype was made. This prototype was made out of paper. The sliders are moveable in the prototype, to show how it might work in the real product. The prototype is displayed in *figure 4.8*.

4.4.3 Smart Keychain

Finally, also for the smart keychain a prototype was created. This prototype mainly focused on discovering the possible shapes that the keychain might have. In *figure 4.9* the prototype is displayed.

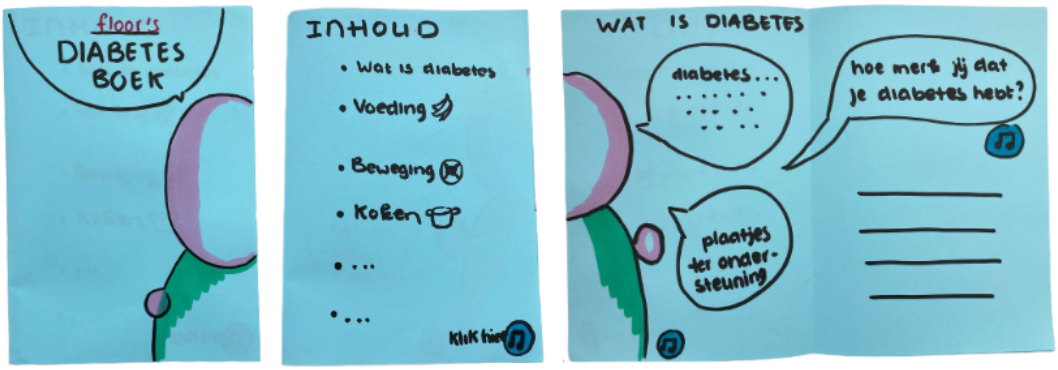


Figure 4.7: Prototype interactive book

Figure 4.8: Prototype diabetes board

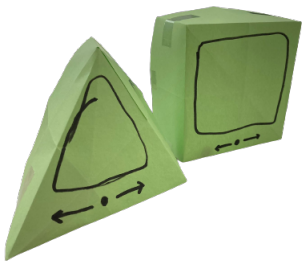


Figure 4.9: Prototype smart keychain

4.5 Results

To evaluate the five main concepts, an expert focus group was set up. The focus group consisted of three experts and myself. One of the experts has a background in physiotherapy and health sciences. Nowadays, she is focused on behavioural change regarding lifestyle. Her area of expertise includes health psychology and the development and evaluation of evidence-based eHealth interventions. The second expert has a background in nursing, in the direction of Health and Technology. Furthermore, her background lies in health sciences. She focuses on behavioural change regarding lifestyle and personal lifestyle coaching by means of eHealth. And the last expert's background lies in artificial intelligence. Her area of expertise is human-computer interaction and the development and evaluation of virtual assistants. The virtual assistants are used for multiple end goals, such as lifestyle coaching and making well-informed decisions.

The focus group started with the researcher briefly explaining the aim of this graduation project. Thereafter, a presentation with the five worked-out concepts was presented. Next, an informal discussion was held about the feasibility, usability and general liking of the concepts. The aforementioned experts expressed their opinion on whether they believe in the proposed concepts.

During the meeting, two concepts came out as favourites. The first concept that was preferred is the interactive book and the second favourite concept is the diabetes board. These two concepts were preferred because of personal preference but also the other concepts had aspects that were not favoured. For example, the smart keychain is an interesting concept, however, it does not make sense to put all the technology in such a small device. The concept of the interactive video was also discarded since the users would have to actively look up the videos and make time for them. This would take dedicated motivation and courage to actually watch the videos. Therefore, this concept is less attractive and also less usable. Regarding the interactive lockscreen, it is an interesting concept, however, it would need some support from an app for additional information. This would be more challenging for people with low health literacy since they usually also have low digital literacy [65]. Therefore, the two concepts of the interactive book and the diabetes board were the two favourite concepts.

The interactive book and the diabetes board also had specific aspects that are desirable. For example, the interactive book and the diabetes board are both physical products. As was mentioned in *chapter 2*, printed flyers or brochures work well for people with low health literacy, because they are physical products, this is usually more attractive for people with low health literacy. Furthermore, both the book and the board make use of implicit technologies. In this way, the users will not actively and consciously make use of technologies. This increases the usability for the users as well as makes it more accessible for them. Additionally, the book can be very useful for an introduction to DM2 and to broaden the knowledge about DM2 for patients. The diabetes board, on the other hand, would be useful during the later stages of DM2. The board can be used to implement the attained DM2 knowledge in their daily lives.

4.6 Conclusion and Preliminary Requirements

To conclude, this chapter discusses the ideation phase of this graduation project, which consists of a stakeholder analysis, concept generation and the results. With these aspects, this chapter attempts to answer the sub-research question formulated at the beginning of this chapter. Additionally, this chapter tries to answer the second sub-research question, mentioned at the start of this chapter.

4.6.1 Conclusion

Based on the sub-research question, it can be stated that the stakeholder analysis shows that there are three primary stakeholders: patients, healthcare providers and investors. This analysis also shows that there are secondary stakeholders to take into account; healthcare policymakers, competitors, family and the diabetes community.

Furthermore, based on the stakeholder analysis, the concept generation started. During this phase, two brainstorming sessions were held. These brainstorming sessions focused on finding possible delivery modes. Five favourite delivery modes came out of these brainstorming sessions: an interactive book, the diabetes board, an interactive lockscreen, interactive videos and a smart keychain.

An expert focus group, with three experts, was held to discuss the outcomes of the concept generation. The experts voiced their opinions and based on these opinions the interactive book and the diabetes board were the favourite and preferred concepts.

4.6.2 Preliminary Requirements

Based on the entire ideation phase and the brief conclusion above, preliminary requirements can be identified. The following requirements are formulated:

- The product should be a physical product,
- The technology that is used could be implicit,

- The product should be easily accessible for users,
- The product could focus on broadening DM2 knowledge,
- The product could focus on the implementation of DM2 knowledge in the user's personal lives.

Chapter 5

Specification

This chapter discusses the specification phase. This is done by means of first discussing the necessary requirements for the design of the final concept. The requirements are split up into two sections; functional requirements and non-functional requirements, all prioritised with the MoSCoW prioritisation. Based on these requirements and the results of the ideation phase, the section thereafter presents and specifies the final concept. In order to define the final concept more elaborately, the interaction and experience are investigated. For this, an interaction diagram is made and two personas are created. Based on one of the personas a user scenario is created.

5.1 Requirements

A list of requirements can be formulated during the specification phase to check whether the prototype meets the user's needs and requests. In *chapter 2.4* and *chapter 4.6* preliminary requirements are formulated. The requirements that are mentioned in the section below are revisions, additions and extensions of the already formulated preliminary requirements.

Requirements can be split up into two categories: functional requirements and non-functional requirements. In general, functional requirements are defined as requirements that the system must meet in order to function properly [66]. Non-functional requirements, on the other hand, focus on requirements that describe how a system works [66]. Both these types of requirements can be prioritised by using the MoSCoW method. This technique prioritises the project requirements in four categories: must have, should have, could have and will not have [67]. This prioritisation will also be used for the requirements of this project.

5.1.1 Functional Requirements

Table 5.1 down below presents the functional requirements that are formulated for this graduation project. As was mentioned in the section above, these requirements are prioritised using the MoSCoW technique.

#	Functional requirement	MoSCow
1	The prototype must be tailored to the needs of the target group by following the mentioned communication strategies and using an easily accessible digital technology.	Must have
2	The prototype should be physical and tangible.	Should have
3	The prototype should have the functionality to read the text out loud.	
4	The prototype could have small exercises to test the user's knowledge.	Could have
5	The prototype could provide personal feedback.	
6	The prototype could have an on/off switch.	
7	The prototype will not have a supporting mobile application.	Will not have

Table 5.1: Functional requirements with MoSCoW prioritization

5.1.2 Non-Functional Requirements

Also, non-functional requirements are formulated to check whether this project meets the needs and requests of the users. *Table 5.2* shows the identified non-functional requirements. Furthermore, the MoSCoW prioritisation is used to prioritise the non-functional requirements.

#	Non-Functional Requirements	MoSCow
1	The prototype must educate the users about DM2, by stressing and highlighting the importance of a healthy lifestyle, regular exercising and healthy nutrition.	Must have
2	The prototype must present DM2 coaching content.	
3	The prototype must make use of low health literacy communication strategies.	
4	The prototype must be aesthetically pleasing.	
5	The prototype should be interactive.	Should have
6	The prototype should be easily accessible.	
7	The prototype should be intuitive to use.	
8	The content should be well-structured.	
9	The prototype could educate users on how to implement DM2 knowledge into their personal daily lives.	Could have
10	The prototype could be customisable.	
11	The prototype could have multiple chapters addressing different topics.	

Table 5.2: Non-functional requirements with MoSCoW prioritization

5.2 Concept Description

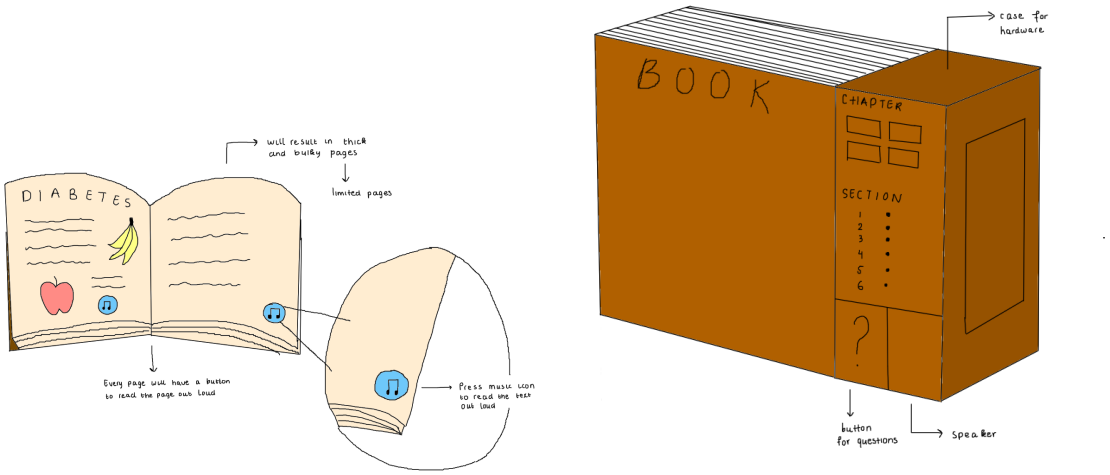
Based on the requirements in the section above, this section presents the final concept description. For the specification of this concept, two scenarios are presented. The first section presents the ideal scenario. This would be the concept in an ideal world, so with plenty of time and resources to realise the concept. However, in reality, this is not the case. Therefore, building upon the ideal concept, the second section presents the realistic scenario that is actually realised during this graduation project.

5.2.1 Ideal Concept Description

Based on the expert focus group and the requirements that were defined an interesting concept came up. This ideal concept consists of a series of two interactive books. The books both focus on different aspects of DM2. The first book in the series focuses on the initiation of new behaviour, such as expanding the DM2 knowledge, risk perception and outcome expectations of the users. These aspects are specific to the initiation phase, which this project focuses on. Later in this chapter, these determinants are discussed more elaborately. The objective of this first book is achieved by means of explaining the pathology of DM2 and all the aspects that are relevant to this disease, such as a healthy lifestyle regarding nutrition and physical exercise. The first book is meant to serve as a foundation for the users, to get a better understanding of DM2 and to form the intentions to change lifestyle behaviours. The second book in the series focuses on implementing the attained knowledge in their daily lives by focusing on specific determinants such as knowledge and risk perception. The aspect of implementation can be encouraged by building upon the concept of the diabetes board. The diabetes board with additional functions and options could be added at the end of the second book, to help users implement the attained knowledge in their own lives. By building upon the concept of the diabetes board, the book can give more personalised feedback.

The two books can read the contents out loud. According to the literature and field research in *Chapter 2*, reading text aloud can be very beneficial and useful for people with low health literacy. Therefore, it is decided to implement this communication strategy and functionality in the final concept for this project.

To explore the design space of an interactive audiobook, there was ideated on two versions of this book. The two options are displayed in *figure 5.1*. The first version is a regular book with music icons on every page. Once the music icon is pressed, the book will read the text on that specific page out loud. For this approach, all the hardware should be inside every page, this results in very thick and bulky pages. This option is visible in *figure 5.1a*. The second option consists of a book attached to a case. This case houses all the electronic hardware that is necessary to make this concept feasible. Therefore, regular pages can be used. Additionally, there are more possibilities with the electronics, since everything is housed together. The second option is visible in *figure 5.1b*.



(a) Audiobook with music icon for audio (b) Audiobook with case for audio

Figure 5.1: Two approaches for an audiobook

Based on the considerations that are described above, it was decided to further develop the audiobook with the case. The main reason for this is the fact that the electronics are easily accessible. Some further ideation was done on this concept. The results of the ideation are visualised in a new concept sketch. This sketch is displayed in *figure 5.2*.

Figure 5.2 shows the casing with one of the books. Both books consist of four chapters. The four chapters are indicated by means of dividers which exceed the length of the book. On the casing, four buttons for the four corresponding chapters are positioned. Underneath the buttons for the chapters, six buttons for the chapters are placed. Each chapter consists of a couple of sections. When selecting the chapter and the section, the book will read the contents of that specific section out loud. Furthermore, the books have a 'Help!' button that can be pressed. If this button is pressed the book provides the user with an explanation about how to use this book. Finally, a speaker was added to the case which enables the book to 'read' out loud.

To provide a more realistic vision of the books a 3D model was made to showcase what the two books would look like. This model is displayed in *figure 5.3*.

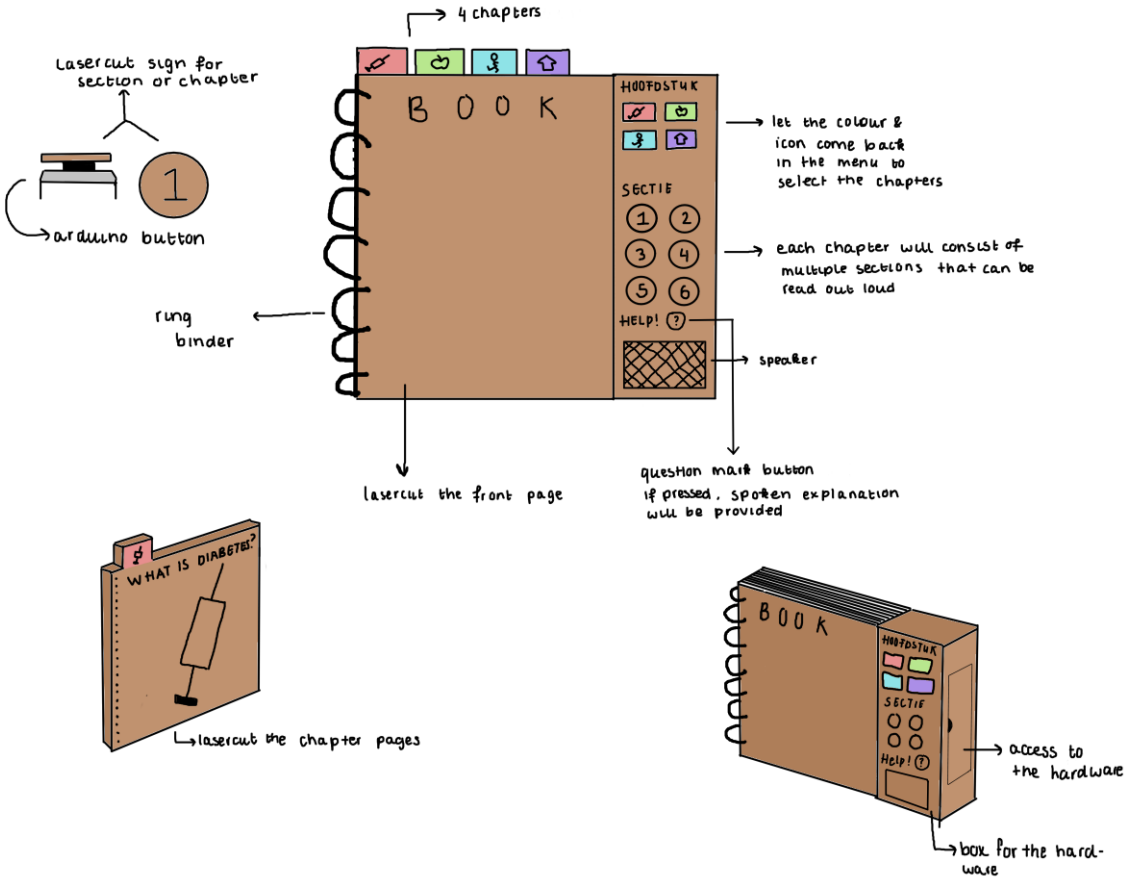


Figure 5.2: Concept sketch for audiobook with case

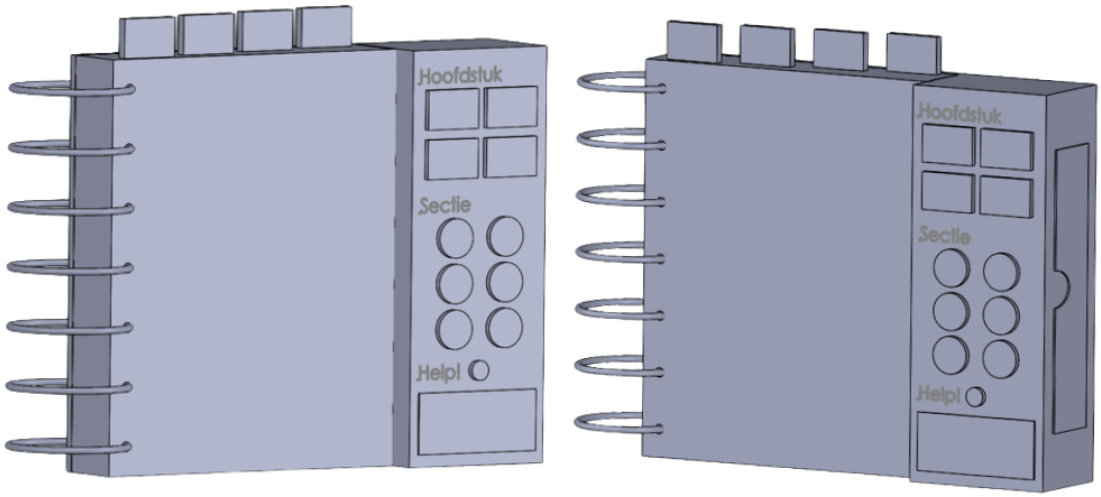


Figure 5.3: 3D model of the two books for the ideal scenario

5.2.2 Realistic Concept Description

The section above describes the ideal concept description, however, due to a lack of time and resources, it is not possible to fully realise two properly functioning books. Therefore, a decision has to be made about which book will be actually created.

Bloom's Taxonomy

The first book focuses on the initiation phase by broadening users' DM2 knowledge, risk perceptions attitude and outcome expectations to form intentions to change lifestyle behaviour. This is an essential step, since without knowledge about what behaviour to implement, lifestyle advice can not actually be implemented. Bloom's taxonomy supports this learning curve. Bloom's taxonomy is a framework that describes the different stages in learning and educational objectives [68]. This framework states that the first level of learning something new is called 'remembering'. This includes recalling information about a specific event, process, method or pattern, for example, remembering that eating two pieces of fruit a day is healthy. The second level of this taxonomy is called 'understanding'. This refers to comprehending and understanding new information in such a way that one is able to explain the concept by themselves. For example, being able to explain why eating fruit is healthy, shows that the user fully comprehends the information that was taught. The next level is called 'applying', which is about executing and implementing the acquired information in a new but similar setting [68]. To illustrate this, the user could make a conscious decision to buy a piece of fruit in the supermarket instead of candy.

Based on Bloom's taxonomy, it can be stated that to implement attained knowledge, first the knowledge should be understood properly and correctly. This would also be the case for DM2 patients, before they can implement knowledge, they first have to understand the knowledge and theory about DM2. Based on this, the researcher decided to focus on the first book in the series, meaning that the researcher will focus on creating a foundation for the users, with which they get a better understanding of DM2. Additionally, the users form intentions to change lifestyle behaviours and the book is supposed to support the initiation phase. These goals are based on the phase-specific determinants that are discussed later in this chapter. Taking the framework from above into consideration, it is a logical step for this research to start working on the first book in the series.

Concept Description

As mentioned above, the book that is going to be realised during this research is the first book in the series. This book discusses the basics of DM2, on an appropriate level for people with low health literacy. To accommodate the users, the book has the option to read the text out loud. The user can select the current chapter and the relevant section on the case of the book, which results in the book 'reading' the contents of the selected section out loud. The content of this book focuses on

the initiation phase which, amongst other aspects, includes broadening the DM2 knowledge of the users. To make the content of the book fitting to the specific needs of this target group, the communication strategies for people with low health literacy are applied to the content, these strategies were discussed in *Chapter 2.1.3*. For example, using pictures to support the text and using white spaces to make the pages as less cluttered as possible.

The book is based on the 3D model in *figure 5.3*, meaning that the book also consists of a case. The casing has four buttons that correspond with the four chapters that the book consists of. Additionally, the casing has six buttons for the sections in each chapter. A help button is added to accommodate the users where necessary. Furthermore, the case houses the speaker, which can 'read' the text of a specific section out loud. A 3D model is created to visualise the book in a realistic manner. The first 3D model that is created can be seen in *figure 5.4*.

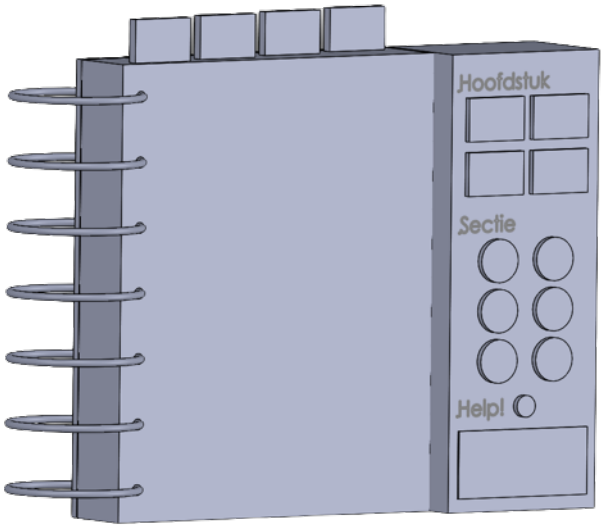


Figure 5.4: 3D model of the first book

The book and case are two separate items but are attached to each other by means of binding rings. To showcase how the case looks without the book attached to it, a 3D model is made. This 3D model is visible in *figure 5.5*. In the model, it is visible that the case consists of a housing for the electronics, the box and a backdrop, which serves as a back cover for the book.

The book is bound by means of binding rings. This allows for easy usage since the pages can be turned 360 degrees. Furthermore, it allows the users to add any additional pages to the book that they find relevant. This allows the user to personalise their book in such a way that it is useful for them. When looking from a practical perspective, binding rings can accommodate more pages. This allows for more pages to be included, but also thicker pages can be used as chapter dividers. An opened book is presented in *figure 5.6*.

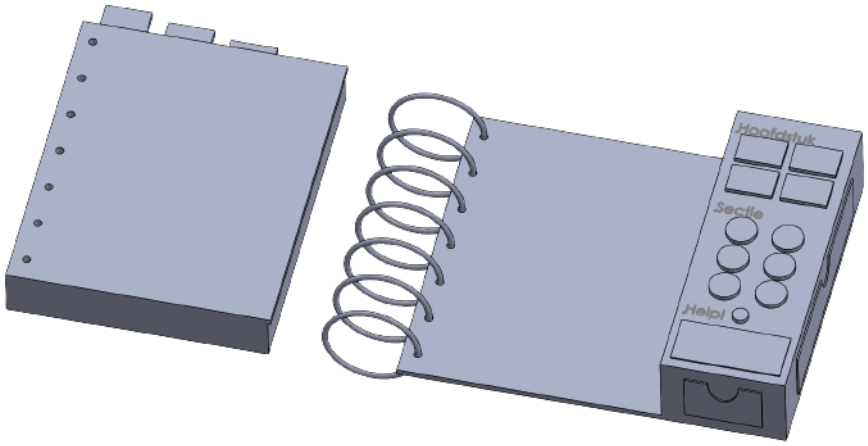


Figure 5.5: 3D model the book and case separated

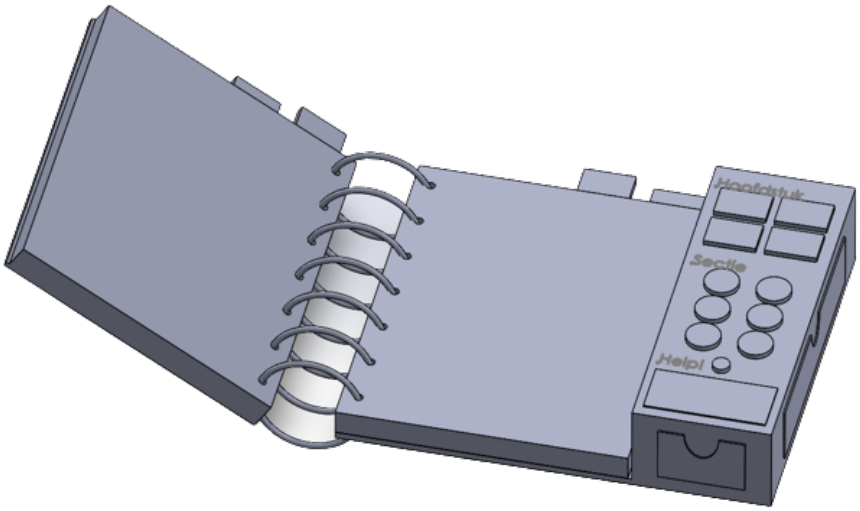


Figure 5.6: 3D model the opened book

5.3 Concept Specification

This section discusses the specification of the concept. This concept is specified by first discussing the specification of the case. Thereafter the content of the book is discussed. Finally, the last section discusses the style of the book.

5.3.1 Case

The main purpose of the case is to house the hardware and electronics. To 'read' the text of a section out loud different electronics are necessary. These electronics need a place to be stored both for safety and aesthetic purposes. The case is a good solution to 'hide' the electronics.

The casing will be made out of laser-cut wood. First, a design of the case, the box and the backdrop, is made in SolidWorks [69]. This design is visible in *figure 5.7*. With the help of this design, a sketch with all the dimensions of the box is made. The exact dimensions can be found in *Appendix D.1*. By defining the dimensions, it is decided that the case is 8 centimetres wide and 21 centimetres long. With the backdrop attached to it, the case has a width of 25 centimetres. The box is 5 centimetres high. This results in the dimensions of the case with the backdrop included of 21 cm x 25 cm x 5 cm (l x w x h). These specific dimensions are necessary to make sure that all the hardware fits inside the case as well as having enough space for the pages and the text itself.

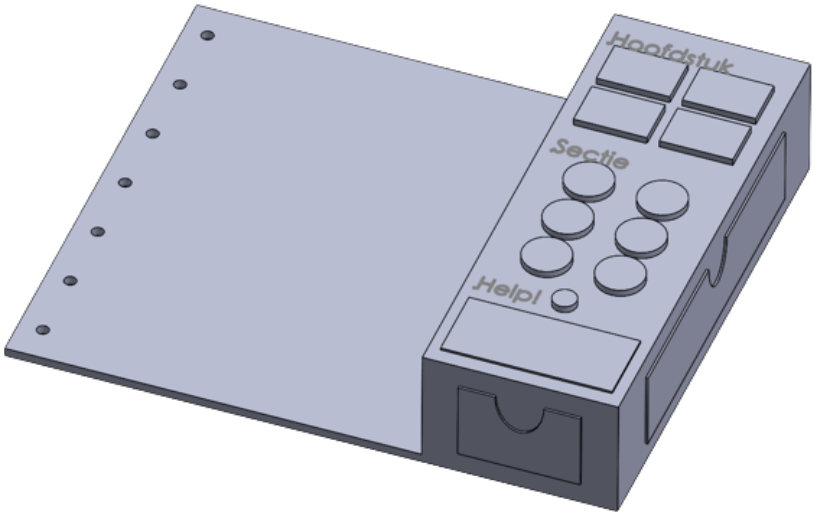


Figure 5.7: Design of the case

To access the electronics easily, two entrances are created in the model. This first entrance is on the right side of the case. This is a, relatively, long entrance, providing easy access to the buttons for chapters and sections. The second entrance is at the bottom of the case, which provides easy access to the speaker and its electronics.

The case has three titles on it, indicating the chapters, the sections and the help button. These titles are laser-cut in the case in the same style as the rest of the book. This is discussed more elaborately in the *subsection 5.3.3*. For each of the chapters, four buttons are necessary. *Section 6.2* discusses which buttons will be used. On top of the four buttons for the chapter category, four rectangles of laser-cut wood will be pasted. This principle is shown in *figure 5.2*. These four buttons each relate to one of the tabs that stick out of the book. The relation between a button and a tab is indicated by means of the same icon and the sequence in which they occur. Furthermore, the category called section consists of six buttons. For these buttons, a circle is used. On each of the circles the numbers one to six will be engraved, referring to sections one to six in the chapters. Finally, the help button also consists of a laser-cut circle that is pasted on the button.

5.3.2 Content

The content of this interactive book is an essential aspect of this prototype. The content provides the foundation of the initiation phase for all the users, the content should therefore be thought through and fitting to the needs of people with low health literacy. As was mentioned in the sections above, the book will consist of four chapters:

1. 'Alles over diabetes'
2. 'Diabetes behandelen met een gezond leven en medicijnen'
3. 'Beweging'
4. 'Eten en drinken'

Each chapter consists of sections. The titles of the sections are posed as a question, this is done to increase the engagement of the users [43]. The subsections down below discuss the four chapters and their contents. The content is based on existing and public content of the DiabetesFonds [70] and the Voedingscentrum[71]. Furthermore, determinants of behaviour that are important in the initiation phase are linked to BCTs [72]. The BCTs are used in the content that is written. The section below discusses these BCTs as well.

'Alles over Diabetes'

The first chapter introduces the user to the subject of diabetes. The title of this chapter roughly translates to 'Everything about diabetes'. This chapter consists of five sections and one section for the exercises, so six sections in total.

The first section is called 'Wat is diabetes?', this roughly translates to 'What is diabetes?' This section explains what diabetes is. It introduces the reader to some essential words that are reoccurring, like diabetes, blood sugars and insulin.

The second section is about the different types of diabetes. This section is called 'Wat zijn de verschillende soorten diabetes?', which translates to 'What are different types of diabetes?'. Despite the fact that there are lots of different types of diabetes this section solely focuses on diabetes type 1 and DM2.

'Waardoor krijg je diabetes?' is the title of the third section. This title roughly translates to 'What are the causes of diabetes?'. As the title suggests this section addresses the causes of DM2. Obesity is highlighted in this section. Additionally, other causes are enumerated.

The fourth section is called 'Hoe herken je diabetes?' which translates to 'How do you recognise diabetes?'. This section explains what the definition of symptoms is and which symptoms are recognisable for DM2. The symptoms are enumerated in a list to make it more clear for the users.

'Wat kunnen de gevolgen zijn van diabetes?' is the title of the last section. This section is about the adverse effects of diabetes. This section enumerates the possible side effects that might occur. Furthermore, this section introduces the reader to hyperglycemia and hypoglycemia since this is also an essential adverse effect that

the reader should be aware of. Additionally, the symptoms of hyperglycemia and hypoglycemia are enumerated.

To conclude chapter one, small assignments are set up to test the users' knowledge. These exercises are worked out in *Chapter 6.3.3*.

'Diabetes Behandelen met een Gezond Leven en Medicijnen'

The second chapter of this book is about called 'Diabetes behandelen met een gezond leven en medicijnen', this title roughly translates to 'Curing DM2 with a healthy lifestyle and medicines'. As the title suggests, this chapter discusses what a healthy lifestyle is and why a healthy lifestyle is important for the self-management of DM2. Additionally, it also discusses how medicines can help with the management of DM2.

The first section is called 'Wat is gezond leven?', which means 'What is a healthy life?'. This provides the reader with the definition of a healthy life. Aspects of nutrition, physical exercise, sleep and stress are included in this section. Also, DM2 is included in this section to indicate how a specific aspect might have an influence on their blood sugars.

The second section ties closely with the previous section, since this section is about why a healthy lifestyle is important for people who suffer from DM2. This section is called 'Waarom helpt gezond leven?', which roughly translates to 'Why does a healthy lifestyle help?' While the previous section also included sleep and stress, this section solely focuses on the influence of healthy nutrition and physical exercise on blood sugar levels. Additionally, this section introduces the readers to remission.

'Hoe helpen medicijnen bij diabetes?' is the title of the last section. This title refers to how medicines can help with the management of DM2. This section briefly addresses medicine use for DM2. Multiple types of medication are mentioned to give an indication of possible medicines that the readers might use. However, since the focus of this book is on nutrition and physical exercise, it is not discussed elaborately.

The second chapter is also concluded with small exercises. These exercises are worked out in *Chapter 6.3.3*.

'Bewegen'

The third chapter is about physical exercise. This chapter consists of four sections. The chapter discusses why physical exercise is important, additionally, tips and tricks are discussed to make exercising easier and more entertaining.

The first section of the chapter is called 'Waarom is beweging belangrijk?', which roughly translates to 'Why is physical exercise important?'. This section discusses the physical benefits of exercising on a daily basis. Additionally, this section also discusses the mental benefits that one might experience while exercising. This part also explains the definition of sufficient exercising, which is moderate exercising for at least half an hour a day for at least five days a week.

The second section of this chapter discusses what happens in one's body when they are exercising while suffering from DM2. The title of this section is 'Wat gebeurt er met mijn lichaam als ik beweeg met diabetes?'. As the title suggests this

section discusses the physical effects of exercising, which include heart rate, blood sugar levels and hypoglycemia and hyperglycemia.

The last two sections fit well together since they both provide tips for exercising. The third section is called 'Hoe kan ik meer bewegen?', which translates to 'How can I exercise more?'. This section gives an enumeration of tips to move more on a daily basis. The fourth section is about making exercising more fun. This section is called 'hoe kan ik bewegen leuker maken?'. Also, this section enumerates a list of tips to make exercising more fun.

The third chapter is concluded with small assignments, these are realised in *Chapter 6.3.3*.

'Eten en Drinken'

The final chapter of this book is about nutrition, including both food and drinks. This chapter discusses what healthy food is and tips for the reader to use in their personal lives. This chapter consists of three sections.

The first section of this chapter is called 'Wat is gezond eten en drinken?', which refers to the definition of healthy nutrition. This section is quite elaborate in comparison to some other sections, but a lot can be told about healthy nutrition. For this section, the 'Schijf van Vijf' is used as guidelines. The 'Schijf van Vijf' are Dutch guidelines for healthy nutrition. Also, additional information about nutrition in combination with DM2 is included in this section.

'Wat voor invloed heeft voeding op mijn diabetes?' is the title of the second section of this chapter. This section discusses the influence of healthy nutrition on their DM2 and their blood sugar values. Since nutrition, and its effects, are very personal, it might be wise to visit a dietitian. The last section discusses how a dietitian can be helpful for people with DM2. The section also enumerates a list of situations when it might be useful to visit a dietitian. Additionally, two websites with additional information about DM2, exercising and nutrition are discussed which the readers can also visit for extra information.

Chapter four is also concluded with assignments. These are realised more elaborately in *Chapter 6.3.3*.

Glossary

In the contents of the book some keywords are printed in bolt. These words are added to the glossary at the end of the book. In the glossary, some important and reoccurring words that might be experienced as difficult are grouped together. If words keep reoccurring in the text, then the users can find the definition of the word or an explanation of the word at the end of the book. This helps the user to comprehend the content of the book better.

Foundation of the Content and BCTs

As was already mentioned in the introduction of this section, the content of the book is based on information from the DiabetesFonds [70] and Voedingscentrum [71]. Di-

abetesFonds has public and free brochures available with a great deal of information about DM2, lifestyle, and nutrition. Moreover, they also have a lot of articles online that address information about physical exercising [70]. The Voedingscentrum has a web page about DM2 and nutrition, also this page is used as a reference for the content.

However, most of the text on these websites and brochures is not altered to the needs of people with low health literacy. Therefore the website 'Is het B1?' is used to rewrite the text in a manner that is more coherent for the target group. Additionally, words that can be experienced as challenging or difficult are explained. Think of words like complications, symptoms and insulin. Furthermore, the content of the book follows the guidelines of communication strategies for people with low health literacy, which are discussed in *Chapter 2.1.3*.

In addition to basing the content on credible and reliable sources, there are plans to have the content checked by an expert during the realisation phase. This is discussed in *Chapter 6.1*.

In addition to altering the text to the needs of the target group, the content is based on BCTs. Behaviour change interventions can be used to improve someone's health and health outcomes, given that the intervention uses BCTs [73]. Since the goal of this book is to improve the health outcomes of the users, BCTs are also incorporated into the content of the book.

The first book of the series, so the one that will be realised, mainly deals with forming intentions to change health behaviour, such as increasing the knowledge of the readers regarding DM2. Hietbrink et al. have developed an intervention approach that can also be applied to this project [38]. This approach has also briefly been mentioned in *Chapter 2.1.4*. The approach consists of three phases, (1) the initiation phase which is necessary to create intentions to know more about DM2 and create intentions to live a healthy life. (2) an action phase is used to transform the intentions into actual behaviour and the (3) maintenance phase is about trying to maintain this lifestyle, in the long run [38]. Based on these phases it can be stated that the book mainly is part of the first phase, the initiation phase, of this intervention approach.

Based on the initiation phase the book is a part of, phase-specific determinants can be identified. The phase-specific determinants that are selected are knowledge, risk perception, attitude and outcome expectancies. The selected phase-specific determinants are based on existing literature and a BCT taxonomy [38], [74].

With the establishment of the phase-specific determinants, related BCTs can be selected to actually achieve the goal. All available BCTs can be found in the BCT Taxonomy, this taxonomy is used to select the specific BCTs [74]. Furthermore, multiple papers of literature are used to base the BCTs on [38], [75], [76]. The determinants with the selected BCTs can be found in *table* **??**.

	Knowledge	Risk perception	Attitude	Outcome expectancies
4.1 - Instruction on how to perform the behaviour	x			
5.1 - Information about health consequences	x	x	x	x
5.6 - Information about emotional consequences				x
9.1 - Credible sources			x	
9.2 - Pros and cons			x	x
9.3 - Comparative imagining of future outcomes				x
13.2 - Framing and reframing			x	

Table 5.3: The selected BCTs for the phase-specific determinants

5.3.3 Style

The layout and style of the book also play an important role in how the book is perceived by the target audience. Creating content for people with low literacy can quickly come across as childish. If the book is perceived as childish, it is less likely to be used. Style plays a big role in this. Therefore, special attention should be paid to the layout of this book. This section discusses the multiple aspects that together make up the style of the book: icons for the chapters, illustrations and the layout of the book. Since style is partly a personal preference there is decided to perform an intermediate evaluation, during the realisation phase, to gain more insights into the opinions of the target audience. Therefore, this section mostly presents ideations on the specific aspects. These ideations will be discussed during the intermediate evaluation.

Icons for the Chapters

The first aspect that plays a role in the style is the icons that represent each chapter. The icons are placed on the four square buttons and the extending tabs that indicate the start of a new chapter. For each chapter, a representative icon is necessary to communicate what the chapter is about. For each chapter, a couple of ideations of icons are created. The ideations can be seen in *figure 5.8*.

The first chapter is about general information regarding diabetes, based on this four icons are created. Two variations of hands with a droplet of blood have been drawn. These icons are supposed to show the blood sugar level checking. The second icon that is created is an injection needle to indicate illness. The final icon that has been created is a diabetes awareness ribbon.

The second chapter in the book discusses the definition of a healthy life and its impact on diabetes. For this chapter two symbols are designed. Both icons have the

shape of a heart, indicating life. The first heart has a heart rate graph in it. The second heart has a healthcare cross in it.

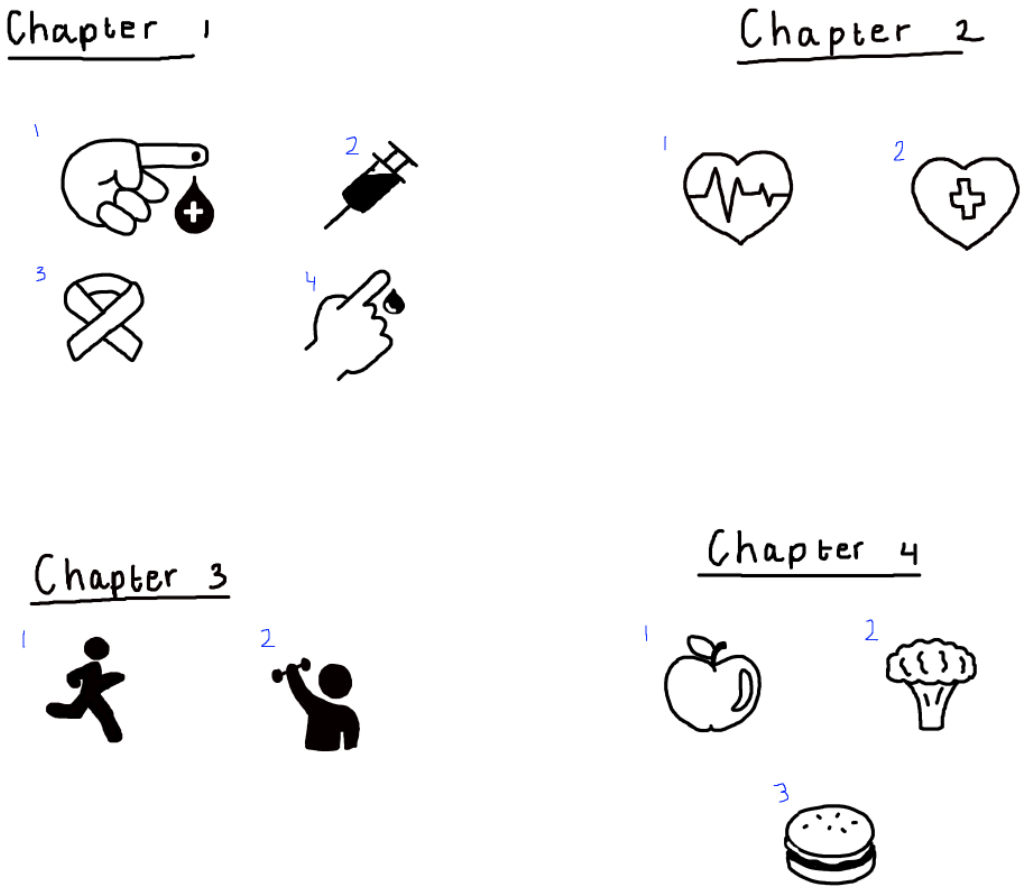


Figure 5.8: Ideation for icons for each chapter

The third chapter of this book is about physical exercise. This chapter discusses why daily exercising is important and some tips and tricks that make exercising easier and more fun. Two icons are created for this chapter. The first icon is a stick man figure that is running, indicating physical exercise. The second symbol that is designed is a stick man figure lifting a weight.

The final chapter discusses nutrition. This chapter discusses what healthy nutrition is and why it is important when one is suffering from DM2. To illustrate this chapter three ideations on icons are created. The first icon that is designed is an apple, which is often associated with healthy nutrition. The second icon symbolises broccoli, which is also a healthy vegetable. The last icon is a burger. Even though this is not considered to be healthy food, it can be an icon that the target group associates with nutrition, therefore it is included in this ideation.

Layout

The layout plays a big role in the total style of the book, this should therefore be carefully considered. Since there are many types of layouts, fonts and colours available these aspects will be addressed for the intermediate evaluation.

For the colour choice in total six colour palettes are selected. These palettes can be found in *Appendix D.2.1.* Two neutral colour palettes are selected with neutral tones of green and blue. Two brighter palettes are selected also in the colours green and blue. Moreover, a bright colour palette is selected with the colours yellow, orange, pink, purple and blue. Finally, also a pastel palette is selected. These palettes will be presented to the participants of the intermediate user evaluation. Based on their opinions a final colour palette will be selected for the final layout of the book.

Additionally, the font of the text of the book can be investigated. For this four types of fonts and four font sizes are selected. Also, these options are presented to the participants of the intermediate evaluation. The fonts and the font sizes that are selected for the evaluation can be found in *Appendix 5.3.3*

Illustrations

The style of the illustrations plays an important role in how the book is perceived. There are different types of illustrations, like realistic illustrations, simple line drawings, cartoon-like illustrations and animated illustrations. What type of illustrations will be used in the book is determined by the outcomes and results of the intermediate user and expert evaluation.

5.4 Interaction and Experience

To define the interaction and the experience of this concept, an interaction diagram is created. The first section discusses this interaction diagram. Additionally, two personas are created in the second section. The final section of this part discusses a design scenario, describing what a possible interaction could look like.

5.4.1 Interaction Diagram

To visualise the interaction in a flowchart, an interaction diagram is created. Interaction diagrams are used to visualise the sequence of interaction [77]. The interaction diagram that is created for this project, is displayed in *figure 5.9.* The interaction diagram showcases two scenarios. However, both scenarios start with the user opening the book. Thereafter, two scenarios are possible. The first scenario that can happen is that the user does not know how to use the book. In this case, the user can press the help button on the case. Then, the book will talk out loud and the book explains how the book is supposed to be used. After this, the user can decide to either use the book as explained or to read the book for themselves. The other scenario that can occur is that the user knows how to use the book. In this

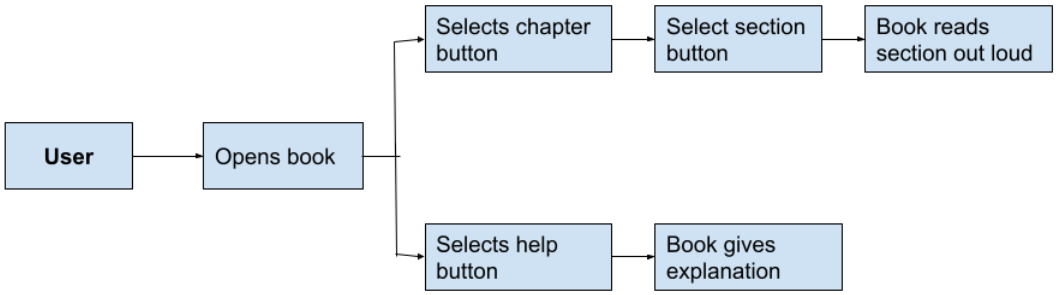


Figure 5.9: Interaction diagram

case, the user opens the book at the chapter and section that they want to read and then the user can press the button for the correct chapter and the button for the correct section. Thereafter, the book starts reading the text of that specific chapter and section out loud.

5.4.2 Personas

To investigate the possible users that might use this product, two personas are created. Personas in general help the researchers to empathise with the users and gain insights into users' habits, characteristics and personal circumstances [78].

Persona 1

The first persona that is created is named Dallas van der Zeeuw, this persona is displayed in *figure 5.10*. Dallas van der Zeeuw is a 67-year-old male, whose parents have an immigrant background. After having complaints for over a year that included fatigue and reoccurring infections, he went to the general practitioner (GP). Now, fifteen years ago, the GP diagnosed Dallas with DM2. After providing a lot of information about this chronic disease, the GP noticed that Dallas had difficulty understanding the information. Finally, after doing some tests, it was found that Dallas has low health literacy. Dallas claims to have difficulty with reading information about DM2, which results in having less knowledge about DM2. Because of this, Dallas claims to have difficulty with making healthy decisions.

Dallas has a laid-back personality. He is rather introverted and therefore a bit more passive. He also feels that he is more lazy than outgoing since he likes to game on his PC and he likes to watch sports games. This results in little physical activity on a daily basis. Furthermore, he likes to have drinks with his friends. Other than the weekly alcohol consumption, he considers his lifestyle quite healthy. However, according to the GP, Dallas still has much to learn in order to improve his lifestyle to a healthier one.

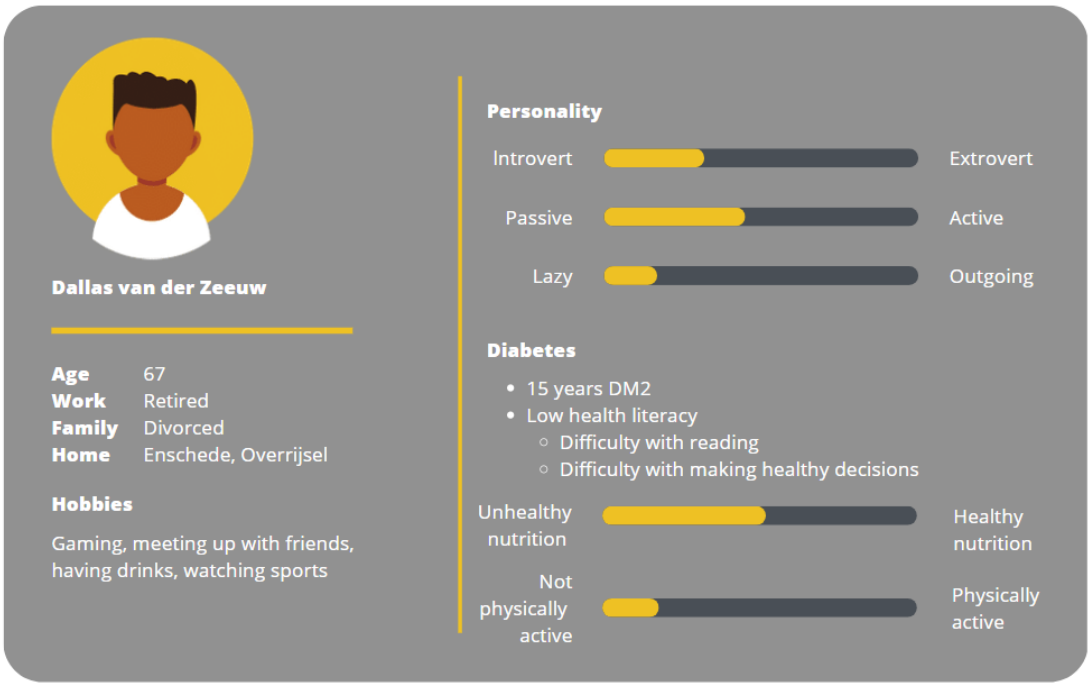


Figure 5.10: Persona 1: Dallas van der Zeeuw

Persona 2

The second persona that is created is named Donna Smit, her persona is displayed in *figure 5.11*. Donna is 45 years old and lives with her husband, three children and dog in Enschede. She has one son and two daughters all aged under the age of 12, so still relatively young. Donna works at a local hairdresser's saloon for three days a week. Two years ago she noticed that she was remarkably thirsty at unusual times, additionally, she was very tired. After visiting the GP and performing some tests Donna was diagnosed with DM2. The GP noticed that Donna asked questions about things that had already been discussed and when the GP used the teach-back method, Donna was unable to re-explain it. After some tests, recently it was concluded that Donna has low health literacy.

However, now Donna is stuck because she does not understand most of the information about DM2. Therefore she cannot make any changes in her lifestyle since she does not really know what to change.

Donna is an outgoing person. She is extroverted and she likes to take initiative. In her free time, she likes to take her dog for a walk. Furthermore, she likes to do fun things with both her friends and family. Because she likes to take her dog for a walk she does consider herself to be somewhat physically active. On the other hand, she does think that she can still learn a lot about healthy nutrition. The GP thinks that she can gain a lot of knowledge from a self-management program tailored to her needs.

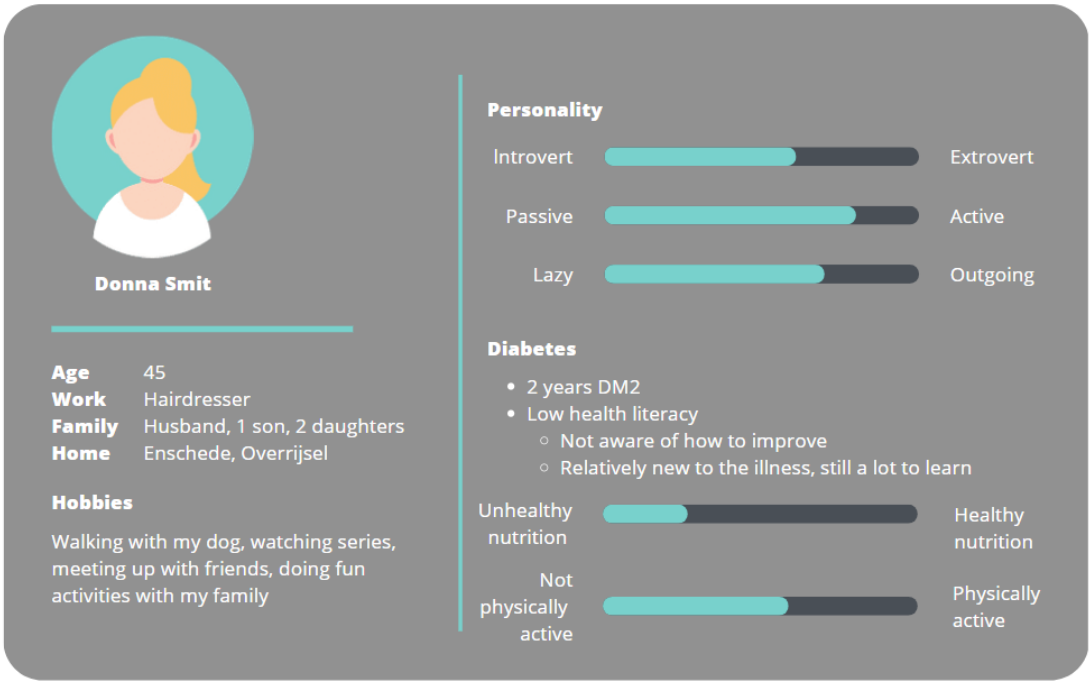


Figure 5.11: Persona 2: Donna Smit

5.4.3 Design Scenario

This section describes a design scenario for this prototype. A design scenario can be defined as a narration on the envisioned usage of a product or system that is still to be designed [79]. Since this prototype is still in the process of being created, this technique is useful to showcase how the usage of this prototype could look like. The second persona that is created in the section above, Donna Smit, is used as a user in this design scenario.

Donna Smit has regular appointments with a diabetes nurse every three months to discuss how it is going. When Donna sits down in the office of the nurse, the nurse hands her Het DiaBoek. The nurse explains that this book can help Donna and others that face similar issues as Donna with getting a better understanding of this disease. The nurse explains that the book can read the content of each section out loud at a slow pace, this will hopefully help Donna to understand the content of the book better. Furthermore, the nurse explains that the book has four chapters, each addressing different topics that are important for the management of DM2. The nurse mentions that every chapter is concluded with small exercises that Donna can fill in. During their next appointment three months later, Donna and the nurse can discuss the assignments. Donna can take the book home and read the book when she has time for it.

Two days later the three kids are at school and Donna's husband is at work. She finally has time to start reading the book. She switches the book on, with the switch at the side of the bookcase. Then Donna opens the book and browses through the four chapters to quickly see what the book looks like. She decides she

wants to start with chapter one, by using the correct tab for this chapter, she ends up at the introduction page of the first chapter. When Donna starts reading the first sentences she notices that she has difficulty with understanding the text. She remembers that the nurse mentioned that the book can read the text out loud, but she does not remember how to do it. Then, she sees the help button with a question mark. Donna presses the button and the book starts talking about how to use this audiobook. The voice explains that she can select a chapter that she is reading with squared buttons and that she can select a section with round buttons that are numbered from one to six. When the explanation has ended Donna tries to do it for herself, she selects the first chapter with the matching icons on the button that matches the icon of the chapter. Then she selects the first section. As expected, the book starts reading the text of the first section of the first chapter. Donna starts reading along with the voice which makes the text more comprehensible since she can read and hear the text now. Additionally, she looks at the illustrations that clarify the text. After reading four sections of the first chapters she needs to pick up the children from school, so she will continue at a later time.

A week later Donna has time to sit down with the book again. She remembers how to let the book read the text out loud, so she selects the first chapter and the fifth section. The book starts reading and Donna starts reading along with the book. After finishing the fifth section, there are six small assignments. Donna starts making the small assignments. One of the questions of the assignment has a bold word in the question. Donna does not remember the definition of the word 'bloedsuikerspiegel'. So she goes to the glossary at the end of the book and she reads the definition of 'bloedsuikerspiegel'. Now that she knows the definition again, she can answer one of the questions. Donna finishes all the questions for the first chapter.

After three months Donna has a check-up appointment with the diabetes nurse. Up until that meeting Donna was able to read the first three chapters. She also has made the assignments for those three chapters. The nurse and Donna discuss Donna's answers to the assignments that she has made. Furthermore, Donna can ask questions that she still had after reading the book. When the nurse asks if Donna wants to continue reading the last chapter and potentially also the second book, Donna is really enthusiastic. She thinks that the book is tailored to her needs and the book helped her to understand her illness better! Donna would recommend this book to others who also suffer from DM2 and who have difficulty understanding information regarding their health.

5.5 Target Audience

Based on this specified concept, the target audience for this specific concept can be identified as well. As was stated in this chapter, the aim of the first book is to initiate new behaviour. This new behaviour is aimed at creating new behaviour and habits regarding lifestyle activities. This book is therefore aimed at people who just got diagnosed with DM2 and how low health literacy. GP's can hand this book to people who have just been diagnosed with this disease and to those whom the

GP suspects have low health literacy. When handing this book to people who just got diagnosed with DM2, allows those people to get a better understanding of their illness early on in the disease. It is anticipated that this facilitates people with DM2 and low health literacy to better self-manage their illness.

Chapter 6

Realisation

Based on the specification of the concept, the realisation can be executed. To involve the specific target group as well as experts in the design process, an intermediate evaluation was executed. This chapter addresses the outcomes of the evaluation as well as the improvements that are made to the specified concept. Thereafter, this chapter discusses how this concept, using electronics, style and hardware of the book is realised.

6.1 Intermediate Evaluation

After specifying the chosen concept, the choice was made to conduct an intermediate evaluation. With this intermediate evaluation, the researcher could get a better understanding of the users' needs regarding the style of the book. Based on the outcomes and the results of the intermediate evaluation, specific design choices were made with the results of user testing as a supporting reference. The intermediate evaluations took place between May and June 2023.

6.1.1 Study Objective

The aim of this intermediate evaluation is to get insights into the preference of potential users regarding specific design elements in the style. Based on the preferences, specific design choices can be made with the opinions of experts and potential users as references. The aim is to gather many opinions and thoughts of people with different backgrounds. This results in many perspectives which can bring light to interesting issues.

6.1.2 Methods

Recruitment

To obtain input from different and multiple stakeholders, it was decided to include participants with low health literacy as well as experts on the target group. Additionally, design experts were included. Also, experts on DM2 and health, in general,

were included. Based on these inclusions, experts and participants were recruited.

For recruiting participants from the target group, over thirty emails were sent to organisations with potential connections to this target group. The recruitment email that was sent to the organisations can be found in *Appendix F.1.* To whom the emails were sent with the outcomes of the emails can be found in *Appendix F.2.* After emailing back and forth with a few organisations, an employee of ABC Overijssel sought contact with a phone call. She helped the researcher recruit one person with low health literacy. Additionally, an employee of Pharos replied to the recruitment email. The employee recruited a low-health literacy expert.

For the recruitment of the design expert as well as a DM2 expert the network of the supervisors of this project was used.

Data Collection

For the research with the design expert, the low health literacy expert and the participant from the target group, a semi-structured interview was conducted. So, based on the responses of the participants follow-up questions can be posed. This method of data collection allows the researcher to explore interesting aspects of the participant's responses. Semi-structured interviews resulted in qualitative data. The qualitative data were collected by means of recording the evaluation sessions' audio. Additionally, notes were taken during the evaluation session. The notes took two aspects into account, the answers the participants give and the body language of the participants. The notes and transcripts of the interviews were analysed by means of highlighting the most interesting and remarkable comments and outcomes. These outcomes are discussed in this report.

The health expert that was recruited, did not participate in an interview. The health expert was asked to fact-check all the information in the book. This results in qualitative data. This data is processed by means of taking the suggestions into account and improving the content of the book where necessary.

Procedure

As all the experts and the participants have different areas of expertise, the procedure differed slightly for each of them. However, they all started with an introduction and signing the informed consent forms and they all concluded by debriefing the evaluation. The paragraphs below each describe the specific procedure of each evaluation.

The first intermediate evaluation was the evaluation with the low health literacy expert. The interview started with posing questions about the experts' experience. Next, the design concept was explained. Then, the concept was discussed by means of eight questions, excluding the sub-questions. Aspects that were included in the questions are; colour use, illustrations and font. The specific questions can be found in *Appendix E.1.*

The second evaluation is the evaluation with the design expert. First, some time was dedicated to the expert to explain his expertise and his experiences. After his experiences, a set of questions was asked. For this, a set of guiding questions

were formulated. The questions touch upon subjects such as how to address serious topics, how to make a book more engaging and how to make the assignments in the book more fun and engaging. The exact questions that were formulated can be found in *Appendix E.2*.

The third evaluation took place with a participant with low health literacy. First, some demographic questions were posed to start this evaluation. Thereafter, the design concept was explained to the participant. Then, the concept was discussed by means of eight questions, excluding the sub-questions. The questions that were asked to this participant are also asked to the low health literacy expert. These questions can be found in *Appendix E.1*.

The fourth expert that was asked to join this evaluation is the health expert. The procedure for this evaluation was to send the written text of the book to the expert via email. Thereafter, the expert wrote down her thoughts and feedback. Then, she sent the document with her notes back to the researcher.

Ethics

To carry out this intermediate evaluation, an ethics review was submitted to the Ethics Committee of Computer and Information Science (EC-CIS). The request consists of eleven sections, each addressing (ethical) issues that can arise during the execution of the research. Accompanying the request an informed consent form and an information letter were written. Both the information letter and the informed consent form followed the template of the University of Twente.

For the informed consent form, first the text was written on a regular Dutch level. Taking the research on communication strategies for people with low health literacy into account, the informed consent form was revised in a way that is more appropriate for the target group. To check if the language is appropriate for this target group, the website 'Is het B1?' was used [80]. The informed consent form can be found in *Appendix C.1*.

For the information letter, the letter was initially written in Dutch, based on a template of the University of Twente. To make the letter better comprehensible for the target group, communication strategies for people with low health literacy were used. First of all, simple language was used. Furthermore, the text was structured in sections to make the information less dense. Finally, at the end of the letter, a summary is included to highlight the most important information from the letter. Furthermore, the website 'Is het B1?' was used to check if the language is on an appropriate level for the target audience [80]. The information letter that was written can be found in *Appendix C.2*.

For the experts, an altered informed consent form and information letter were written. The informed consent form for the experts can be found in *Appendix C.3*.The information letter for the experts can be found in *Appendix C.4*.

On May 8^{th} the review was approved by the ET-CIS, indicating that the researcher is allowed to carry out this usability evaluation.

6.1.3 Results

This section discusses the results of the intermediate evaluation. Each of the sections down below discusses the results of the specific participant.

Low Health Literacy Expert

Participant Characteristics
To get insights from a low health literacy perspective, a 53-year-old male was recruited. According to himself, he is ex-illiterate. The expert is Taal Ambassadeur (roughly translates to language ambassador) for the Dutch organisation Pharos. Pharos is a healthcare organisation that strives to have equal and optimal healthcare for everyone [81]. The role of the Taal Ambassadeur is to check content, letters, websites and flyers from this organisation and others if they are on an appropriate level to be comprehensible for most people. Furthermore, his role is to promote going back to school to other adults who are facing problems with language and possibly low health literacy. This low health literacy expert also has DM2.

Findings
The low health literacy expert provided perfect insight into what it is like to have low health literacy. He explained how overlooked this issue is since everyone assumes that anyone can read and write. According to him, in the last couple of years, more awareness has been raised for this issue, however, it should be even more known than it is now. When explaining his experiences it became clear to the researcher how urgent this problem really is. His experience truly showed the researcher that none of the available health-related information about DM2 is tailored to his specific needs. Eventually, he found this frustrating as he always had to rely on his sister for information.

When explaining the concept of this graduation project, he reacted enthusiastically. The main outcomes of the aforementioned questions were that the font should be big and not light. The text should be clearly readable, so with contrasting colours. Furthermore, the expert preferred realistic pictures. Inquiring about the icons for chapter 1, visualised in *figure 5.8*, the expert favoured the icons depicting fingers and droplets of blood. The other icons were not specific enough and not specifically related to diabetes. For the second chapter, the expert thought that none of the icons were fitting. For the chapter about exercising, the experts did not have a preference for the two icons. Both of the icons would be fitting according to him. For the final chapter, the expert said explicitly to not use the burger icon. This icon is related to unhealthy nutrition. Since chapter four is about healthy nutrition, these two should not be associated with each other. Additionally, the expert thought that adding exercises to conclude each chapter would be a good idea to test the knowledge as well as to start a conversation with a GP.

Design Expert

Participant Characteristics

The expert that was recruited has a technical and design background. The design expert is working at a company called 8D Games. This company focuses on gamification of serious topics in the areas of healthcare, education and government. Their ultimate goal is to teach children aspects that are not (sufficiently) taught in school. They want to make children resilient for the future.

Findings

An interesting outcome of the interview is the double-diamond approach that the design expert uses within his company. This is a design approach that makes use of two diverging and two converging phases to ultimately reach the final solution [82]. This is an interesting method since this differs a bit from the Creative Technology Design Process that was followed for this project.

Another interesting aspect of this conversation was how his company addresses serious topics in their games. According to the expert, they try to show multiple perspectives in their games, which makes these serious topics more accessible to be discussed.

Lastly, the small assignments that conclude each chapter in the book were discussed. The expert gave some good insights into how to make these assignments less boring and basic. For example, involve someone in the user's direct environment with the assignments. This will have a positive influence on the users. Additionally, he mentioned making use of creative ways to answer the questions. For example, instead of writing the answer, allow the user to draw the answer.

Participant with Low Health Literacy

Participant Characteristics

For the participant with low health literacy, a 48-year-old male was recruited. This male is also Taal Ambassadeur (roughly translates to language ambassador) for the region of Overijssel for the organisation ABC. He has low health literacy and he struggles with numerous illnesses. The male does not suffer from DM2, but he is familiar with the disease.

Findings

When presenting the participant with the concept of this prototype, the participant reacted in a very enthusiastic way. The participant thought that this prototype could educate people with low health literacy so that it is understandable for them. After presenting the concept some design questions were posed, as described in the study design. From his answers, it became clear that he prefers a font that is big with bold letters. He also prefers a big size for the letters, since this enhances the readability. For colour use, he suggested using colours that fit with the images. He preferred the light blue palette as well as using red and yellow as colours. He also said that he liked it if the pages were off-white since that is less bright for his eyes. For images, he preferred realistic images. According to him, these images are the

clearest and showcase the message of the image in the best way. When asking him about the icons of the chapters, the participant had a couple of preferences. For the icons of chapter one, which are presented in *figure 5.8*, the participant preferred the two icons with the finger and the blood droplet. According to him, these are the most clear, since the injection needle is too generic. For the symbol of chapter two, the participant preferred the heart with the electrocardiogram (ECG) in it. Thereafter, the participant thought that both icons for Chapter 3 would be suitable. However, if people have difficulty walking, like himself, the second icon with the figure lifting a weight might be more inclusive. For the last chapter, the participant thought the fruit and the vegetable were more fitting since the burger is not considered to be healthy nutrition. Additionally, the participant was asked about adding small assignments as a conclusion of each chapter. The participant reacted positively to this suggestion, he thought that it could help the readers with checking if the knowledge was understood correctly. The final question was about the reading pace. The participant concluded that he likes a reading pace that is relatively slow, this gives him the time to comprehend the information.

Health Expert

Participant Characteristics
To obtain feedback on the content of the book, a female co-assistant from ZGT was recruited, who is also called a junior doctor.

Findings
The co-assistant checked the text and provided feedback and tips on how to improve the quality of the text. The main takeaway from this check is to include a glossary at the end of the book with reoccurring challenging words. Furthermore, she suggested some changes regarding repeating information throughout the book. Lastly, she fact-checked all the information that was written.

6.1.4 Conclusion

Based on the opinions of the participant and experts some aspects can be taken into consideration for the rest of the realisation as well as some improvements that can be made. First of all, based on the design expert's opinion the concluding assignments of every chapter can be made more engaging by involving others in there as well and thinking of creative ways in which the user can answer the question, by for example drawing the answer. The creation and development of the assignments are discussed in *section 6.3.3* down below.

Taking the feedback and comments of the content expert into account, it was decided to include a glossary at the end of the book. In the text some words will be printed in bold, these words can then be found in the glossary at the end of the book. The words that will be in bold, are considered difficult words that are not on a B1 language level. Additionally, some improvements were made to the text, for

example including the reason why the users might experience specific complications. This creates a better understanding for the users as to why they are experiencing specific complications.

Based on the feedback and thoughts of the low health literacy and the participant with low health literacy many conclusions can be made. First of all, concerning the font of the book, the font should be big and easily readable. Both the expert and the participant preferred a font called Comic Sans. When asking about colour use in the book, there was not one obvious favourite. The most important for colour use is that the colours should be contrasting with the text and preferably the colours that are used should match images that are positioned in the book. For the icons, it became clear that the images should not be too difficult, but on the other hand, they should be specific enough. Additionally, both the expert and the participant preferred realistic images over drawn images, since this provides the user with the most clarity. Finally, when asked about the reading pace of the book, they both indicated that they preferred a slower reading pace. The participant indicated that a slower reading pace gives him more time to process what is being said, which makes it easier to comprehend for him.

These conclusions will be taken into account for the rest of the realisation, to make adjustments in such a way that the prototype will be better suited for the specific needs of the target audience.

6.2 Electronics

An important step in the realisation phase is working out the electronics. To be able to read the text of the book out loud, this project makes use of some electronics, like buttons and a speaker. During the realisation phase, the specific electronics are realised and integrated. The sections down below describe the electronics that are used and realised.

6.2.1 Microcontroller

For all the electronics one main driver will be used, the Arduino Uno. This is a microcontroller that can be used for the controlling and creating of digital devices and setups [83]. Accompanying the Arduino Uno is a breadboard, on which the electric circuits are composed. Next to that, wires are necessary to connect all the different components together on the breadboard. Usually, the microcontroller is powered by means of a connection to a laptop. However, to enhance the mobility of the book, a 9 Volts battery pack is used to power the Arduino Uno. To connect the battery pack to the Arduino a snap connector is necessary. Furthermore, an on/off switch can be used to switch the battery on and thus the audiobook on and off. For this an on/off switch was selected: the Solder Lug SPST On/Off Mini Boat Rocker Switch [84]. The on/off button, the battery and the Arduino Uno are connected by means of a power jack connector. The placement of the on/off button is on the right side of the case, as can be seen in *figure 6.4*.

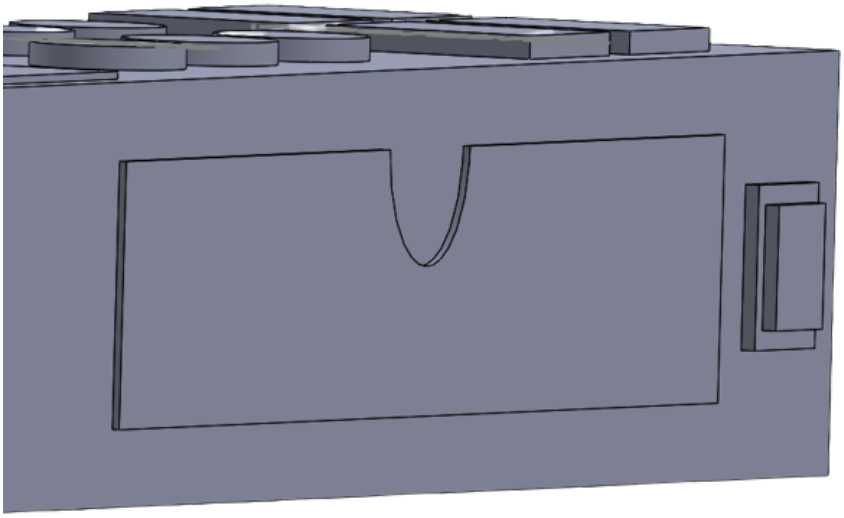


Figure 6.1: Positioning of the on/off button

6.2.2 Buttons

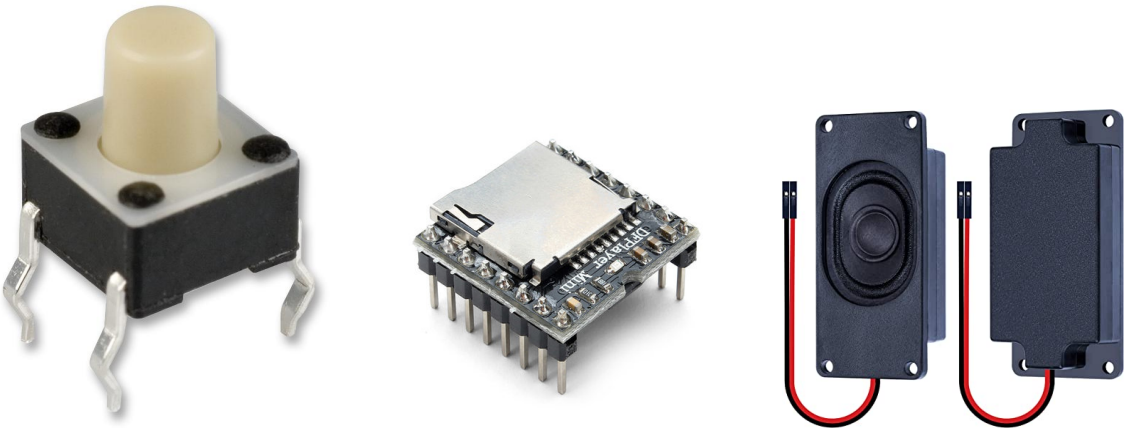
One of the components that is used for this project is buttons. In the section above it was already mentioned, however, eleven buttons are necessary to realise this project. For each of these buttons, the same type of button is used. It was decided to use the FSM10JH which is produced by TE Connectivity [85]. This button differs from other regular buttons because the height of the actual button that can be pressed is higher than usual. Therefore, this button is better suitable for this project because the button is high enough to exceed the thickness of the laser-cut case. A picture of the button is presented in *figure 6.2a*.

6.2.3 Audio

To 'read' the text out loud, an audio system is necessary. This consists of a speaker to increase the volume of the spoken text and an MP3 module to be able to play actual sounds from a Secure Digital card (SD card).

The Arduino Uno is able to play some simple sounds, however, it is not possible to play more complex sounds like spoken text. This is caused by the limited storage of the Arduino Uno. When spoken text needs to be played, it consumes too much storage. Therefore, MP3 modules are used to be able to play more complex sounds from an SD card. There are different MP3 modules available, however, for this project, there was chosen to use the DFPlayer Mini [86]. This is a low-cost and small MP3 module that is easy to use. The module can be used independently only with a speaker but with the use of a 1000 Ω resistor it can also be connected to the Arduino Uno. Additionally, a speaker can be easily connected to the module. The MP3 module is presented in *figure 6.2b*.

To increase the volume of the spoken text a speaker should be used. This speaker can be connected to the MP3 directly, on condition that the drive speaker has less than 3 Watts. Furthermore, the speaker should be quite small, since it should fit within the designed case. Based on these requirements a speaker was selected: the CQRobot Speaker [87]. The speaker is displayed in *figure 6.2c*. This speaker has a Wattage of 3, which was one of the requirements. Furthermore, the speaker has a width of 7 centimetres and a length of 3 centimetres. The speaker is 1.6 centimetres deep so, so it fits perfectly within the designed case.



(a) FSM10JH Button (b) DFPlayer Mini (c) Speaker

Figure 6.2: Button, MP3 module and speaker that is used

6.2.4 Wiring

All these separate components should be connected with wires to be able to work properly. *Figure 6.3* shows how the different components can be connected in one circuit. For buttons, it is necessary to use a pull-up resistor between the button and the ground. However, the Arduino Uno offers the possibility to use an internal pull-up resistor, which can be activated in the code. Since eleven buttons are used, this internal resistor is more efficient to use.
Breadboards are commonly used for prototyping; however, they are not very sturdy or reliable. The wires can easily slip out of the breadboard if it is not handled carefully. Therefore, there is decided to solder the electronic circuit on a perfboard. The circuit still has the same connections as presented in *figure 6.3*. However, the placement of the components is different to accommodate the layout of the top face of the case. This soldered circuit is presented in *figure 6.4*.

6.2.5 Software

To control the Arduino code is necessary. For this project, code is necessary to control the DFPlayer Mini as well as check if the buttons are pressed or not. The exact code that was written can be found in *Appendix E.4*.

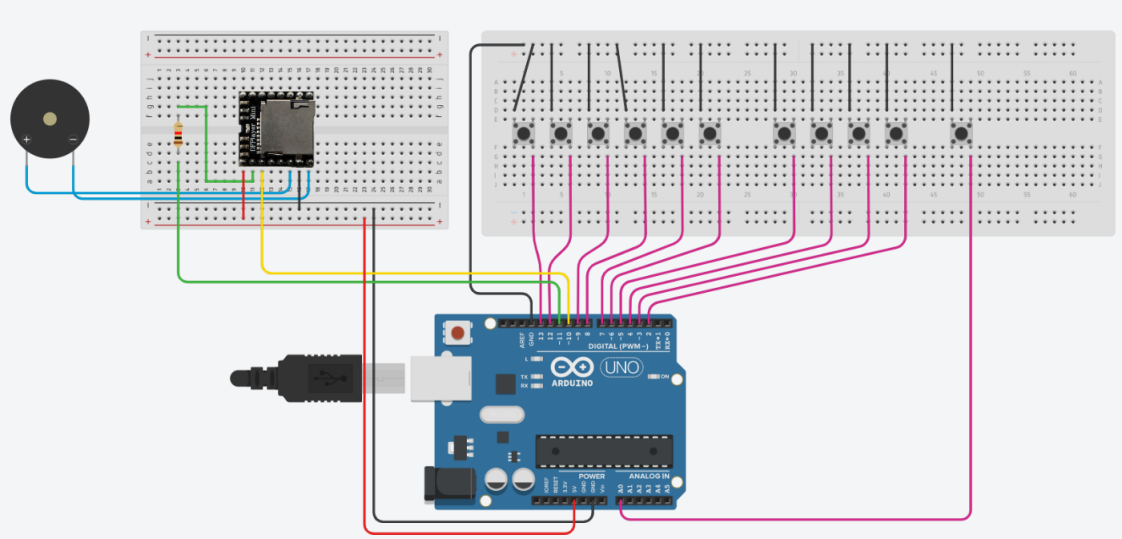


Figure 6.3: Electronic circuit

The code starts with initialising the DFPlayer Mini as well as initialising the buttons in two arrays. The first array is for the buttons of the chapters, the second array is for the buttons of the sections. In the setup, a variable for the current state and a variable for the previous state is created. These variables are an array consisting of two values; one value for the chapter and one value for the section. In the loop of the code, first, the code reads the values of the buttons for the chapter in an array. Then, the current state is updated for these buttons. Thereafter, the code reads the values of the buttons for the sections, also the current state is updated. Then, a nested for loop is used in combination with an if statement to loop through all the buttons and check if they are pressed. Depending on the pressed button for the section, a calculation is made to select the correct audio file. To conclude the loop of the code, all the values of the current state are reset.

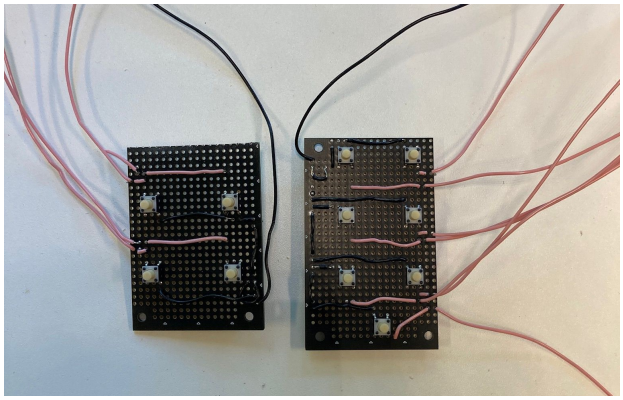


Figure 6.4: Soldered circuits of the buttons

6.3 Style

As mentioned in the previous chapter, the style of the book plays an important role in how the target group perceives the book. Based on the outcomes of the intermediate evaluation that is described at the start of this chapter, design choices are made for the style of this book. This section discusses these choices and the final look of the book.

6.3.1 Name of the Book

A short brainstorming session was held to come up with a name for this prototype. The brainstorming session can be found in *Appendix E.3*. Finally, it was decided to go with the name of 'Het DiaBoek'. This name is partly based on the app, on which this research is based, which is called the 'Diameter'. Het Diaboek is a contraction of the two Dutch words 'diabetes' and 'boek'. Together they make up 'DiaBoek' which, thus, roughly translates to the diabetes book.

6.3.2 Layout

The layout considers multiple aspects. For example, colour use, fonts and also how the book is designed and with which elements. The subsections down below discuss the realisation of these aspects of the layout.

Colour Use

First addressing the colour use. According to the intermediate evaluation, there was not one clearly preferred colour palette. Therefore, it was decided to make use of a blue colour palette. According to the definition of the colour blue, this colour is calm and neutral. It radiates positivity and wisdom [88]. These are fitting definitions for a colour of a book that is about one's health and educating the readers about their health. Additionally, the symbol of diabetes is also blue. The six colours that are used throughout the entire book are visualised in the colour palette in *figure 6.5*.

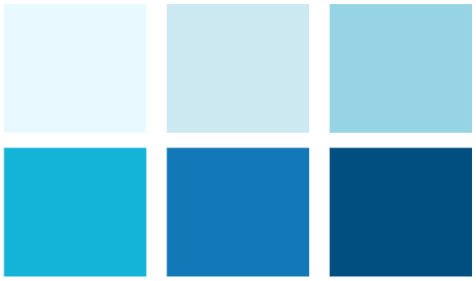


Figure 6.5: Used colour palette

Font and Size

The font of the written text is an essential aspect of this book. If the font is unclear or the font size is too small, the users might refrain from reading the book. This aspect was also asked about during the intermediate evaluation. Both the low health literacy expert and the participant with low health literacy indicated that they preferred the font Comic Sans of the four options. Both participants indicated that this font is bold and clearly readable. Based on this, for the final book it is decided to use the font Comic Sans in the book.

During the intermediate evaluation there was also asked about the font size. The participant indicated that he preferred a big font, like 14 or 16. The low health literacy expert's opinion was in the same line. Based on their opinions it is decided to use a font size of 14 for the regular text. For the titles of the sections, 16 is used. For the titles of the chapters font size 23 is used.

Icons for the Chapters

The icons for the chapters were also one of the aspects of the intermediate evaluation. The ideation for these icons can be found in *figure 5.8*, in *Chapter 5.3.3*.

For the first chapter, both the low health literacy expert and the participant with low health literacy preferred one of the icons with the hand and a droplet of blood. Based on their opinion, the simplest icon of the two is selected, since according to design guidelines less is more [89].

For the second chapter, there was not one icon that was clearly preferred by the expert and participant. The participant did like the heart with the ECG in it. Based on his opinion the heart icon with the heart ECG in it is selected for the book.

For the two designed icons for chapter three there was not one icon that was clearly preferred. Both the expert and the participant thought that the icons were very clearly visualising exercising. So both icons would be suitable in that case. However, the participant with low health literacy indicated that he has difficulty walking due to his illness. The icon of a person running is excluding him in that way. Therefore, to be inclusive, the icon of a person lifting a weight with their arm is selected.

For chapter four, three icons were designed. The expert was keen on the two icons of the vegetables. He said that the third icon of a burger should be regarded immediately since this has no association with healthy nutrition. The participant with low health literacy also preferred the two healthy food items. Based on their opinion, it was decided to select the apple as an icon for the fourth chapter.

After selecting the four icons, the icons have been realised and recreated in Adobe Illustrator [90]. This allows the researcher to resize the images easily as well as easily adjust the colours if necessary. The final icons are displayed in *figure 6.6*.

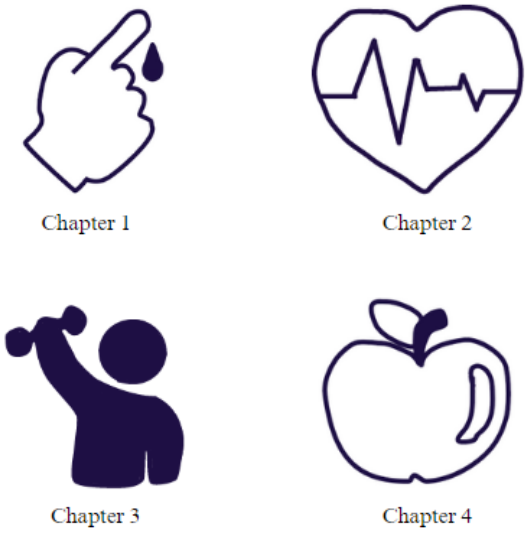


Figure 6.6: Selected icons for each chapter

Design of the Pages

After deciding on a colour palette and the font, the actual design of the pages was looked into. The book consists of a section which explains how the book works, four chapters and a glossary. So, in total there are six chapters. Each of these sections has its own colour. The first chapter starts with the lightest colour and the last chapter ends with the darkest colour. These colours are reoccurring in the book. For example, it is decided to make the title page of each chapter in that specific colour. Additionally, a small coloured bar is added to each page, indicating which chapter the users are currently reading.

In *figure 6.7* one of the pages of the book is showcased. Most of the reoccurring elements in the book are visible on this page. First of all, the coloured bar at the right side of the page. This colour is the lightest colour of the palette, which indicates the user is reading the section about the explanation of the book. These coloured bars are added to clearly divided the content into sections. This makes it more clear for the reader which part of the book the reader is reading. Furthermore, some of the text in the book is sectioned, this provides the reader with a better overview of the content. This is also one of the communication strategies which was investigated in *Chapter 2.1.3*. For this two types of sections are used. The first one is the light blue section, at the top of this page. This type of section is mostly used for enumerating lists. The second type of section is the dashed-line section. This section is mainly used to section specific information that belongs together. Using these sections creates a clear overview for the readers. Sometimes, the sections are also used to make the page look less overwhelming for the reader. This is also one of the communication strategies that was investigated in *Chapter 2*.

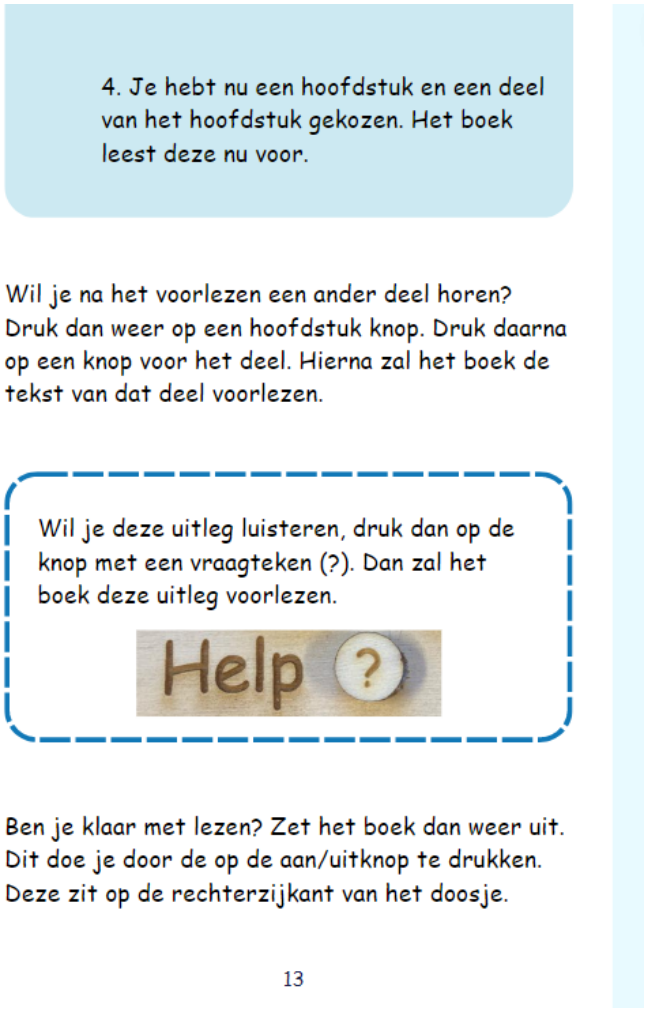


Figure 6.7: Page from the book

However, this page does not showcase all the reoccurring elements. Another element that is reoccurring is the underlining of important information. This makes the most important stand out from the other text. This is also mentioned in *Chapter 2.1.3* as a recommended communication strategy. Additionally, words that could be considered as difficult for the reader are printed in bold. These words can be found in the glossary. The glossary is a list of difficult words that occur throughout the book. The glossary is ordered alphabetically, so the reader can find the definition of the words easily. Furthermore, the book has many pictures and figures which support the textual content. Figures provide the readers with a visual explanation, which makes the content more comprehensible for the users. In these figures, red and green colours are used to indicate wrong and right, like was recommended as a communication strategy in *Chapter 2.1.3*.

6.3.3 Concluding Assignments

Every chapter is concluded with small assignments that test the users' understanding and knowledge. The user can discuss these exercises with the people in their surroundings as well as with the DM2 nurse. The type of exercises that are designed are based on the recommendations and suggestions of the design expert. The design expert advised against using exercises involving written and spelled-out answers. Since most people from this target group have difficulty with writing. He suggested types of exercises that involve drawing their answers, multiple choice questions and linking words to their meaning.

The first chapter is concluded by means of six small assignments. The first two assignments are about the anatomy of the human body. The questions ask the reader to point out the stomach and pancreas in a drawing of the human body. The first two questions are displayed in *figure 6.8*. The third question asks the reader about how the human body produces energy from food and drinks. To help the reader a bit, the steps are already given, however in the incorrect order. So, the reader is asked to put the events in the correct order. The fourth question asks the user about what goes wrong with the pancreas when one suffers from DM2. This question is posed in the form of a multiple-choice question. The fifth assignment is about indicating from which symptoms the readers suffer(ed). The last question is about indicating the difference between hyperglycemia and hypoglycemia. The readers can answer this question by means of making a drawing.

Also, chapter two is finalised with small assignments. The first exercise is about the abbreviation 'BRAVO', which is discussed in this chapter. The second question is about how often and how long one needs to exercise as a minimum, the reader can draw their answer. Finally, the last question is a multiple choice question, which is about DM2 remission.

The third chapter also consists of four small assignments. The first assignment is about what happens in your body and what happens with the insulin in one's body when exercising. This question is a multiple-choice question, so the reader can select the correct answer. The second question is about putting the events of exercising and its effects in the correct order. For the third assignment, the reader is asked to draw the most important tip for having more movement on a daily basis. Finally, the last assignment asks the user to involve family and friends. This question asks the reader how they can make exercising more fun for themselves. The questions suggest drawing their ideas as well as discussing them with their family and friends.

Chapter four is also concluded with three small assignments. The first assignment asks the readers to draw the 'Schijf van Vijf' and label each part. The second assignment presents six items of food and drinks. The reader is supposed to indicate whether the items contribute to healthy nutrition. The final exercise of the book addresses the definition of a dietitian, in the form of a multiple-choice question.

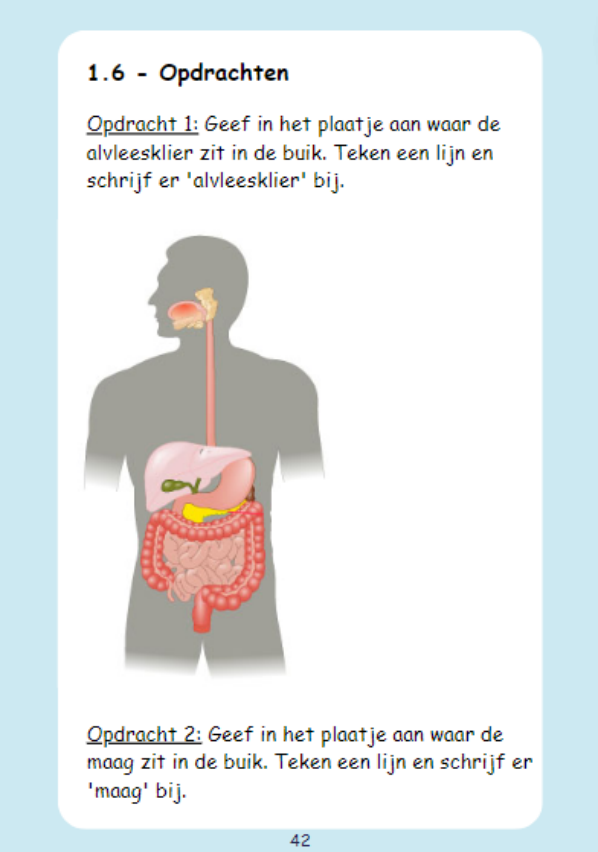


Figure 6.8: Assignment 1 and 2 for chapter 1

6.3.4 Used Communication Strategies

Most of the design choices for the layout of the book are made based on the communication strategies that were investigated and described in *Chapter 2.1.3*. For example, adding sections to the layout of the book to structure the content. This provides the user with a better overview of the text and it makes it less overwhelming for the user. Also, the text is written in plain language which is also one of the communication strategies. In the conclusion of *Chapter 2.4.1* an overview was provided of all the available communication strategies. Based on this original table with strategies (*table 2.2*), *table 6.1* down below, provides an overview of which of these strategies are used for the design of the prototype.

6.4 Case

In *Chapter 5.3.1* the dimensions of the case were already specified. Based on this specification a 3D model is created in SolidWorks [69]. This one differs from the previous one as it is made specifically for the laser cutter and includes the addition of, e.g., tabs and slots. This increases the surface of the edges, which makes the case less vulnerable when mounting it. This 3D model is visualised in *figure 6.9*.

Category	#	**Strategy**	**Is this strategy implemented?**
Written communication	1	Use plain language.	Yes
	2	Organise the main ideas in the text in unites.	Yes
	3	Use pictures.	Yes
	4	Underline important information.	Yes
	5	Put text underneath each other.	Yes
	6	Use pictograms.	Yes
	7	Use smileys in combination with corresponding colours.	Yes
	8	Draw out explanations.	Yes
Oral communication	9	Use plain language.	Yes
	10	Read instructions out loud.	Yes
	11	Write out instructions.	No
	12	Ability to record voice memos.	No
Interactivity	13	Use the teach-back method.	Yes
	14	Ask questions to the patients.	Yes
	15	Use (interactive) videos to illustrate concepts.	No
Environment	16	Create a trustworthy environment for the patients.	No
	17	Allow patients to bring family along to consultants.	No

Table 6.1: Summary of communication strategies with an indication of which strategies were implemented

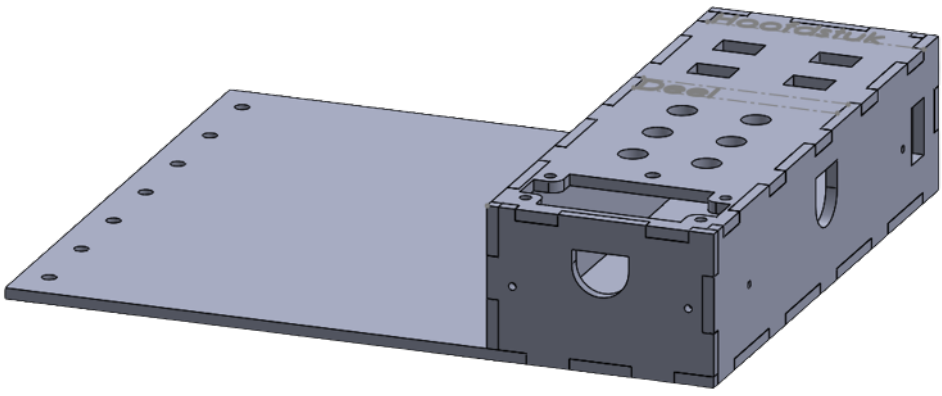


Figure 6.9: 3D model for the laser-cutter

The wood thickness of this 3D model is 4 millimetres. This means that the thickness of the laser-cut wood is 4 millimetres as well. After making the model in SolidWorks, the file is exported to Adobe Illustrator [90]. This program allows the addition of text on the top face of the case. Three words have been added to the top face of the case: 'Hoofdstuk' (Chapter), 'Deel' (Section) and 'Help' (Help). Based on the intermediate evaluation, the preferred font is Comic Sans MS. This font is also used for the top face of the case. The size of the letters is 10 millimetres. After customising SolidWorks files in Adobe Illustrator, the files are sent to the laser cutter. When picking the laser-cut parts from the laser cutter, the parts looked as follows, see *figure 6.10*.

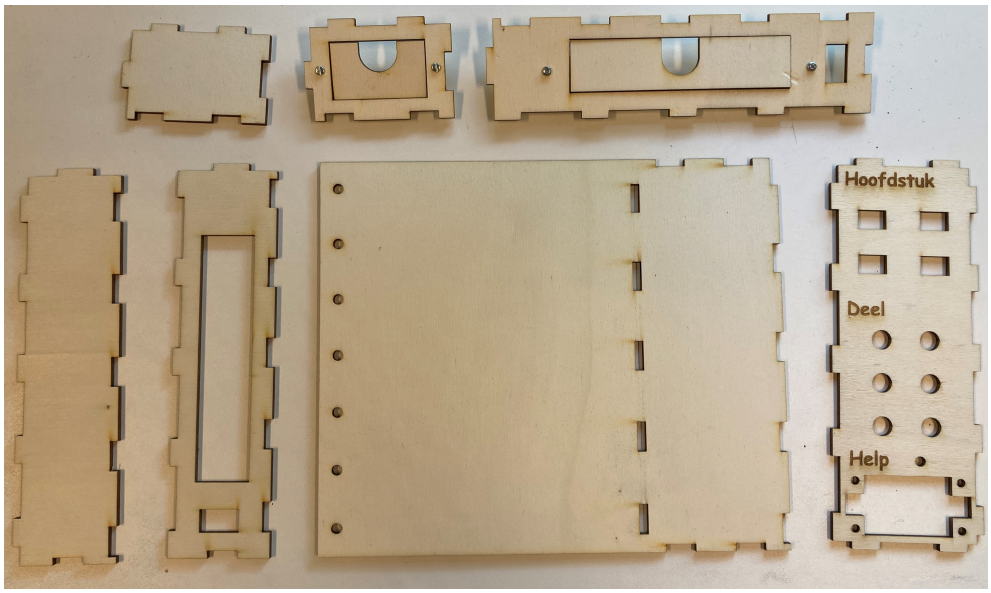
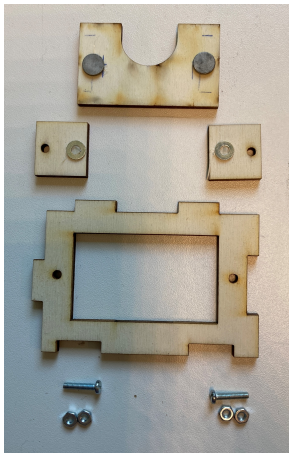
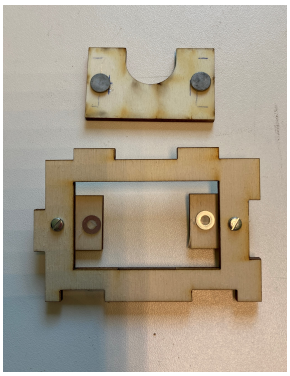


Figure 6.10: Separate parts of the case after laser cutting

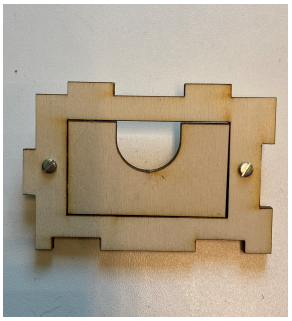
Before assembling the case and mounting it, the speaker should be attached to the top face and the entrances to the electronics should be mounted. The speaker is attached to the top face by means of four 2.5M screws and four bolts. Regarding the entrances to the electronics, a special mechanism is created, this is visualised in *figure 6.11*. For this idea, two 2.5M screws and four 2.5M bolts are used. This is presented in *figure 6.11a*. The idea consists of two small plates of laser-cut wood attached to the back side of this side of the case. For every screw two bolts are used. The plates are mounted in such a way, that one can see the two rings when facing this side of the case, as is visible in *figure 6.11b*. After this, two magnets can be glued on the 'door' of the entrance. These magnets should be aligned with the magnetic rings. When everything is mounted, the 'door' can be attached to the frame. The two pieces are held together by means of magnetism. This mechanism is created to ensure that the 'doors' of the entrance will not fall out of their frame when the prototype is being used. The final result is visible in *figure 6.11c*. This mechanism is used for both entrances.



(a) Components for the entrance to the electronics



(b) Entrance to electronics mechanism



(c) Finished entrance to electronics

Figure 6.11: Button, MP3 module and speaker that will be used

After assembling the entrances and attaching the speaker to the top face of the case, the entire case can be mounted. The sides can be attached to each other, after which they can be attached to the base of the case. The attachment is done by means of using wood glue. The final result of the case is presented in *figure 6.12*.

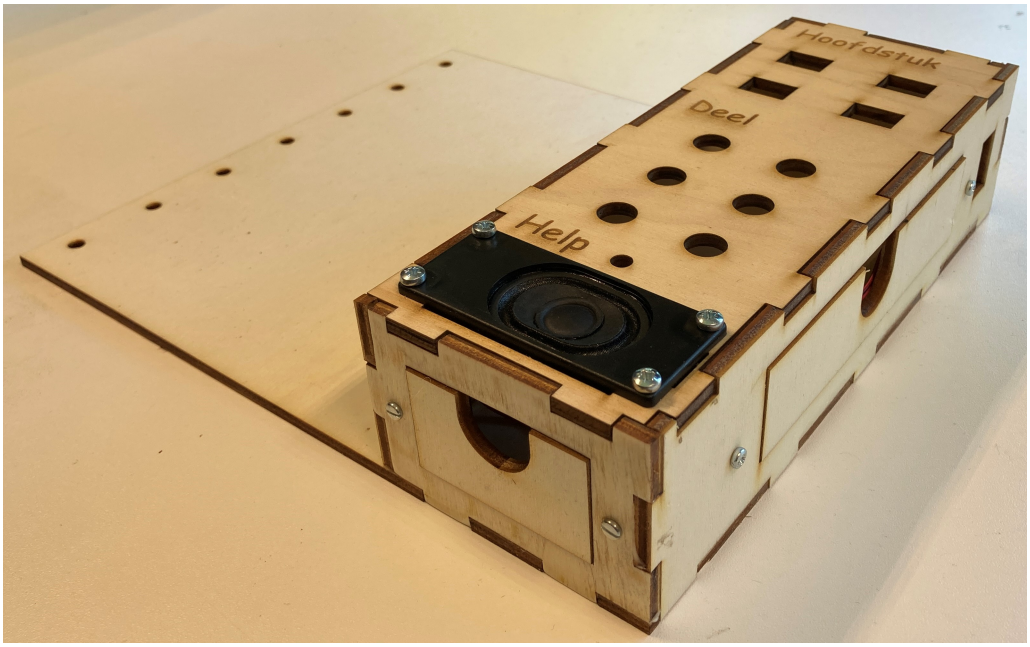


Figure 6.12: Assembled case

The case, however, is not finished yet. There are seven holes, with a diameter of 5 millimetres, present in the case. These holes serve as openings for the binding rings that will be used. This can also be seen in the dimensions that were established in *Appendix D.1.* It is decided to use binding rings of the Woodware Craft Collection. These rings come in four versions, for this project, the version with the biggest diameter of 50 millimetres will be used [91]. The material of the rings is metal. The case after attaching the rings is displayed in *figure 6.13.*

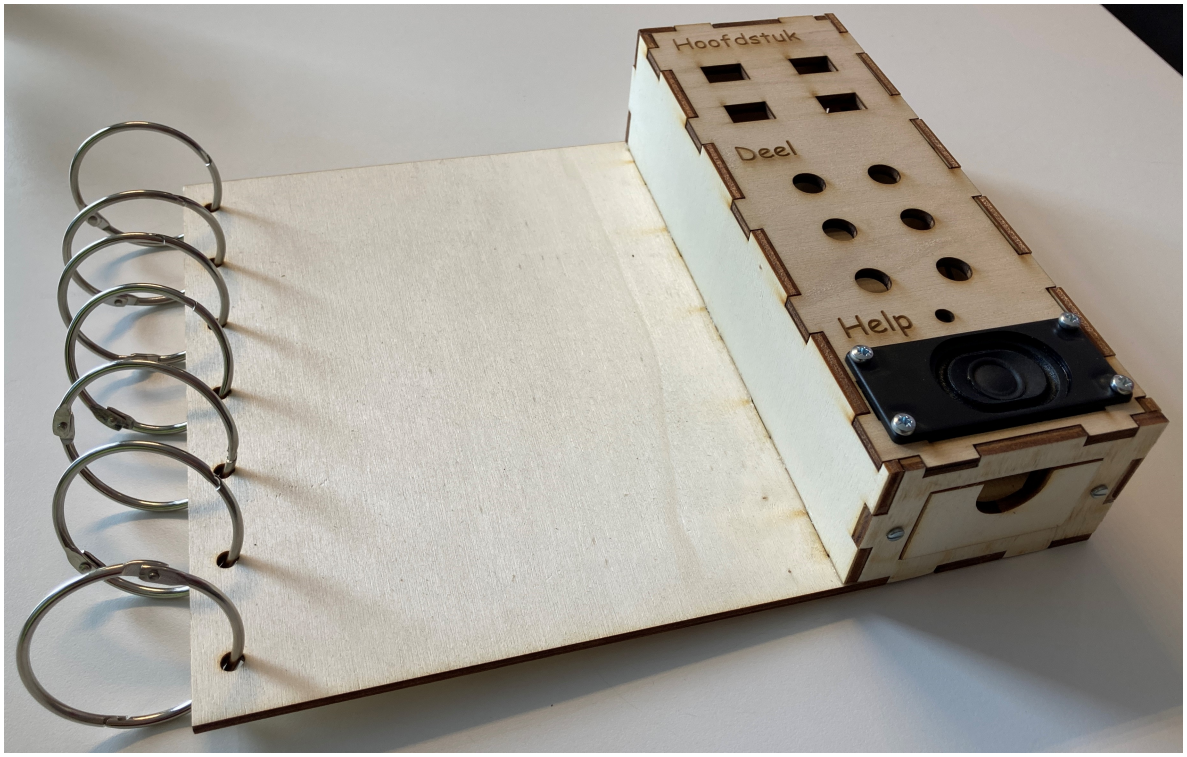


Figure 6.13: Assembled case with the attached rings

One of the final steps, in finishing the case, is adding the buttons to the case. The buttons that are used, are described in one of the *section 6.2*, earlier in this chapter. On top of these buttons, small laser-cut plates are glued, to indicate which button corresponds with which chapter and section. This principle is discussed in *Chapter 5.2.1.* Four of the plates have icons on them corresponding to each of the chapters. These plates are 3 centimetres wide and 2 centimetres high. These icons are discussed in the *section 6.3* above. Six of the buttons are numbered from one to six. These plates are shaped like a circle with a diameter of 2 centimetres. Additionally, one button is created with a question mark on it, to indicate that it is the help button. This plate is shaped like a circle with a diameter of 1 centimetre. For the numbers and the question mark, the font Comic Sans MS is used, like in the rest of the book as well. The icons, numbers and question mark are created in

the program Adobe Illustrator [90]. The small plates are laser-cut on wood with a thickness of 4 millimetres. These plates are visualised in *figure 6.14*.

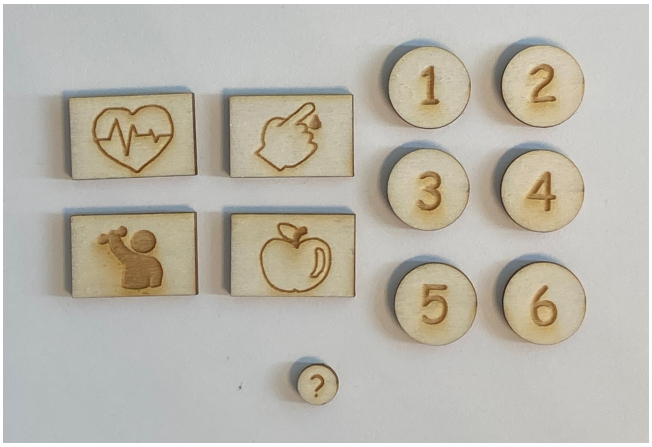
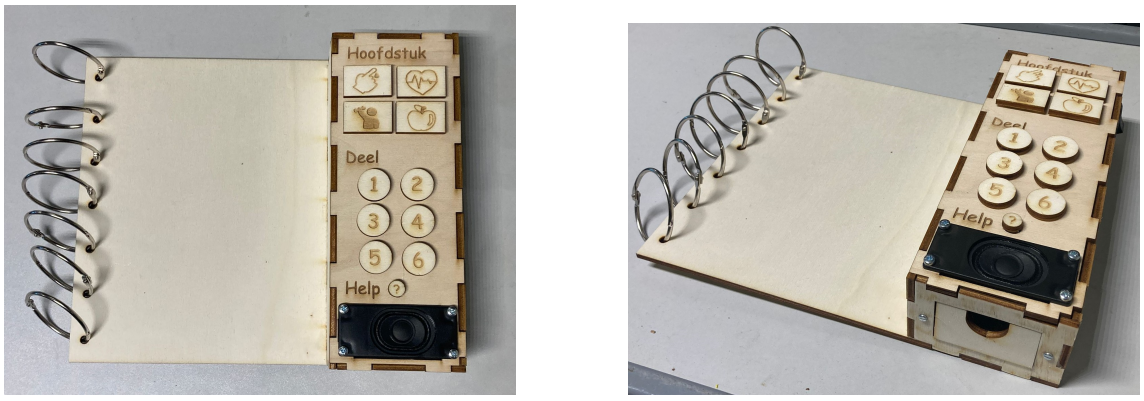


Figure 6.14: Plates for on top of the buttons

The button plates should be glued on top of the buttons in the soldered circuits, displayed in *figure 6.4*. Therefore, the soldered circuits are attached to the backside of the top face of the case. All the available screws at the university are too long, which results in the screws being visible on the top face of the case. Therefore, it is decided to use tape to attach the soldered circuits to the backside of the top face of the case. Additionally, all the other electronic components are placed in the case. This includes the Arduino Uno and the electric circuit with the DFPlayer Mini. Thereafter, the case is closed by placing the top face on top of the other case. Henceforth, hot glue is used to attach the button plates to the actual buttons. The final result of the closed case with electronics and the buttons attached to it is presented in *figure 6.15*.



(a) Case with buttons, top view

(b) Case with buttons, trimetric view

Figure 6.15: Case with buttons

The second to last step in finishing this prototype, is adding the printed book to the case. The designed book was sent to the printer Xerox Carré at the University of Twente. After the book was printed, seven holes are made in the book, according to the seven holes in the case. These holes serve as opening for the binding rings. Thereafter, the book was attached to the case by means of the binding rings. Finally, the last step is to add the chapter dividers in each chapter. For this, four squares of the same size are printed twice. The squares have the icons and colours of each chapter. One of the squares is attached to a small paperclip with tape. The other similar square is taped on the backside of the paperclip. This is repeated for the dividers of each chapter. Thereafter, the dividers are correctly placed in the book. The final prototype is presented in *figure 6.16*.

Figure 6.16: Final prototype top view

Chapter 7

Evaluation

This chapter discusses the evaluation of 'Het DiaBoek'. Before evaluating the product, first, the study design is formulated. The section below discusses this study design by means of addressing the aim of this study, the participants and recruitment, data collection and the procedure. The section thereafter presents the results of the evaluation. The evaluation is divided into two sub-sections: a functional evaluation and a usability evaluation. The results of both evaluations are presented.

7.1 Study Design

This section describes the study design of this evaluation. The evaluation mainly consists of qualitative research, resulting in qualitative data. This data is gathered by using the think-out-loud principle when the participants carry out tasks and by using semi-structured interviews to ask about the participants' experiences.

7.1.1 Aim

There are two aims that this evaluation tries to tackle. The first aim is to get an answer to the third sub-research question that is mentioned in *Chapter 1.1*. This sub-research poses: *'To what extent is the designed prototype useful for people with DM2 and low health literacy to teach them about diabetes lifestyle self-management?'*. This question is about evaluating the usability of the designed prototype. To test the usability, there is focused on three aspects: (1) subjective satisfaction, (2) aesthetics and (3) whether the prototype is tailored to the needs of the target audience. These assessed aspects determine the usability of the prototype. Additionally, this evaluation aims to check whether this prototype meets the formulated functional requirements.

7.1.2 Participants and Recruitment

The target group that was asked to participate in this evaluation is people who suffer from DM2 with low health literacy. People who only suffer from DM2 without low health literacy were excluded. People that solemnly have low health literacy were

included. Additionally, experts were also asked to participate in the evaluation to obtain a wide range of perspectives. The experts that were included in this study have fields of expertise that should include one of the following: DM2, low health literacy, human-computer interaction (HCI) or eHealth.

Recruitment of Participants

In general, the above-mentioned target audience is challenging to reach due to several reasons. Firstly, individuals suffering from DM2 form a specific group, which poses a challenge in itself. Moreover, the participants must also exhibit low health literacy, making it even more specific. Additionally, low health literacy is often undiagnosed, and people are generally unaware of others with this condition, complicating efforts to reach people with low health literacy even more.

To recruit participants, the recruitment method was used as the intermediate evaluation, as described in *Chapter 6.1*. Because of this, the recruitment of participants and experts is partially the same for this study as for the intermediate evaluation. In total, over thirty emails were sent to organisations with potential connections to this target group. The recruitment email that was sent to the organisations can be found in *Appendix F.1*. To whom the emails were sent with the outcomes of the emails can be found in *Appendix F.2*. After emailing back and forth with a few organisations, an employee of ABC Overijssel sought contact by calling. She helped the researcher recruit two participants.

After sending the recruitment emails, for a while, there was no positive result. Therefore, it was decided to post a LinkedIn message to reach more people. The text of the message that was posted on LinkedIn can be found in *Appendix F.3*. This LinkedIn post was shared by an expert whose expertise lies in lifestyle coaching in Twente. The LinkedIn post resulted in, the researcher visiting a dietitian in Hengelo. Unfortunately, the dietitian could not be of more help.
Originally, it was planned to recruit five participants. According to Nielsen, five participants can be very insightful since they bring most issues to light [92]. Also, having a smaller group allows the researcher to take more extensive notes, which can make the reporting more effective and easy [92]. In reality, however, only two participants could be recruited. This is less than expected. However, Nielsen does state that two participants can bring light to half of the usability issues [93]. Therefore, two participants are sufficient to point out the biggest issues of the design.

Recruitment of Experts

Additional to patients evaluating the prototype, experts were included in the evaluation. Experts were included to complete the functional evaluation as well as the regular usability evaluation. Experts were included because of their expertise; this means that they could indicate issues that users may not be aware of [94]. The experts could look at the prototype from another perspective which can be very insightful for the evaluation of 'Het DiaBoek'. The experts were recruited through the networks of the supervisors of this project.

7.1.3 Data Collection

For the usability evaluation, the prototype was assessed on usability by means of focusing on three aspects: tailored to the target audience, subjective satisfaction and aesthetics. To measure these aspects, several techniques were used. First of all, during the tasks that the participants had to execute, the think-out-loud protocol was used for which the observations were noted down. Thereafter, the System Usability Scale (SUS) was used to evaluate the usability. Based on the answers of the SUS, a semi-structured interview was conducted.

Think-Out-Loud Principle

The think-out-loud protocol is a usability testing technique. When using this technique, the researchers ask the participants to think out loud while executing specific tasks [95]. In other words, while using the prototype, the participants verbalise their thoughts and say how or what they experience at that moment. According to Nielsen, this may be the "single most valuable usability engineering method" [95].

However, only hearing the thoughts of the participants does not suffice. Therefore, observations were made during this process, and these observations were noted down. These notes are considered qualitative data. From the observations, the most interesting aspects are described and highlighted in the report.

The observations especially focused on three aspects. The first aspect was facial expressions. These can be very insightful to see if the participants are experiencing difficulty. Next up, attention was paid to the body language of the participants since this can also be very insightful. Finally, there was a focus on the comments the participants made since these are the things they think.

SUS

The SUS is a widely accepted usability scale that can be used to evaluate the usability of a product or system [96]. The original developer described it as a "quick and dirty usability scale". This scale is a very quick and effective scale to measure perceived usability [97]. Therefore, the SUS was used to evaluate the general usability of 'Het DiaBoek'.

This scale consists of ten statements and a scale. The participants are expected to agree or disagree with these statements on a Likert scale [96]. The Likert scale is a five-point scale ranging from strongly disagree to strongly agree. Afterwards, the results are processed, which finally results in a value ranging from 1 to 100. Generally speaking, a score of 68 is sufficient [96].

The results of the SUS can be calculated as follows: 'strongly disagree' earns zero points and 'strongly agree' earns four points. Thereafter, the score contribution of each question is calculated. The score contribution of the even questions is five minus the score position. The score contribution of the odd questions is the scale position minus one. Thereafter, all the score contributions are summed. Finally, this sum should be multiplied by 2.5, which ultimately results in the final score [98].

Based on the information about the SUS, it can be stated that this scale results

in quantitative data. Therefore, this data will be analysed in Excel. Calculations in Excel can be done automatically, so the analysis of this type of data is more practical.

Semi-Structured Interview

A semi-structured interview is a type of interview in which the list of interview questions of the interviewer is not fixed [99]. With this interview method, the list of formulated questions is used as a guide for conversation, but this list is not fixed. Meaning that the interviewer can deviate from the list of questions. This allows the interviewer to be free to explore interesting comments of the interviewees [99].

This type of interviewing was used to ask questions to the participants after they had filled in the SUS. The interview questions were based on the questions of the SUS as well as their answers. This interview method gave more insight into how the participants perceived this prototype.

Semi-structured interviews result in qualitative data. Therefore, this data was analysed by means of coding the transcripts [54]. This is done with the same approach as the coding of the interview transcripts in *Chapter 2.3.1.* For an explanation of the process of coding, please refer to *Chapter 2.3.1.* For qualitative coding, first, the text is read. Based on this first read, four main themes are established: subjective satisfaction, aesthetics, tailored to the target audience and suggestions/improvements. Next, the text was read again while coming up with sub-themes and highlighting the text that belongs to the themes and sub-themes. The results of the coding can be found in *Appendix F.7.*

Functional Evaluation

The above-mentioned data collections were all used during the usability evaluation; however, also the functional requirements should be evaluated. During the specification phase, a list of functional requirements was formulated in *Chapter 5.1.1.* During the evaluation phase, it should be verified whether these requirements are met. To get an unbiased result, an external expert could execute this functional evaluation [100]. The possible answers to whether the requirement was met are either 'yes' or 'no'. This could be encoded into quantitative data. Therefore, this could also be evaluated as qualitative data. 'Yes' could be encoded as one and 'no' could be encoded as zero. The sum of these values yields a final value for comparison against the total available points.

7.1.4 Procedure

The evaluations took place at the residences of the participants. So, before the evaluation started, the researcher installed herself in the seating area of the participants' residences. Thereafter, the participant was welcomed by the researcher. Next, the researcher introduced herself and the graduation project. Then, the informed consent form was discussed and signed.

After the forms were signed, the audio recording was turned on. Then, a short introduction was provided about the tasks that the participant was supposed to carry out. This introduction only mentioned that the participant was supposed to carry out the five tasks that were formulated without any additional information. The first task asked the participants to use the book and try out for themselves how the book works. This task gave insights into how user-friendly this prototype is for new users. The second task asked the participant if they understood how the book works after trying it for the first time. If the participant indicated understanding how the prototype worked, this task was omitted. Otherwise, the participant was asked to find out how the book worked. The third task asked the participants to let the book read section one of chapter one out loud. The fourth task was in the same line as the last one. However, now the participant was asked to let the book read section four of chapter three out loud. The final task asked the participants to find the glossary in the book. While executing the tasks, the participants were encouraged to use the thinking-out-loud principle. The researcher took notes during the execution of the tasks.

After the tasks were executed, the participant was asked to fill in the printed SUS. The SUS that was used for this evaluation was altered to make it comprehensible for the specific target group. First of all, the SUS was translated into Dutch. Thereafter, the translated text was rewritten to B1 level by using the website 'Is het B1?' [80]. Furthermore, a special design was created for the questionnaire, with smileys and red, yellow and green colours to make it as clear as possible. Additionally, white spacing was added to make the SUS less overwhelming. The rewritten statements for the SUS and part of the layout can be found in *Appendix F.4*.

Based on their answers to the SUS, the researcher started the semi-structured interview. The guiding questions that were formulated for the semi-structured interview were partly based on the SUS. On the other hand, the questions address aspects that were not discussed yet, like the layout of the book and the functionality of reading the text out loud. The guiding questions for the semi-structured interview for the participants can be found in *Appendix F.5*. The guiding questions for the interview of the experts can be found in *Appendix F.6*.

After the interview ended, the evaluation could be concluded. The researcher thanked the participant and provided contact information for possible follow-up questions. After the debriefing, the audio recording was stopped.

7.1.5 Ethics

To carry out this study design, an ethics review was submitted to the Ethics Committee of Computer and Information Science (EC-CIS). This is the same request as was done for the intermediate evaluation, since the request combined both evaluations. So, for more information about this request, please refer to *Chapter 2.3.1*.

7.2 Results

This section describes the results of the evaluations. This evaluation consists of the aforementioned functional and usability evaluation. The usability evaluation consists of potential users evaluating the usability of the prototype. The expert evaluation consists of an expert evaluating the prototype similarly to how the potential users evaluate it.

7.2.1 Functional Evaluation

For the functional evaluation, an expert was recruited. She studied health sciences and nowadays her expertise is personalised lifestyle counselling, especially for people who suffer from DM2. As was described in the methods section, for the functional evaluation, the expert was asked to indicate for each of the functional requirements if the prototype meets these requirements. The results of this evaluation can be found in *table 7.1*.

#	**Functional requirement**	**Is this requirement met?**
1	The prototype must be tailored to the needs of the target group by following the mentioned communication strategies and using an easily accessible digital technology.	Yes
2	The prototype should be physical and tangible.	Yes
3	The prototype should have the functionality to read the text out loud.	Yes
4	The prototype could have small exercises to test the user's knowledge.	Yes
5	The prototype could provide personal feedback.	No
6	The prototype could have an on/off switch.	Yes
7	The prototype will not have a supporting mobile application.	Yes

Table 7.1: Results of the functional evaluation

Based on the responses from the expert, it can be stated that from the seven requirements, six were met and one requirement was not met. The one requirement that was not met, is the requirement about the option of personalised feedback. 'Het DiaBoek' does not offer any personalised feedback, therefore this requirement was not met. Based on these results, it can be concluded that the prototype meets most of the functionalities that were formulated during the specification phase. Which is a positive result for the functionality of this prototype.

7.2.2 Usability Evaluation by Users

The usability evaluation consists of potential users evaluating the prototype through the aforementioned study design.

Participant Characteristics

Due to difficulties with reaching people from the target group, for the usability evaluation, only two participants were included. Both participants were males. The first participant was aged 76 and the second participant is a 48-year-old male. The second participant was already involved in this research since he also participated in the intermediate evaluation. Both participants do not suffer from DM2, however, they were familiar with the disease. The participants have followed low-qualified education and they have been illiterate from their youth onward. The researcher visited both participants at their own residences. During the evaluation with participant 2, a caregiver was present. For clarification purposes, the demographic data of the two participants are presented in *table 7.2*.

Participant	**Gender**	**Age**
Participant 1	Male	76
Participant 2	Male	48

Table 7.2: Demographic information of the two participants

Tasks

The first task was about discovering how the prototype works. No additional information was provided, so the participants started this task clueless. Both participants started by opening the book and reading the table of contents. Thereafter, both participants started reading the chapter about how the book works. One of the participants then pushed the button with the question mark to read this explanation out loud.

After the participants thought they finished the first task, the researcher explained the second task, which was about asking if they think that they understand how the book works. When asking this question both participants indicated that they understand how the book works.

However, the results of the third task show another truth. The third task asked the participants to let the book read the content of section one, chapter one out loud. During this task, both participants initially did not get this working. The first participant pressed two times the '1' button to let the book read out loud. The second participant only pressed the '1' button once to play the audio. This, however, in both cases, resulted in no audio. After reading the explanation again the first participant still was not able to get the audio working. After some help from the caregiver, the second participant succeeded in letting the book read the specific

section out loud.

The fourth task asked the participants to go to chapter three and make the book read section four of this chapter out loud. The first participant now first pressed the section and then the chapter. This, again, resulted in no audio. The second participant made the same mistake as the previous task. However, thereafter he corrected himself and first pushed the chapter button and then the section button which resulted in the book reading the correct section of chapter three out loud.

The last task was about finding the glossary in the book. Even though the necessary time for both participants was different, both participants did end up finding the glossary at the end of the book.

SUS

The results of the SUS should be calculated and processed. This is done according to the score calculation that is described in *section 7.1.3*. For both participants, the scores were calculated following this prescription. The result of the first participant is a score of 42.5. The result of the second participant is 85. This results in a rounded-off average value of 64, on a scale of 1 to 100. However, the SUS results should not be directly interpreted as percentiles. Based on the scoring system of the SUS, a value of 64 results in a score between 'OK' and 'good' [101]. This score has a percentile between 35 and 40 [101]. Based on this result, it can be concluded that the usability of this prototype is sufficient, however, there is still room for improvement.

Semi-Structured Interview

The first theme that was identified was subjective satisfaction. Within this theme, six sub-themes were identified. One of the most occurring sub-themes was that the prototype is clear. Participant 1 illustrated this sub-theme: "The prototype looks nice and neat, also the book is very clear". However, another oft-occurring theme was that the book has a lot of reading material. "The book had too much information to read in one day." (participant 2). Other identified sub-themes included easy-to-use, well-made and neat. The last occurring sub-theme that was identified is useful, "I think this prototype is useful." (person 1).

The second theme was about the aesthetics of the prototype. The most occurring sub-theme within this theme was 'good pictures'. Person 2 illustrated this theme: "The pictures look good.". Another reoccurring sub-theme for aesthetics was a neutral opinion. When asked about the general impression of the prototype, one of the responses was neutral. Other less occurring sub-themes in this theme are good reading voice and the format of the book.

The third theme was about whether the prototype was tailored to the needs of the target audience. The most occurring sub-theme was comprehensiveness. Participant 1 stated: "The explanation is comprehensible for people who normally have difficulty with reading.". Participant 2 agreed with this. Another oft-occurring subtheme was that the images provide visual support for the text. "The illustrations support the written text." (participant 2). Other sub-themes were: clear voice, correct information and boldly printed words. Also, suitable font is a sub-theme,

both participants agree that the used font is well-readable and well-suited for this purpose.

The last theme that was identified was suggestions and improvements for the prototype. The most occurring sub-theme is the binding method. Participant 2 said: "Use smaller rings, this allows me to turn the page easier without any hassle". Participant 1 also suggested another binding method for the book. Another oft-occurring sub-theme is to have a louder volume of the reading, both participants 1 and 2 agreed with this suggestion. Other sub-themes were: rechargeable batteries, the addition of a bookmark, lower reading pace and less text on pages.

7.2.3 Usability Evaluation by Experts

Participant Characteristics

For the expert evaluation, the same expert was recruited as for the functional evaluation. For ease of reading, her expertise is repeated; the expert studied health sciences in Amsterdam. Nowadays, she focuses on personalised lifestyle counselling, especially for people suffering from DM2. The researcher met the expert at a meeting space at the University of Twente, close to the expert's office. One of the supervisors of this project was also present during this evaluation.

Tasks

As was mentioned in the methods for this evaluation, the expert executed the same tasks as the potential users. The first task was to find out how the book works, without any given information. First, the expert opened the book. Then she read the pages about the functioning of the book. After reading through this explanation quickly, she turned the pages over to chapter one. She pressed the button for chapter one and the button for section one. Based on this selection, the book worked and played the audio file successfully.

The second task was about understanding how the book worked. The expert indicated that she understood the functioning of the book. The third task proved this statement. The third task asked the expert to play chapter one section one. The expert pressed the correct sequence of buttons and got the audio working. Also, both the fourth and fifth tasks were completed successfully.

SUS

After processing and calculating the scores of the SUS, the expert had a final score of 100 in a range between 0 and 100. As mentioned in *section 7.2.2*, the values of the SUS cannot be directly interpreted. However, based on the scoring system, a score of 100 shows a result of 'best imaginable' [101]. So, the expert was very positive about this prototype.

Semi-Structured Interview

For the coding of the interview transcript of the expert, similar themes were used as with the other participants: subjective satisfaction, aesthetics, tailored to the target audience and suggestions/improvements. The results of this coding can be found in *Appendix F.8*.

The first theme that was identified is subjective satisfaction. The sub-theme that was most occurring in this theme was that the prototype is easy to use for the expert. She said: "The book is clear and it explains difficult subjects in an easy manner". One issue for subjective satisfaction is that the explanation about how the book works still has a lot of text, which might overwhelm the target group. But other than that, the general impression was very positive.

The second main theme was the aesthetics of this prototype. The most occurring sub-theme is that the book is aesthetically pleasing. According to the expert's assessment, the book looks clean and satisfactory. Also, the tabs are a fitting addition to the book. However, the expert did indicate that the case of the book might be too big: "I can imagine that people would prefer a smaller case for the book".

Whether the prototype is fit to the needs of the target audience is verified by the third main theme. The most occurring sub-theme for this theme was that the book has very clear and understandable explanations for the target group. Additionally, the expert indicated that she thought that the illustrations are clear: "I think that the icons are clear and understandable". Additionally, she thought that the reading-out-loud function facilitates the users in a better understanding of the text since the users can read along with the voice. Based on these sub-themes, it can be stated that this expert thought that the prototype is tailored to the needs of people with low health literacy and DM2.

Finally, suggestions and improvements together make up the last theme. The expert had some interesting suggestions for further improvements to this prototype. First of all, she suggested adding a pause button on the case. Such a button allows the readers to pause the voice, to for example look at an illustration. Possibly, even a forward button could be added to fast-forward a part of the audio file. Another suggestion was to increase the format of the book while reducing the format of the case. Increasing the book size allows for more space on all the pages. By reducing the size of the case, the readers can write their answers in the books more easily. The last suggestion was the addition of tabs on the right side of the book for the assignments.

7.3 Conclusion

The evaluation of the 'Het DiaBoek' consisted of a functional evaluation and a usability evaluation. The results of the functional evaluation indicate a 6 out of the 7 requirements were met, meaning that the functionality of the prototype has a positive result. The usability evaluation showed an overall positive response to 'Het DiaBoek'. The two participants with low health literacy indicated that they think that the prototype fits well with their specific needs, by for example making use of

audio fragments, illustrations and sectioned content. The expert who evaluated the prototype agreed with this, she thought the prototype can facilitate people with low health literacy to learn about DM2. On the other hand, the three participants did indicate that they thought that there is still room for improvements, like the design of the case and the binding method. This is in accordance with the results of the SUS. The average value of the SUS results in a value between 'OK' and 'Good'. Which indicated that there are still possibilities for refinement. However, overall 'Het DiaBoek' showed promising future prospects.

One of the aims of this evaluation was to answer the third sub-research question, this question was posed as follows: *'To what extent is the designed prototype useful for people with DM2 and low health literacy to teach them about diabetes lifestyle self-management?'*. Based on the brief conclusion described above, it can be stated that 'Het DiaBoek', can be useful for people with low health literacy, since the book is well-tailored to their specific needs. Even though there is still room for improvements and refinements, the results of the evaluation show this prototype can facilitate people with low health literacy and DM2 to educate them about their illnesses and the importance of a healthy lifestyle, in a way that fits their needs.

Chapter 8

Discussion

This thesis describes the design of 'Het DiaBoek', a lifestyle self-management tool for people with DM2 and low health literacy. The aim of the 'Het DiaBoek' is to encourage the initiation of new behaviour. The Creative Technology Design Process was used as a guide through the development of this program. Drawing upon the state of the art, only two lifestyle self-management programs were suitable for people with low health literacy. Additionally, it was found that using pictures and using short and easy sentences are effective communication strategies for people with low health literacy. Based on the ideation phase and the results of a focus group the concept of an interactive audiobook was specified. With feedback from experts and a person with low health literacy, the book was realised. The content of the book makes use of communication strategies found in the background research, such as using visual support, underlining important information and reading text out loud. The contents of the book tackle different aspects of DM2 and a healthy lifestyle. Finally, the prototype was evaluated by two participants with low health literacy and an expert. The overall impression was positive. The participants and expert noticed that the book was tailored to the specific needs of people with low health literacy. However, there is still room for improvement, like the appearance of the case.

8.1 Principle Findings

To develop 'Het DiaBoek' the Creative Technology Design Process was used as a leading method [55]. In addition to this method, a participatory design approach was used. During the background research, the ideation phase and the realisation phase, inputs from experts and a participant with low health literacy were collected. Several studies indicate that the involvement of potential users and stakeholders has a beneficial influence on the development, implementation and evaluation of the designed prototype [38], [102], [103]. Involving stakeholders, experts and potential users in the design process, results in prototypes which are more likely to successfully achieve the desired effect. Therefore, during the realisation phase, an intermediate evaluation took place. The experts and participant with low health literacy, for example, had an influence on the style of the book as well as the content.

When comparing 'Het DiaBoek' to other interventions for people with DM2 and low health literacy, this prototype distinguishes itself from others. First of all, 'Het DiaBoek' incorporates implicit digital technologies, while remaining a physical product. To illustrate this, the user is not aware of the fact that the case houses the electronics. The users are not actively aware that they are interacting with these electronics, therefore they can be called implicit digital technologies. Other scientific and international programs for people with low health literacy, like the 'Living with Diabetes' guide [104] and the DLNET [48] are physical products. These tangible products are preferred by people with low health literacy [53]. During the design process of 'Het DiaBoek', consideration was given to the expressed desire, of the target group, for a physical product. However, this prototype elevates the concept of a physical product to a new level by incorporating implicit digital technologies. Findings from the background research (*Chapter 2.2.4*), indicate that incorporating digital technologies has the potential to improve healthcare [50]. Therefore, the integration of implicit digital technologies can facilitate the achievement of the desired effect of this supporting tool.

When comparing the NDF [39] and PRIDE Toolkit [43], both programs incorporate similar communication strategies. For example, using pictures and sectioning the content to make it less overwhelming for users with low health literacy. The created prototype for this thesis also incorporates these communication strategies. However, the inclusion of digital technology enables the researcher to incorporate a new communication strategy that is distinct from existing programs for people with low health literacy: reading written text out loud. By incorporating this new communicating strategy, the aim is to increase the comprehensiveness of the book. By using the reading-out-loud function, the users can read along with the spoken text. It is anticipated that this function helps the users to get easier through the entire book. The results of the evaluation also indicate that the participants and the expert think that this feature facilitates the user to understand the contents of the book more easily.

Another feature that distinguishes 'Het DiaBoek' from other existing programs is the fact that the content of the book is based on BCTs. Research indicates that using BCTs facilitates successfully a decrease in glycaemic levels [105]. Phase-specific determinants lay the foundation for the BCTs. The aim of 'Het DiaBoek' is to initiate new behavior, based on this aim the following key determinants are incorporated: knowledge, risk perception, attitude and outcome expectancies. Other existing supporting DM2 tools make use of BCTs as well, like the Diameter [38]. The Diameter makes use of phase-specific determinants for the initiation, maintenance and action phases. Based on this, 'Het DiaBoek' makes use of BCTs regarding the initiation phase of new behaviour, such as information about health consequences and instructions on how to perform a behaviour. By incorporating the aforementioned determinants and BCTs that specifically target the initiation of health behaviour, the content of 'Het DiaBoek' is theoretically substantiated, which increases the chance that it achieves the desired effects [106]–[108].

Finally, there was an unexpected outcome of the usability evaluation. The usability evaluation showed, that the design and layout of the buttons are difficult to understand for the users from the target group. The researcher thought the solution with only two buttons for the selection of a section would be suitable since only two actions are required. However, the results of the final user evaluation proved this wrong, since the participants with low health literacy struggled visibly to select the correct sequence of buttons. Contrarily, this unexpected result can be explained, because this aspect of the prototype is not evaluated throughout the design process with experts or people with low health literacy. Since this aspect is not evaluated throughout the process, it results in an aspect that is not entirely fit to the needs and requirements of the target group. A recommendation to tackle this issue is by making new designs for the case and testing them with a group of participants with low health literacy, to verify which design might be most suitable. Also, co-design sessions could be held, to design an interface, together with the target group, most fitting to their needs and requirements.

8.2 Strengths and Limitations

During the development of this research, some strengths and limitations were encountered. The sections down below address and discuss these strengths and limitations.

8.2.1 Strengths

One of the strengths of this research is the participatory design approach that was used since both experts and two participants with low health literacy were involved. Involving experts throughout the design process provides an unbiased view of the prototype. Also, the participants, people with low health literacy, evaluated the prototype two times during the design process. This provides valuable feedback on their specific needs and requirements.

Another strength of this research is that the book is based on BCTs. A study by Hietbrink et al. also makes use of these BCTs to maintain the initiation of desired behaviour long-term. Based on the findings of this study, the incorporation of BCTs facilitates the long-term maintenance of this behaviour [38]. The content of this prototype is also based on BCTs with specific determinants including, knowledge, risk perception, attitude and outcome expectancies. With this addition, it is anticipated that the users of this prototype maintain the initiation of the desired behaviour.

Finally, another strength of this research is that the designed intervention successfully makes use of communication strategies for people with low health literacy. The background research investigated existing communication strategies, which were confirmed by the field research. The prototype makes use of most of these strategies, for example, the content of the book is structured as suggested by these strategies. The participants with low health literacy confirm that these strategies are implemented successfully. To illustrate this confirmation, they state that the book is

understandable for them and they think that the illustrations visually support the written text.

8.2.2 Limitations

This study also knows some limitations. First of all, the prototype was evaluated on its usability by two participants who have low health literacy, however, they do not suffer from DM2. This means that they are not exactly potential users for this prototype. The participants were suitable to comment on language level and the used communication strategies. However, these participants do not have the intention to actually use this prototype, since they do not suffer from DM2. Additionally, only two participants were recruited. Originally, it was planned to recruit five participants, however, in reality, only two participants were found. These are too few participants to make accurate conclusions about the perceived usability. The results of the user evaluation might, therefore, be less representative. However, Nielsen does state that two participants can already point out more than half of the usability-related issues. So, the most prominent issues should have been indicated by the participants.

The ethical procedure is also a limitation of this research. The informed consent form and the information letter were translated into Dutch and rewritten to an easier language level. This was done to make the ethical procedure more understandable for the participants with low health literacy. However, the information letter was still quite long and information-dense for people with low health literacy. Therefore, the researcher answered the questions from the participants orally. Based on this, the participants should understand what they signed up for. However, it is still something that can be improved for future research involving participants with low health literacy.

Finally, another limitation that should be addressed is the illustrations that are used throughout the entire book. The images and illustrations that are used are basic images from Google. Since all the illustrations and images have different styles, this creates an unprofessional look for the book. However, due to a lack of time, it was not possible to design specific images for this book. Additionally, using internet images raise copyright concerns. For this prototype, no attention was paid to this issue. But if this prototype is to be developed further in the future, this issue should be taken into consideration.

8.3 Future Recommendations

Based on the discussion, strengths and limitations some recommendations for future research can be made. The first and foremost future recommendation is about conducting a longitudinal study, where users from the defined target group, people who just got diagnosed with diabetes and with low health literacy, use the book for two months. During these two months, weekly or bi-weekly small evaluations can be conducted to check how it is going. When the two months are over, the

participants are asked to join in an elaborate interview to evaluate the use of the prototype. Additionally, to make this study more representative more participants should be recruited for this longitudinal study. With this longitudinal study with the right target audience, a more representative conclusion can be made about the effectiveness and usefulness of this prototype.

Another future recommendation is to further develop this prototype together with the target group. Different aspects of the prototype can be investigated and improved. Like, redesigning the placements of the buttons on the case. This redesign process can be enhanced by involving people from the target group during this design process. A co-creation session could be organised in which the designer can sit together with people from the target group. Together the researcher and the participants can brainstorm for a new layout and even new functionalities. After this, the designer can develop some prototypes, which should be evaluated by the target group before implementing these aspects in the actual prototype. This hopefully increases the usability of the prototype. While re-designing the case, there should also be looked into reducing the size of the case. Also, the possibility of adding a pause button on the case would increase the usability of the case.

A final suggestion for future research is to research, design, develop and realise the second book in this series. In *Chapter 5.2.1* an ideal concept description was provided about a series of two books. The first book focuses on the initiation of new behaviour and the second book focuses on the implementation of this new behaviour in daily life. For this thesis, there was decided to develop the first book. Since the results of the evaluation of this prototype are promising, it would be interesting to further investigate the development of a second book about the implementation of the attained knowledge.

Chapter 9

Conclusion

The aim of this study was to design a communication method for a lifestyle self-management program for people who suffer from DM2 with low health literacy. By combining literature research, the active involvement of experts and people with low health literacy, the use of BCTs and technical tools the first version of 'Het DiaBoek' was developed. 'Het DiaBoek' is a lifestyle self-management tool for people with low health literacy and DM2. The book aims to initiate new behaviour by educating users on DM2 and the importance of a healthy lifestyle. The evaluation shows a positive response to this prototype, from both the participants and the expert. The participants and expert think the prototype is well-tailored to the needs of people with low health literacy. However, there is still some room for improvement, like the design of the case. Future work could focus on improving and refining the prototype. This includes redesigning the case, designing specific images for the book and investigating and developing a second book which focuses on the implementation of the attained knowledge. Thereafter, a longitudinal study should be conducted which evaluates the usability and functionality of the improved prototype with participants from the target group: people with low health literacy and DM2. Overall, 'Het DiaBoek' shows promising future prospects to initiate more healthy lifestyle choices in people with DM2 and low health literacy.

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Appendix A

Background Research

The coding schemes of the 14 interviews can be found down below. The number of codes for the sub-themes with the highest occurrence, are presented in bolt.

Theme	Subtheme	Number of codes	Total codes	Comments
Diabetes type 2	Age 18 - 80	**3**	15	
	Using insuline	1		
	Using medication	1		
	Using pills	**3**		
	Therapy infidelity	**3**		
	Overweight	**3**		
	Wounds	1		

Figure A.1: Coding scheme for theme 'Diabetes Type 2'

Theme	Subtheme	Number of codes	Total codes	Comments
Communication strategies for low health literacy	Using pictures	**17**	55	Pictures with a caption
	Put text underneath each other	2		
	Using pictograms	2		
	Smiley in combination with corresponding colours (green, orange, red)	3		
	Movie clips	11		Talk on a low tempo, animation videos help
	Ability to record voice memos	2		
	Additional explanation	3		
	Usage of short, easy sentences with explanation	5		
	Teach-back method	1		
	Posing concrete questions	1		
	Draw out explanations	2		
	Read explanations aloud	5		
	Important words are bold	1		

Figure A.2: Coding scheme for theme 'Communication strategies for people with low health literacy'

Theme	Subtheme	Number of codes	Total codes	Comments
Low literacy	Low health literacy	3	18	
	Low education	1		
	Scared for people with high education	1		
	Different for each person	4		
	Using excuses to make it look like they understand it	**5**		
	Feels ashamed	3		
	Immigrants	1		
Motivation	Difficult to motivate	1	6	
	Using incentives	1		
	Intrinsic motivation	**2**		
	Environment dependent	1		
	Motivational interviewing	1		
Lifestyle coacing	Physical movement	2	13	
	Nutrition	**3**		
	Sleep	2		
	Stress	1		
	No technology	2		
	Positive effect	2		
	Different for each person	1		

Figure A.3: Coding scheme for themes 'low literacy', 'motivation' and 'lifestyle coaching'

Theme	Subtheme	Number of codes	Total codes	Comments
Product ideas	App	3	15	
	Printed flyers	**4**		
	GLI-Programma	1		
	Nutrition diary	1		
	Explanation videos	1		
	No app	**4**		
	Notifications	1		
Issues patients encounter	Difficulty with technology	3	22	
	Difficulty with reading	2		
	Difficult words	**6**		Leaflets are challenging
	Long texts	4		
	No visual support	1		
	Dependent on someone for information	4		
	Small letter	2		

Figure A.4: Coding scheme for themes 'product ideas' and 'issues patients encounter'

Appendix B

Ideation

The results of the concept generation can be found in the sections down below.

B.1 Brainstorm 1

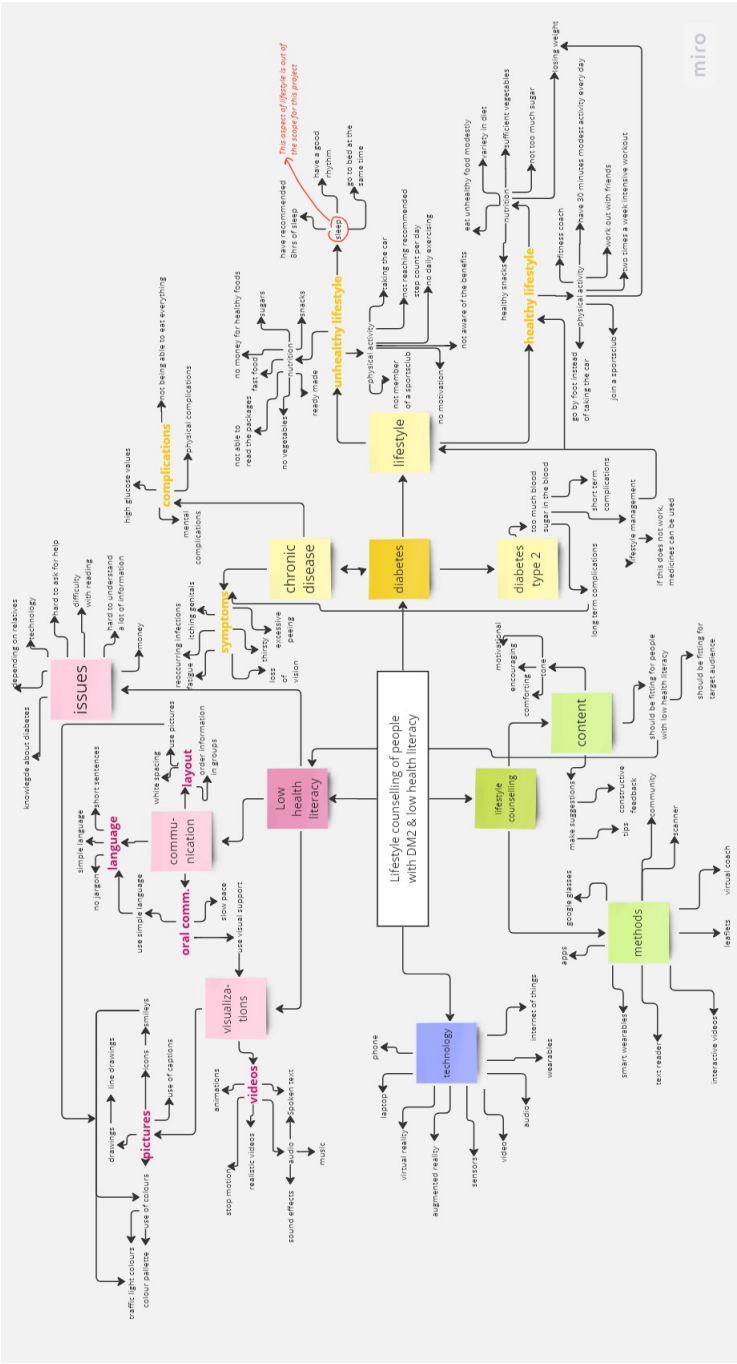

Figure B.1: Mind map for brainstorm 1

B.2 Brainstorm 2

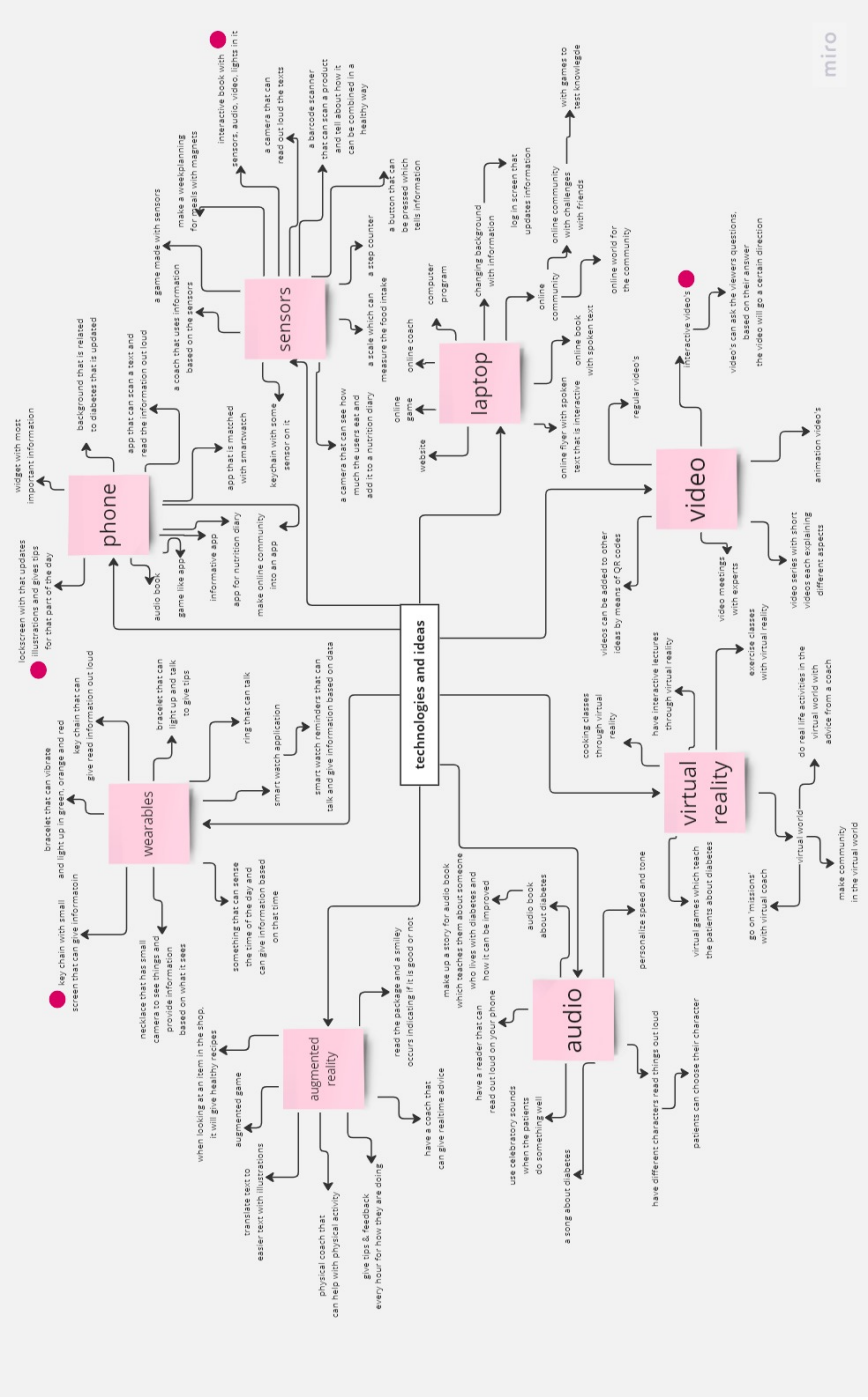

Figure B.2: Results of the second brainstorm session

B.3 Concept Interactive Book

B.3.1 Mood Board Interactive Books

Figure B.3: Mood board interactive books

B.3.2 Prototype: Size of Interactive Book

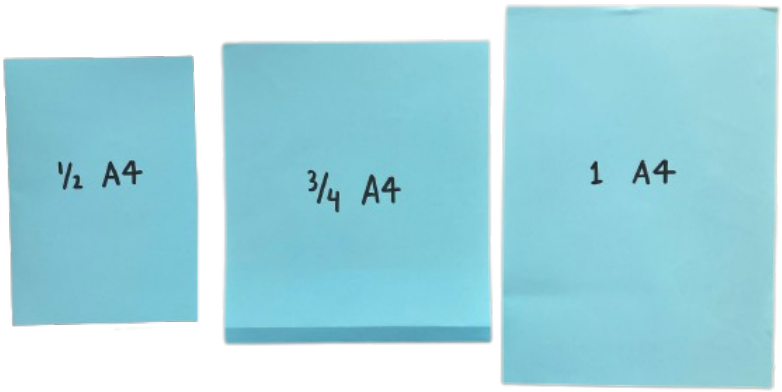

Figure B.4: Possible size of Interactive Book

B.3.3 Layouts Diabetes Board

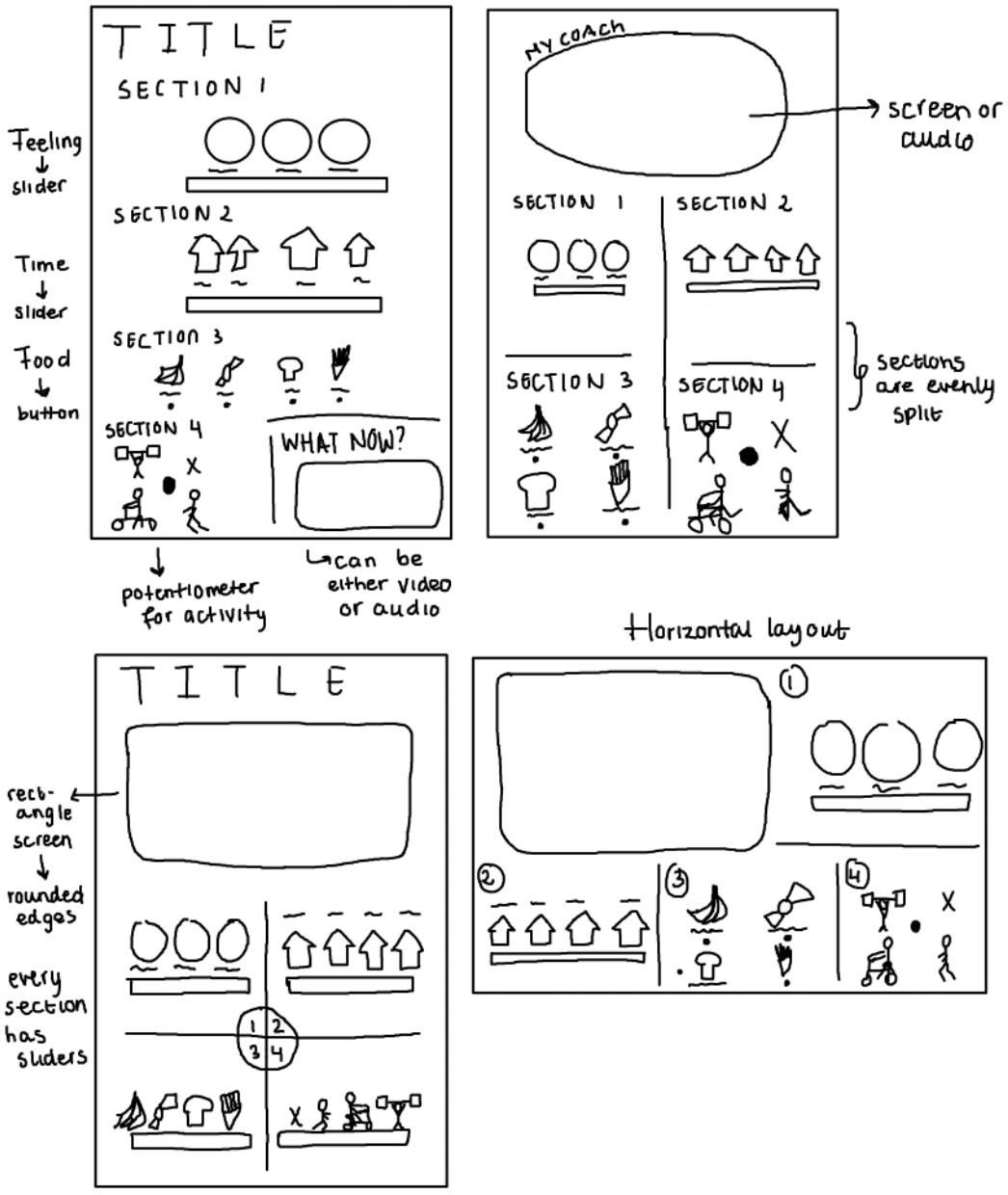

Figure B.5: Different layouts for the diabetes board

B.3.4 First Sketch Diabetes Board

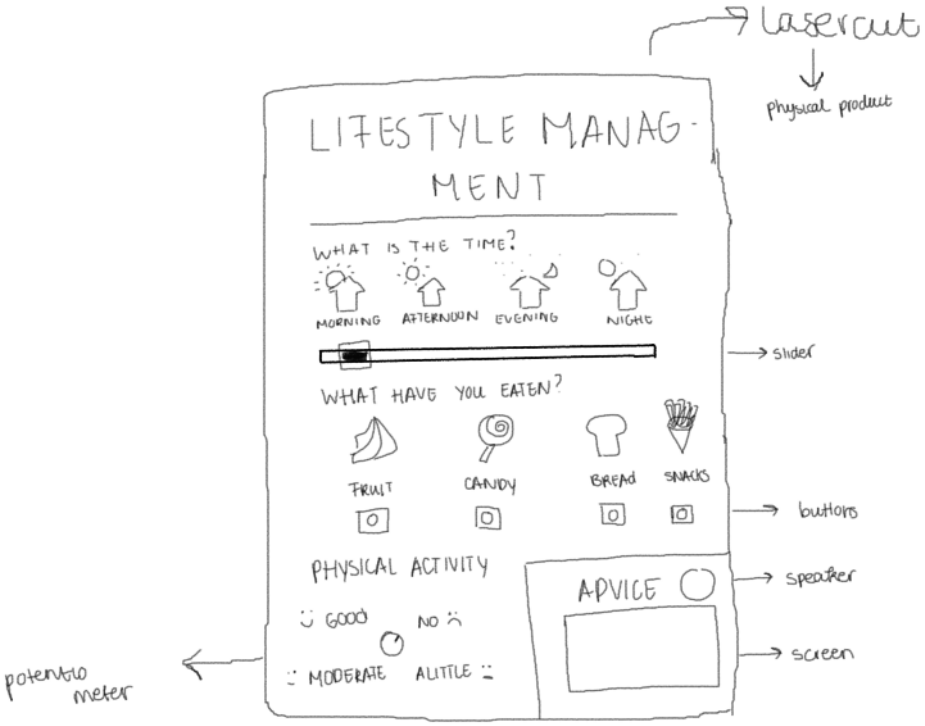

Figure B.6: Different layouts for the diabetes board

B.4 Concept Smart Keychain

B.4.1 Mood Board

Figure B.7: Mood board for the smart keychain

B.4.2 Shapes

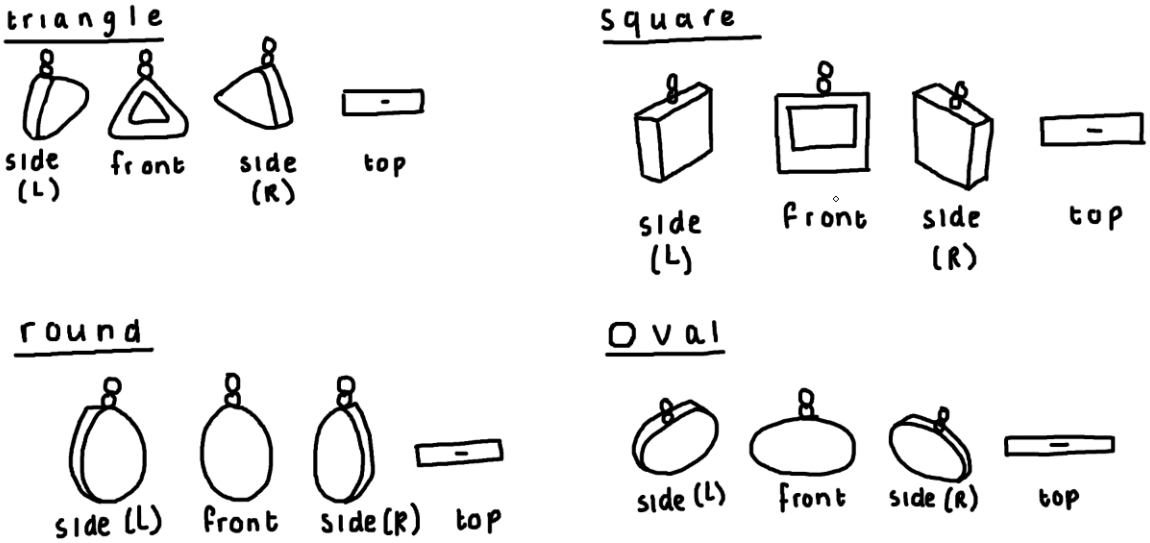

Figure B.8: Ideation on shapes for the smart keychain

B.5 Concept Interactive Video

Interactive Video

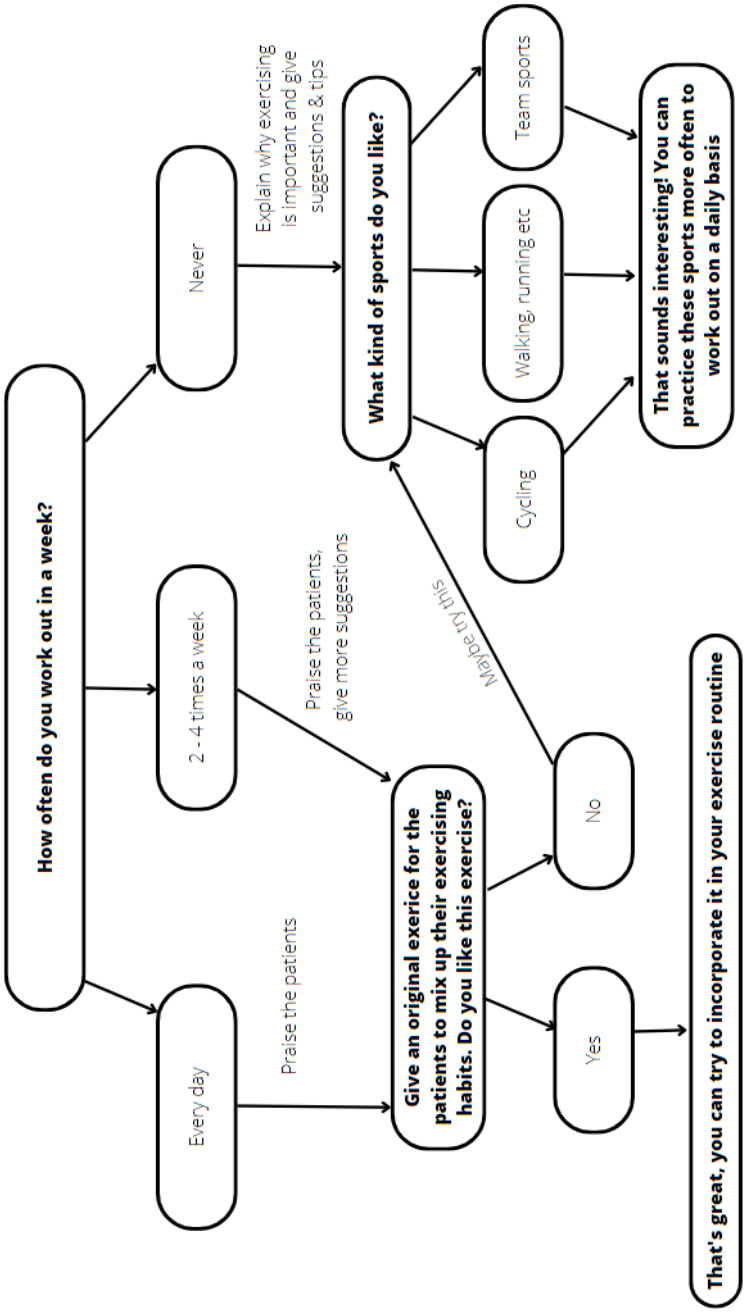

Figure B.9: Flowchart of script for interactive script

B.6 Concept Interactive Lockscreen

Mood Board

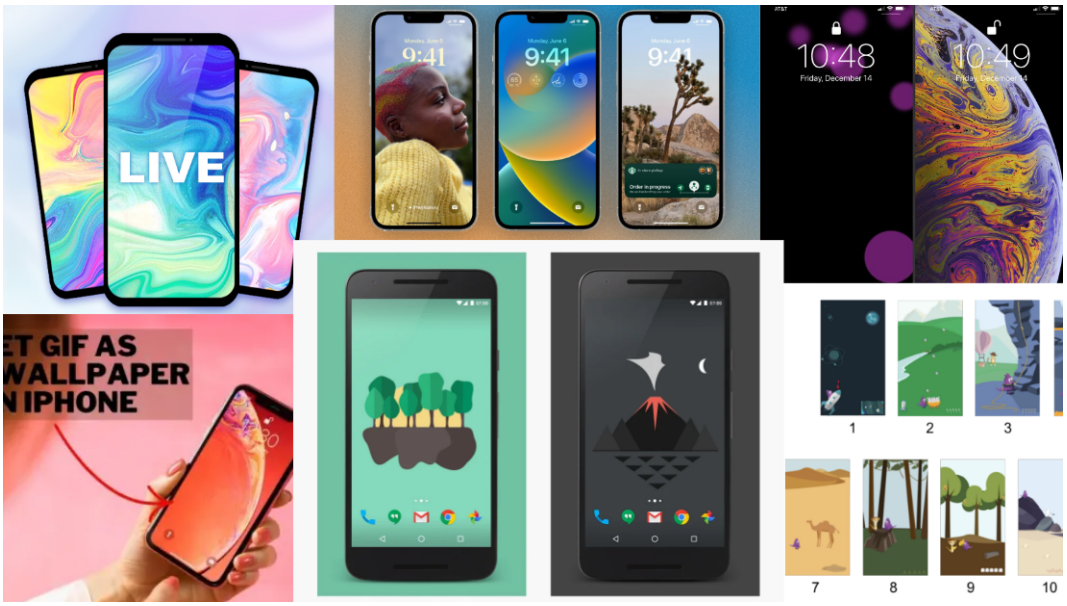

Figure B.10: Mood board for interactive lockscreen

Appendix C

Ethical Request

This appendix presents the informed consent form and the information letter that have been sent to the participants of the research.

C.1 Informed Consent Form Participants

Onderzoek Toestemmingsformulier

Titel: Op zoek naar een product om gezonder te leven voor mensen die diabetes type 2 hebben en moeite hebben met het begrijpen van informatie over gezondheid.
Geschreven door: Floor Lieverse
Datum: 30-05-2023

Goed gekeurd door: Ethische Commissie van Informatiekunde en Informatica van de Universiteit van Twente.

Samenvatting van onderzoek: Dit onderzoek gaat over uitproberen van een testversie van een product om gezonder te leven met diabetes. Deze testversie is speciaal gemaakt voor mensen die moeite hebben informatie over gezondheid te begrijpen. We onderzoeken de testversie door mensen te vragen hardop na te denken tijdens het testen en vragen te beantwoorden.

Kruis het geschikte antwoord aan.

Meedoen met de studie

	Ja	**Nee**
Ik heb de informatiebrief met de datum DD/MM/YY gelezen of deze is aan mij voorgelezen.	O	O
Ik kon vragen stellen over het onderzoek.	O	O
Mijn vragen zijn goed beantwoord.	O	O
Ik kies er zelf voor om mee te doen aan dit onderzoek.	O	O

Uw gegevens

	Ja	Nee
Ik snap dat meedoen aan dit onderzoek betekent dat ik een testversie van een product gebruik, mijn mening geef en vragen beantwoord hierover.	O	O
Mijn stem mag opgenomen worden.	O	O
Ik snap dat mijn naam niet gedeeld wordt met andere mensen dan de onderzoekers.	O	O
Ik weet dat ik op elk moment kan weigeren vragen te beantwoorden en kan stoppen met mijn deelname aan dit onderzoek zonder dat dat gevolgen heeft.	O	O
Ik wil graag betrokken blijven bij deze studie.	O	O

Deelnemer

_____ _____ _____
Naam Handtekening Datum

Onderzoeker
Ik heb de informatie uitgelegd aan de deelnemer en tot mijn beste kunnen ervoor gezorgd dat de deelnemer weet waaraan zij deelnemen.

_____ _____ _____
Naam Handtekening Datum

Contactinformatie onderzoeker:
Naam: Floor Lieverse
E-mailadres: f.lieverse@student.utwente.nl

Voor vragen over uw rechten en deelname aan het onderzoek, of als u vragen heeft over het onderzoek die u niet met de onderzoeker wil bespreken, kunt u contact opnemen met: ethicscommittee-CIS@utwente.nl.

C.2 Information Letter Participants

Informatie over deelname aan een studie

Titel: Op zoek naar een product om gezonder te leven voor mensen die diabetes

type 2 hebben en moeite hebben met het begrijpen van informatie over gezondheid.
Geschreven door: Floor Lieverse
Datum: 30-05-2023

Beste deelnemer,

In Nederland hebben 1.2 miljoen mensen diabetes. Voor deze ziekte is het belangrijk om gezond te leven. Gezond leven is bijvoorbeeld voldoende bewegen en gezond eten. Maar, veel mensen in Nederland hebben moeite met het begrijpen van informatie over gezondheid en gezond leven.

We weten dat veel mensen informatie van de huisarts of het ziekenhuis over gezond leven moeilijk vinden. Daarom gaan wij onderzoeken hoe wij de informatie over diabetes en gezond leven voor iedereen begrijpelijk kunnen maken.

Wij doen onderzoek in opdracht van Universiteit Twente. Wij onderzoeken hoe informatie over diabetes en gezond leven eruit moet zien voor mensen die het begrijpen van informatie over gezondheid moeilijk vinden. Bijvoorbeeld, voor mensen die moeite hebben met lezen en schrijven. We willen ook kijken hoe technologie kan helpen om deze informatie te geven.

Wat moet ik doen als ik meedoe?
De studie bestaat uit twee delen, die op twee verschillende dagen plaats vinden.

1. Deel 1 bestaat uit (tijd: maximaal 30 minuten):
    (a) De onderzoeker geeft u een aantal keuzes over het ontwerp van het product. U mag de vragen beantwoorden door te zeggen welke keuze u het mooiste vindt.
    (b) Uw stem wordt opgenomen en de onderzoeker maakt aantekeningen.
2. Deel 2 bestaat uit (tijd: maximaal 45 minuten):
    (a) De onderzoeker geeft u de afgemaakte testversie van het product. U voert dan een aantal taken uit. Als u de taken uitvoert vertelt u hard op wat u denkt. De onderzoeker maakt hierbij een aantekeningen.
    (b) Hierna geeft de onderzoeker u een vragenlijst die u invult. De onderzoeker zit erbij om vragen te beantwoorden en het als u wilt voor te lezen.
    (c) Daarna stelt de onderzoeker vragen over uw ervaring met de testversie. Uw stem wordt opgenomen en de onderzoeker maakt aantekeningen.

Zijn er nadelen als ik meedoe aan de studie?
Er zijn geen risico's bij dit onderzoek. Het onderzoek is goedgekeurd door een commissie van Universiteit Twente. Die commissie beoordeelt of studies waar mensen aan meedoen uitgevoerd mogen worden. U mag op elk moment stoppen met uw deelname of weigeren vragen te beantwoorden zonder gevolgen. Ook hoeft u niet

uit te leggen waarom u stopt.

Wat doen jullie met mijn gegevens?
Wij nemen het interview op met geluid. Gegevens die bewaard worden zijn uw naam en een opname van uw stem tijdens het interview. Uw naam is nodig om toestemming te geven voor deelname aan de studie. Alleen de onderzoekers weten uw naam. Uw naam wordt niet gedeeld met andere mensen. Uw naam zal niet genoemd worden in het verslag. U mag vragen om uw gegevens te bekijken of te laten verwijderen op elk moment na de studie.
Uw gegevens worden 10 jaar bewaard op een beveiligde server van de Universiteit Twente.

Contactinformatie onderzoekers
Onderzoeker
Naam: Floor Lieverse
E-mailadres: f.lieverse@student.utwente.nl
Begeleiders onderzoek
Naam: Eclaire Hietbrink
E-mailadres: e.a.g.hietbrink@utwente.nl
Naam: Tessa Beinema
E-mailadres: t.c.beinema@utwente.nl

Contactinformatiecommissie Universiteit Twente
Heeft u vragen over de studie? Bijvoorbeeld over uw rechten of vragen die u liever niet aan de onderzoeker stelt? Dan kunt u contact opnemen met Universiteit Twente via de mail: ethicscommittee-CIS@utwente.nl.

Bedankt voor uw tijd!

Brief in het kort

Doel van het onderzoek
Wij onderzoeken hoe we informatie over diabetes en gezond leven voor iedereen begrijpelijk kunnen maken. Bijvoorbeeld, voor mensen die moeite hebben met lezen en schrijven.

Meedoen aan het onderzoek

1. Deel 1 (maximaal 30 minuten)
    (a) U beantwoord vragen over het ontwerp
2. Deel 2 (maximaal 45 minuten)
    (a) U voert taken uit met het hulpmiddel

(b) U vertelt wat u denkt tijdens het gebruiken van het hulpmiddel

(c) U vult in vragen lijst in

(d) U beantwoordt vragen over uw ervaring met het hulpmiddel

Nadelen

1. Er zijn geen nadelen of risico's
2. U mag op elk moment stoppen met mee doen

Mijn gegevens

1. Uw naam wordt genoteerd
2. Uw stem wordt opgenomen
3. De stem opname wordt anoniem verwerkt in het onderzoeksverslag
4. U mag op elk moment vragen uw gegevens te zien of te laten verwijderen
5. Uw gegevens worden voor 10 jaar bewaard op een beveiligde server van de Universiteit Twente

Contactinformatie onderzoekers
Onderzoeker
Naam: Floor Lieverse
E-mailadres: f.lieverse@student.utwente.nl
Begeleiders onderzoek
Naam: Eclaire Hietbrink
E-mailadres: e.a.g.hietbrink@utwente.nl
Naam: Tessa Beinema
E-mailadres: t.c.beinema@utwente.nl

Contactinformatiecommissie Universiteit Twente
Heeft u vragen over de studie? Bijvoorbeeld over uw rechten of vragen die u liever niet aan de onderzoeker stelt? Dan kunt u contact opnemen met Universiteit Twente via de mail: ethicscommittee-CIS@utwente.nl.

C.3 Informed Consent Form Experts

Onderzoek Toestemmingsformulier

Titel: Leefstijl begeleiding voor mensen met diabetes type 2 en beperkte gezondheidsvaardigheden
Geschreven door: Floor Lieverse

Datum: 02-06-2023

Goed gekeurd door: Ethische Commissie van Informatiekunde en Informatica van de Universiteit van Twente.

Samenvatting van onderzoek: Dit onderzoek gaat over het onderzoeken van hoe technologie kan worden ingezet voor de leefstijl begeleiding voor mensen met diabetes type 2 en beperkte gezondheidsvaardigheden. Hierbij vraag ik naar uw expertise en ervaringen als expert zijnde.

Kruis het geschikte antwoord aan.

Meedoen met de studie

	Ja	**Nee**
Ik heb de informatiebrief met de datum DD/MM/YY gelezen.	O	O
Ik kon vragen stellen over het onderzoek.	O	O
Mijn vragen zijn goed beantwoord.	O	O
Ik kies er zelf voor om mee te doen aan dit onderzoek.	O	O

Mijn gegevens

	Ja	**Nee**
Ik snap dat meedoen aan dit onderzoek betekend dat ik vragen beantwoord over mijn expertise en ervaringen.	O	O
Mijn stem mag opgenomen worden.	O	O
Ik begrijp dat alleen de geanomisieerde data gedeeld kan worden binnen het project.	O	O
Ik weet dat ik op elk moment kan weigeren vragen te beantwoorden en kan stoppen met mijn deelname zonder dat dat gevolgen heeft.	O	O
Ik wil graag betrokken blijven bij deze studie.	O	O

Deelnemer

Naam	Handtekening	Datum

Onderzoeker
Ik heb de informatie uitgelegd aan de deelnemer en tot mijn beste kunnen ervoor gezorgd dat de deelnemer weet waaraan zij deelnemen.

Naam	Handtekening	Datum

Contactinformatie onderzoeker:
Naam: Floor Lieverse
E-mailadres: f.lieverse@student.utwente.nl

Voor vragen over uw rechten en deelname aan het onderzoek, of als u vragen heeft over het onderzoek die u niet met de onderzoeker wil bespreken, kunt u contact opnemen met: ethicscommittee-CIS@utwente.nl.

C.4 Information Letter Experts

Informatie over deelname aan een studie

Titel: Leefstijl begeleiding voor mensen met diabetes type 2 en beperkte gezondheidsvaardigheden.
Geschreven door: Floor Lieverse
Datum: 02-06-2023

Beste deelnemer,

In Nederland hebben 1.2 miljoen mensen diabetes. Voor deze ziekte is het belangrijk om gezond te leven. Gezond leven is bijvoorbeeld voldoende bewegen en gezond eten. Echter hebben veel mensen in Nederland moeite met het begrijpen van informatie over gezondheid en gezond leven.

We weten dat veel mensen informatie van de huisarts of het ziekenhuis over gezond leven moeilijk vinden. Daarom gaan wij onderzoeken hoe wij de informatie over diabetes en gezond leven voor iedereen begrijpelijk kunnen maken.

Wij doen onderzoek in opdracht van Universiteit Twente. Wij onderzoeken over hoe technologie kan worden ingezet voor de leefstijl begeleiding voor mensen met

diabetes type 2 en beperkte gezondheidsvaardigheden. Hierbij ben ik benieuwd naar uw ervaringen en expertise.

Wat moet ik doen als ik meedoe?
De studie bestaat uit een interview. In een interview stellen de onderzoekers u enkele vragen. Er zijn geen goede of fouten antwoorden. Bij het interview vraag ik u vooral naar uw ervaring en uw expertise binnen uw werkveld. Het interview duurt 30 tot 45 minuten. De vragen hebben verschillende onderwerpen.

Zijn er nadelen als ik meedoe?
Er zijn geen risico's bij dit onderzoek. Het onderzoek is goedgekeurd door een commissie van Universiteit Twente. Die commissie beoordeelt of studies waar mensen aan meedoen uitgevoerd mogen worden. U mag op elk moment stoppen met uw deelname of weigeren vragen te beantwoorden zonder gevolgen. Ook hoeft u niet uit te leggen waarom u stopt.

Wat doen jullie met mijn gegevens?
Wij nemen het interview op met geluid. Gegevens die bewaard worden zijn uw naam en een opname van uw stem tijdens het interview. Uw naam is nodig om toestemming te geven voor deelname aan de studie. Alleen de onderzoekers weten uw naam. Uw naam wordt niet gedeeld met andere mensen. Uw naam zal niet genoemd worden in het verslag. U mag vragen om uw gegevens te bekijken of te laten verwijderen op elk moment na de studie.
Uw gegevens worden 10 jaar bewaard op een beveiligde server van de Universiteit Twente.

Contactinformatie onderzoekers
Onderzoeker
Naam: Floor Lieverse
E-mailadres: f.lieverse@student.utwente.nl
Begeleiders onderzoek
Naam: Eclaire Hietbrink
E-mailadres: e.a.g.hietbrink@utwente.nl
Naam: Tessa Beinema
E-mailadres: t.c.beinema@utwente.nl

Contactinformatiecommissie Universiteit Twente
Heeft u vragen over de studie? Bijvoorbeeld over uw rechten of vragen die u liever niet aan de onderzoeker stelt? Dan kunt u contact opnemen met Universiteit Twente via de mail: ethicscommittee-CIS@utwente.nl.

Bedankt voor uw tijd!

Doel van het onderzoek

Wij onderzoeken hoe we informatie over diabetes en gezond leven voor iedereen begrijpelijk kunnen maken. Bijvoorbeeld, voor mensen die moeite hebben met lezen en schrijven.

Meedoen aan het onderzoek

1. U doet mee aan een onderzoek waarbij een interview wordt afgenomen. De onderzoeker stelt u vragen over verschillende onderwerpen. Wij horen graag uw mening.
2. Het interview zal tussen de 30 en 45 minuten duren.

Nadelen

1. Er zijn geen nadelen of risico's
2. U mag op elk moment stoppen met mee doen

Mijn gegevens

1. Uw naam wordt genoteerd
2. Uw stem wordt opgenomen
3. De stem opname wordt anoniem verwerkt in het onderzoeksverslag
4. U mag op elk moment vragen uw gegevens te zien of te laten verwijderen
5. Uw gegevens worden voor 10 jaar bewaard op een beveiligde server van de Universiteit Twente

Contactinformatie onderzoekers
Onderzoeker
Naam: Floor Lieverse
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E-mailadres: t.c.beinema@utwente.nl

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Heeft u vragen over de studie? Bijvoorbeeld over uw rechten of vragen die u liever niet aan de onderzoeker stelt? Dan kunt u contact opnemen met Universiteit Twente via de mail: ethicscommittee-CIS@utwente.nl.

Appendix D

Specification

D.1 Case

Dimensions of the case:

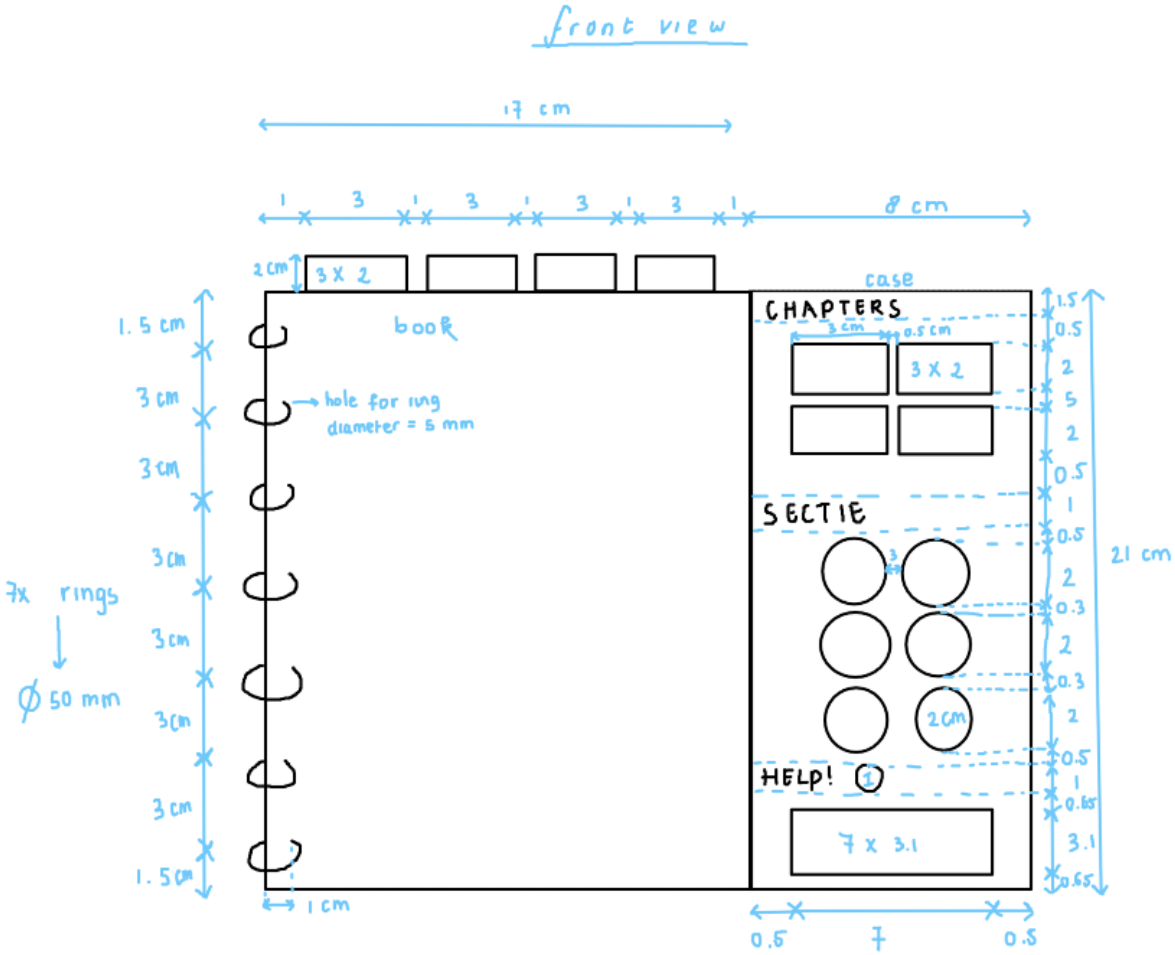

Figure D.1: Dimensions front view

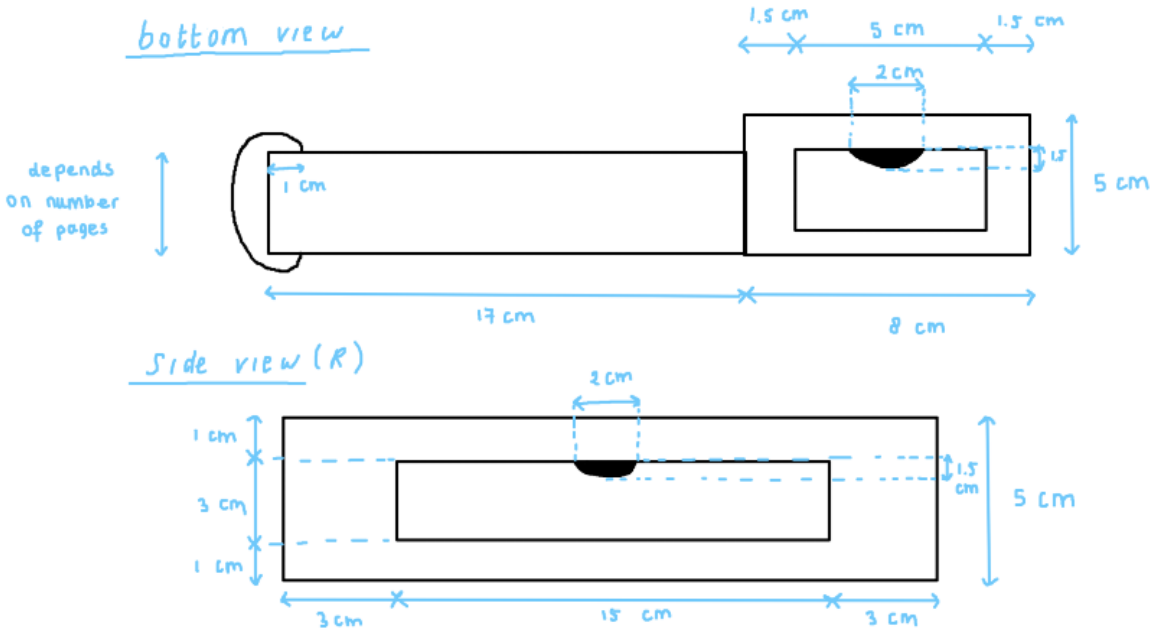

Figure D.2: Dimensions bottom and side view

D.2 Style

D.2.1 Colour Palettes

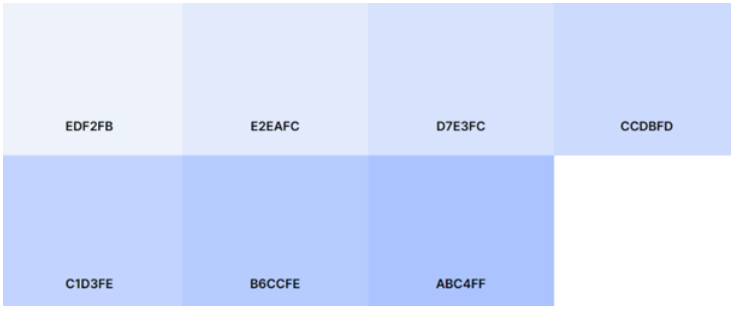

Figure D.3: Neutral colour palette blue

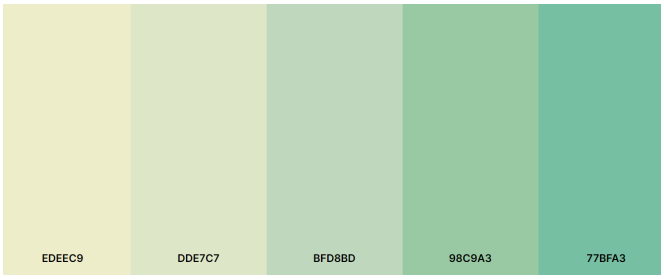

Figure D.4: Neutral colour palette blue

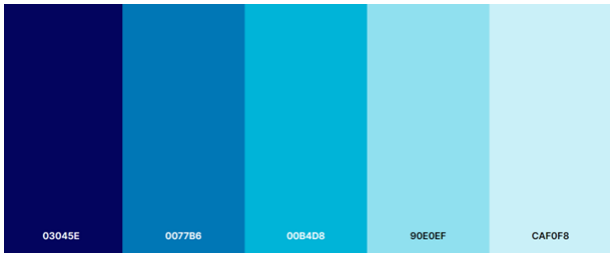

Figure D.5: Colour palette bright blue

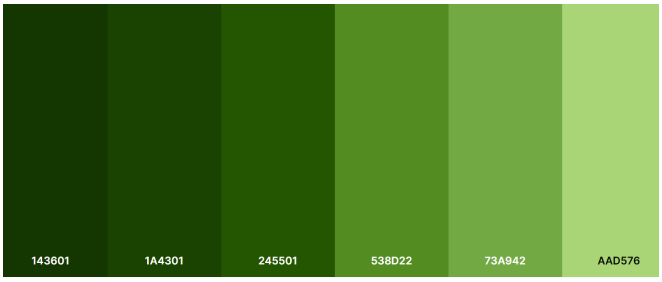

Figure D.6: Colour palette bright green

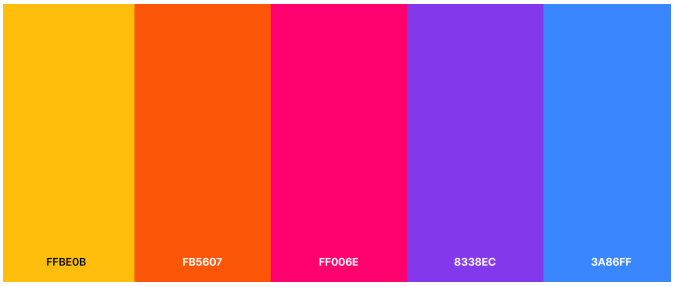

Figure D.7: Colour palette bright colours

Figure D.8: Colour palette pastel colours

D.2.2 Fonts

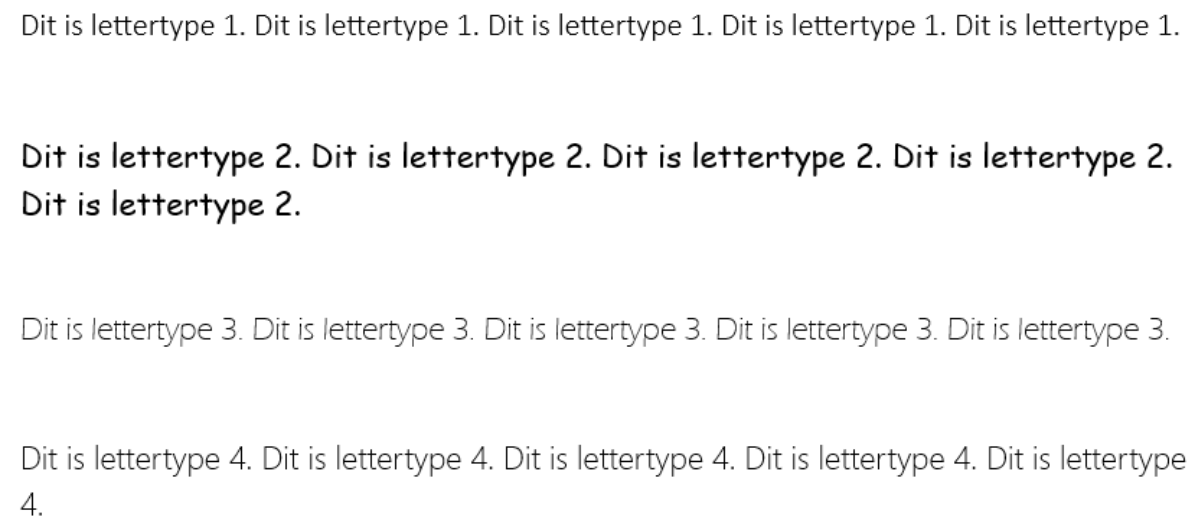

Figure D.9: Four select fonts

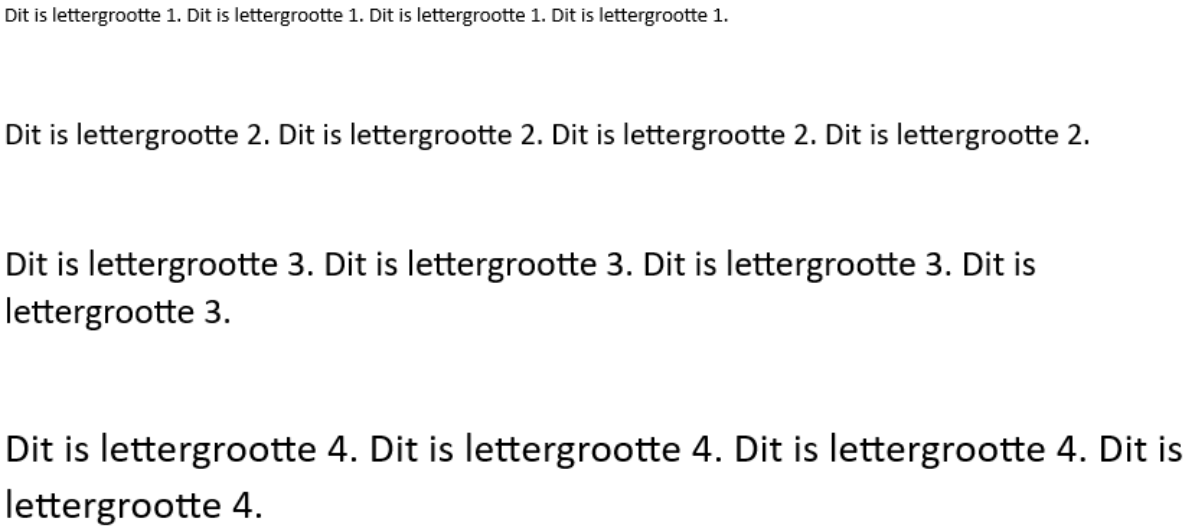

Figure D.10: Four select font sizes

Appendix E

Realization

E.1 Intermediate User Evaluation Questions

1. Demografische vragen.
   (a) Wat is uw geslacht?
   (b) Wat is uw leeftijd?
   (c) Wat is uw hoogst behaalde opleiding?
   (d) Heeft u wel eens moeite met het invullen van een formulier van het ziekenhuis?
   (e) Heeft u wel eens moeite met het lezen en begrijpen van bijsluiters en medicijnen?
   (f) Wat vindt u daar dan moeilijk aan?
2. Vragen over lettertypen.
   (a) Welke lettertype vind je het fijnste lezen?
      i. Optie 1 = lettertype Calibri Light (12)
      ii. Optie 2 = lettertype Comic Sans MS (12)
      iii. Optie 3 = Eras Light ITC (12)
      iv. Optie 4 = Segoe UI Light (12)
   (b) Welke lettergrootte vindt u het fijnste om te lezen?
      i. Optie 1 = grootte 8
      ii. Optie 2 = grootte 12
      iii. Optie 3 = grootte 14
      iv. Optie 4 = grootte 16
3. Vragen over kleur gebruik.
   (a) Welke kleur vindt u het mooiste?
   (b) Waarom?

(c) Welke kleuren palette vindt u het beste bij het boek passen?

(d) Waarom?

4. Vragen over icoontjes voor de hoofstukken.

   (a) Het eerste hoofdstuk heet 'alles over diabetes'. Dit hoofdstuk gaat over wat diabetes is en basisinformatie over diabetes. Welk plaatje vindt u het beste bij dit hoofdstuk passen?

   (b) Het tweede hoofdstuk heet 'een gezond leven'. Dit hoofdstuk gaat over wat een gezond leven is en waarom gezond leven belangrijk is voor diabetes. Welk plaatje vindt u het beste bij die hoofdstuk passen?

   (c) Het derde hoofdstuk heet 'beweging' en gaat zoals de titel zegt over beweging. Het gaat over waarom beweging belangrijk is en het hoofdstuk geeft veel tips over hoe je meer en leuker kunt bewegen. Welk plaatje vindt u het beste bij dit hoofdstuk passen?

   (d) Het laatste hoofdstuk heet 'eten en drinken'. Dit hoofdstuk gaat over gezond eten en drinken en waarom dit belangrijk is als je diabetes hebt. Welk plaatje vindt u het beste hierbij passen?

5. Vragen over plaatjes in het boek.

   (a) Welk soort plaatje vindt u het fijnste?

   (b) Waarom?

6. Vragen over de oefeningen aan het einde van een hoofdstuk

   (a) Wat vindt u van oefeningen aan het einde van het hoofdstuk?

   (b) Waarom kan dit u wel of niet helpen?

   (c) Wat voor soort oefening vindt u fijn?

7. Vragen over de snelheid van voorlezen.

   (a) Wat vindt u fijne spraaksnelheid voor een gesprek?

   (b) Wat vindt u een fijne voorlees snelheid?

E.2 Interview Questions Design Expert

1. Vragen over 8D Games

   (a) Wat doen jullie als bedrijf?

   (b) Wat is uw rol hierin?

   (c) Wat zijn voorbeelden van project waar jullie aan werken?

   (d) Wat is uw favoriete project?

(e) Wat is de doelgroep voor jullie projecten?

2. Vragen over mijn project

   (a) Hoe kan je een boek interessant, meeslepen en aansprekend maken voor de gebruikers?

   (b) Als ik een oefening wil toevoegen aan het einde van elk hoofdstuk, hoe kan ik die oefening begrijpelijk, leuk en leerzaam maken?

   (c) Hoe kan je een kaft interessant maken?

   (d) Hoe kan je its ontwerpen in een speelse manier zonder dat het kinderachtig wordt?

   (e) Hoe pas je een game aan op een volwassene doelgroep? Zijn er dan dingen die je anders doet moet kinderen?

   (f) Wat voor ontwerp strategieën pas je toe voor volwassene?

   (g) Doen jullie ook aan storytelling in jullie games? Hoe doen jullie dat? En hoe maken jullie dat meeslepend en leuk?

   (h) Hoe maken jullie serieuze onderwerpen bespreekbaar in jullie games zonder dat het kwetsend kan zijn?

   (i) Zijn er ontwerp tips die u voorstelt?

E.3 Brainstorm for the Name

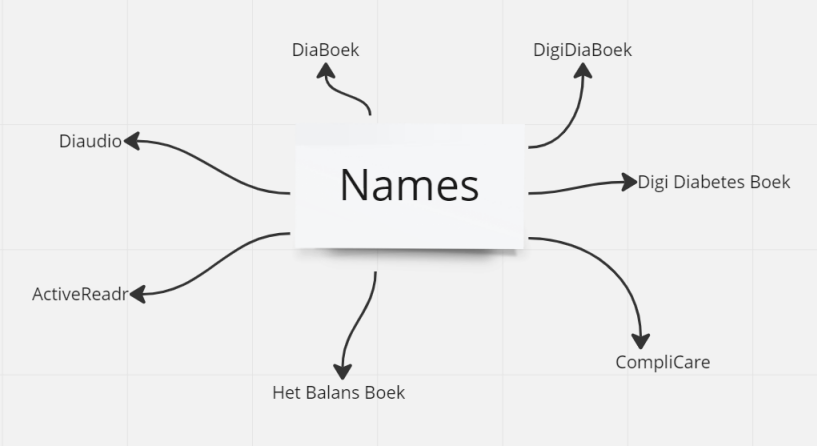

Figure E.1: Brainstorm for possible names for the book

E.4 Arduino Code

```
#include "Arduino.h"
#include "SoftwareSerial.h"
#include "DFRobotDFPlayerMini.h"

SoftwareSerial mySoftwareSerial(10, 11); // RX, TX
DFRobotDFPlayerMini myDFPlayer;
void printDetail(uint8_t type, int value);

const int buttonCountChap = 4; //number buttons chapters
const int buttonCountSect = 6; //number buttons sections
const int buttonPinsChap[buttonCountChap] = {2, 3, 4, 5}; //pins for chapter
const int buttonPinsSect[buttonCountSect] = {6, 7, 8, 9, 12, 13}; //pins for section
#define HELP_BUTTON A1 //pin help button
int currentState[2] = {-1, -1}; //current state {chapter, section}
int previousState[2] = {-1, -1}; //previous state {chapter, section}

void setup() {
  //start serial communication
  mySoftwareSerial.begin(9600);
  Serial.begin(115200);

  Serial.println(F("DFRobot DFPlayer Mini Demo"));
  Serial.println(F("Initializing DFPlayer ... (May take 3~5 seconds)"));

  //Use softwareSerial to communicate with mp3
  if (!myDFPlayer.begin(mySoftwareSerial)) {
    Serial.println(F("Unable to begin:"));
    Serial.println(F("1.Please recheck the connection!"));
    Serial.println(F("2.Please insert the SD card!"));
    while(true);
  }

  Serial.println(F("DFPlayer Mini online."));

  //Initialize the buttons for chapters with internal pull up resistor
  for (int i = 0; i < buttonCountChap; i++) {
    pinMode(buttonPinsChap[i], INPUT_PULLUP);
  }

  //Initialize the buttons for sections with internal pull up resistor
  for (int i = 0; i < buttonCountSect; i++){
    pinMode(buttonPinsSect[i], INPUT_PULLUP);
  }

  //initialize analog pin 1 for the help button
  pinMode(HELP_BUTTON, INPUT_PULLUP);
}

```

```
void loop() {
  // Play help after pressing help button
  int helpButtonState = digitalRead(HELP_BUTTON);
  if (helpButtonState == 0){
    myDFPlayer.play(25);
  }

  //Read the values of the buttons for chapter
  for (int i =0; i < buttonCountChap; i++){
    int readChap = digitalRead(buttonPinsChap[i]);
    // Serial.println(readChap);
    if (readChap == 0){
      currentState[0] = i;
    }
  }

  //Read the values of the buttons for the sections
  for (int i =0; i < buttonCountSect; i++){
    int readSect = digitalRead(buttonPinsSect[i]);
    // Serial.println(readSect);
    if (readSect == 0){
      currentState[1] = i; //4
    }
  }

  //check if the current state has changed
  bool changed = false;
  for (int i =0; i < 2; i++){
    if (currentState[i] != previousState[i]){
      changed = true;
      break;
    }
  }

  //if it has not change return
  if (!changed) return;

  previousState[0] = currentState[0];
  previousState[1] = currentState[1];

  //check which buttons are pressed and play correct audiofile
  for (int section = 0; section <= 5; section++) {
    if (currentState[1] == section && currentState[0] != -1) {
      int audioFile = section + currentState[0] * 6 + 1;
      myDFPlayer.play(audioFile);
      currentState[0] = -1; //reset the current state
      currentState[1] = -1; //reset the current state
      break;
    }
  }

  //Print the detail message from DFPlayer to handle different
   errors and states.
  if (myDFPlayer.available()) {
```

```
    printDetail(myDFPlayer.readType(), myDFPlayer.read());
  }
}

void printDetail(uint8_t type, int value){
  switch (type) {
    case TimeOut:
      Serial.println(F("Time Out!"));
      break;
    case WrongStack:
      Serial.println(F("Stack Wrong!"));
      break;
    case DFPlayerCardInserted:
      Serial.println(F("Card Inserted!"));
      break;
    case DFPlayerCardRemoved:
      Serial.println(F("Card Removed!"));
      break;
    case DFPlayerCardOnline:
      Serial.println(F("Card Online!"));
      break;
    case DFPlayerPlayFinished:
      Serial.print(F("Number:"));
      Serial.print(value);
      Serial.println(F(" Play Finished!"));
      break;
    case DFPlayerError:
      Serial.print(F("DFPlayerError:"));
      switch (value) {
        case Busy:
          Serial.println(F("Card not found"));
          break;
        case Sleeping:
          Serial.println(F("Sleeping"));
          break;
        case SerialWrongStack:
          Serial.println(F("Get Wrong Stack"));
          break;
        case CheckSumNotMatch:
          Serial.println(F("Check Sum Not Match"));
          break;
        case FileIndexOut:
          Serial.println(F("File Index Out of Bound"));
          break;
        case FileMismatch:
          Serial.println(F("Cannot Find File"));
          break;
        case Advertise:
          Serial.println(F("In Advertise"));
          break;
        default:
          break;
      }
      break;
```

```
156     default:
157       break;
158   }
159 }
```

Appendix F

Evaluation

F.1 Recruitment Email

Onderwerp: Deelnemers gezocht: scriptie beperkte gezondheidsvaardigheden, laaggeletterdheid en diabetes type 2.

Bijlage: Toestemmingsformulier, informatiebrief.

Beste lezer,

Met deze email wil ik graag mijzelf en mijn onderzoek voorstellen om te kijken of u mij hierbij kunt helpen. Mijn naam is Floor Lieverse, ik zit momenteel in mijn laatste jaar van de bachelor Creative Technology aan de Universiteit Twente. Momenteel ben ik bezig met afstuderen waarvoor ik een scriptie schrijf. Deze scriptie gaat over leefstijl begeleiding voor mensen met diabetes type 2 en beperkte gezondheidsvaardigheden. Voor dit onderzoek is het de bedoeling dat ik een prototype maak die mensen met diabetes type 2 en beperkte gezondheidsvaardigheden kan ondersteunen met het zelf-managen van hun diabetes op het gebied van leefstijl.

Momenteel ben ik bezig met het ontwikkelen van een prototype en voor de ontwikkeling dit prototype wil ik een aantal vragen m et potentiële gebruikers bespreken. Omdat het prototype nog niet gemaakt is, is het doel dat mensen hun voorkeur uitspreken tussen verschillende keuzes. Deze evaluatie zal maximaal een 30 minuten duren. Het prototype zal dus tijdens deze sessie niet getest worden; dat gebeurt pas tijdens een gebruikersevaluatie die later zal plaatsvinden.

Voor dit onderzoek heb ik een deelnemers informatiebrief geschreven, deze vindt u als bijlage aan deze mail. Ook het toestemmingsformulier dat ik heb opgesteld kunt u vinden in de bijlagen van deze mail. De Ethische Commissie van Universiteit Twente heeft deze documenten en mijn onderzoek goedkeuring gegeven. Met deze goedkeuring heb ik toestemming gekregen om dit onderzoek uit te voeren.

Op uw website las... *(pas aan per organisatie)*. Aangezien mijn project daar ook over gaat vroeg ik mij af u mij zou willen helpen om in contact te komen met mensen die laaggeletterd zijn of beperkte gezondheidsvaardigheden hebben? Of misschien weet u wel organisaties die hier mij hier verder bij kunnen helpen?

Ik ben bereid om eventuele vragen vanuit uw kant te bespreken in een meeting, telefonisch of via de mail.

Ik hoor graag van u,

Met vriendelijke groet,
Floor Lieverse

F.2 Organisations to which Recruitment Emails have been Sent

Organisation	**Result**
Huis voor Taal en Meedoen	Reply from employee, who would ask around. No other reply since.
Bibliotheek Enschede	No reply.
Hof Bibliotheek Goor	No reply.
Alifa	No reply.
Lezen en Schrijven	Reply from employee who recommended contacting ABC.nl and Pharos.
Lezen en Schrijven Regio Twente Advisor	The advisor recommended contacting ABC.nl and she suggested contacting the contact person of the program 'Voel je Goed!' which is active in the region of Twente.
De Roef buurthuis Enschede	No reply.
M-Pact	No reply.
Leer Werk Loket Twente	Reply which suggested contacting Alifa, especialy the manager of Alife who is expert in low health literacy.
Manager Alife, low health literacy expert	She forwarded to email to people who could be of help. No reply since.
Power Noord Enschede	No reply.
Power Oost Enschede/Glanerburg	No reply.
Power Royael Enschede	No reply.
Power Zuid Enschede	No reply.
Pharos NL	No reply.
ROC Twente	Cannot offer any help.
Sive	No reply.

Organisation	Result
Voorlees Express Bibliotheek Enschede	Cannot offer any help. They did recommend contacting Huis voor Taal en Meedoen.
Ga Voor Taal	No reply.
GGD Twente	They recommended me to contact the region coordinator about lifestyle and health of the Twente Koers.
Twente Koers Region Coordinator about lifestyle and health	The coordinator forwarded the recruitment email to other people who might be able to help out. Also, he suggested to make a LinkedIn post which he could share, since he has a big following in this field of expertise.
Saasen Groep	No reply.
Pharos contact person	She set up a meeting between the low health literacy expert and me.
ABC.nl secretary	Recommended contacting ABC Overijssel.
ABC Overijssel Employee	Set up intermediate user evaluation with participant from the target group. He also wanted to participate in the final evaluation. The employee also set up a meeting with another male for the final evaluation.
Taalambassadeur Heldere Taal (Loo van Eck)	Cannot offer any help.
Nutry Dietistepraktijk	No reply.
Policy advisor adult education and low health literacy, municipality Enschede	Forwarded the email to people who can probably help me. No reply since.
Nurse on the department of pulmonary medicine	Replied that she would be willing to help since this target group is often patient at her department. However, this email exchange did not result in anything concrete.
Policy advisor public health, municipality Enschede	Sent a list of people who could help me.
Stichting Langerhans	No reply.

Table F.1: Organisation to which recruitment emails have been sent and the result

F.3 LinkedIn Post

DEELNEMERS GEZOCHT: SCRIPTIE BEPERKTE GEZONDHEIDSVAARDIGHEDEN EN DIABETES

In mijn scriptieonderzoek voor de Bachelor Creative Technology kijk ik hoe we technologie kunnen gebruiken om betere leefstijlbegeleiding te bieden aan mensen met diabetes type 2 en beperkte gezondheidsvaardigheden.

Voor mijn onderzoek ben ik op zoek naar mensen die beperkte gezondheidsvaardigheden hebben of die laaggeletterd zijn en die iets zouden willen zeggen over mijn ontwerpen. Als zij diabetes type 2 hebben is dit mooi meegenomen, maar aangezien deze doelgroep moeilijk te bereiken is, is het geen vereiste dat de deelnemers diabetes type 2 hebben.

Kent u mensen binnen deze doelgroep of mensen die actief zijn bij organisaties die mij verder zouden kunnen helpen dan hoor ik graag van u! Mocht u nog vragen hebben of kunt u mij verder helpen, dan kunt u contact met mij opnemen via LinkedIn of u kunt mij een email sturen naar f.lieverse@student.utwente.nl.

Delen zou erg gewaardeerd worden, alvast bedankt!

F.4 SUS

The rewritten statements for the SUS:

1. Ik denk dat ik deze testversie vaak zou gebruiken.
2. Ik vond de testversie onnodig moeilijk.
3. Ik vond de testversie makkelijk te gebruiken.
4. Ik denk dat ik hulp nodig heb van een technisch persoon om deze testversie te gebruiken.
5. Ik vond dat alle onderdelen van de testversie goed bij elkaar passen.
6. Ik vind dat er te veel foutjes in de testversie zitten.
7. Ik denk dat veel mensen deze testversie makkelijk kunnen leren te gebruiken.
8. Ik vind de testversie moeilijk te gebruiken.
9. Ik voelde me zelfverzekerd toen ik de testversie gebruikte.
10. Ik moest veel nieuwe dingen leren voor ik de testversie kon gebruiken.

Picture of the improved layout of the SUS.

F.5 Semi-Structured Interview Guiding Questions

1. Waarom vindt u de testversie makkelijk/moeilijk om te gebruiken?
2. Waarom zou de testversie wel/niet vaak gebruiken?
3. Wat vindt u van de uitleg van het boek?

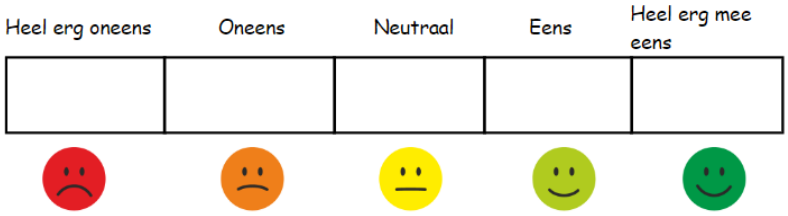

Figure F.1: Improved layout for the SUS

4. Hoe vindt u dat de testversie eruitziet?
5. Wat vindt u van de vormgeving van het boek als u erdoorheen bladert?
6. Wat vindt u van de hoeveelheid tekst op een pagina?
7. Vindt u dat de plaatjes de tekst ondersteunt?
8. Wat vindt u van het voorlezen?
9. Hoe helpt de voorleesfunctie u met het begrijpen van de tekst?
10. Als u iets kon veranderen aan het ontwerp wat zou dat zijn?
11. Wat is uw algemene indruk van de test versie?

F.6 Expert: Semi-Structured Interview Guiding Questions

1. Waarom vindt u dit prototype moeilijk of makkelijk om te gebruiken?
2. Waarom denkt u dat dit prototype makkelijk of moeilijk te gebruiken is voor de doelgroep (mensen met diabetes type 2 en beperkte gezondheidsvaardigheden?)
3. Wat vindt u van de uitleg in het boek?
4. Hoe vindt u dat het prototype eruit ziet?
5. Wat vindt u van de vormgeving van het boek als u erdoorheen bladert?
6. Hoe past de vormgeving wel/niet bij het boek?
7. Hoe denkt u dat de voorleesfunctie mensen van de doelgroep helpt met het begrijpen van de tekst?
8. Als u iets kon veranderen aan het prototype wat zou dat zijn?
9. Wat is uw algemene indruk van het prototype?

10. Waaorom denkt u dat dit prototype mensen uit de doelgroep wel/niet kan helpen?

F.7 Semi-structured Interview Coding Results

Theme	Subtheme	Number of codes	Total codes	Comments
Subjective satisfaction	Makkelijk te gebruiken	2	15	
	Netjes	2		
	Duidelijk	**4**		
	Knap gemaakt	2		
	Nuttig	1		
	(Te) Veel inhoud	**4**		
Aesthetics	Neutraal	2	7	
	Fijne stem	1		
	Goed formaat boek	1		
	Plaatjes zijn goed	**3**		
Tailored to the target audience	Goed lettertype	2	13	
	Dik gedrukte woorden	1		
	Juiste informatie	1		
	Voldoende tekst op een pagina	1		
	Plaatjes ondersteunen tekst	2		
	Voorlezen duidelijk	2		
	Begrijpelijk	**4**		

Figure F.2: Coding results 1

Theme	Subtheme	Number of codes	Total codes	Comments
Suggestions / improvements	Andere manier van binden	**2**	8	
	Gebruik oplaadbare batterijen	1		
	Bladwijzer erbij	1		
	Luider geluid	**2**		
	Lager tempo voorlezen	1		
	Minder tekst op pagina	1		

Figure F.3: Coding results 2

F.8 Expert: Semi-structured Interview Coding Results

Theme	Subtheme	Number of codes	Total codes	Comments
Subjective satisfaction	Easy to use	**2**	4	
	Too much tekst	1		
	Positive	1		
Aesthetics	Tabs are nice	1	4	
	Case is too big	1		
	Book looks good	**2**		
Tailored to target audience	Clear explanations	**3**	4	
	Clear illustrations	1		
Suggestions / improvements	Button for pause	1	3	
	Increase format	1		
	Tabs for assignments	1		

Figure F.4: Expert coding results