Designing communication and diabetes type 2 coaching content for people with low health literacy

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Bachelor Thesis

Creative Technology

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Abstract

Almost one third of the Dutch citizens have a limited health literacy, making it challenging to obtain, process and understand health related content to make informed health decisions. Additionally, one in fourteen people have diabetes, the majority having type 2 diabetes. At the same time, studies have shown that living a healthy lifestyle can reduce the need for medication and decrease the burden of the condition substantially. In this thesis, communication and coaching content was researched and designed for diabetes type 2 patients with low health literacy. This was done with the aim to motivate this group and ensure they were able to obtain, process, and understand health related content, in order to make informed health decisions. A literature review was conducted that surfaced 21 communication strategies to tailor information to the target audience. Next to this, five technological tools were discovered in literature, which implemented only a limited number of strategies and were mostly digital. The iterative Creative Technology Design Process was used to produce a technological tool that incorporated multiple communication strategies. This process included four phases: ideation, specification, realisation and user evaluation. During the ideation phase, ideas were generated and iterated upon with the help of an expert opinion. A final idea was chosen and further iterated upon, considering requirements set up during the specification phase. In this phase a PACT analysis was applied, and functional and non-functional requirement lists were generated and prioritised using the MoSCoW tool. In the realisation phase the idea was physically realised. The product provides daily challenges written on cards in four categories: physical movement, nutrition, information, and quiz. Every day the user takes a card from the category indicated by an LED, reads the challenge, and puts it on a platform to hear it. The card can also be scanned using NFC to see a video of the daily challenge. A user evaluation was conducted with three users who were asked to perform tasks with the product. Observations were made, and questions were asked about the tasks and product through a semi-structured interview. The user evaluation showed that users were able to obtain and understand the information provided through the various means of communication (textual, oral and audio-visual). Furthermore, they were positive about the ease-of-use and access to information. A suggestion is to add audible reminders to take a card. Implementing multiple strategies to communicate to people with low health literacy may improve understanding of diabetes type 2 coaching content for low health literacy users; however, further user testing is needed to evaluate the long-term impact.

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Chapter 1: Introduction

Affecting over 1.2 million citizens, diabetes is one of the most common chronical conditions in the Netherlands [1]. The condition is characterized by the body's inability to regulate it's glucose level due to the lack of a hormone called insulin [1]. Nine out of ten people with diabetes have Type 2 diabetes, making it the most common form of diabetes [2]. Patients with this condition visit the doctor once or twice a year for reasons ranging from checking up on patients' glucose levels to medication support and lifestyle coaching [3]. The care process for someone with diabetes is illustrated in Figure 1 and highlights the effect that a positive mindset, progres and control have on the frequency of check-ups.

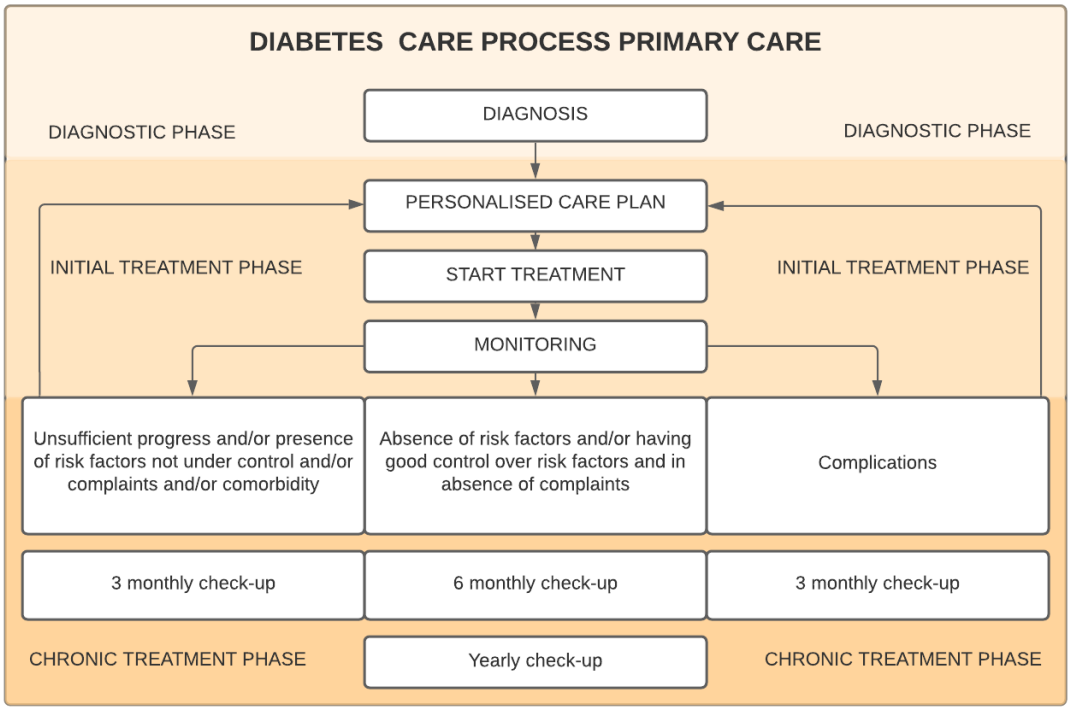


Figure 1 Diabetes care process of primary care [4]

Lifestyle coaching is an essential step in dealing with Type 2 diabetes in the most effective way, to combat the condition and reduce it's burden on the patient [5]. A healthy lifestyle can; improve the immune system, increase glucose level stability and reduce the need for medication [5]. However, according to the client, patients encounter challenges both during the doctor visits and the time in-between them. First, during the session it is up to the patient to describe their current situation and lifestyle. Since these are not tracked in any way, their explanation may result in a possibly incomplete or biased view of the patients current situation. Thereby making it difficult for the doctor to prescribe the proper medication and provide adequate advice. Second, in the time between the sessions, patients are left to independently keep up healthy lifestyle habits. Since they lack the guidance of a doctor during these periods, it is hard to form and keep habits.

To combat the challenges patients with diabetes face with regard to lifestyle, many digital health applications have been developed to support patients in self-managing their condition. One such app is the Diameter which was developed in a cooperation between the Biomedical Signals and Systems (BSS) group of the University of Twente (UT), the Internal Medicine/ Nephrology department of

Ziekenhuisgroep Twente (ZGT) and Roessingh Research and Development (RRD). This app includes features such as data logging, where the patient can log their exercise, food and glucose values, as well as coaching messages to stimulate a healthy lifestyle. While evaluating the app, the client (UT, ZGT and RRD) found that it is not yet tailored to include their entire target group, currently not including people with a low health literacy.

There is no universal definition of low health literacy, the various definitions used in literature focus on different aspects based on their application. Berkman, et al. [6] reviewed thirteen different definitions of health literacy found in literature. They stated that it is complicated to reach consensus on the definition of health literacy due to the nuance and different focus of each definition. They offer the following definition of low health literacy, "the degree to which individuals can obtain, process, understand, and communicate about health-related information needed to make informed health decisions" (p. 16). While Riley, et al. [7] use a slightly different definition, they continue by stating that health literacy also includes accessing health information, understanding voiced instructions, working with medication doses and finding your way around complex delivery systems. These studies together offer a well-rounded description of what health literacy entails. This paper interprets low health literacy as a combination of the definitions posed by Berkman, et al. [6] and Riley, et al. [7]:

> *"The degree to which individuals can obtain, process, understand, and communicate about health-related information needed to make informed health decisions. This includes accessing health information, struggling to understand voiced instructions, working with medication doses and finding their way around complex delivery systems."*

Making content tailored to people with a low health literacy is crucial. According to Fransen, et al. [8], people with a low health literacy often have increased health issues such as asthma, diabetes, cancer, heart problems and psychological challenges. Moreover, almost one in three Dutch citizens have a limited health literacy and 2.5 million Dutch citizens have a low health literacy [9]. This illustrates the need for more understandable forms of communication for this target group.

That the Diameter does not take the needs of users with a low health literacy into consideration is mainly visible in the coaching feature of the app which exclusively uses a textual format. Ownby, et al. [10] found that people with low health literacy respond better to information in non-textual format. This makes it difficult for people with low health literacy to understand, let alone implement the advice of the coaching content in their daily lives. As such, the objective of this study is to research and design a tool to communicate diabetes type 2 lifestyle coaching content to those with a low health literacy. The tool should motivate and ensure users can obtain, process and understand health related content to make informed health decisions for a healthy lifestyle.

1.1 Research question

The main research question is therefore as follows:

How to design the communication of type 2 diabetes coaching content to motivate people with a low health literacy to change their lifestyle?

The first sub-question goes into strategies that are currently used to make content suitable for people with low health literacy. Doing this effectively means ensuring that people with low health literacy can understand and apply the information.

SubRQ1: What strategies exist to effectively communicate to people with low health literacy?

The second sub-questions invites to explore existing technological tools tailored to people with low health literacy. Investigating these tools gives insights into what methods have already been applied and if this application was effective in making information understandable and motivating lifestyle changes.

SubRQ2: What technological tools exist that are designed to be low health literacy appropriate and which strategies are used for this?

This third sub-question aims to evaluate the usability of the designed technological tool. Specifically, the extent to which it communicates type 2 diabetes coaching content in an understandable, easy to use and aesthetically pleasing way to motivate people with a low health literacy.

SubRQ3: To what extent is the designed technological tool usable in communicating type 2 diabetes coaching content to people wit a low health literacy?

1.2 Thesis structure

The first chapter introduces the thesis by offering background information and insight in the topic addressed throughout the thesis. Chapter 2 starts by going into relevant background studies including a literature review into strategies to communicating to people with a low health literacy. Thereby answering the first sub question. Chapter 2 then answers the second sub-question in the state of the art section that explores existing technological tools and reflects on what low health literacy strategies they implement. Chapter 3 describes the methods and techniques used throughout the thesis to develop the coaching content. Chapter 4 explains the process of the ideation phase ending in a set of requirements which were developed into specifications in chapter 5. Chapter 6 describes the realisation phase of creating a hi-fi prototype. Of which the user evaluation on it's understandability is explained in chapter 7. Chapter 8 discusses and reflects on the complete study, including the user evaluation, limitations and future work. The thesis is concluded in chapter 9.

Chapter 2: Background research

This chapter investigates relevant background information needed to design coaching content that is understandable and motivating for people with low health literacy. Chapter 2.1 goes into the existing Diameter app and its relevant features for this paper. Chapter 2.2 and 2.3 describe the outcome of a literature review which was conducted with the aim of answering the second sub-question. This was done by identifying strategies to communicate to people with low health literacy. The literature review was done by utilizing the Scopus literature database. First, search terms were used to find the most relevant papers. Each search term started with 'low health literacy' and then a term was added. Additional terms included 'methods', 'strategies', 'mHealth', 'eHealth', 'coaching', 'app'. Second, papers were saved based on their titles and a quick scan of the abstract. In the end, 28 papers that seemed relevant were saved. Third, the relevancy was further evaluated based on the abstract and conclusion. The most important inclusion criteria was that it focussed on communication strategies for low health literacy. Not all research was aimed at helping people with diabetes, some focussed on other medical conditions. However, because the focus of this study is aimed at low health literacy and all studies were aimed at this, the research was still taken into consideration. Fourth, notes were taken on the papers in Excel where the type of paper, aim, communication strategies and conclusions were summarised. Finally, the communication strategies that were identified in the papers were categorised by highlighting similar strategies a certain colour. These categories formed the base to describe the communication strategies in a structured manner in the background research. The technological tools in Chapter 2.4 were found in the literature during the literature review. The tools were evaluated based on the strategies found in Chapter 2.3 in order to answer the second sub-question.

2.1 The Diameter App

The Diameter app [11] was developed by a team of researchers aiming to create an E-supporter for people with Type 2 diabetes (see Figure 2). The aim was for users to be able to self-manage their condition and improve their health by working on their behaviour in terms of movement and nutrition. The app included features that enabled the user to track their health and receive coaching content, both of which were based on behavioural determinants and behavioural change techniques (BCTs). Users could track their health using a Fitbit, the Freestyle Libre and self-reporting their activity and nutrition. The coaching content and behavioural change techniques are explained in more detail in Chapters 2.1.1 and 2.1.2, as these features are also relevant for this thesis. That is because this thesis aims at implementing the existing coaching content and behavioural change techniques, used in the Diameter app, more suitably to ensure users with a low health literacy benefit from them.

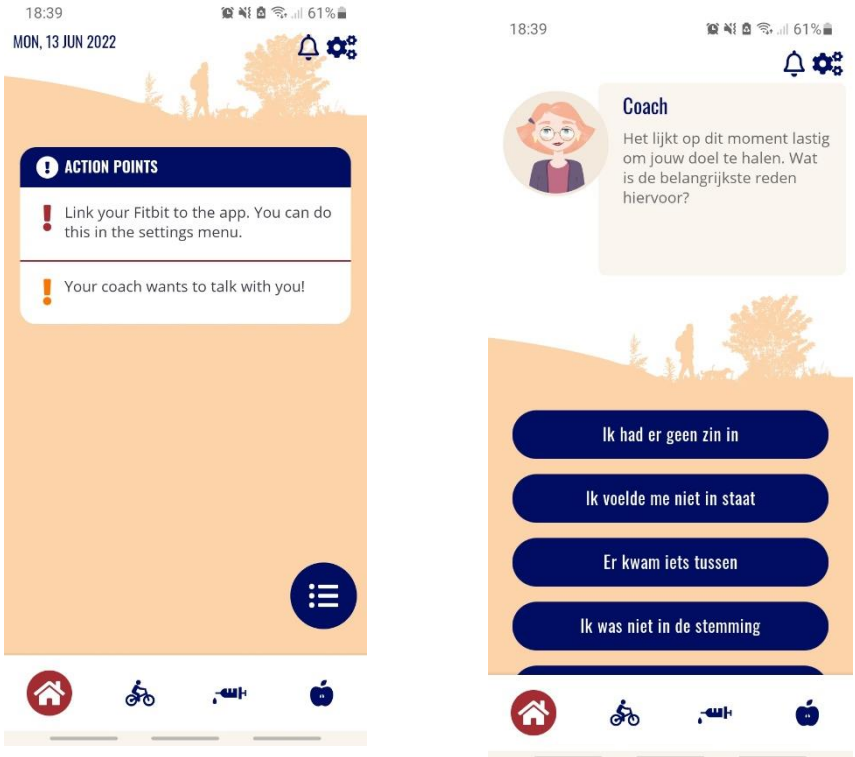


Figure 2 Screenshots of Diameter app homepage (left) and talking with coach (right)

2.1.1 Coaching content

The Diameter app coaching content was given in a textual format through push notifications and written text from a virtual coach. The content covered three main categories; nutritional information, physical activity and self-management. The nutritional information provided was based on The Dutch "Guidelines for a good diet" from 2015 [12]. The physical activity content was based on guidelines provided by the Dutch Health Council [13]. The content formulation and timing of notifications were based on behaviour determinants and behavioural change techniques.

2.1.2 Behavioural change techniques

Behavioural change interventions "can be defined as coordinated sets of activities designed to change specified behaviour patterns." (p.1) [14]. These are relevant for the project because they can be used to motivate behavioural changes, specifically, encourage healthy lifestyle habits for people with Type 2 diabetes. While the BCTs are relevant, the main aim of this study is to make the current content of the Diameter app low health literacy appropriate. Therefore, literature on BCTs was not studied separately but instead a paper by Hietbrink, et al. [15] was used. This paper describes the systematic development of the Diameter app and which BCTs were applied to it. These BCTs were selected based on theory and evidence to address determinants of behaviour, based on existing studies and reviews. The BCTs are ultimately still relevant and applicable to this thesis because it builds upon the existing Diameter app.

Hietbrink, et al. [15] divides the behavioural change process into three phases. First is the intention phase where an intention is formed to adopt a healthy lifestyle. Second is the action phase in which intentions are put into action to actually change behaviours. Third the maintenance phase, aimed at sustaining the behaviour change for the long-term. Furthermore, behaviour determinants based on

the Health Action Process Approach (HAPA) model [16] were identified in each of the phases. Additionally, two key determinants were used in each phase. Figure 3 presents the determinants and linked BCTs used in the Diameter app.

Phase	Key det.		Initiation					Action		Maintenance			
BCTs/ determinants	Action control	Self-efficacy	Knowledge	Risk perception	Outcome expectancies	Attitude	Social support	Action planning	Coping planning	Mood management	Habits	Satisfaction	Social influences
1.1 Goal setting (behavior)		■											
1.2 Problem solving		■						■	■	■	■		
1.4 Action planning		■						■	■		■		
1.5 Review behavior goal	■												
2.2 Feedback on behavior	■												
2.3 Self-monitoring of behavior	■	■											
2.4 Self-monitoring of outcome(s) of behavior												■	
3.1 Social support, including motivational interviewing		■					■						■
3.2 Social support (practical)							■						■
4.1 Instruction on how to perform the behavior		■	■										
5.1 Information about health consequences			■	■	■	■							
5.6 Information about emotional consequences					■								
6.3 Information about others' approval													■
7.1 Prompts/cues								■			■		
8.3 Habit formation											■		
9.1 Credible source						■							
9.2 Pros and cons					■	■							
9.3 Comparative imagining of future outcomes					■								
11.2 Reduce negative emotions		■								■			
13.2 Framing/reframing						■							
15.1 Verbal persuasion about capability		■											
15.3 Focus on past success		■											

Figure 3 Determinants and linked BCTs incorporated in the Diameter app [15]

According to the client, a few of the most relevant BCTs are goal setting, self-monitoring and review behaviour goal. To illustrate how BCTs are defined a description is offered of most relevant ones. The following descriptions are based on Abraham and Michie [17] definitions of the BCTs. Goal setting involves making a plan of what a person will do, including details such as the frequency, duration and location. Self-monitoring refers to a person keeping track of specified behaviour. Review behaviour goal involves reviewing and considering set goals and intentions.

2.2 Relevancy of low health literacy appropriate communication

There are two instances where communication suitable for low health literacy is deemed especially relevant for this thesis: (1) when looking at the capacity to self-manage diabetes and (2) when using technological tools. Looking into these instances is important because low health literacy appropriate communication methods are crucial for more positive healthcare outcomes [7, 18, 19]. Additionally, since digital tools offer a unique communication platform for self-managing diabetes, it is important to consider their usability for people with low health literacy [20].

Fransen, et al. [21] looked into the evidence for the association between health literacy and diabetes self-management. Based on 11 studies, they found that there is generally little evidence for the

relation between the two. On the contrary, Marciano, et al. [22] conducted a more recent meta-analysis study to investigate the role of health literacy in diabetes knowledge, self-care and glycaemic control. The analysis included 61 studies and found that all three aspects were related to health literacy. That is, health literacy plays a substantial role in diabetes knowledge. Similarly, Rademakers [23] stated that low health literacy is associated with decreased health outcomes. This is because people with low health literacy struggle with health competencies such as self management, knowledge, lifestyle and access to healthcare. Moreover, Mackert, et al. [19] investigated how patients with low health literacy perceived health information technology tools. They concluded that patients with low health literacy would be less likely to use health information technology tools or perceive them as easy or useful.

Accordingly, the findings of the studies pose a relevant challenge, namely that people with low health literacy struggle to self-manage as well as use technological tools to do so. This illustrates that special care should be taken to design self-management technological tools so they are suitable for people with low health literacy. Further research is needed to verify this and formulate strategies for creating such technological tools.

2.3 Strategies for low health literacy appropriate communication

Berkman, et al. [6] suggests there are no universally integrated principles of clear language relating to health information and material. However, some consensus can be drawn between strategies in literature regarding health literacy appropriate communication. Moreover, if these principles were universally integrated, the population's health literacy would be higher [6]. Nevertheless, until that is the case, it is important to take these strategies into account when designing health information tools for a low health literacy audience. Consequently, during the literature study many strategies were found. These can be divided into three categories, the language use, the communication approach and the medium and means through which information is communicated.

2.3.1 Language use

Various studies suggest different levels of low health literacy appropriate reading material. To start, Ownby, et al. [10] state that text should be in 3rd grade level with audio narration. Whereas O'Meara, et al. [24] and Weiss, et al. [25] suggest a 5th grade reading level. The difference likely lies in their methods of determining the levels. Ownby, et al. [10] distinguish between below basic, basic, intermediate and proficient, with the intermediate level requires a 6th to 8th grade level. Yet Weiss, et al. [25] looked specifically at the reading level of older adults with low health literacy. Since the latter is most relevant for this study, information will be written in a 5th grade level or below if a textual format is used.

Additional suggestions regarding language are that it should be short and easy to read [26], in an active form [27], plain language should be used [28-30], information should be focussed on the key message such as emphasizing 1 to 3 key points and writing down important information [28, 29, 31], medical professionals should speak more slowly [32, 33], simple and clear language should be used [7, 33] and lastly the process should be explained step-by-step [31].

2.3.2 Communication approach

The two most common communication approaches presented in the literature are using interactive communication and repeating information.

2.3.2.1 Interactive communication

While multiple authors suggest using an interactive communication style, there are many ways through which this can be implemented.

First, Ownby, et al. [10] advise asking questions to ensure patients understand the content. Second, Kripalani and Weiss [29], Kountz [33] and Williams, et al. [30] advise encouraging patients to ask questions. This way, the medical professional can find out what it is the patient doesn't understand and reiterate the information. Third, Kountz [33], Kripalani and Weiss [29] and Goessl, et al. [34] mention the teach-back strategy. This is when the patient is asked to teach the information back to the medical professional, ultimately, to test their understanding and find barriers.

Furthermore, Broderick, et al. [35] recommend writing actionable content such as short statements with positive messages that explain the benefit of the behaviour followed by how to take action. They also suggest letting users interact with content such as through polls and quizzes which can ultimately be integrated into their daily lives.

Moreover, Uemura, et al. [36] researched the "Effectiveness of an Active Learning Program in Promoting a Healthy Lifestyle among Older Adults with Low Health Literacy". Their active learning program consisted of a weekly 90-minute active learning session for 24 weeks. Activities during these sessions included exploratory learning through homework assignments where participants needed to find information on healthy lifestyles, in-class group discussions reflecting on the homework and progress, and finally self-planning and implementing healthy lifestyle choices. The intervention led to significant improvement in participants "health literacy, step count, engagement in moderate-to-vigorous physical activity, dietary variety, life-space mobility, social network size, grip strength, gait speed, and depressive symptoms" (p.33). Thereby illustrating the benefit of exploratory learning for people with a low health literacy.

Additionally, Thapa-Chhetry and Keck [37] explain the background and implementation of a chrome extension that analyses the page and implements low health literacy strategies to help the reader comprehend the information. Two interactive features are implemented in this extension. First, it automatically generates true or false questions to test patients' understanding, clarify concepts and give positive feedback when the answer is answered correctly. Second, users can click on medical terms they do not understand to see a pop-up box with the definition. This study indicates that using polls and quizzes, exploratory learning and getting positive feedback are effective strategies.

There are various ways to communicate information interactively depending on the medium. Ultimately, this communication approach helps to ensure patients understand and remember voiced and written information. These strategies can be implemented in a variety of ways as will be done during the ideation phase.

2.3.2.1 Repeating information

Various authors stress the importance of repeating or reteaching information. First, Ownby, et al. [10] states that the repetition of information is an important factor in effective healthcare interventions. They continue by stating that digital tools are therefore effective methods for communicating information because they are suitable for automating the repetition of information and can offer the information unlimited times. Ultimately, this can decrease the load on medical professionals.

Second, Goessl, et al. [34] agree with this through their evaluation of the effectiveness of technology versus in-person diabetes prevention interventions. Aiming to evaluate which best enhances the comprehension of learning objectives among patients with differing health literacy. They found that a technological prevention program, a DVD, was more effective than the in-person sessions, this was probably because DVD's can be rewatched unlimited times.

On the contrary, Fransen, et al. [38] concluded that solely repeating information does not fit the needs of people with low health literacy. They investigated the perceptions and strategies health care providers implement regarding diabetes self-management support for patients with low health literacy. Additionally, they compared the current support with the needs of the patients. The study found that nurses mainly, and almost exclusively, implemented the strategy of repeating information. This did not fit the needs of low health literacy patients. This conclusion may be because the nurses did not, or barely, used other low health literacy suitable communication strategies. Illustrating that the repeating information strategy should be used in combination with other strategies for it to be effective.

The literature findings demonstrate that repeating information to low health literacy patients is an effective communication method. However, it is important to keep in mind that solely repeating information without using any other communication strategy will most likely not be beneficial.

2.3.3 Medium and means of communication

The most prominent medium of communication found in the literature is using visual and audio means. For instance, Ownby, et al. [10] state that instructional strategies should have an audio narration of visually presented content with graphical illustrations. Similar findings were presented by Visscher, et al. [26] who explored the needs of people with Type 2 Diabetes and low health literacy. They concluded that participants had different preferences ranging from spoken information or animations to booklets and applications with limited writing. In like manner, O'Meara, et al. [24] found that health information should be communicated through various methods such as a combination of visual and audio. Likewise, Travis Gossey, et al. [39] found that offering patients an audio booklet (a printed booklet that accompanies an audio program) increased their enjoyment and knowledge more than standard care material.

Moreover, Volk, et al. [40] found that entertainment education may be an effective strategy for informed decision making. In their study they compared the effectiveness of an audiobook with a soap-opera episode with interactive learning modules. Similarly, Moran, et al. [41] compared a narrative and a non-narrative film with adequate and low health literacy participants. They found that while both films increased knowledge, the narrative film was most effective. Likewise, Jibaja-Weiss, et al. [42] conducted a similar study with soap opera episodes and concluded entertainment strategies are desirable for communicating to a low health literacy audience.

Furthermore, Eckman, et al. [43] conducted a study comparing the effectiveness of providing patients with a DVD accompanying a booklet or only a booklet. They found that the participants who received both a booklet and a DVD had significant improvement in weight loss and exercise. Similarly, Goessl, et al. [34] found that a DVD-based diabetes prevention program was more effective than an in-person sessions. These findings illustrate some of the benefits of using digital means over physical means. Namely digital tools offer the possibility to combine visual and audio as well as repeating content.

Although it would be expected that if videos are effective, moving images are more effective than static images. Housten, et al. [44] finding's oppose this in their study investigating if animations improved comprehension of risk information in patients with low health literacy. They found that animated pictographs did not appear to communicate information more effectively than static pictographs (both animated and static pictographs were accompanied by audio narration). However, this result may be due to a general difficulty to understand pictographs. To illustrate, Wolpin, et al. [45] found that many adults with low literacy found it difficult to understand a substantial amount of common medication label pictographs.

After all, combining both digital and physical means may be the most effective method. For instance, Yeung, et al. [46] did a study where participants were given flashcards that illustrated medical concepts accompanied by QR codes on medicine bottles that linked to 30-second counselling videos with the same content as the flashcards but with audio narration. Supporting a physical product with digital means was deemed effective. Nevertheless, Williams, et al. [30] state that research is limited to many methods such as the use of podcasts and smartphones. This means there is a need for innovative research and products that use technological tools to their advantage. For example the 'Talking Pill Bottle' and 'Interactive Jewellery Box' which will be explained in more depth in Chapter 2.4.

Besides the way information is communicated, the way it is presented is also relevant. For example, Broderick, et al. [35] go into depth on the visual aspect of designing apps tailored to people with low health literacy. They state that content should be displayed clearly with big fonts and 'chunking' information by grouping related information together. Furthermore, apps must engage users which could be done by offering the possibility to print, share content and integrate new media.

In addition, there are also general strategies one can take into account when designing low health literacy appropriate content. Such as making information personalised, recognizable and relevant to the viewer [10], learning about the user and understanding them (e.g. through co-design) [35, 47] and evaluating the products' usability continuously [47].

2.3.4 Low health literacy strategies overview and conclusion

Table 1 provides an overview of the various communication strategies found in the literature to make information understandable for people with low health literacy.

Table 1 Overview of low health literacy communication strategies grouped in categories

#	Strategy	Category
1	3rd to 5th grade reading level [25]	Language
2	Write content short, easy to read and in an active form [26, 27]	
3	Use plain language [28-30]	
4	Focus on key message e.g. emphasizing 1 to 3 points, writing down important information [28, 29, 31]	
5	Speak more slowly [32, 33]	
6	Write simple and clear language [7, 33]	
7	Explain processes step-by-step [31]	
8	Ask questions to patient [10]	Interactive communication
9	Encourage patient to ask questions [29, 30, 33]	

10	Encourage patients to teach-back information [29, 33, 34]	
11	Write actionable content [35]	
12	Use polls and quizzes [37]	
13	Encourage exploratory learning [36, 37]	
14	Interact with content and get positive feedback [37]	
15	Reteach and repeat information [10]	Repetition of information
16	Utilize digital tools that enable unlimited repetition e.g. DVD's [34]	
17	Combine various means of communication (visual, oral, textual, video) [10, 24, 26, 39]	Medium and means of communication
18	Communicate in a narrative manner [10, 40-42]	
19	Combine digital and physical means of communication [34, 39, 43, 46]	
20	Digital information should be presented with big fonts, chunking information [35]	
21	Make information personal, recognizable and relevant to the viewer [10]	

It is important to mention that most strategies were not used independently in literature. They were often used in combination with eachother, thereby enhancing their effectiveness. Thus, combining these strategies and techniques offers a valuable overview of communication strategies that can make information understandable for people with low health literacy. The strategies can be implemented in a variety of use-cases, including that of the Diameter app.

2.4 State of the art

Various technological tools already exist that are tailored towards people with low health literacy, each with a different goal and implementation of the strategies in Table 1. In this chapter the tools found in literature are explained in more depth. Then, in the concluding section, an overview is provided of the strategies that each tool implements. Thereby answering the second sub-question.

healthfinder.gov

An award-winning website designed based on formative research. Methods that were used were card sorting, interviews and usability tests with more than 700 people of which a large amount had limited health literacy. The website is written in plain and actionable language.

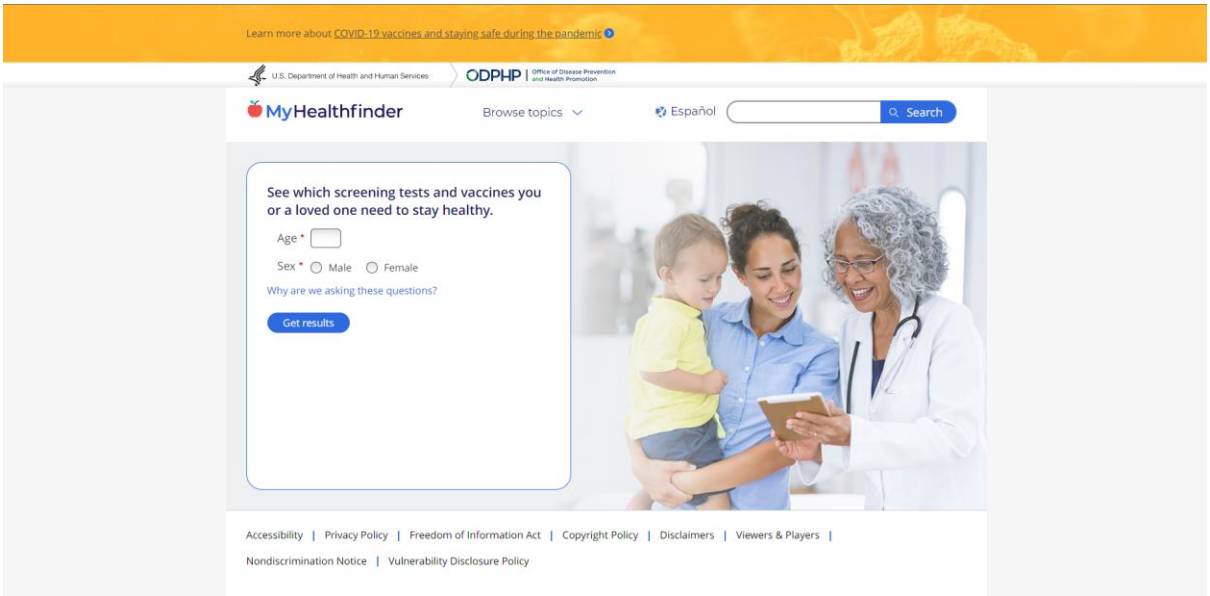


Figure 4 MyHealthfinder homepage

Myfamily

Myfamily is an app that helps users build personal and family health plans. This app is the winner of healthfinder.org challenge to create and easy-to-use mhealth app. The app uses low health literacy appropriate communication strategies such as grouping, organising and simplifying information.

Figure 5 Myfamliy app homepage

Got It

Got It is a chrome plug-in that analyses the user's current page and offers a context-sensitive personalised learning tool. The aim is to facilitate interactive learning, thereby helping the reader improve their health literacy and confidence. The extension includes three main features. First, it automatically generates true or false questions based on the paragraph to test the user's understanding and clarify concepts followed by positive feedback (e.g. Good job!). Second, it offers focus assist, which highlights an area around the cursor when there is no scrolling for 30 seconds, this brings the readers' focus back to the text. Third, it defines medical terminology through a pop-up box when the user clicks on a medical term.

Talking Pill Bottle

The Talking Pill Bottle project is a pill bottle holder that can play pre-recorded messages from the doctor about the correct usage of the medication. The study researching this product found that providing audio-assisted medication instructions positively affected blood pressure control. The product was also well accepted by patients with low health literacy.

Figure 6 Talking Pill Bottle product

Interactive jewellery box

The interactive jewellery box is a project made to assist women in (1) recording and reflecting on issues of concern with possible treatments, (2) deliberating over surgery decision, and (3) communicating with physician and significant others. The interactive jewellery box is a digital platform with clickable items e.g. clicking on the flower goes to the next piece of information, clicking on the jewellery box opens the issues the user added. There is also a narrated soap-opera video that explains the journey of a women being diagnosed with breast cancer going through the process of choosing what surgery to have.

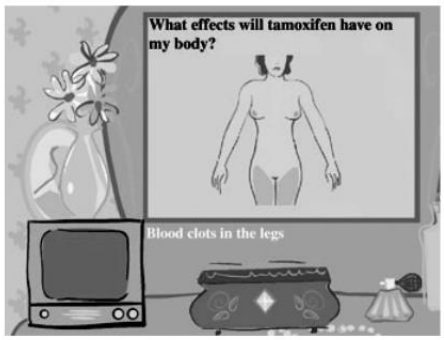


Figure 7 Screenshot from interactive learning module of Interactive jewellery box

2.5 Conclusion

The background research conducted was used to answer the first two sub-questions.

SubRQ1: *What strategies exist to effectively communicate to people with low health literacy?*

A literature review of previous studies on the subject of communicating to people with low health literacy was used to answer this sub-question. 21 strategies were identified which can be divided into

four categories. The first is language which refers to the simple use of language and 5th grade reading level. The second is interactive communication meaning engaging the user by making information interactive. The third is repetition of information which can be done using various methods such as digitalising content so it is repeatable unlimited times. The fourth is using various medium and means of communication referring to using textual, audio and visual ways to communicate.

SubRQ2: *What technological tools exist that are designed to be low health literacy appropriate and which strategies are used for this?*

The state of the art investigates various existing technological tools that are designed for people with low health literacy. These are the healthfinder.org website, Myfamily app, Gotit chrome plug-in, the talking pill box and the digital interactive jewellery box. The tools implement various strategies found in the literature review. Table 2 illustrates which strategies the tools implemented.

Table 2 low health literacy strategies implemented by technological tools created for people with LHL

Strategy	Healthfinder.org	My family	Got It	Talking Pill Bottle	Interactive Jewellery Box
3rd to 5th grade reading level [25]					
Write content short, easy to read and in an active form [26, 27]					
Use plain language [28-30]					
Focus on key message e.g. emphasizing 1 to 3 points, writing down important information [28, 29, 31]					
Speak more slowly [32, 33]					
Write simple and clear language [7, 33]					
Explain processes step-by-step [31]					
Ask questions to patient [10]					
Encourage patient to ask questions [29, 30, 33]					
Encourage patients to teach-back information [29, 33, 34]					
Write actionable content [35]					
Use polls and quizzes [37]					
Encourage exploratory learning [36, 37]					
Interact with content and get positive feedback [37]					
Reteach and repeat information [10]					
Utilize digital tools that enable unlimited repetition e.g. DVD's [34]					

Combine various means of communication (visual, oral, textual, video) [10, 24, 26, 39]					
Communicate in a narrative manner [10, 40-42]					
Combine digital and physical means of communication [34, 39, 43, 46]					
Digital information should be presented with big fonts, chunking information [35]					
Make information personal, recognizable and relevant to the viewer [10]					

A limitation of the background research, is that some studies were not conducted with people with low health literacy even though their research was targeting a low health literacy audience.

Chapter 3: Methods and Techniques

The Creative Technology Design Process (see Figure 9) developed by Mader and Eggink [48], was used to develop a low health literacy appropriate eHealth coaching tool. This approach serves as a guideline for the design process, making use of diverging and converging phases and spiral models. These were implemented in the four different phases of the design process: ideation, specification, realization and evaluation. Because this approach is extensive, a wide variety of facets are covered in the process ensuring a thorough and well-designed end product.

3.1 Ideation

During the ideation phase a diverging approach is essential as this is the phase in which ideas are formulated and elaborated on. Additionally, applying the spiral models is also crucial as this phase is an iterative process. Accordingly, the needs of the user, stakeholder requirements, technology and creative ideas are taken into account. Each of these is a possible starting point for the ideation phase. In this thesis the user needs and stakeholder requirements were the starting point.

In combination with the Creative Technology Design Process, the Human-Centred Design Process (HCDP) was also applied in the ideation phase. The HCDP is divided into three stages consisting of observation, ideation and implementation. Each phase has various phases of converging and diverging processes. The Ideation chapter of this thesis starts with the converging phase of the HCDP ideation stage. This converging phase is based on the literature study from Chapter 2 as well as the user needs and stakeholder requirements. When generating ideas, the diverging phase is entered. This was done using the brainstorming technique where as many ideas as possible are written down within a certain time frame.

During the idea generation, the most promising concept was elaborated upon by thinking out a simple use case scenario and persona. A use case scenario illustrates how a user may use the system by describing a set of steps taken to accomplish a certain task [49]. A persona is a fictional character, created based on research, to illustrate the type of user that may use the product [50]. Moreover, creating personas may help define the needs of the user as it forces the researcher to step outside their own experience. In the end, the final concept was taken into the last stage of the HCD process by testing the idea with an expert through an informal discussion. With the aim of investigating if it is understandable and usable for communicating content to people with low health literacy.

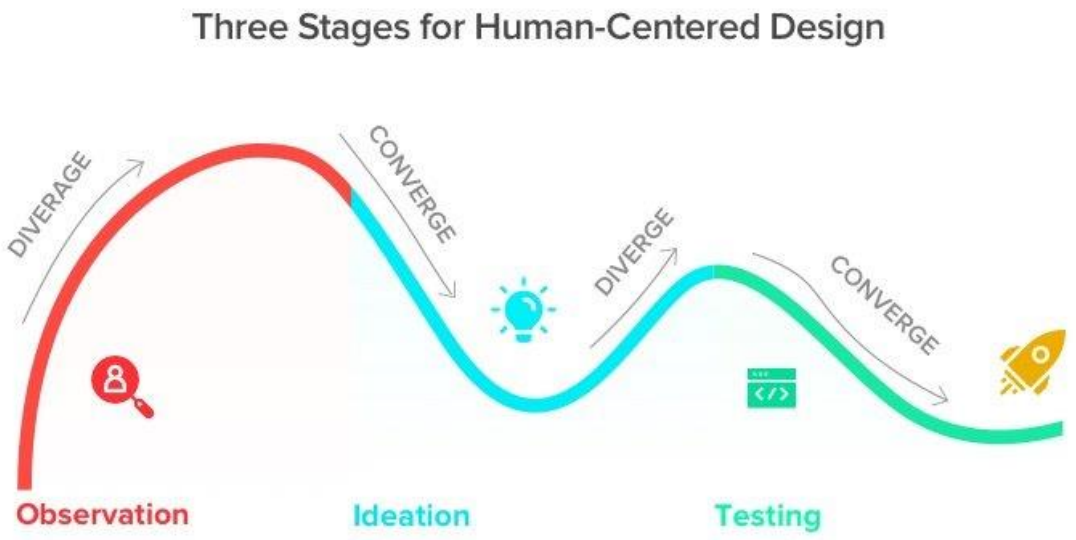


Figure 8 Human Centred Design Process [51]

3.2 Specification

In the specification phase the outcomes of the ideation phase were used. The most promising idea was explored in more depth by investigating three main elements, the experience the user should have, the functionalities the product should have and the priority of implementing the functionalities. This leads to the formulation of specifications for the final product according to which the early prototypes can be iterated on again.

In this thesis, the specification phase was done using various strategies to come to a final set of requirements that formed the final concept; a PACT analysis [52] was done, functional and non functional requirements were listed, the implementation of BCTs and low health literacy communication strategies were described and a MoSCoW analysis [53] was done. PACT is an acronym for people, activities, contexts and technologies. This analysis can be used to evaluate and determine requirements for designs and technologies from the perspective of the user [52]. Functional requirements refer to how the system must work [54]. Non functional requirements refer to how the system is used and should perform [54]. In this thesis the requirements are based on the PACT analysis, expert opinion and literature. MoSCoW is a method for prioritization and stands for must have, should have, could have and won't have [53]. Must haves are critical features that make the product useful. Should have are non-critical features but are still important. Could haves are features that may be included if there is time and resources. Won't haves are features that are explicitly excluded from the execution plan and may be included in future development. The requirements acquired during the specification phase will be prioritised using MoSCoW. This phase is finalised by producing a final digital prototype, taking into consideration all requirements.

3.3 Realization

The realization phase realises the digital prototype of the previous phase. This is done in various steps for different elements which were combined in the end to form the final high-end prototype. The various elements that had to be realised were the cards, case, hardware, software, audio, quiz and

animation. These were built in parallel to each other. Parts of the hardware and software were based on existing project found online[1] that could be adapted to this use case.

3.4 Evaluation

During the evaluation, the final prototype was evaluated in terms of how it communicates Type 2 diabetes coaching content to people with low health literacy. This was done through user evaluations and investigating if the original requirements set in the specification phase were met.

During the user evaluation, the aim was to investigate the usability of the communication and coaching content tool as posed in the third sub-question. This was done by evaluating three aspects: (1) to what extent people with low health literacy understood the lifestyle information, (2) to what extent the tool was easy to use and (3) what people with low health literacy thought of the appearance. Each of the aspects are part of the tool's usability as posed by van Genugten, et al. [56] who describes a usability taxonomy with usability attributes. The first, understanding the information, is part of the 'tailoring to user group' usability attribute. The second, ease-of-use, is part of the 'learnability' attribute. The third, the appearance, is part of the 'aesthetic appearance' attribute.

For this study, it was also crucial to evaluate the prototype with the target audience, namely, people with low health literacy. This was done by approaching organisations that may come into contact with this target group. Additionally, the evaluation must be adapted to this target group. This was especially relevant when preparing the ethics consent form, in the formulation of the questions and the way the researcher communicated to the user. Chapter 7 will further elaborate on how these aspects were adapted to the target audience. To evaluate the tool, a think aloud session and semi-structured interview were performed among people with low health literacy. Thinking aloud is a simple usability test where participants are asked to use a system while verbalizing their thoughts [57]. This method was used because it gives the opportunity to discover what the user thinks of the system without being guided by questions. To get a more general idea of what people with low health literacy thought of the tool, a semi-structured interview was conducted after the think aloud session. For this a set of predefined questions were used as a guide. A semi-structured interview makes it possible to ask follow up questions or ask questions in a different order depending on the answers of the user. Additionally, it offers sufficient structure to allow all desired aspects to be discussed. To summarise, the evaluation phase consisted of a user evaluation of the final prototype through think aloud sessions and a semi-structured interview where the setup was tailored to people with low health literacy.

[1] [55] T. Voss. "TONUINO." https://www.voss.earth/tonuino/ (accessed 10.05.22, 2022).

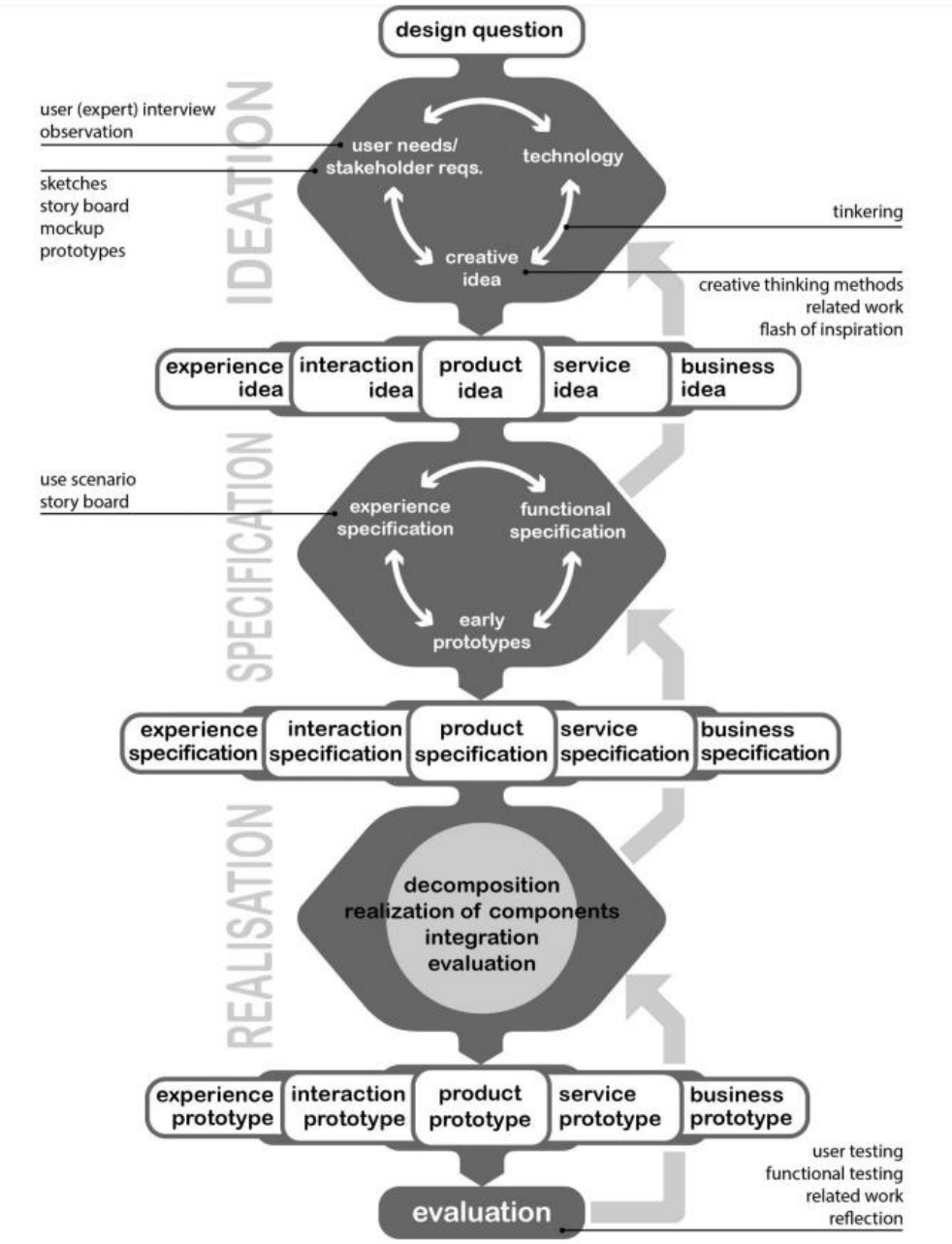


Figure 9 Creative Technology Design Process [48]

Chapter 4: Ideation

As mentioned in Chapter 3.1, the aim of the ideation phase is to produce a wide variety of ideas. Specifically, the goal was to think of concepts that would communicate type 2 diabetes coaching content in a low health literacy understandable way. This phase started by defining preliminary requirements for the project based on the background research and conversations with the client (see Table 3). These requirements formed the starting point of the ideation phase.

Table 3 Preliminary requirements

No.	Requirement	Source
1	It should be appropriate for people with a low health literacy. To do this low health literacy strategies should be implemented.	Client and literature
2	The content should be motivating and enjoyable for every user	Client
3	The tool should build upon the content of the Diameter app	Client

4.1 Concept generation

Taking into account the requirements and the outcome of literature, a concept was generated by doing two brainstorms. These led to one concept consisting of a combination of ideas.

4.1.1 Brainstorm

During the brainstorm, the focus was on diverging exploration whereby the goal was to think of as many ideas as possible. In total, two brainstorms were held whereby the second one built upon and visualised many of the ideas from the first brainstorm. To capture the second brainstorm, a mind map was made (Figure 10). While brainstorming, rough sketches of a few concepts and a preliminary use case and persona were written out. The latter two will be written out in chapter 4.1.2 together with the chosen concept (see Figure 11) which incorporated many of the other ideas and techniques.

<u>First brainstorm</u>

- Using gamification elements
    - High score/socials page for people to see other peoples progress and streaks
    - In studies participants appreciated the contact with fellow people with diabetes
- Draw a card every day with the challenge of the day: eat a piece of fruit, go for a walk, glass of water instead of fizzy drink
    - After drawing the card the user can say if they did it and how hard it was, the algorithm can then adjust to their level and increase the level over time
    - There is a streak of completed cards every day, lose the streak if you miss completing it one day
    - Physical card game, put a stack of cards and then take 1 a day hang it up and then if you've completed out on green plate of not completed put on orange plate
        - Scanning the card (in app or external device) plays a video or audio fragment explaining its importance (importance of healthy snack or walking)
- Motivating messages in the form of a notification at challenging times: before meals or in-between meals

    - The amount of notifications should be changeable by the user as studies found that some like it while others don't
- A coaching page in the app with
    - Challenges: small exercises to do
    - Motivational messages
    - Explainer videos: change is important
- Audio devices activate on movement
    - E.g. Opening fridge at breakfast plays audio with advice on healthy breakfast, or at 11.00 on healthy snack
    - E.g. Opening the door or walking in hallway gives advice on going for a walk and movement. The reminders are then given at the times when it is relevant.
- Physical display with buttons of different exercises, fruits and vegetables, they light up when they're pressed. Goal is to press 1 exercise, 2 fruit and 3 vegetables every day. Progress saved in app and amount maybe increases over time and progression.
- Interactive movie or just a movie soap opera following someone with diabetes on their journey to being free of medicine

Second brainstorm

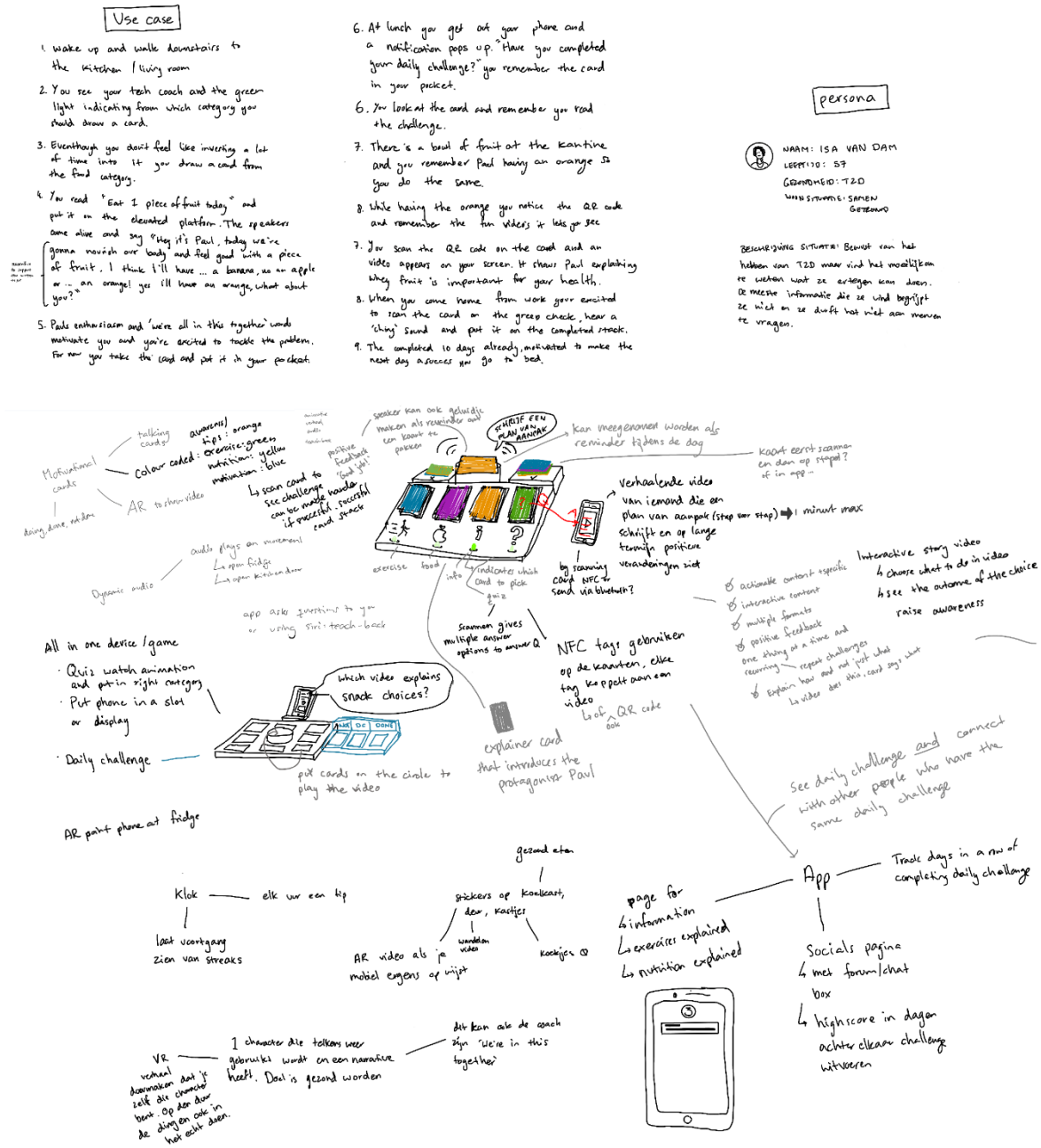


Figure 10 Brainstorm mind map incl. preliminary sketches, use case and persona

4.1.2 Initial concept

After the brainstorm, a concept was chosen that combined as many ideas and low health literacy communication strategies as possible. When evaluating the concept based on the communication strategies in Table 1, it already included 15 of the 21 strategies (numbers 1-6, 8, 11-12, 14-19, 21). The concept was illustrated in Illustrator to clarify it's design further as visible in Figure 11.

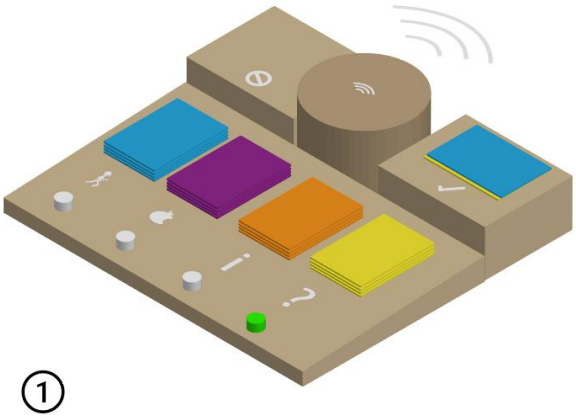


Figure 11 First prototype design

The preliminary use case and persona noted during the brainstorm were written to clarify the concept and find initial points of improvement. They were also used during the expert opinion in Chapter 4.2 to describe the product. The use case and persona are described below, in the use case the character Paul was created to represent the character the user interacts with on the cards and in the sound and video:

Use case

1. You wakes up and walks downstairs to the kitchen for breakfast
2. You see the tech coach standing on the counter and a green light indicating from which category they should draw a card
3. Even though you don't feel like investing a lot of time into it you still draw a card from the food category
4. You read 'eat 1 piece of fruit today' and put the card on the elevated round platform. From the speaker you hear a voice say "Hey its Paul, today we're going to nourish our body and feel good with a piece of fruit. I think I'll have…a banana. No, an apple…or…an orange! Yes I'll have an orange, what bout you?"
5. Pauls enthusiasm and 'we're all in this together' words motivate you and you're excited to tackle today's challenge. For now, you take the card and put it in your pocket.
6. At lunch you get out your phone and see a notification pop-up "Have you completed you daily challenge?". You now remember the card in your pocket.
7. You look at the card again and are reminded of the challenge
8. There is a bowl of fruit at the canteen and you remember Paul having an orange so you also take an orange
9. While eating the orange you notice the QR code on the back of the card and remember you can scan it to see a fun video.
10. You scan the QR code with your phone and a video appears of Paul explaining why fruit is important for your health

11. When you come home from work your excited to scan the card on the platform with a checkmark that gives a positive 'ching' sound and put the card on the completed stack
12. You completed 10 days already, motivated to make the next day another success you go to bed.

Persona

Table 4 Preliminary persona

Name	Isa van Dam
Age	57
Health condition	Type 2 diabetes
Living situation	Living with husband
Description	Isa is bewust van het hebben van T2D maar vind het moeilijk om te weten wat ze ertegen kan doen. Ze weet niet zo goed waar ze informatie kan vinden en de informatie die ze vind begrijpt e vaak niet. Ook durft ze het niet aan mensen te vragen.

4.2 Expert opinion

4.2.1 Method

An expert with a background in health literacy and older adults was asked to evaluate the initial concept. The aim was to investigate to what extent the concept would be effective in communicating to people with low health literacy. Ultimately, the researcher wanted to get a clearer vision of which aspects of the product would and wouldn't work in their effort to communicate content to a low health literacy audience.

A meeting with the expert was set up on Microsoft Teams. The researcher introduced themselves and explained the plan and goal of the meeting. The plan was to start by explaining the concept and then have an informal discussion where the expert could voice their opinion on the effectiveness and usability of the concept. As such, the researcher shared their screen to show the digital prototype, explained the concept through the use case and clarified design choices based on literature. Next, the researcher asked what the expert thought of the concept. Specifically, its usability and content understandability for people with a low health literacy. The expert then voiced their opinion on various elements such as the usability, aesthetics, understandability and possible pitfalls. The researcher typed along with the expert's comments in a Word document using bullet points and occasionally asked questions for clarification. Following the meeting, the researcher processed the comments by dividing them into seven categories; location, usability, physicalising, design, long-term integration, limitations, and use case scenario and persona. In addition, duplicate comments were removed and similar comments were combined.

4.2.2 Results

A summary of the feedback for each of the seven categories is described in Table 5.

Table 5 Expert opinion results

Category	Feedback
Location	• Take various scenarios and usages into consideration to find what location would be most appropriate. ○ For example, putting it in the kitchen is smart because that is where most people go in the morning and food is a big struggle

	for those with diabetes. However, you should consider who prepares the food
Usability	• Don't include bringing the card with you, it is better to have everything in one place • Have a cut-out in the holder so the cards don't fall over but sit securely • Nice to have every category included in one week but it would be nice if it's related to what you need that day. • There needs to be a reminder to take a card • Instead of the not done stack they put it back in the stack
Physicalising	• Smart to use LED's and icons to indicate what card to use and what type of card it is • Adding audio elements is also good • Good to use the product in combination with the app • Having it physically, offers an obvious reminder to do something and there is a clear reward and accomplishment when putting a card on the 'done' stack

Design	Case
	• Design it in a way that fits the location and target group
	• Since people with LHL are often ashamed of it they shouldn't be ashamed of this device but it should look nice and they should be proud of it, something they can show off
	  o For example: one colour in different shades rather than many different colours
	Cards
	• The back of the card is a mini cartoon of Paul is nice because it adds a narrative so the user wants to turn the card to see it
	• Could add a narrative to the cards by making them combine to form an image or story in cartoons
	• Don't make every card a different colour
	• User test: text vs no text vs cartoon
	
	Video
	• Don't need to use animations you can also have a real person Paul, that would make it more real.
	• Don't want to hear Paul say the same generic thing every day
	• User test: very simple animation and real-life video and then ask what they prefer to see
	Audio
	• Think about the appropriate length
	• Don't want to hear the same generic thing every day
	
	Character Paul
	• Having a character can be patronizing (Dutch: "betuttelend")
	  o User test: character design cartoon versus real, it can differ from person to person

Long-term integration	• Important to integrate this product into the users routine
	• Don't need to use this their whole life, they just need to understand what to do to stay healthy, that's what they the cards for
	  ○ For example: you can say you need to use this device for 3 months, then they know how it works and can do it themselves (give it back to ZGT) then the phone still has the animations
	  ○ Use scenario: ZGT gives it and explain how it works, you have it for 3 months and then give it to the next person. Limits the number of cards as well, it makes it more feasible and realistic
	• Think about how many cards would be needed for the final product
	  ○ For example: for 3 months you would need 90 cards, 23 cards for each category

Limitations	• Think about various scenario's ○ For example: What if users lose the card, the NFC doesn't work anymore or other electronic parts malfunction • Card content can't be changed

Use case scenario and persona	• Envision target group and use scenario. Consider how and how long users will use it and then make a decision for the product
	  ○ What happens when they go on vacation?
	  ○ What happens if they live with multiple people?
	  ○ Who prepares the food?
	• If adults is the target audience the design and features should reflect that. Remember that they are adults and should feel respected.
	• If it is only for Dutch people with LHL then add that to the requirements

4.3 Preliminary requirements

Based on the ideation and expert opinion, preliminary requirements can be formulated (see Table 6). These build upon the requirements listed at the start of the chapter.

Table 6 Revised preliminary requirements

No.	Requirement	Source
1	The design and content of the product should be adapted to the target audience and their usage	Expert opinion
2	The product should have physical aspects	Expert opinion
3	The product should be aesthetically pleasing and fitting in the location it will be used	Expert opinion
4	The product is made for Dutch speaking people	Client

Chapter 5: Specification

Based on the literature review, outcomes of the expert opinion and ideation phase, more specific requirements can be set up. This process was started by doing a PACT analysis followed by setting up functional and non functional requirements, then the implementation of various BCTs and communication strategies from literature are explained, finally, the requirements are prioritised using MoSCoW. These specifications techniques and iterations based upon them led to a final concept.

5.1 PACT analysis

A PACT analysis (see Chapter 3.2), is done to determine requirements for the design and technologies from the user's perspective.

People

The target audience of the product is people with low health literacy. While the information in this product is specifically tailored towards people with Type 2 diabetes, the aim is to find out if the content is understood. This can be evaluated by anyone with a low health literacy, not solely those with diabetes. Furthermore, people that will be using the product usually struggle to understand health related information such as living a healthy lifestyle. Additionally, they lack either the knowledge or cues to remember to do things that are beneficial for their health. Moreover, information is best understood if it is communicated in a non-textual format in several ways such as orally and visually. Likewise, repeating information is crucial. Another aspect to take into consideration is that the user might live with other people who will also see the device. This must not influence users' behaviour such as not using the device out of shame.

Activities

Characteristics of the activities the product offers, are communication information in a textual, oral, visual and audio-visual format. Further, the duration of the information ranges from a few seconds to read the daily task to a 40-second video. In addition, the content should be easily and quickly understood to make the barrier for using the product as low as possible. Other activities that can be done are opening drawers to take out cards, putting cards on a platform and scanning cards with a phone to watch the video. Each action should be intuitive and easy to perform to ensure ease of use.

Contexts

The context can be described from a physical and social perspective. The physical location of the product will most likely be in the user's living room or kitchen. The product must therefore be designed to fit in these surroundings. For instance, in a kitchen it is important not to expose electronics in case water splashes. Likewise, when placed in the living room the device cannot be ugly or stand out too much, otherwise users may put it in a cupboard and forget about it. Furthermore, one aspect of the social context was shortly described in the section about people. Namely that attention should be given to the fact that the device is placed in a setting where other house members are also present. Therefore, things to consider in this context are the amount and volume of the sounds the device makes and how exposed objects of the device are, for example, children might start playing with the cards if they are 'up for grabs'.

Technologies

The technologies used in the product should enable the user to scan a card to activate a voice and scan the same card with their phones to see an animation. Accordingly, both hardware and software tools are needed to realise this. Possible hardware tool that could be used are an RFID scanner, RFID

cards, a passive speaker, an amplifier, an SD card, an SD card reader, an Arduino, a power cable, jumper cables and a mobile phone which the user should have themselves. The software tools could include Arduino IDE, which is an application to control the Arduino to then control all the hardware devices. The other software tool is NFC, which is a feature on phones needed to scan the RFID cards for opening the animation video and quiz questions. The technology should not be too exposed to the viewer as it may look complicated or malfunction when toyed with.

5.2 Functional and non functional requirements

To further define the product functional and non function requirements were formulated (see Table 7). Later, these were implemented and prioritised using MoSCoW.

Table 7 Functional and non-functional requirements for product

Functional	Non-functional
All the electronics fit inside	Nice to look at
Device is portable within the house	The case should be nice to look at and fit in its environment
Device is powered without needing a laptop	BCT's are implemented
Built sturdy	Low health literacy strategies are implemented to make information understandable
Cards can be scanned by the product which then plays a voice over	Make content enjoyable
Card can be scanned by mobile phones which then show a video or quiz	The character used on the cards and animation should be personal, relevant and recognisable for the viewer. They should somewhat represent the user by being slightly overweight, an older adult and have a friendly expression. The character should be going through the lifestyle changes himself as well functioning as both a coach and a buddy character.
LED indicate what category to take cards from	The voice used in the sound and animation should be fitting for the character. This creates a concise story and experience.
Make cards hidden so other household members do not play with them or to combat user shame	The voice recording should be natural, kind, motivating and not too fast.
Audio that plays when cards are put on the platform should play only once even if the card remains on the platform	

5.3 Behavioural determinants and change techniques

The product focusses on the first two phases defined by Hietbrink, et al. [15], the initiation phase and action phase. The main aim is to inform patients with no prior experience of basic actions they can take to improve their health, why this is important and how to do it. Still BCTs from each phase are relevant because ultimately the product also helps the user create and sustain some level of a healthy lifestyle. Some BCTs are more relevant than others for this product, Table 8 offers an overview of the BCTs that were implemented and how.

Table 8 BCT's implementation in product

BCT	Implementation
1.1 Goal setting	When the user takes a card a goal is set for the day to complete the challenge
1.4 Action planning	When reading the challenge the user needs to think about it and plan when to execute the task
1.5 Review behaviour goal	Putting the card on the 'accomplished' stack when the challenge is completed or shuffling it back in the category stack if the challenge wasn't completed
2.2 Feedback on behaviour	Implemented to a certain extent: If the user puts the card on the 'accomplished' stack they hear a voice saying something motivational
2.3 Self-monitoring of behaviour	The user needs to self-monitor if they completed the challenge or not
2.4 Self-monitoring of outcome of behaviour	See 1.5
3.2 Social support	Implemented to a certain extent: the character Paul guides the user through his voice and animation can be seen as social support in the sense that he supports the user and goes through the process with them
4.1 Instruction on how to perform the behaviour	The user can scan the card and see an animation of Paul modelling the behaviour
5.1 Information about health consequences	Paul describes the positive health related consequences of a healthy lifestyle through the audio and video
5.6 Information about emotional consequences	Paul describes the positive emotional related consequences of a healthy lifestyle through the audio and video
7.1 Prompts/cues	The green LED indicating from which category to take a card
8.3 Habit formation	The user forms the habit of taking a card every day
9.3 Comparative imagining of future outcomes	See 5.1
11.2 Reduce negative emotions	Paul's audio and video is positive and motivating for the user
13.3 Framing/reframing	Positive behaviour is framed through the challenges and reframing is done by encouraging users to replace current behaviour with healthy ones e.g. drink water instead of fizzy drinks.
15.1 Verbal persuasion about capability	Paul verbally encourages the user
15.3 Focus on past success	Implemented to a certain extent: the 'accomplished' stack will grow over time thereby highlighting the past success

5.4 Low health literacy communication strategies

The main aim of the product is to implement the strategies found in literature to make information understandable for people with a low health literacy. To illustrate how every strategy is taken into consideration, Table 9 provides an overview of the implementation of each strategy in the prototype.

Table 9 Implementation of low health literacy communication strategies

Strategy	Implementation
3rd to 5th grade reading level [25]	Written content on cards
Write content short, easy to read and in an active form [26, 27]	Written content on cards
Use plain language [28-30]	Written content on cards and narrative voice
Focus on key message e.g. emphasizing 1 to 3 points, writing down important information [28, 29, 31]	Written content on cards, specifically in the information category where cards highlight three main benefits of physical activity and nutrition.
Speak more slowly [32, 33]	Narrative voice
Write simple and clear language [7, 33]	Written content on cards
Explain processes step-by-step [31]	Narrative voice and video that models the behaviour for the physical activity and nutrition challenges
Ask questions to patient [10]	Quiz category cards, narrative voice and online quiz
Encourage patient to ask questions [29, 30, 33]	Quiz category cards, narrative voice and online quiz
Encourage patients to teach-back information [29, 33, 34]	Quiz category cards, narrative voice and online quiz
Write actionable content [35]	Written content on cards, especially the daily challenges from the physical movement and nutrition categories
Use polls and quizzes [37]	Quiz category cards, narrative voice and online quiz
Encourage exploratory learning [36, 37]	The product as a whole that prompts physical interaction and exploration with content
Interact with content and get positive feedback [37]	The product as a whole that prompts physical interaction and exploration with content
Reteach and repeat information [10]	The cards, narrative voice and video that can be read, listened to and seen an unlimited amount of times
Utilize digital tools that enable unlimited repetition e.g. DVD's [34]	The narrative voice, video and quiz are digital and can be listened to, seen and filled in an unlimited amount of times
Combine various means of communication (visual, oral, textual, video) [10, 24, 26, 39]	The card offers information in a textual format, the narrative voice offers information in an oral format and the video offers information in an audio-visual format
Communicate in a narrative manner [10, 40-42]	Both the voice and video are in a narrative format
Combine digital and physical means of communication [34, 39, 43, 46]	The product itself is physical and scanning the cards offers information digitally by opening YouTube and Google
Digital information should be presented with big fonts, chunking information [35]	The digital information where this is relevant is the quiz, this page is orderly, uses a lot of white space and clearly legible fonts
Make information personal, recognizable and relevant to the viewer [10]	The character named Paul is designed in a way that he reflects the average person with type 2 diabetes and low health literacy, namely 50+ years old and slightly overweight

5.5 MoSCow

MoSCoW (see Chapter 3.2) was used to prioritise the functional and non-functional requirements and refine the specifications by defining what features would and would not be included in the product.

Must have

- Strategies to make information understandable for people with low health literacy must be implemented (see Table 9)
- BCT's must be implemented (see Table 8)
- The device must be easy to use
- Electronics must fit inside the case
- LEDs indicate what category to take cards from
- A concise, personal and representative design of the character on the cards, the voice and animation
- Card can be scanned by mobile phones which then show a video or quiz
- Cards can be scanned by the product which then plays a voice over

Should have

- The product should make content enjoyable
- The case should be aesthetically pleasing and fitting in it's environment
- Built sturdy
- Card can be left on the scanning platform without the audio repeating continuously
- Content should be enjoyable
- The voice should be kind, clear and not too fast

Could have

- Cards could be hidden so other household members do not play with them or to combat user shame
- The product could have integration with the original Diameter app
- Device is powered without needing a laptop
- Device is portable within the house

Won't have

- The product will not have content that is personalised or adaptable to the user.

5.6 Final concept

The final concept was developed based on the specifications described in this chapter. The iterations of the final concept were done in parallel with defining the specifications. Part of these iterations was making decisions regarding the card, audio, video and case design. Elements that needed to be decided upon were: (1) stylised or realistic card and video design, (2) a narrative or informative audio and video, (3) the length of the audio and video and (4) making the cards in the case visible or not. Initially the expert in Chapter 4.2 advised to do A/B user testing to evaluate these elements. However, because it is challenging to reach people with low health literacy [58], there was not be enough time to conduct this evaluation. Additionally, most of the decisions could be made based on results of the literature review and expert opinion. First, literature pointed out that narrative and short content was better, answering point 2 and 3. Second, based on the expert opinion it appeared to be better to hide the cards in case of children playing with them, answering point 4. Finally, after reviewing a few papers

on agent design, realistic content appeared to be better for this target group. However, this was not possible due to resource constraints as it would mean hiring an actor for the cards and video. In the end, each decision on the elements was grounded and reasoned for.

The following images illustrate the process of the final product iterations. Each set of images is accompanied by a description explaining the reasoning for the design iteration.

Figure 12 First and second case design iteration

In the second iteration, the case and card colours were made more neutral to be appropriate for the adult target audience.

Figure 13 Third and fourth case design iteration

In the third iteration the device was made more compact by removing the platform where cards could be put that were not executed that day. The cards could simply be mixed back into the original category stack. This change also made the device smaller which would be more appropriate when placing the device in a home as it would not be in the way. In the fourth iteration, a cut out was made for the card stacks, this was done to improve the usability so cards would not move around or fall off the device.

Figure 14 Fifth and sixth case design iteration

The fifth iteration featured a more prominent cut-out for the card stacks and a cutout for the scan and checkmark platforms. Similarly, this was done so cards would not fall or blow off. The overall device was also made much more compact, making it more mobile and sturdy. The sixth iteration was a design that would be even more compact and aesthetically pleasing. However, this idea was not explored further because it would take too much time and resources to realise a circular structure.

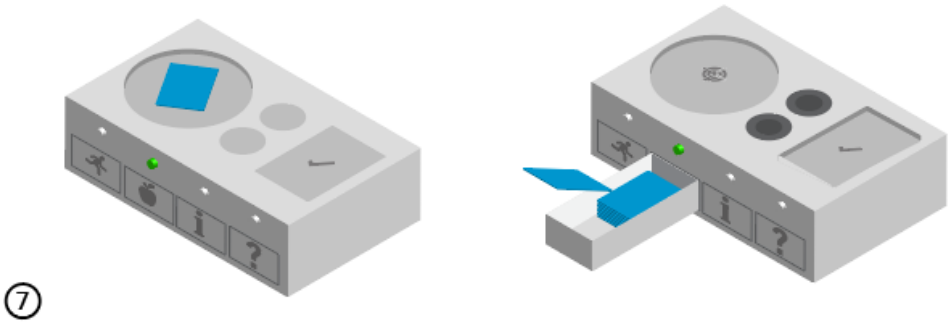


Figure 15 Seventh case design iteration

The final design iteration completely hid all the cards in drawers underneath the scan, checkmark and speaker area. This made the device more compact and less prone to cards falling when the device was moved. Additionally, it ensured that the cards were not taken or played with. The speaker was also visibly added to the design instead of hiding it in the side or back panels. This was more appropriate because now it points towards the user. Moreover, this would make it easier to understand the voice and less prone to accidentally being covered.

Chapter 6: Realisation

Realising a high-end prototype of the device meant various components needed to be built or designed after which they would be combined to create one product. The components can be divided into three categories namely the technology, content and design. These were often executed in parallel to each other. The specifications and the desired interaction with the product, were used to determine what technologies were used, what the content was and what the designs looked like.

6.1 Interaction

The device facilitates various interactions, user inputs and gives outputs. To clarify this, a sequence diagram was made (see Figure 16) to illustrate the user interaction with the device, the inputs and the outputs the device gives. The diagram also functions as a base for deciding which technologies were needed to realise the interactions.

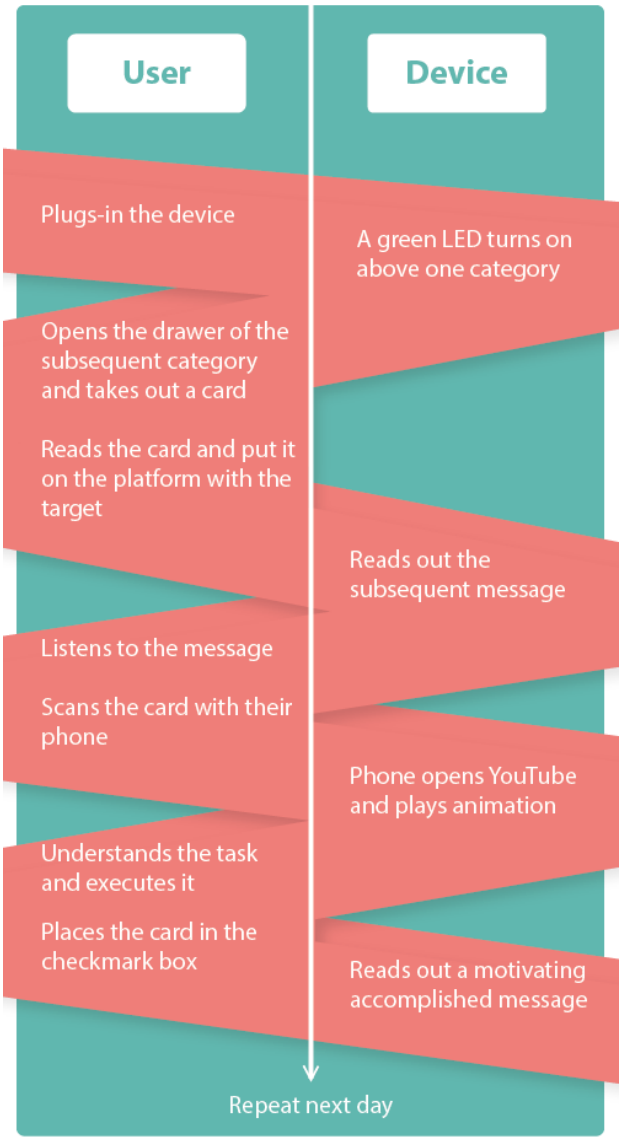


Figure 16 Product sequence diagram

6.2 Technology

The technology category consisted of hardware and software elements. Hardware elements were the electronics inside the case and the software was the program that controlled the hardware. When developing the idea, it quickly became clear that radio-frequency identification (RFID) technology was most appropriate. This technology offered the possibility for both the device and a phone to scan the same card and give different outputs. The first being a voice message and the second being a video or a quiz. While some alternative possibilities were explored for displaying the video, such as adding a screen to the prototype, this would make the device too big, expensive, fragile and complicated. Furthermore, using RFID made it possible to completely hide the electronics and made the usability much more intuitive because the same card could be used for every interaction. It was also clear that a speaker was needed for the auditory feedback.

After a search online, a project using similar hardware was found. Voss [55] created an interactive music box for children who could put a card on a speaker and some music started playing, there were also three buttons which could pause, play the next song and play the previous song. This project was a perfect proof of concept that confirmed my idea of using RFID would be suitable. Additionally, Voss [55] collaborated with AZ-Delivery to sell a Tonuino set on Amazon which included the most important electronic parts: RFID reader, RFID cards, DPlayer mini and an Arduino Nano [59]. In the end an Arduino Uno was used because it had more space to add additional components. The Toniuno set was ordered early in the process to ensure delivery times would not cause any time delays when realising the project. Other components needed for the project are described in more detail below and were either already present or bought separately. Once the components had arrived, were assembled and programmed. This process is described in more detail below.

6.1.1 Electronics and programming

The technological system consisted of various hardware components which were first assembled and programmed separately and then combined. That way it was easier to debug the code and identify other issues. The software Arduino IDE was used to program the Arduino Uno to control the other components. The code used to operate all the electronics can be found in Appendix A. The code was essentially a combination of code found online (see Table 10) which was adapted to the project specifications. Table 10 describes the various parts of the system, the components used for these parts and what the code made the components do.

Table 10 Electronics and programming parts

System parts	Components	What code does
RFID	• Arduino Uno • RFID reader • RFID cards • Jumper cables • Breadboard	Being able to distinguish between the scanned cards. Specifically, having the serial monitor to display the scanned RFID numbers and 'granting access' or 'denying access' to certain cards [60].
RFID + Speaker	RFID components + • DPlayer mini • Micro SD card 32GB • Passive speaker	When a card is scanned the speaker should play a certain audio file based on the cards' RFID number. The audio files are retrieved from an SD card inserted into the DPlayer mini [61]. Ensuring that the speaker does not continually play the

		audio when a card is left on the scanner but only plays it once.
LED's	• Arduino Uno • 4x LED's • Button • Jumper cables • Breadboard	Cycle through 4 LED's by pushing a button [62]. Eliminating debounce of the button [63].
RFID + Speaker + LED	RFID + Speaker + LED components	Have all the components work together using one code, one Arduino and one breadboard.
Power	Power adapter 7.5V	Connecting a power adapter to the Arduino so that it is independent of the laptop

The following figures illustrate the progress of implementing the various components as well as the final schematic.

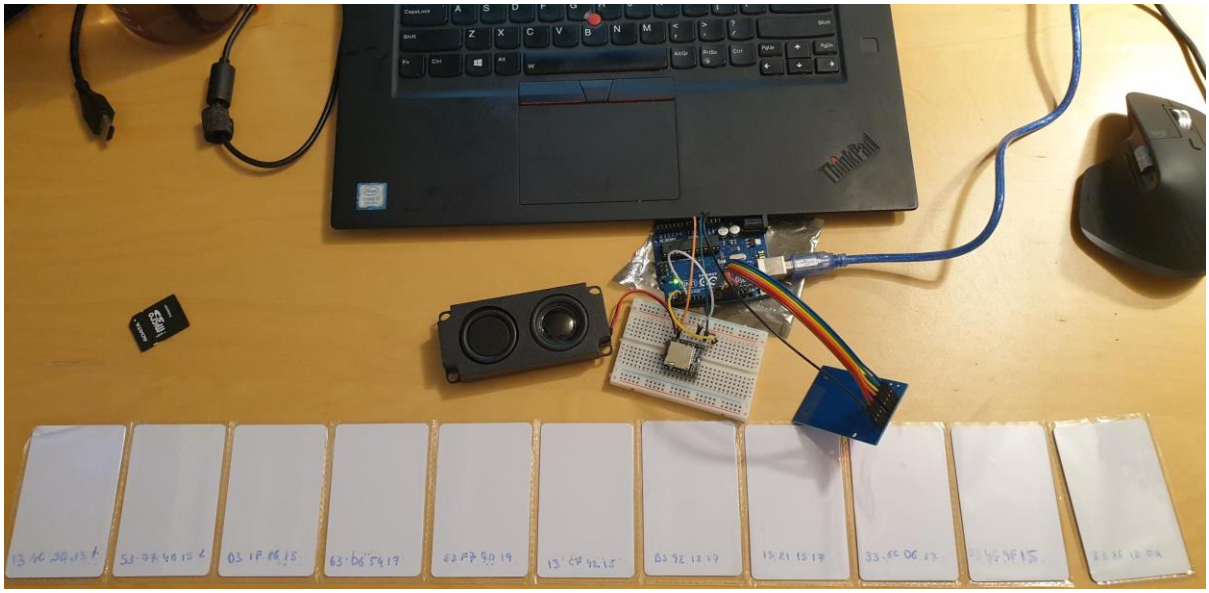


Figure 17 RFID scanner and speaker connected to an Arduino Uno with RFID cards and their codes

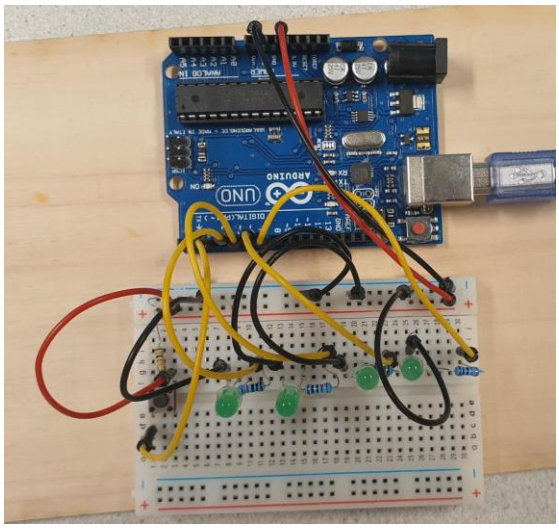


Figure 18 Four LEDS and a button connected to an Arduino Uno

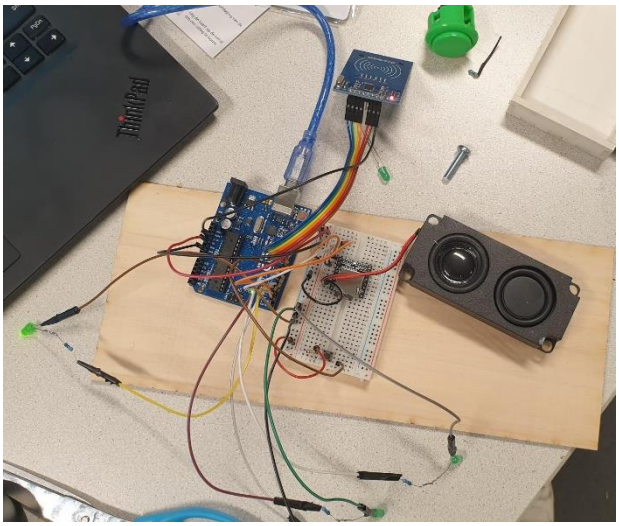


Figure 19 RFID scanner, speaker and LED's connected to an Arduino Uno

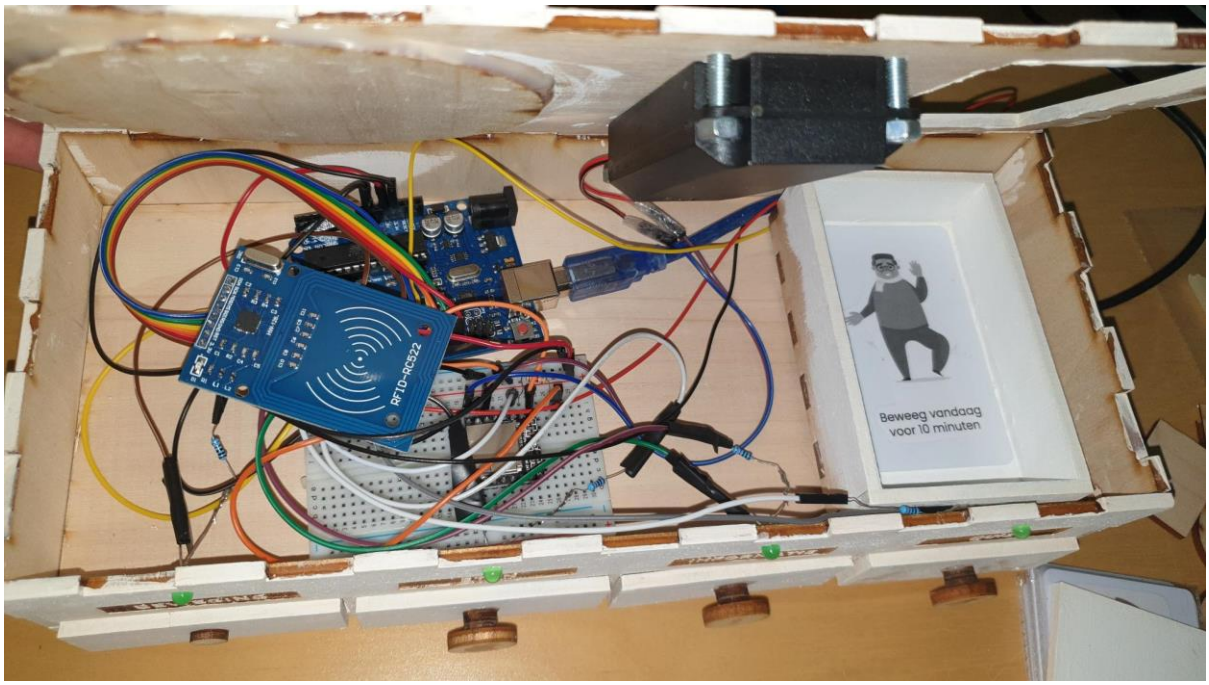


Figure 20 All components built into the case

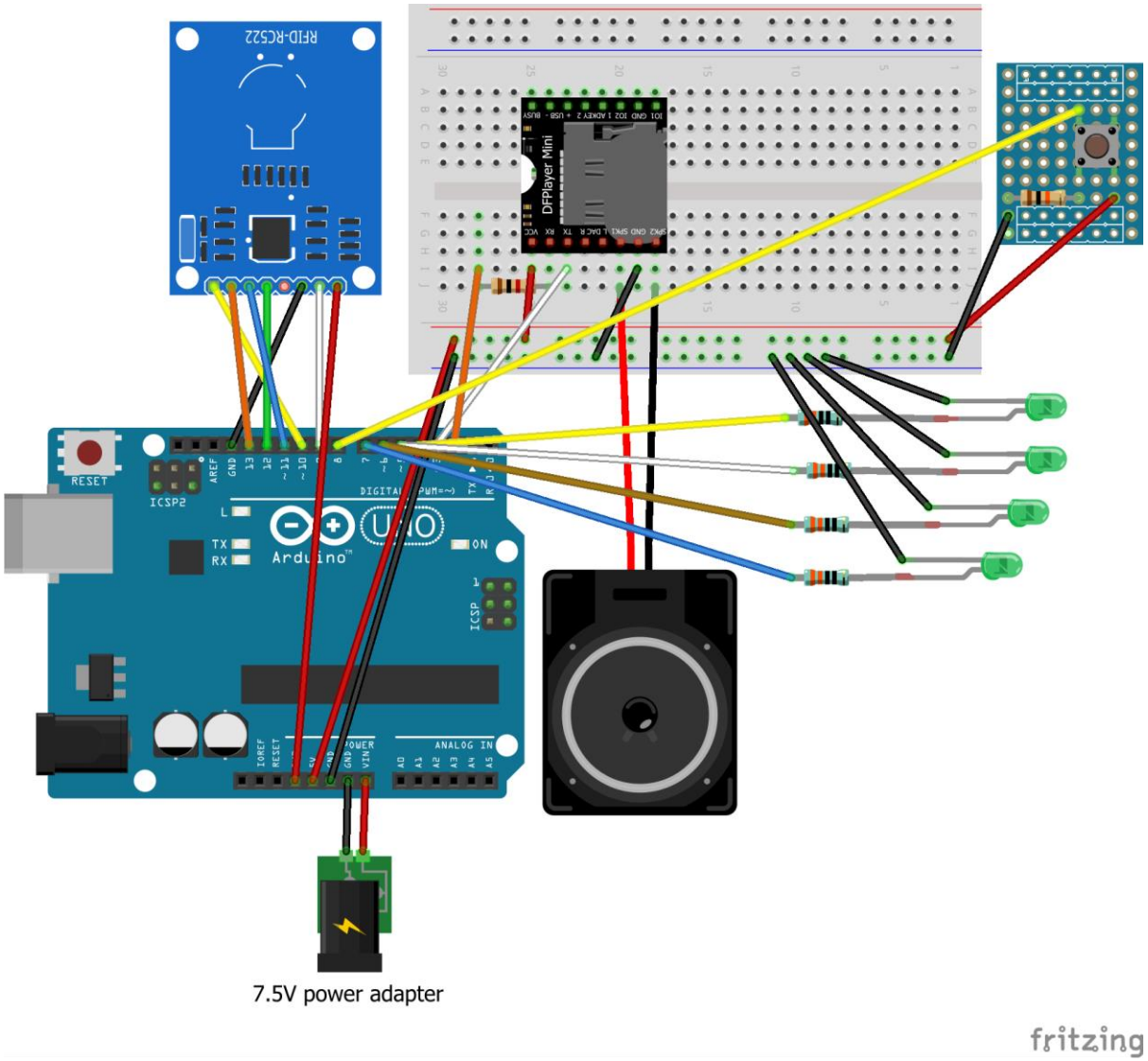


Figure 21 Electronics schematic using Fritzing

6.1.2 Mobile phone

The second to last user interaction (see Figure 16), was realised using a mobile phone to scan the card. Consequently, Youtube or Google needed to open to see an animation or answer the quiz question. This feature was realised using an Android app named NFC Tools [64]. This app enables programming an RFID card by writing data onto, in this case URL's. In the prototype one animation was made for the nutrition category, the animation was uploaded to YouTube and the URL was written onto the RFID card. Similarly, to create the quiz a website called Typeform [65] was used. The URL to the quiz was written onto the RFID card. The cards could then be scanned with any phone that has NFC turned on (always available on iPhones, manually turned on for Android phones) to open the URLs written onto the RFID cards.

6.3 Content

The card, sound and video content were based off of information about lifestyle coaching content provided by the client (Appendix B). This information was then implemented into the various types of communication. In the nutrition and physical activity category the card stated the daily challenge, the

sound repeated this with some narration and the video modelled the behaviour. In the information category, the card summarised three main benefits of healthy eating and physical activity. The sound then repeated this information in a narrative form together with more benefits. The video explains the points in more depth. For the quiz, the card stated the question, the sound repeated the question and the possible answers and the card could be scanned to answer the question. Moreover, multiple BCTs were implemented in the cards, sound and phone content, namely: goal setting, action planning, self-monitoring behaviour and outcome, social support, instruction on how to perform the behaviour, information on health consequences, comparative imagining of future outcomes, reduce negative emotions, framing/reframing and verbal persuasion about capability (see Table 8). Table 11 offers an overview of how the information was divided over cards, sound and phone.

Table 11 Information type for each medium (card, sound, video)

Categories	Card	Sound	Phone
Movement and Nutrition	Call to action	Explain the desired action in narrative manner with the character as the protagonist being positive and motivating.	YouTube opens and shows a video where the character models the desired behaviour.
Information	Summarizes three main benefits	Summarize multiple points and invite to watch the video for more information.	YouTube opens and shows a video that explains the three points and more information in more depth.
Quiz	States the question	Repeat the question and present the three possible answers. Also inviting to scan the card to answer the question.	A website opens where the user can choose from three multiple choice answers.

Table 12 describes the text that was put on to the cards, the script of the voice for the sound, the script and story of the animation and the content of the quiz. The text written and designed based on a checklist for low literacy accessible information developed by Pharos [66] to ensure the low health literacy standards were met. Besides the question and answers, the quiz also describes the reasoning behind an incorrect answer and tells the user the correct answer. Furthermore, due to time constraints, because animating is time consuming, an animation was only made for the first nutrition category card.

Table 12 Content of the various communication types (card, sound and phone)

Category	Card	Sound	Phone
Movement	“Ga vandaag 10 minuten buiten lopen”	“Hey met Paul, ik ga vandaag een rondje van 10 minuten lopen, lekker frisse lucht en mijn hoofd leegmaken, heerlijk, doe je mee!? Oh en wil je weten hoe en wanneer ik het doe? Kijk dan de video door de kaart te scannen”	Paul is shown doing three things 1) Thinking about/planning the route he will walk 2) Deciding on a time to go 3) Going for a walk at the set time. A timer is also shown to indicate the walk takes 10 minutes.

Movement	"Beweeg vandaag 10 minuten"	"Hey, ik ga vandaag 10 minuten op een leuke manier bewegen, ik denk dat ik ga fietsen of dansen?! Scan de kaart om erachter te komen wat ik vandaag doe"	Paul is shown doing three things 1) Thinking about the different activities he can do 2) Deciding on a time to go 3) Doing the activity he decided on. A timer is also shown to indicate the walk takes 10 minutes.
Nutrition	"Drink vandaag 2 glazen water"	"Hallo daar, Paul hier, ik heb dorst en normaal drink ik dan fris maar vandaag ga ik een keer water proberen, blijkt beter te zijn voor m'n gezondheid. Drink jij vandaag ook 2 glazen water met mij mee? Scan de kaart en zie hoe ik het doe"	Paul is shown at home walking to the fridge, he sees coke but then realises water is better for his health, he closes the fridge and drinks a glass of water. "Ik heb berst dorst zeg Eens even kijken of er wat lekkers in de koelkast staat Oh ja cola Wacht eens even Ik kan beter water drinken dan een suikerig drankje als cola Ik neem een glas water en doe er wat citroen sap bij heeft het nog een lekker fris smaakje ook Ah ook gewoon lekker ik hoef helemaal niet altijd fris te drinken Ik heb nu al zin in nog een glaasje Drink jij twee glazen water met mij mee?"
Nutrition	"Eet vandaag 1 stuk fruit"	"Goedendag, ik ga vandaag een stuk fruit eten, maar ik kan niet kiezen welke, er zijn zo veel opties, neem ik een banaan, een appel, een peer, kijk de video om te zien welke ik kies, welk stuk fruit neem jij vandaag?"	Paul is shown at the grocery store standing in front of the crisps isle, he decides to skip this and he goes to the fruit section. Different fruits are shown and Paul picks a pear. Then he is shown at home washing and eating the pear.
Information	"Beweging is belangrijk omdat: 1. Je hebt minder medicijnen nodig 2. Je hebt minder stress 3. Je krijgt energie"	"Paul hier weer, ik hoorde net dat bewegen blijkbaar heel veel voordelen voor je gezondheid heeft, je hart en bloedvaten problemen kunnen 20% minder worden, je leeft langer, je krijgt energie, je hebt minder stress, je hebt minder medicijnen nodig…*Paul haalt weer adem*…en nog veel meer, bekijk de video en dan leg ik het nog beter uit"	Paul is standing in front of a white board and explains the benefits of movement.
Information	"Gezond eten is belangrijk omdat 1. Je verkleint de kans op ziektes 2. Je krijgt goede voedingsstoffen binnen 3. Je krijgt een gezond gewicht"	"Hoi hoi, wist je dat eten heel veel invloed heeft op je gezondheid? Gezond eten verkleint de kans dat je ziek wordt, je krijgt goede voedingsstoffen binnen, je gewicht gaat omlaag, je bloedvaten blijven gezonder en je voelt je mentaal en fysiek beter. Er zijn nog meer voordelen maar die leg ik uit in het filmpje, scan de kaart om die te zien"	Paul is standing in front of a white board and explains the benefits of healthy eating.

Quiz	"Welke stelling is waar? Scan de kaart om de stellingen te zien"	"Vandaag een leuke quiz vraag, klaar? Welke stelling is waar? a. 30 minuten bewegen per dag vermindert je risico op diabetes type 2 b. Met wandelen verbrand je meer calorieën dan met yoga. c. Je moet meer bewegen om een pizza Margherita te verbranden dan voor een Big Mac met een grote portie frietjes Scan de kaart om je antwoord in te vullen"	Welke stelling is waar? a. 30 minuten bewegen per dag vermindert je risico op diabetes type 2 I. Helemaal goed! 30 minuten bewegen per dag vermindert je risico op diabetes type 2 b. Met wandelen verbrand je meer calorieën dan met yoga. I. Helaas! Met wandelen verbrand je net zo veel calorieën als met yoga. c. Je moet meer bewegen om een pizza Margherita te verbranden dan voor een Big Mac met een grote portie frietjes I. Helaas! Je moet net zo veel bewegen om een pizza Margherita te verbranden als voor een Big Mac met een grote portie frietje
Quiz	Wat is de gezondste keus? Scan de kaart om de stellingen te zien	"Vandaag weer een leuke quiz vraag, okay klaar voor? Welke van de volgende opties is de gezondste keus? a. Cola vervangen door een smoothie b. Chocolapasta vervangen door 100% pindakaas c. Broodje kroket vervangen door een wit broodje met salami Scan de kaart om je antwoord in te vullen"	Welke van de volgende opties is de gezondste keus? a. Cola vervangen door een smoothie I. Helemaal goed! Chocolapasta vervangen door 100% pindakaas is de gezondste keus. b. Chocolapasta vervangen door 100% pindakaas I. Helaas! Cola vervangen door een smoothie is niet de gezondste keus. Dit komt omdat er ook suiker in smoothies zit en het minder vullend is. c. Broodje kroket vervangen door een wit broodje met salami I. Helaas! Broodje kroket vervangen

			door een wit broodje met salami is niet de gezondste keus. Dit komt doordat er in beide veel zout en vet zit

6.4 Design

Next, the design of the cards, sound, animation and case was realised. For the sound, attention was given to the type and tone of voice. Essentially, the design of the character used on the cards and animation had to be consistent and match the voice. Ultimately, in the end the final product would be more than the sum of it's parts. Thereby offering a well-rounded, understandable and consistently designed prototype.

6.4.1 Card

Three types of cards were designed based on the content of the cards described in Table 12. The movement and nutrition cards needed text and an illustration of a character that was executing the action. The information cards needed text and illustrations that visualised the text. The quiz cards only needed text. To improve the usability and make it clear what category each card belonged to, an icon was added to the back of the cards (see Figure 22). These icons were also used on the drawer knobs of the product.

Figure 22 Category icons for knobs and back of cards (categories from left to right: nutrition, physical activity, information and quiz)

The first step to designing the movement and nutrition cards, was finding a character that fit the specifications (see chapter 5.6). This was done by browsing the website Envato elements [67] which is a subscription based website that provides graphic content templates. The following character set was deemed appropriate because of the friendly expression, being slightly overweight and being an older adult (see Figure 23). These features would play into the social aspect of sharing experiences with others which was found to be appreciated by the target group in literature. Some changes were made to the character to make it more fitting. First, the glasses were made thinner because they were distracting. Second, the hair was made black and the walking stick was removed so the character did not look as old. Finally, the stomach was made a bit smaller so the character looked a bit less overweight. In the end the character fulfilled the character design specifications.

Figure 23 Envato Elements character set from SlideFactory [68]

Next, the illustrations for the information cards were made. For this, it was important to pay attention to keeping the details to a minimum as the illustrations would be printed quite small. Furthermore, they had to clarify the text rather than make the card busy and chaotic.

Finally, the quiz cards were made. These only had text since illustrating a question would most likely lead to confusion.

The final cards designs are shown in Figure 24. These were printed and taped onto the cards with transparent tape. This saved time and resources as opposed to getting customized stickers or printing it on the cards with a specialised printer. The final cards are shown in Figure 25.

Figure 24 Final card design illustrations

Figure 25 Final RFID cards

6.4.2 Sound

The most important aspects of the sound design was that the voice matched the character Paul. Since Paul is a Dutch speaking male adult that could be between 40-60 years old, this is also what the person recording the audio should be. The text from Table 12 was recorded by a 54 year old Dutch male, using the microphone of an iPad Pro 2020. Getting the highest quality microphone was not the priority because the sound of the speaker used on the device was also not of high quality. Thus, high recording quality would be lost anyway. General requirements for the voice were described in Table 7 and sometimes segments were re-recorded because they did not satisfy those requirements. In the end, each card and the script of the animation was recorded.

6.4.3 Animation

Creating the animation about drinking two glasses of water, started by making a storyboard based on the script in Table 12. The character Paul from the card design was reused and addition illustrations of a living room and refrigerator were found on Envato elements. The kitchen illustration was reused

and updated from a previous project. Figure 26 shows the storyboard designed in Adobe Illustrator including all the illustrations.

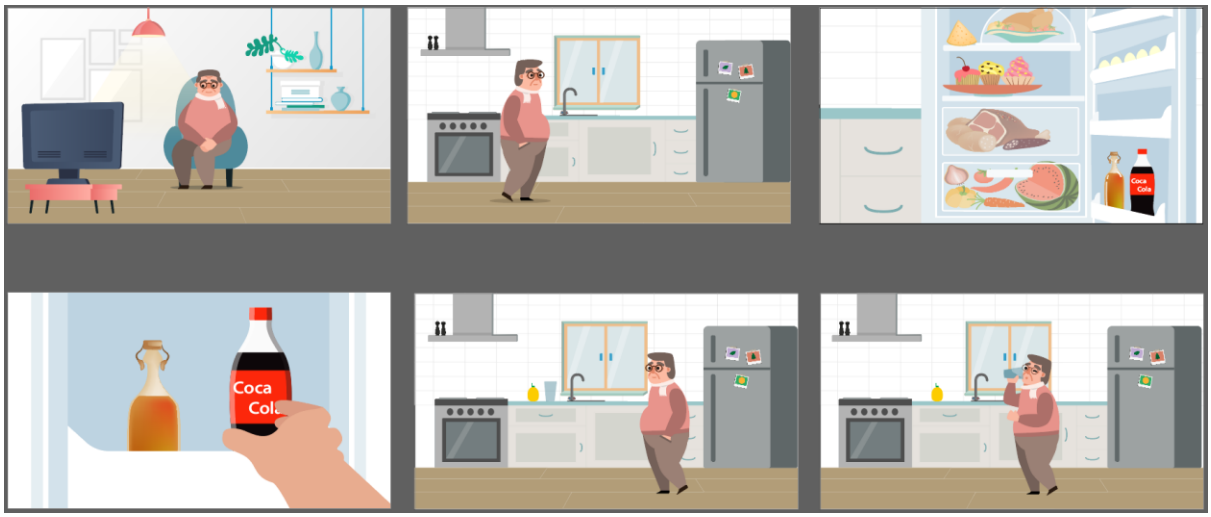


Figure 26 Animation about drinking two glasses of water storyboard

Next the animation needed to be made which was done in Adobe After Effects (see Figure 27). The voiceover was used as a reference for the timing of the movements.

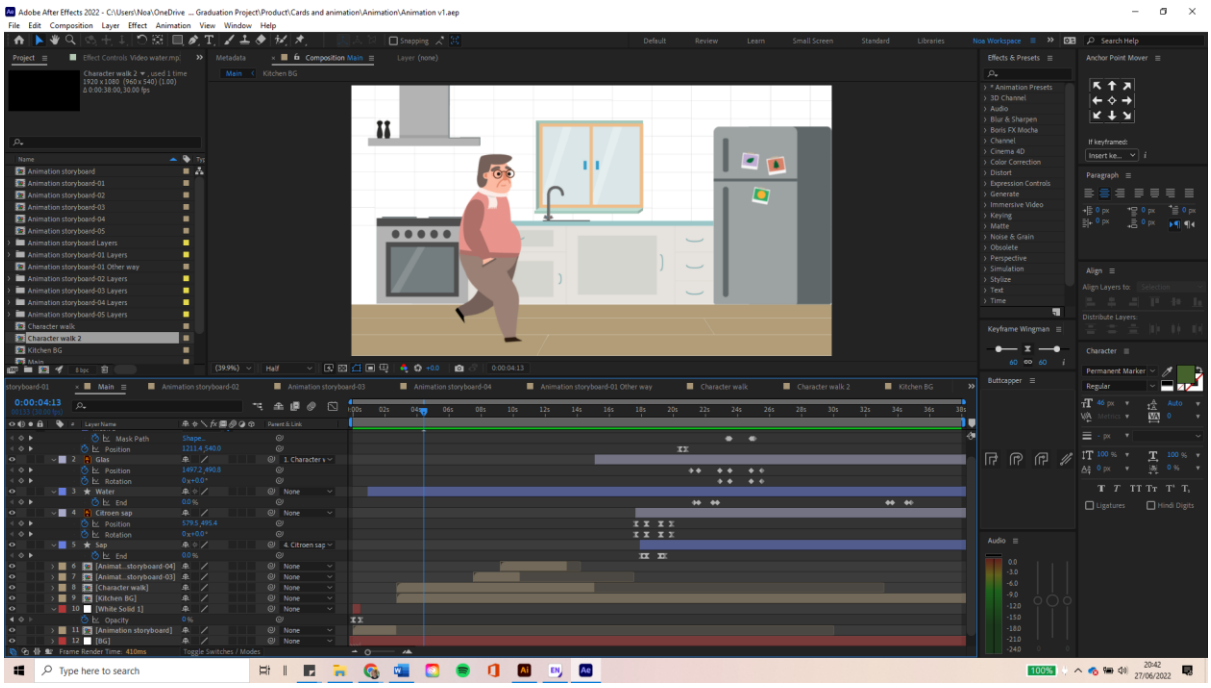


Figure 27 Making the animation in After Effects

6.4.4 Case

The case was made using plywood which was laser cut in the desired shape and size. Ultimately, the device had to be as compact as possible, the main downsizing limitations were the amount of space needed for the electronics and the width of the cards and their drawers. Figure 28 shows the files

that were sent to laser cut the case, red lines were cut out and black sections were engraved. The following figures show the laser cut pieces and built case.

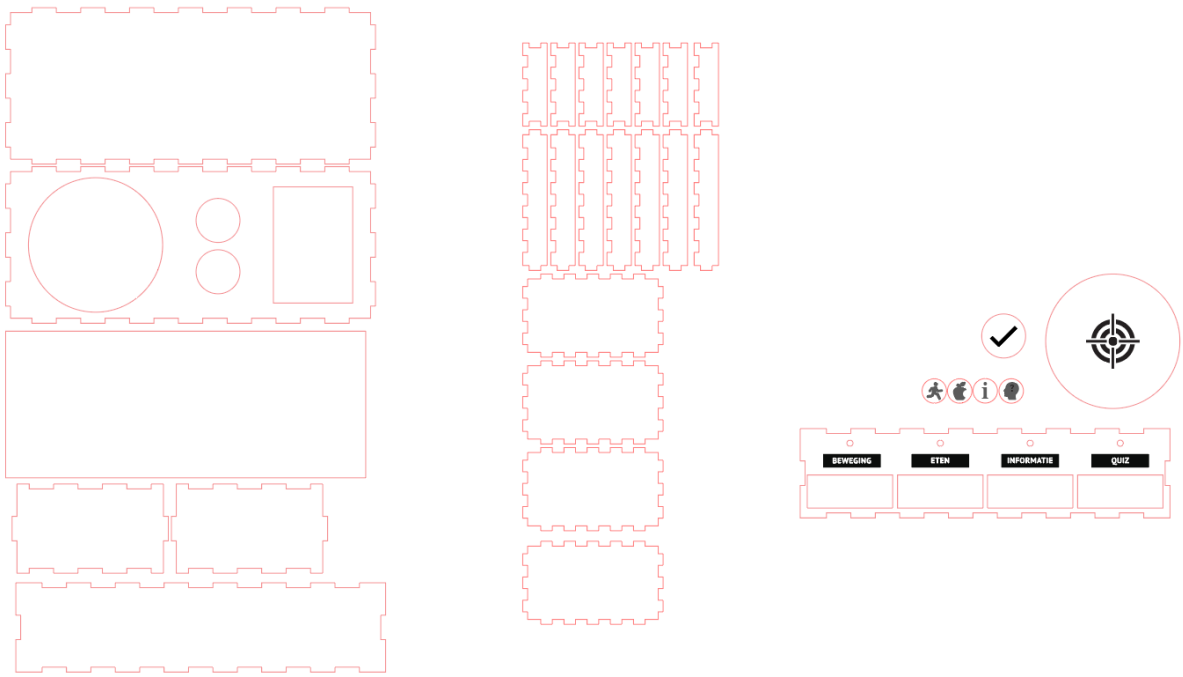


Figure 28 Lasercut file of case (left), drawers (middle) engraved parts and knobs (right)

Figure 29 Lasercut plywood

Figure 30 Lasercut plywood case put together

In order to improve the aesthetics, the wood was painted multiple coats of white (see Figure 31). The pieces were then glued together using wood glue and a hot glue gun.

Figure 31 Painting the plywood white

6.5 Final high-end prototype

When all the electronics was done, the cards were made and the case was laser cut and painted, everything was combined to build the final prototype visible in Figure 32. Additionally, the use of the final product is illustrated in a picture sequence in Figure 33.

Figure 32 Final high-end prototype

1 See above which category the LED is turned on

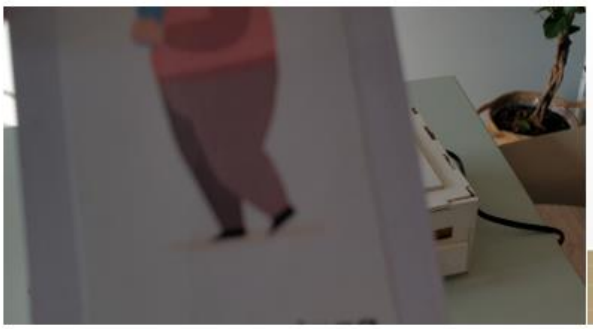
2 Open the corresponding drawer

3 Take a card from the drawer

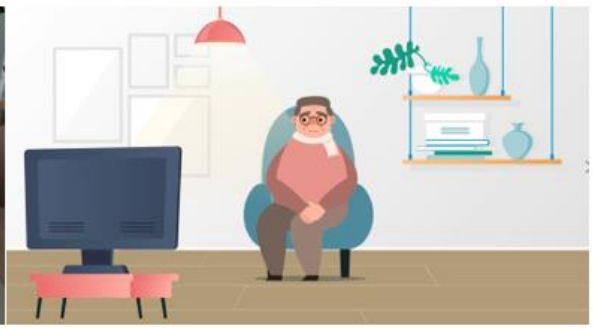
4 Read the card

5 Put the card on the scanning platform

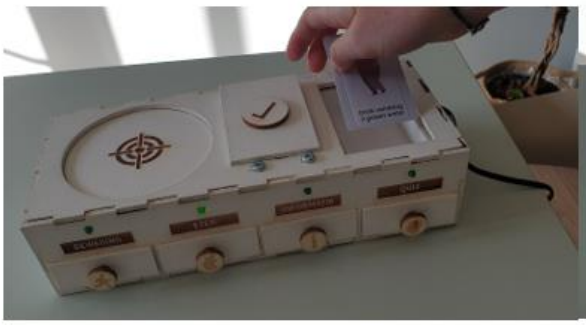
6 Listen to the audio



7 Scan the card with your phone using NFC



8 Watch the animation



9 After doing the task on the card put the card in the completed box

10 Listen to the voice giving positive feedback

Figure 33 Final product usage picture sequence

Chapter 7: Evaluation

7.1 Study design and aims

To evaluate the high-fi prototype, a user evaluation was conducted using the methods and techniques described in Chapter 3.4. The user evaluation consisted of think aloud sessions and semi-structured interviews. The user evaluation aimed to investigate the usability of the designed communication and coaching content tool for people with a low health literacy. Thereby answering the third sub-question. This was done by evaluating three attributes of usability posed by van Genugten, et al. [56]; (1) the degree it is tailored to the target group, (2) the learnability and (3) the aesthetic appearance.

7.2 Participants and recruitment

A crucial part of effectively evaluating the product was testing it with the target audience, namely people with a low health literacy. The initial goal was to evaluate the product with eight users as this would ensure rich data from a variety of perspectives. To find organisations that may know these people, a google search was done on low health literacy in Enschede. A specific search was also done to find community centres that offered help to people with a low health literacy. Soon, the library in Enschede was found which had an organisation called 'Huis voor Taal & Meedoen' (Translated: 'House for Language & Participation'). They offer a place for people to come to get help with language, reading and writing skills. This organisation was emailed (see Appendix C) with an explanation of the thesis, a picture of the prototype, the ethics information brochure and consent form. The email also asked if they saw any opportunity for a user test to be done with the people that visit them. After some back and forth email contact, they shared the contact details of a dietician that was enthusiastic about the product. The dietician was emailed (an iteration of the email in Appendix C) and a meeting was set up to discuss the product as well as the possibility to evaluate it with their clients. The meeting was held on Monday the 20th of June 2022. The following Wednesday there was an opportunity to sit in a neighbouring office at the dietician practice. The dietician would explain to their client that a student was doing a graduation project with a product that needed to be tested. The client was asked if they were willing to participate in the study. Over the course of the day (9:30 – 17:00), three clients were willing to participate. While this is less than the amount initially aimed for, according to Nielsen and Landauer [69], more than 60% of the usability issues can already be identified with 3 user tests.

7.3 Data collection

General characteristics

General information that was collected from each participant at the start of the user evaluation was their age group and health literacy level. The latter was evaluated using three screening questions from the Set of Brief Screening Questions (SBSQ) posed by Chew, et al. [70]. These questions are (1) "How often do you have someone help you read hospital materials?", (2) "How confident are you filling out medical forms by yourself?" and (3) "How often do you have problems learning about your medical condition because of difficulty understanding written information?". The questions are answered based on a 5-point Likert scale from 0-4 points. To evaluate the literacy level, the points are added up and averaged. If the outcome is 2 or higher the user has low health literacy.

Think aloud, observations and interview

Table 13 offers an overview of the methods of evaluation and subsequent questions for each attribute. While it is usually preferred to ask open-ended questions when user testing, because that gives the researcher as much information as possible, this wasn't the case with this target group. The dietician

advised to use yes and no questions as this would make it easier for the user to understand and answer the question. To account for both (dis)advantages, both open and closed questions were prepared. The intention was that the open question would be asked first and in case it wasn't understood, the closed question could be asked. All prepared questions as well as the tasks can be found in Appendix D.

Table 13 User evaluation methods to test usability attributes

Aspect	Evaluation
Tailored to target group	Observations • How did the user respond when reading the card, listening to the voice and seeing the video? • Were they able to answer the quiz question? Questions • What is today's task? • Did you understand the information on the card and video??
Learnability	Observations • Does the user seem to know what to do when asked to perform the following tasks: ○ Take todays card ○ Listen to todays message ○ Watch todays video ○ Place the card where you would put it if you successfully did todays task Questions • Was it easy or hard to execute todays task?
Aesthetic appearance	Questions • What is your opinion on the product as a whole? • What is your opinion on the audio? • What is your opinion on the case? • What is your opinion on the cards? • What is your opinion on the character illustrations?

7.4 Procedure

The user evaluation was planned to take 15 minutes and to be conducted as followed:

1. The researcher introduces themselves and the graduation project
2. The researcher takes the user through the ethics information brochure and consent form and gets it signed. Thereby also explaining how the study will go.
3. The researcher starts the voice recorder on an iPad using the Voice Memo app
4. The researcher asks the user three questions according to SBSQ to evaluate the users health literacy level [70]
5. The researcher asks the user questions related to their previous experience with obtaining and understanding health information
6. The researcher explains and demonstrates the product
7. The researcher asks the user to perform tasks while thinking aloud
8. The researcher also asks questions after certain tasks

9. The user performs tasks while thinking aloud and the researcher makes notes in a Word document
10. The researchers asks the user questions about the product through a semi-structured interview and fills in the answers in a survey using Qualtrics

The three evaluations generally followed this method, however, step five was left out of the evaluation to save time. Additionally, the SBSQ was not conducted nor was the audio recorded for one user.

7.5 Ethics

Ensuring that the study was understood by the target group was crucial for a successful and ethical evaluation of the prototype. Therefore, the ethical forms were formulated with special care to make them understandable for the target audience. First, the information brochure and consent form were written following a general template provided by the University of Twente Ethics Committee of Computer & Information Science (EC-CIS) [71], to ensure all the necessary information was included. Then, the forms were revised and rewritten to make the language level suitable for people with low health literacy. This was done based on general knowledge, strategies found during the literature review (see Chapter 2.3) and the website www.ishetb1.nl [72]. The latter can be used to test if the word you enter is B1 reading level, meaning 80% of Dutch citizens understand it. Additionally, the text was written in an active form using personal pronouns [27]. Furthermore, the information letter was accompanied by a bullet list summary of the written text and the consent form was divided into clear sections and a yes or no check-off list. The final information letter and consent form were approved by the EC-CIS and can be found in Appendix E and Appendix F subsequently. Other measures that were taken to ensure ethical user evaluations, were the registration of personally identifiable data that would be collected. This included the user's name on the consent form and their recorded voice. The registration was done in the General Data Protection Regulation (GDPR) database of the University of Twente.

7.6 Results

The results of the evaluation start with the outcomes of the conversation with the dietician. Then, the user evaluation is explained starting with the user's health literacy levels and then the three usability attributes are presented; tailored to the user group, learnability and aesthetic appearance. Finally, the implementation of the functional and non-functional requirements will be evaluated based on the MoSCoW priorities.

7.6.1 Dietician opinion

While an interview to evaluate the product with the dietician was not prepared, valuable comments were made during the informal conversation about the product and user evaluation. The overall response to the product was very positive. The dietician was enthusiastic about the possibilities it offered to personalise content to various user groups. For instance, cards could be tailored towards elderly to do activities for staying fit and flexible or the language could be changed to Turkish or Moroccan for people with a migration background. The dietician also stated that if the product would be used long-term, clients could get a new set of cards with more challenging content every few weeks; thereby improving their habits gradually. The dietician also responded positively to the fact that the product was a physical object. The dietician said clients were often happy when they got information physically on paper. Therefore, such a product, where users can interact with the information, seemed like a great fit for the target audience. Finally, regarding the simplicity of the

content. When the researcher asked if the content was too simple, the dietician answered that if you think it is too simple it is perfect for this target audience.

7.6.2 Participant characteristics and health literacy level

The age group of three users and health literacy of two users was evaluated. The results are presented in Table 14. The answers of user 1 give an average of 1. The answers of user 3 give an average of 1.3. Because neither averages are above 2, neither users have low health literacy based on their answers.

Table 14 User evaluation age and SBSQ results

User	Age group	SBSQ1 score	SBSQ2 score	SBSQ2 score	Average	Low health literacy
1	41-50	1	1	1	1	No
2	61-70	x	x	x	x	x
3	31-40	1	2	1	1.3	No

7.6.3 Tailored to the user group

The 'tailored to the group' usability attribute reflects the degree to which coaching content was understood. Specifically, if the user knew what the information on the cards, in the voiceover and in the animation was. All three users were able to teach-back the task of the day and thereby understood the information. After being asked what the information was when hearing the voice connected to a nutrition card one of the users said:

"[Translated] Yes I understand it, I just need to drink two glasses of water"

Furthermore, users felt the voice was clear and understandable. They also thought it was a good idea to have spoken information. One user mentioned that these features would be especially valuable for blind or elderly people for whom reading is even more challenging. This was amplified by the fact that the voice could be heard by simply laying the card on the platform. However, they did state that the audio would need to be louder for elderly people to hear it properly.

Two users talked positively about how the devices can help people learn about health. One specified this further by stating it was a good device because it enables you to easily and quickly get information by simply scanning a card:

"[Translated] The cards are also nice, you can just scan it and quickly find information on YouTube or google"

One user did the quiz and was unsure about the correct answer. They ended up being delighted about learning that switching chocolate spread with 100% peanut butter was better than switching coca cola with a smoothie. This goes to show that they understood the content adequately to make a decision and learn from it.

When asking if users would use the product themselves, one user said they would not, instead they would recommend it to their mother-in-law. This was because their mother-in-law had trouble remembering healthy habits and needed information repeated to her multiple times to remember it. Two users said they would use the device themselves, mainly as a reminder to drink water and eat fruit. However, these responses were slightly contradicted by other answers. One user said that it

would be good for children such as her son who liked to eat and drink sweet things. Another user asked who the target audience was and that elderly people would need the sound to be louder.

Finally, two users suggested adding audible reminders to the device, since they mainly struggled with forgetting to execute healthy habits (rather than not understanding them). Reminders could be given to eat fruit and drink water. One user gave an example of having a sound at around 8 a.m. to eat fruit during breakfast and then another sound at 10 a.m. to drink a glass of water. They also suggested adding multiple audible reminders during the day to drink water. One user thought this feature would be effective because they imagined executing the task on the card straightaway rather than doing it later that day. However, they agreed that the number of audible reminders depended on the task. For example, reminder for exercise tasks could be done once a day at an appropriate time and drinking water multiple times a day.

Overall, the device seemed to be adequately tailored to the user group. The information on the cards, the voice, in the animation and the quiz were understood by each user. Additionally, there were positive responses to the information ease of access and the ease of learning health-related information. Finally, suggestion were made to add audible reminder sounds and have multiple tasks to execute each day depending on the type of task.

7.6.4 Learnability

The learnability usability attribute essentially reflects on the ease-of-use of the system. All three users said the system was not hard to use. There also did not seem to be substantial confusion while using the system. When asked to take todays card, all users were able to identify the category of that day and take out the card. It was noticeably hard to grab a card, this was most likely because the cards are quite slippery and stick to each other easily. Through observations it also became clear that most users didn't actively read the card but put it on the scanner platform immediately. However, some users read the card out loud after it was put on the scanner when waiting for the voice to start. While this highlights the ease-of-use of the scanning system, it may remove the textual form of communication and reduce the number of times information is repeated.

Additionally, it was challenging to evaluate if scanning the card with their phones using NFC was intuitive. The researcher needed to help turn on NFC or give instructions in how to hold the card against the phone. However, this was the first time they used this feature so it cannot be expected they know how it works immediately. There didn't seem to be any frustration or confusion in the process of turning on NFC and scanning the card. The researcher did need to tell one user doing the quiz that they needed to tap one of the options to answer. This explanation would probably not be needed next time.

The intuitiveness of putting the card in the checkmark box was not evaluated properly due to miscommunication. When asking what one of the users would do if they completed the challenge (drink 2 glasses of water), they stated that they don't drink fizzy drinks. Possibly meaning that the challenge was irrelevant for them.

In general, the device seemed to be easy-to-use. Especially taking the card from the correct category and scanning the card on the platform to hear the voice were very intuitive. Other interactions, such as scanning the card with NFC and putting the card in the completed box, were less intuitive the first time or weren't evaluated adequately.

7.6.5 Aesthetic appearance

The 'aesthetic appearance' usability attribute, reflects on users' satisfaction with the appearance of the case, cards and character. One user answered 'Good' to every question regarding what they thought of the product, cards and animation design. While this is very limited information it is generally positive. Another user was specifically asked what they thought of the size of the device and they said they didn't find it very big:

"[Translated] The size? It's just not very big. I don't think it's big"

The two users that would use the device themselves had overlapping opinions on where they would place the device. One user would put it in the kitchen on the counter and the other in the living room on the table. The latter reasoned that she would see the device clearly and be reminded to take a card when it was put there. This may point towards a general acceptance and aesthetic satisfaction of the device because users would not hide it away.

When asking what users thought of the cards, referring to the appearance, there was some miscommunication. Namely, one user commented on the technological capabilities, such as retrieving information quickly by scanning it. Another user was asked more direct questions on the appearance and thought the character on the cards could be a bit thinner.

Overall, users seemed satisfied with the appearance of the case, cards and character. Minor comments were made when specific questions were asked such as the size of the character.

7.6.6 MoSCoW and Functional and non-functional requirements

The conversations with the dietician, user evaluation and functional evaluation of the product can be used to review the implementation of the requirements set in the specification. Table 15 shows whether the requirements were met.

Table 15 Evaluation of functional and non-functional requirement implementation

No.	Requirement	Priority	Requirement met?
1	Strategies to make information understandable for people with low health literacy must be implemented (see Table 9)	Must	YES
2	BCT's must be implemented (see Table 8)	Must	YES
3	The device must be easy to use	Must	YES
4	Electronics must fit inside the case	Must	YES
5	LEDs indicate what category to take cards from	Must	YES
6	A concise, personal and representative design of the character on the cards, the voice and the animation	Must	YES
7	Card can be scanned by mobile phones which then show a video or quiz	Must	YES
8	Cards can be scanned by the product which then plays a voice over	Must	YES
9	The voice should be kind, clear and not too fast	Should	YES
12	The product should make content enjoyable	Should	YES
13	The case should be nice to look at and fit in its environment	Should	YES

14	Built sturdy	Should	YES
15	Card can be left on the scanning platform without the audio repeating continuously	Should	YES
16	Content should be enjoyable	Should	PARTIALLY MET
17	Cards could be hidden so other household members do not play with them or to combat user shame	Could	YES
18	The product could have integration with the original Diameter app	Could	NO
19	Device is powered without needing a laptop	Could	YES
20	Device is portable within the house	Could	YES
21	Content that is personalised or adaptable to the user	Won't	PARTIALLY MET

Based on the user evaluation and functional tests most requirements were met. The enjoyable content requirement was partially met. While users were positive about the device, they were not asked specifically if they enjoyed the content. Furthermore, the product does not have integration with the Diameter app but is a product on its own. In the future, integration may be possible but it was deemed outside the scope of the project. Finally, the product does not have content that adapts to the user inherently. However, this may be partially met because the dietician expressed enthusiasm for the possibility to change the content of the cards according to the needs of the user. This would require the researcher or designer to make new cards.

Chapter 8: Discussion and Future Work

The developed product seems to be a promising concept, however, both strengths and limitations were identified in the development progress. The following chapter discusses principle findings, the strengths and limitations of the thesis and recommendations for future work.

8.1 Discussion of principle findings

The aim of the thesis was to design the communication and diabetes type 2 coaching content to be understandable for people with low health literacy. In this thesis 21 strategies to communicate to people with a low health literacy were found and implemented into a diabetes type 2 coaching product through an iterative process. An evaluation was conducted with a dietician, user and requirement reflection. The results are discussed below and reflected upon in relation to existing literature.

The comments made by the dietician were positive. They reflected on the possibilities of the device to offer different content for several health conditions and audiences. Furthermore, the object being physical was a big advantage because it facilitates interactions. Having a physical object that is adaptable to various conditions is unique. The technological tools previously found (see Chapter 2.4) were mostly digital products or aimed at specific medical content such as medication prescription or breast cancer treatment.

The results of the user evaluation point towards an overall positive response to the product from a usability point of view. However, a clear conclusion cannot be drawn regarding the usability for people with low health literacy since these users didn't seem to have a low health literacy. Furthermore, due to the language barrier and limited users, the results may not be fully accurate. The product was adequately tailored to the user's literacy level because the coaching content was understood by each user. This is the result of implementing the 'language use' category strategies found in literature. These ensured that the content was written and spoken at a simple and suitable level.

Two users suggested to add audible reminders at certain times to take a card and doing multiple tasks a day. This raises the question if this change would be in line with the aim of the product, namely to make healthy lifestyle habits easy to obtain, understand and implement. The aim is not merely to remind the user execute healthy habits they already know are healthy. The suggestion to add audible reminders may therefore indicate that the content of the cards was too easy for the users as they already knew it was healthy to do the task.

The learnability of the product was satisfactory to a certain extend. The LEDs indicating the category, taking a card from the drawer and putting the card on the platform were intuitive. However, scanning the card with NFC, answering the quiz, and putting the card on the completed stack were not adequately evaluated for reaching a clear conclusion. Once one user understood the NFC they commented that they enjoyed the easy access to information by simply scanning a card and hearing it or opening YouTube. This was made possible due to the combination of multiple communication means and methods in the product and using easy to use technologies. Implementing these features sets the product apart as it enables both physical and digital interaction with the content. Additionally, users can receive information in the communication format that works best for them.

Users thought the aesthetic appearance was good, one user commented that the case was the right size but that the character could be a bit thinner. This is a relevant point as it may suggest that the user does not identify with the character even though that was part of the character design goal.

However, it is not known if the user has diabetes type 2 themselves, so it may not be relevant whether or not this user identified with the character.

As for the requirements, all 'must have' and 'should have' requirements were met. One 'could have' requirement was not met, namely integrating the original Diameter app. The 'won't have' requirement was partially met because the product could be adapted to any users needs by designing suitable content. However, this would require manually creating content for that target audience.

8.2 Strengths and Limitations

The strengths and limitations of the thesis are described in two phases, the product development and evaluation phase. The first reflects on the process from conducting the literature review to realising the physical prototype. The evaluation phase mainly reflects on the user evaluation.

8.2.1 Product development

A strength during the product development phase was the extensive literature review on low health literacy communication strategies. This resulted in an overview of 21 strategies that could be implemented in a physical and digital product. Ultimately, each of the strategies was implemented in the final prototype leading to a unique product that met the needs of the user.

Another strength identified is the amount of design iterations that were done during the ideation and specification phases. Each time new information was identified it was implemented in the digital prototype which could then be evaluated again. Essentially, iterations occurred parallel to defining requirements based on the expert opinion, PACT and MoSCoW, thereby streamlining the process so each requirement was implemented.

A limitation during the literature research phase was that potentially relevant topics could not be explored in depth. These were topics such as behavioural change techniques, gamification and digital agent design. While each of the topics was shortly explored, the scope of the thesis had to be strictly defined to avoid getting lost in the vast amount of papers on the topics. The scope was investigating communication strategies to make content understandable for people with low health literacy. Behavioural change techniques were still implemented based on their previous use in the original Diameter app. Gamification elements are partially incorporated in the product such as daily challenges, however these are not based on gamification literature specifically. Researching gamification more extensively could have made content more enjoyable.

Furthermore, digital agent design was shortly investigated. The few papers that were reviewed, pointed towards the conclusion that a realistic character was preferred over a highly stylised character. This would mean an actor was needed to pose for the pictures on the cards and act in the videos during the realisation phase. This was not doable as it would require too much time and financial resources. Therefore, the researcher chose to use a cartoon character with relatively realistic body proportions and a friendly expression. The character could be used for the cards and animation which would still satisfy the requirement of using a consistent character.

Three limitations were identified during the implementation phase. First, content can not be customised to the user nor change over time based on their behaviour. This was not realisable due to the physical format of the device. Since the content of the cards, sound and video are made manually in advance, they cannot adapt to the user. Furthermore, to make customisation possible, integration with the diameter app could be used. For example, daily goals could be given in the app and based on

physical activity and nutritional data that the user fills in. However, in this thesis the advantage of having a physical product was prioritised over personalisation. As previously mentioned, personalisation could be made possible to a certain extent. For example, the device could be used for 3 months and then a new set of cards could be given with more challenging tasks.

Another limitation in the implementation phase was that the prototype was not completely finished. Ultimately, every card would be linked to an animation giving more explanation (see Table 12). However, an animation was only made for the 'Drink two glasses of water' challenge. This was due to time constraints as making a one-minute animation can take multiple hours. Additionally, nine animations would be unnecessary for the purpose of evaluating the concept, as there would not be enough time during the user evaluation to see every animation. However, more animations may be required for larger scale user testing or evaluations.

The last limitation encountered in the implementation phase related to not conducting intermediate user evaluations with the target audience. For example, before the realisation phase decisions needed to be made regarding the card, audio, video and case design elements: (1) stylised or realistic card and video design, (2) a narrative or informative audio and video, (3) the length of the audio and video and (4) making the cards in the case visible or not. While A/B testing was initially planned, this was not done for two reasons. First, because it is very difficult and time consuming to reach this target group [58]. Second, because grounded decisions could be made based on the literature and expert opinion. Evaluating these elements and involving the end user during the entire product development process, may have revealed issues that the literature and expert opinion could not account for.

8.2.2 Evaluation

The two main strengths of the evaluation were adjusting the questions and ethical consent and information brochure to fit the user needs and the fact that that an evaluation was conducted despite the difficult target audience.

Limitations identified within the user evaluation refer to the spare amount of users, the background of the users and conditions that may have influenced the user. First, only three people were found willing to participate in the study and each user came from the same dietician practice. The low amount of users led to limited input which may have influenced the final outcome. This makes it difficult to know how relevant and applicable the suggestions and opinions of the users were.

Second, the users may not be the correct target audience. Both because they did not have low health literacy based on the evaluation answers and due to the language barrier. The latter made it hard to know if the information was understood and if the user was able to voice their opinion adequately. Additionally, one could wonder if the three questions to determine the user's health literacy were properly understood and answered truthfully. The latter may be due to the user feeling shame for not understanding health-related information. Additionally, the user may feel uncomfortable and distrustful because of the unfamiliar room, foreign language and unknown person. This may have influenced their ability to answer questions to their fullest extent.

Third, the users seemed to already have general knowledge of a healthy lifestyle. Therefore, they may already have understood the content because it was not new information. This was illustrated by the suggestion to take multiple cards a day, which was probably because the content was too easy. Additionally, users seemed to be focussed on knowing the information rather than what they thought of the usability and aesthetic appearance. This made it hard to get an opinion on the system as a whole

and the aesthetic appearance. While this showed they understood the content, it limited the input for other factors that were evaluated. Moreover, this makes the results less relevant for this thesis as it is aimed at people with little knowledge of a healthy lifestyle.

The main limitation to the researcher's method when conducting the user evaluation was their lack of experience with this target group; having both a migration background and possibly low health literacy. This led to the limitation that some questions were not asked due to fear of offending or confusing the user. For example, the questions to define low health literacy were not asked to one user because the researcher felt that may offend them. Additionally, questions may have been formulated in an unclear way. Furthermore, other questions were not asked due to time constraints. During the user evaluation the researcher noticed it would take more than 15 minutes, but they did not want to take up more time. Fortunately, because questions were not asked in a specific order, every question does have at least one answer. The researcher's limitation could be partially combatted by practising the user evaluation with others beforehand.

Ethical limitations were identified as a consequence of the user and researcher limitations. The main issue was that the information brochure and consent form may not have been discussed thoroughly enough. Because of the language barrier and possibly unclear explanation of the researcher, it was challenging to explain what the ethical forms were for. Even though the researcher explained the study and the most important ethical points, it was still unclear if the users really understood what they were signing and what the study was about. Starting the user evaluation with the ethics form may have caused confusion with the user resulting in a possibly tense start of the actual evaluation.

8.3 Recommendations for future work

The following chapter describes recommendations for future work if the product were to be developed further. These recommendations are based on the discussion and user evaluation outcomes.

First and foremost, the product would benefit from additional user evaluations. These should be done with users that fall within the target audience namely Dutch-speaking people with low health literacy. Ultimately, the study would be a longitudinal study where the device is used for three months. The aim would be to evaluate how easy-to-use, motivating and enjoyable the product is to use long-term. Furthermore, these evaluations should be done, or accompanied by, someone with experience or expertise in communicating with the target audience. This would combat the current limitations related to the researcher (see Chapter 8.2).

A second recommendation is to iterate on the product design based on current user evaluation outcomes. For instance, iterations could be made on the drawer system so it is easier to take a card and the case design. The case could also be made more aesthetically appealing to be more fitting in someone's living room or kitchen. Additionally, the content could be made more difficult to match the users current level of understanding.

A third recommendation is developing and evaluating the product for different applications. This could be within the medical sector by making content for other conditions. For example, these could range from gut issues or movements the elderly should do to stay strong and flexible. Additionally, the content of the cards and narration could be translated into other languages. That way the device can also be used by people who do not understand Dutch. In the future, the product may even be adapted to other sectors such as education. For instance, it could contain questions and challenges for children

to learn math and spelling. Exploring this recommendation may open up a range of opportunities for the product to be implemented. However, additional literature research may be required to ensure the product would be effective in the chosen sector.

Chapter 9: Conclusion

This thesis aims to answer the following research question:

How to design the communication of type 2 diabetes coaching content to motivate people with a low health literacy to change their lifestyle?

First a literature review was conducted where 21 strategies to communicate to people with a low health literacy were found. These were divided into four categories; language use, interactive communication, repeating communication and medium and means of communication. Second, five existing technological tools tailored to the needs of people with low health literacy were found. Third, based on the literature review, technological tools, expert opinion and through the Creative Technology Design Process, a product was developed. Finally, the product usability was evaluated with users which led to an overall positive response and understandability. However, the users were not proven to have low health literacy. So to answer the research question; the communication and diabetes type 2 coaching content to motivate people with low health literacy should implement communication strategies tailored to people with a low health literacy. Additionally, user tests should be conducted throughout various stages of the development process to ensure it meets the users needs. Moreover, ultimately the tool is developed with the help of an expert in the field of low health literacy and diabetes type 2. To conclude, more research is needed to further improve the product and investigate other opportunities it may offer. The product has the potential to be a great contribution to the medical sector to close the gap between people with low health literacy and the current healthcare system. The most relevant next step would be to conduct additional user evaluations and investigate the long-term impact of the product.

Appendices

Appendix A: Arduino Code

Filename: Everything Work (DaanV2)

```
/*
 * RFID PART
 *
 * All the resources for this project: https://randomnerdtutorials.com/
 * Modified by Rui Santos
 *
 * Created by FILIPEFLOP
 *
 * DF Player Part
 *
 * How DF Player Mini Play Audio File | DF player to Arduino Interface | Fair Electro
 *
 * Button part: https://arduinogetstarted.com/tutorials/arduino-button-debounce
 * LED part: https://www.youtube.com/watch?v=aMato4olzi8&ab_channel=PaulMcWhorter
*
* Card and lastcard by Daan Mulder
 */

// Pre-setup RFID reader
#include <SPI.h>
#include <MFRC522.h>

#include <ezButton.h> // Include button library for rebounce

#define SS_PIN 10
#define RST_PIN 9
```

```
MFRC522 mfrc522(SS_PIN, RST_PIN);   // Create MFRC522 instance.

// Pre-setup DFPlayer
#include "SoftwareSerial.h"
#include "DFRobotDFPlayerMini.h"

  // Use pins 2 and 3 to communicate with DFPlayer Mini
static const uint8_t PIN_MP3_TX = 2; // Connects to module's RX
static const uint8_t PIN_MP3_RX = 3; // Connects to module's TX
SoftwareSerial softwareSerial(PIN_MP3_RX, PIN_MP3_TX);

// Setup up of led pins and button
int LEDPin1 = 7;
int LEDPin2 = 6;
int LEDPin3 = 5;
int LEDPin4 = 4;
int buttonPin = 8;
int state = 1;

  // Create the Player object
DFRobotDFPlayerMini player;
ezButton button(8);

boolean cardRead = false;
int lastCard=0;
int card=0;

void setup()
{
```

```
Serial.begin(9600);        // Initiate a serial communication

// Set up LED
pinMode(LEDPin1, OUTPUT);
pinMode(LEDPin2, OUTPUT);
pinMode(LEDPin3, OUTPUT);
pinMode(LEDPin4, OUTPUT);

digitalWrite(LEDPin1, LOW);
digitalWrite(LEDPin2, LOW);
digitalWrite(LEDPin3, LOW);
digitalWrite(LEDPin4, LOW);

pinMode(buttonPin, INPUT);

button.setDebounceTime(50);

// Set up DFPlayer and RFID
SPI.begin();               // Initiate  SPI bus
mfrc522.PCD_Init();        // Initiate MFRC522
softwareSerial.begin(9600); // Init serial port for DFPlayer Mini

Serial.println("Approximate your card to the reader...");
Serial.println();

  // Start communication with DFPlayer Mini
if (player.begin(softwareSerial)) {
 Serial.println("OK");
```

```
  // Set volume to maximum (0 to 30).
  player.volume(25);

 } else {
  Serial.println("Connecting to DFPlayer Mini failed!");
 }

}
void loop()
{

 //LED AND BUTTON
 button.loop();

 if (button.isPressed())
 {
  if (state == 1) {
   digitalWrite(LEDPin1, HIGH);
   digitalWrite(LEDPin2, LOW);
   digitalWrite(LEDPin3, LOW);
   digitalWrite(LEDPin4, LOW);
   state = 2;
  }
  else if (state == 2) {
   digitalWrite(LEDPin1, LOW);
   digitalWrite(LEDPin2, HIGH);
   digitalWrite(LEDPin3, LOW);
   digitalWrite(LEDPin4, LOW);
   state = 3;
```

```
  }
  else if (state == 3) {
   digitalWrite(LEDPin1, LOW);
   digitalWrite(LEDPin2, LOW);
   digitalWrite(LEDPin3, HIGH);
   digitalWrite(LEDPin4, LOW);
   state = 4;
  }
  else if (state == 4) {
   digitalWrite(LEDPin1, LOW);
   digitalWrite(LEDPin2, LOW);
   digitalWrite(LEDPin3, LOW);
   digitalWrite(LEDPin4, HIGH);
   state = 1;
  }
 }

 // RFID AND SPEAKER
 // Look for new cards

  if ( ! mfrc522.PICC_IsNewCardPresent())
  {

    return;

  }
// Select one of the cards
  if ( ! mfrc522.PICC_ReadCardSerial())
  {
```

```
    return;

  }



 //Show UID on serial monitor
 Serial.print("UID tag :");
 String content= "";
 byte letter;

 for (byte i = 0; i < mfrc522.uid.size; i++)
 {
   Serial.print(mfrc522.uid.uidByte[i] < 0x10 ? " 0" : " ");
   Serial.print(mfrc522.uid.uidByte[i], HEX);
   content.concat(String(mfrc522.uid.uidByte[i] < 0x10 ? " 0" : " "));
   content.concat(String(mfrc522.uid.uidByte[i], HEX));
 }

 Serial.println();
 Serial.print("Message : ");
 content.toUpperCase();

 //if (cardRead = true)
 //{
 //    cardRead = false;
 //}

  if (content.substring(1) == "13 CF 42 15") //change here the UID of the card/cards that you want to
give access
```

```
{
  Serial.println("card 1");
  //player.play(1); // Play the x MP3 file on the SD card
  delay(3000);
  card=1;
}

else if (content.substring(1) == "53 F7 9D 19")
{
  Serial.println("card 2");
  //player.play(2); // Play the x MP3 file on the SD card
  delay(3000);
  card=2;
}

else if (content.substring(1) == "63 D6 54 17")
{
  Serial.println("card 3");
  //player.play(3); // Play the x MP3 file on the SD card
  delay(3000);
  card=3;
}

else if (content.substring(1) == "03 1F 86 15")
{
  Serial.println("card 4");
  //player.play(4); // Play the x MP3 file on the SD card
  delay(3000);
  card=4;
```

```
}

else if (content.substring(1) == "55 77 40 15")
{
  Serial.println("card 5");
  //player.play(5); // Play the x MP3 file on the SD card
  delay(3000);
  card=5;
}

else if (content.substring(1) == "13 40 34 15")
{
  Serial.println("card 6");
 //player.play(6); // Play the x MP3 file on the SD card
  delay(3000);
  card=6;
}

else if (content.substring(1) == "13 21 15 17")
{
  Serial.println("card 7");
  //player.play(7); // Play the x MP3 file on the SD card
  delay(3000);
  card=7;
}

else if (content.substring(1) == "B3 92 12 17")
{
  Serial.println("card 8");
```

```
  //player.play(8); // Play the x MP3 file on the SD card
  delay(3000);
  card=8;
}

else if (content.substring(1) == "33 6C D6 17")
{
  Serial.println("card 9");
  //player.play(9); // Play the x MP3 file on the SD card
  delay(3000);
  card=9;
}

  else if (content.substring(1) == "D3 4C 9F 15")
{
  Serial.println("card 10");
  //player.play(10); // Play the x MP3 file on the SD card
  delay(3000);
  card=10;
}

else
{
  Serial.println(" Access denied");
  delay(3000);
  card=0;
}

if (card != lastCard)
```

```
 {
  lastCard=card;
  player.play(card);
 }
}
```

Appendix B: Content provided by client

Boodschappen voor in het hulpmiddel voor de Diameter app

1. Bewegen challenges

Challenge 1: Loop vandaag een rondje van 10 minuten door de buurt

Voor het verhaal achter je challenge is het misschien wel leuk om een “doel” te geven aan het rondje lopen of een manier om het leuk te maken. Bijvoorbeeld, vindt iemand het leuk om te fotograferen, muziek te luisteren of om samen met iemand te wandelen? Daag iemand dan uit om het rondje wandelen niet alleen een verplichting te maken, maar het ook zo in te richten dat iemand het ook leuk gaat vinden. Dus bijvoorbeeld:

· Iemand foto’s laten maken tijdens de wandeling

· Muziek luisteren

· Bellen of samen lopen met iemand.

Achtergrond: Het idee hierachter is dat je iets langer volhoudt als je het ook leuk vindt. Dus als je bewegen leuk weet te maken voor jezelf dan is het ook makkelijker om vol te houden dan wanneer je het elke keer met tegenzin moet gaan doen (intrinsieke motivatie).

Challenge 2: Plan een beweegmoment van minimaal 10 minuten in.

Voorbeelden die je kan opnemen:

· Rondje fietsen

· Rondje wandelen

· Dansen in de huiskamer

· Pak vaker de fiets of ga lopend naar je werk, school of de supermarkt.

· Tuinieren

· Zit je veel door je werk of hobby? Probeer ieder uur te staan: geef de plantjes water of haal een glas drinken.

· Aan het werk? Maak dan een lunchwandeling samen met je collega's.

· Neem vaker de trap in plaats van de lift.

Laat mensen zelf de volgende dingen bedenken in door het kijken van de video:

· Wat wil ik gaan doen? (welke activiteit)

· Wanneer wil ik dat gaan doen? (hoe laat?)

· Met wie wil ik het gaan doen? (alleen/vrienden o.i.d.)

· Hoe lang wil ik het gaan doen?

Achtergrond: Je kunt niet alles tegelijk doen, zoals gezonder gaan eten, meer bewegen én stoppen met roken. Begin met iets kleins. Door kleine doelen te stellen kan je stapje voor stapje je manier van leven verbeteren. Als je dan een doel gehaald hebt, kan je aan het werkt met een volgend doel. Door haalbare doelen te stellen blijft het ook leuk. Als je doel stelt is het ook belangrijk dat je er een plan bij maakt, anders blijft het bij voornemens en dan doe je het niet.

2. Voeding challenges

Challenge 1: Doe een eetwissel

Je kunt eetwissels doen voor ieder eetmoment, maar misschien is het handig/makkelijk om te beginnen met een eetwissel voor een tussendoortje. Een leuke eetwissel kan zijn om een ongezond tussendoortje te wisselen voor een gezond tussendoortjes. Dus bijvoorbeeld snoep of chocolade door een stuk fruit of snoepgroenten.

Zie de website van het voedingscentrum voor verschillende voorbeelden die je kunt gebruiken voor in je challenge/ video: https://www.voedingscentrum.nl/nl/thema/eetwissel.aspx

Achtergrond: Het idee achter de eetwissel is dat je niet je hele eetpatroon in één keer moet veranderen, maar dat het beter is om in kleine stapjes te doen. Iedere eetwissel die je doet is weer een stapje richting een gezonde leefstijl. Daarnaast is het makkelijker om een ongezonde keuze te vervangen voor een gezonde keuze (dus iets doen vervangen met iets doen (niet letterlijk zo overnemen)), dan alleen iets weglaten (bijvoorbeeld: ik eet geen chocolade meer).

Challenge: Doe een drinkwissel

Je kunt ook een drinkwissel doen, dus bijvoorbeeld cola vervangen voor water (kraanwater/ Spa rood) met een schijfje/stukje citroen erin. Ook hiervan heeft het voedingscentrum verschillende voorbeelden op de website.

Achtergrond: Hetzelfde idee als voor de eetwissel.

3. Kennis/ informatie

Kennis bewegen: Wat zijn voordelen van bewegen?

Meer dan de helft van de Nederlanders beweegt te weinig. Dit is jammer, want voldoende bewegen is gezond voor jou en je hart. Mensen met diabetes hebben een grotere kans op problemen met hun hart en bloedvaten. Waarom is bewegen gezond voor jou? Hier zijn enkele voorbeelden die je kunt gebruiken:

· Voldoende bewegen kan de kans op problemen met hart en bloedvaten met 20% verlagen.

· Je bloeddruk wordt lager, waardoor de kans op bijvoorbeeld een hartinfarct of beroerte kleiner is.

· Mensen die voldoende bewegen leven langer.

· Bewegen zorgt ervoor dat stress vermindert.

· Je wordt energieker.

· Wanneer je meer beweegt, verbetert je stofwisseling. En iemand met diabetes die voldoende beweegt, heeft vaak minder medicijnen nodig. Ook is de kans op complicaties kleiner.

· Bewegen verlaagt de kans op psychische klachten, zoals depressieve gevoelens en angsten. Dagelijks bewegen, liefst buiten, helpt om je prettiger en gezonder te

voelen. Het helpt ook om beter te ontspannen. Bovendien slaap je beter. Je wordt daardoor uitgerust wakker en kunt

· eventuele spanningen gedurende de dag ook beter aan.

Kennis voeding: Waarom is gezond eten belangrijk?

Als je eet volgens de schrijf dan neem je producten die zorgen voor een betere gezondheid. Zo verlagen groente en fruit de kans op verschillende soorten kanker en problemen met het hart en bloedvaten. En peulvruchten (misschien voorbeeld bij geven) en noten verlagen ongezond cholesterol. Ongezonde cholesterol kan blijven plakken aan de binnenkant van je bloedvaten en daardoor slippen de bloedvaten langzaam dicht. Daardoor kan het bloed minder goed door de bloedvaten stromen. Dit kan tot verschillende problemen leiden.

In deze link staat veel informatie die je kunt gebruiken voor deze kennisclip: https://www.voedingscentrum.nl/nl/gezond-eten-met-de-schijf-van-vijf/waarom-is-gezond-eten-belangrijk-.aspx

4. Quizz

Quizz vraag bewegen: Welke stelling is waar?

A. 30 minuten per dag bewegen vermindert je risico op diabetes type 2 (goed antwoord)

Uitleg: Dat is waar. Bewegen zorgt ervoor dat je lichaam gevoeliger wordt voor insuline. Verder val je ervan af en je spieren worden steviger, dat kan diabetes ook voorkomen. Daarnaast is het ook goed voor je bloeddruk en cholesterol.

B. Met wandelen verbrand je meer calorieën dan met yoga.

Uitleg: Je zou denken dat je met wandelen meer calorieën verbrandt, maar dat is niet waar. Het blijkt dat je met wandelen net zoveel calorieën verbrandt als met yoga.

C. Je moet meer bewegen om een pizza Margherita te verbranden dan voor een Big Mac met een grote portie frietjes (fout antwoord)

Uitleg:

· Je moet gemiddeld ongeveer 60 minuten intensief bewegen (zoals hardlopen) of 85 minuten krachtraining doen om een pizza te verbranden.

· Voor een BigMac moet je gemiddeld 45 minuten intensief bewegen of een uur gewichtheffen. Dit is hetzelfde voor een grote portie friet. Eet je dit tegelijk? Dan moet je dus anderhalf uur intensief bewegen of twee uur gewichtheffen! En dan heb je je cola er nog niet bij…

Quizz vraag voeding: Wat is de beste eetwissel?

A. Cola vervangen door een smoothie (fout antwoord)

Uitleg:

1. Je zit minder vol

In een fruit- of groentesmoothie zitten meer vezels dan in de meeste sappen, zoals versgeperst sinaasappelsap of vruchtensap uit pak. Van het drinken van groenten of fruit in smoothies raak je echter minder snel vol dan wanneer je groenten of fruit in zijn geheel eet. Tijdens het kauwen van groenten en fruit krijgen je hersenen namelijk signalen dat je aan het eten bent. Deze signalen zorgen ervoor dat je eetlust geleidelijk minder wordt en je verzadigd raakt. Bij het drinken van smoothies krijgen je hersenen geen kauwsignaal. Hierdoor verzadigd een smoothie minder dan wanneer je een hele sinaasappel of een bakje aardbeien eet en krijg je sneller weer trek.

2. Suiker in fruitsmoothies

Een fruitsmoothie bevat suiker. Het gaat hier om de suiker die van nature aanwezig is in de vruchten die je pureert. Hoe meer vruchten je toevoegt aan je smoothie, hoe meer suiker deze bevat. Sommige smoothies bevatten evenveel suiker als een glas frisdrank. Drink je te veel suikerrijke smoothies, dan kan dit leiden tot gewichtstoename.

B. Chocolapasta vervangen door 100% pindakaas (goede antwoord)

Uitleg: 100% pindakaas of notenpasta zonder toegevoegd suiker en zout valt in de Schijf van Vijf. Deze soorten zijn dus gezond broodbeleg, ook voor je kind. Aan veel potten pindakaas en notenpasta is zout en suiker toegevoegd. Dat is een minder gezonde keuze. Het eten van ongezouten noten waaronder pinda's verlaagt het ongezonde cholesterol en verkleint de kans op hartziekten. Deze effecten komen waarschijnlijk doordat er veel onverzadigd vet in noten zit. Ongezond cholesterol is niet goed voor de bloedvaten.

C. Broodje kroket door een wit broodje met salami (fout antwoord)

Uitleg: Een broodje kroket levert meer calorieën dan een broodje met salami. Alleen in beide broodjes zit veel zout. Toch is een wit broodje met salami niet heel gezond. Wit brood kan je beter vervangen door bruin of volkoren brood, want dat bevat meer vezels. In salami zitten veel ongezonde vetten.

Salami is ook rood vlees. Het is gezonder om weinig rood vlees te eten. De wereldwijde gezondheidsorganisatie zegt dat er een verband is tussen het eten van rood vlees en het risico op kanker, met name darmkanker. Het mogelijk verhoogde risico betekent dat bij een dagelijks gebruik van 100 gram rood vlees ten opzichte van iemand die geen rood vlees eet, het risico op darmkanker mogelijk toeneemt van 6 op de 100 naar 7 op de 100. Ook is er sterk bewijs voor een verhoogd risico op longkanker door een hoog gebruik van rood vlees.

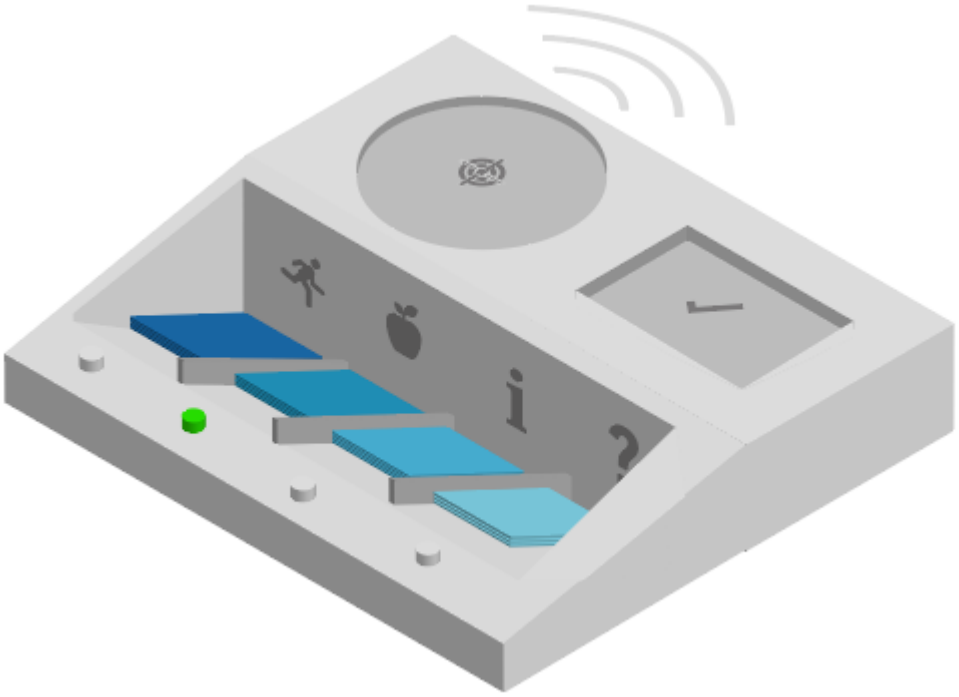
Appendix C: Study explanation email to organisations

Beste medewerkers van Huis voor Taal & Meedoen,

Ik ben Noa Barneveld, student aan de Universiteit van Twente, en ik ben momenteel aan het afstuderen van mijn bachelor Creative Technology. Hiervoor ontwikkel ik een hulpmiddel om mensen met een lage gezondheid geletterdheid te motiveren en informeren over een gezonde leefstijl.

Mijn onderzoek werkt voort op een bestaande app genaamd Diameter die ontwikkelt is door de Ziekenhuisgroep Twente (ZGT) en de Universiteit van Twente voor mensen met diabetes type 2. In deze app kunnen patiënten hun glucose waardes, voeding en beweging bijhouden en krijgen ze coaching berichten via notificaties om hun te informeren en motiveren om gezonder te leven. De app ontwikkelaars/onderzoekers merkte echter dat veel patiënten een lage gezondheid geletterdheid hadden en dat de app daar momenteel niet geschikt voor is omdat de coaching berichten allemaal in een tekstueel format staan. Mijn onderzoek gaat hierop verder door een coaching hulpmiddel te ontwikkelen dat toegepast is op mensen met een lage gezondheid geletterdheid. Het hulpmiddel combineert bevindingen van een literatuur onderzoek en geeft de gebruiker in tekst, audio en visueel informatie. Hieronder staat een foto van het hulpmiddel die werkt als volgt:

1. Elke ochtend ziet de gebruiker een groen led lampje bij een bepaalde categorie (beweging, voeding, informatie, quiz)
2. De gebruiker pakt een kaart van de aangewezen stapel en leest de opdracht die ze die dag moeten proberen uit te voeren. Dit kan bijvoorbeeld zijn: “Eet vandaag één stuk fruit”, bij de tekst staat ook een illustratie/foto van een iemand die de opdracht uitvoert.
3. De kaart kan dan op de cirkel (links boven) gelegd worden om de tekst hardop uitgesproken te horen
4. De kaart kan ook gescand worden met een smartphone om een uitlegfilmpje te zien over waarom het uitvoeren van de opdracht belangrijk is voor een gezonde levensstijl
5. Tot slot kan de kaart op de stapel met het vinkje gelegd worden om een motiverend berichtje te horen.



Om te evalueren of mijn hulpmiddel informatie over een gezonde levensstijl ook echt begrijpbaar maakt zou ik deze graag testen met Nederlanders die een lage gezondheid geletterdheid hebben. Zo kwam ik bij jullie terecht, ik vind het geweldig hoe jullie je inzetten voor mensen met laaggeletterdheid en ik hoop dat mijn project een stukje bij kan dragen aan deze groep mensen tegemoet komen. Ik vroeg mij af of jullie open zouden staan/een mogelijkheden zien voor mij om een keer langs te komen om mijn hulpmiddel te testen voor mijn afstudeeronderzoek.

Ik zou graag individueel met 8-10 mensen het hulpmiddel testen door eerst drie vragen te stellen om hun gezondheid geletterdheid vast te stellen, dan vragen of ze een aantal taken willen uitvoeren met het hulpmiddel terwijl ze hardop vertellen wat ze denken en tot slot een aantal vragen stellen over wat ze van het hulpmiddel vinden. Het onderzoek duurt naar schatting ongeveer 15 minuten per persoon. Als jullie hiervoor open staat zou ik graag in week 25 (20-24 juni) langskomen.

Ik heb in de bijlage een informatie brief en toestemmingsformulier gezet die ik voor het onderzoek met de deelnemer zal doornemen en vragen of ze die willen ondertekenen.

Ik hoop dat ik jullie hierbij voldoende geïnformeerd heb en dat jullie net zo enthousiast zijn als ik om mijn coaching hulpmiddel zo goed mogelijk te testen en ontwikkelen. Bij vragen of twijfels kunt u gerust terug mailen. Ik kijk uit naar uw reactie.

Met vriendelijke groet,

Noa Barneveld

Appendix D: User evaluation questions and tasks

Persoonlijk

In welke leeftijdsgroep valt u?

- 20-30
- 31-40
- 41-50
- 51-60
- 61-70
- 71-80
- 81-90
- 91-100

Laaggeletterdheid

Set of Brief Screening Questions

1. Hoe vaak helpt iemand u met het lezen van brieven of folders van uw huisarts, het ziekenhuis of andere zorginstellingen?
    a. Nooit
    b. Af en toe
    c. Soms
    d. Vaak
    e. Altijd
2. Hoe zeker bent u ervan dat u medische formulieren zelf goed invult?
    a. Heel erg
    b. Nogal
    c. Een beetje
    d. Een klein beetje
    e. Helemaal niet
3. Hoe vaak is het moeilijk voor u meer te weten te komen over uw gezondheid, omdat u geschreven informatie niet goed begrijpt?
    a. Nooit
    b. Af en toe

c. Soms

d. Vaak

e. Altijd

Ervaring

- Hoeveel weet u over gezonde levensstijl?
- Waar krijgt u informatie over een gezonde levensstijl?
- Begrijpt u de informatie die u krijgt?
- Hoe past u de informatie toe? Wat doet u met de informatie?

Product testen

Eerst geef ik een uitleg over hoe het product werkt. Daarna observeer ik de gebruiker en geef taken. Ik vraag ook of ze hardop kunnen vertellen wat ze denken.

Uitleg

- Er zijn vier categorieën
- Groen lampje geeft aan welke categorie aan de beurt is
- Open laatje bij het lampje
- Pak een kaart en lees hem
- Dan kan je hem op de plateau leggen en luisteren
- Dan kan je hem scannen met de mobiel om een filmpje te zien
- Aan het einde van de dag mag je de kaart op de afleg stapel leggen als je het gedaan hebt, anders moet die terug in de la onderop

Taken

1. Pak een kaart van de categorie die vandaag aan de beurt is.

Vraag: wat is de taak van vandaag?

2. Beluister het bericht van vandaag.

Vraag: Begreep u de inhoudt / kunt u uitleggen wat de audio vertelde

3. Kijk de video van vandaag.

Vraag: Begreep u de inhoudt / kunt u uitleggen wat er in de animatie werd verteld?

4. Leg de kaart waar je hem zou leggen als je de opdracht hebt voltooid

Na Afloop

Fysiek / ontwerp

Product

Wat vind u van het product/idee?

Audio

Wat vind u van:

- Snelheid van de stem
- Toon van de stem

Case

Wat vind u van:

- De grootte?
- De kleur?
- Het ontwerp?

Kaarten

Wat vind u van:

- De illustratie?
- De tekst?
- Kunt u uitleggen wat er op de kaart staat / wat is de taak die u vandaag uit moet voeren?

Animatie

Wat vind u van:

- Het ontwerp

Character Paul

Wat vind u van:

- Wat voor indruk maakt Paul op u?
- Hoe zou je Paul omschrijven?
- Ja en nee vragen

<u>Gebruikbaarheid (usability)</u>

- In zijn geheel, hoe makkelijk of moeilijk was het om deze taak uit te voeren?
    - Als moeilijk: hoe zou het makkelijker kunnen? Meer uitleg, product anders
- Hoe waarschijnlijk is het dat jij het product zou aanraden aan iemand anders?
- Hoe waarschijnlijk is het dat u het product zelf zou gebruiken?

- Waar zou u het product neerzetten in uw huis?
- Begrijpt u informatie over een gezonde levensstijl beter na het product te gebruiken?

Als u alles kon veranderen, wat zou u dan veranderen?

Appendix E: Information Letter

Onderzoek Informatie Brief

Een studie naar een hulpmiddel om gezonder te leven voor mensen die moeite hebben met het begrijpen van informatie over gezondheid

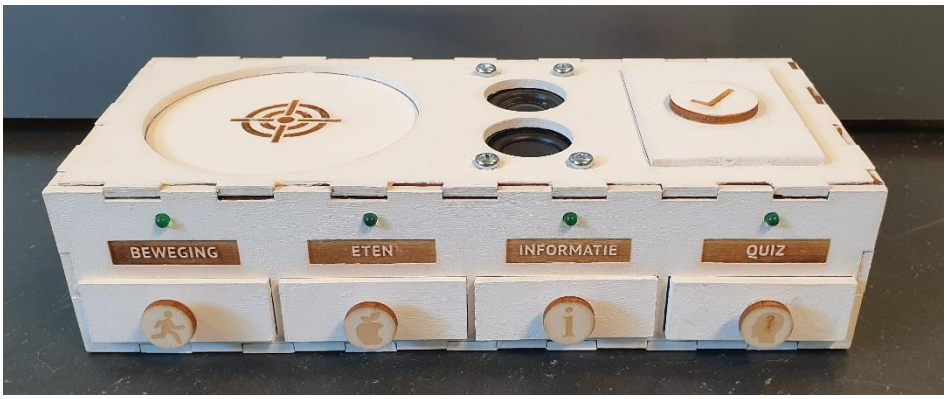
Geschreven door: Noa Barneveld

Datum: 19.05.22

Brief

Beste deelnemer,

Er is een hulpmiddel (zie de foto hieronder) bedacht om gezonder te gaan leven. Dit hulpmiddel is speciaal gemaakt voor mensen die moeite hebben met het begrijpen van informatie over gezondheid. In deze studie willen wij onderzoeken of mensen begrijpen hoe het hulpmiddel werkt. Wij willen ook graag weten wat mensen van het hulpmiddel vinden.



Een foto van het hulpmiddel

Wat moet ik doen als ik meedoe?

De studie heeft verschillende onderdelen:

- Aan het begin van de studie zal de onderzoeker drie vragen stellen om te bepalen hoe goed u informatie over gezondheid kunt begrijpen.
- Daarna zal de onderzoeker u een aantal taken geven die u mag uitproberen met het hulpmiddel. Een taak kan bijvoorbeeld zijn om de kaart van vandaag te pakken. Als u de taken uitvoert mag u hardop vertellen wat u denkt.
- Tot slot zal de onderzoeker u een aantal vragen stellen over uw ervaring met het hulpmiddel. Het onderzoek zal ongeveer 15 minuten duren. Uw stem zal opgenomen worden en de onderzoeker zal aantekeningen maken van wat u doet met het hulpmiddel tijdens het onderzoek.

De adviezen en medische informatie die het hulpmiddel geeft zijn nep en mogen niet als echt beoordeeld worden. Bijvoorbeeld, de tekst op de kaarten en in de video. U moet altijd met een dokter praten voor medische informatie.

Zijn er nadelen als ik meedoe aan de studie?

Er zijn geen risico's bij dit onderzoek. Het onderzoek is goedgekeurd door een commissie die beoordeelt of studies waar mensen aan meedoen uitgevoerd mogen worden (de Ethische Commissie van Informatiekunde en Informatica). U mag op elk moment stoppen met uw deelname of weigeren vragen te beantwoorden zonder gevolgen.

Wat doen jullie met mijn gegevens?

Gegevens die bewaard worden zijn uw naam en stem opname. Uw naam is nodig om toestemming te geven voor deelname aan de studie en zal verder niet gebruikt worden. De stem-opname wordt anoniem in het verslag gebruikt. Het kan zijn dat sommige zinnen die u zegt woord voor woord in het verslag zullen staan. Uw naam zal dan niet genoemd worden. U mag vragen om uw gegevens te bekijken of te laten verwijderen op elk moment tijdens en na de studie.

Uw gegevens worden na afloop van de studie verwijderd, dit zal op z'n laatst 1 september zijn.

De brief in het kort

Doel van onderzoek

- Onderzoeken of een product om gezonder te leven begrijpelijk is voor mensen die moeite hebben met het begrijpen van informatie over gezondheid
- Het duurt ongeveer 15 minuten

Tijdens het onderzoek

- U beantwoordt vragen om te bepalen of u informatie over gezondheid begrijpt
- U voert taken uit met het hulpmiddel
- U vertelt wat u denkt tijdens het gebruiken van het hulpmiddel

- U beantwoord vragen over uw ervaring met het hulpmiddel

Persoonlijke gegevens

- Uw naam
- Uw stem wordt opgenomen
- De stem opname wordt anoniem verwerkt in het onderzoekverslag
- U mag op elk moment vragen uw gegevens te zien of te laten verwijderen
- Uw gegevens worden op z'n laatst 1 september verwijderd

Risico's

- Er zijn geen risico's
- De informatie die het hulpmiddel geeft (dus wat u leest, hoort en ziet) is nep. Bespreek informatie over gezondheid altijd met uw arts
- Het onderzoek is goedgekeurd door een ethische commissie
- U mag op elk moment stoppen met mee doen

Contact informatie

Onderzoeker

Noa Barneveld

n.j.barneveld@student.utwente.nl

Onderzoeker begeleider

Eclaire Hietbrink

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Ethische Comité

Heeft u vragen over de studie? Bijvoorbeeld over uw rechten of vragen die u liever niet aan de onderzoeker stelt? Dan U kunt contact opnemen met de Ethische Commissie van Informatiekunde en Informatica van de Universiteit van Twente: ethicscommittee-CIS@utwente.nl.

Appendix F: Consent Form

Onderzoek Toestemmingsformulier

Een studie naar een hulpmiddel om gezonder te leven voor mensen die moeite hebben met het begrijpen van informatie over gezondheid

Geschreven door: Noa Barneveld

Goedgekeurd door: Ethische Commissie van Informatiekunde en Informatica van de Universiteit van Twente

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

Meedoen aan het onderzoek	Ja	Nee
Ik heb de informatiebrief met de datum 19/05/2022 gelezen of deze is mij voorgelezen.	◯	◯
Ik kon vragen stellen over het onderzoek.	◯	◯
Mijn vragen zijn goed beantwoord.	◯	◯
Ik kies er zelf voor om mee te doen aan dit onderzoek.	◯	◯
Informatie gebruik		
Ik snap dat meedoen aan dit onderzoek betekent dat ik een product gebruik, mijn mening geef, vragen beantwoord en dat mijn stem opgenomen wordt.	◯	◯
Mijn stem mag opgenomen worden	◯	◯
Ik snap dat de informatie die ik geef gebruikt zal worden voor een verslag voor een opleiding aan de universiteit.	◯	◯
Ik snap dat persoonlijke informatie waaraan ik herkend kan worden niet gedeeld wordt buiten het onderzoeksteam.	◯	◯
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.	◯	◯

Handtekeningen

Deelnemer

Naam:

Handtekening:

Datum:

Onderzoeker

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

Naam:

Handtekening:

Datum:

Contact informatie van onderzoeker:

Noa Barneveld

n.j.barneveld@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.

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