Mobile Education Platform

- Finance management for waste pickers -

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Abstract:

The purpose of the project is to achieve an understanding of how an education platform can be designed for the waste pickers in Brasilia, Brazil. The goal is to develop the first steps towards designing a prototype that will support the waste pickers to learn how to manage their personal finances. The waste pickers are analysed as the target group to create an understanding of them and their needs. A design was developed of the prototype focusing on incorporating an analogy of a traffic light. To gain knowledge of the waste pickers' understanding of the prototype and the analogy, an experiment was designed. Unfortunately due to COVID-19 it was not possible to perform the experiment with the target group. Instead another experiment was developed and conducted online with a different target group consisting of Danes and Brazilians. The conducted experiment aimed to investigate the functionality and adjust the the prototype. In conclusion, this project laid the foundations for developing an interface for a personal finance prototype for the waste pickers. However, it is necessary to conduct experiments with the target group in order to make any final conclusion.

Preface

This report are authored by group 683; Emma Bredahl Mortensen, Ina Vedige Brøchner Rasmussen, and Anja Bang Mejer as a part of their bachelor project in Produkt- og Designpsykologi (Engineering psychology), at Aalborg University. The report is written in the period 01/02-2020 to 27/5-2020 with the supervisors Rodrigo Ordoñez and Paula Cavada-Hrepich, from Aalborg University.
This report is created in connection with EPIC [2017], which is an Erasmus+ Strategic Partnership that helps students work with cross-cultural projects. In addition, a co-operation was made with four students from the University of Brasilia. The students' study Production Engineering on different semesters and have been the main connection to Brazil and the waste pickers, see appendix A.1. The four students will be referred to as collaborator in Brazil.
Five expert interviews can be found in appendix B. These interviews have been conducted by e-mail. The five experts were a part of the EPIC seminar in Hamburg, Germany. The reason using these people are that they have worked with the waste pickers or have a connection to the previous project created in 2019 [Britze and Nielsen, 2019]:

- Tatiana Marins Caiado is a production engineer and has been working with recycling and circular economy towards sustainable production-consumption, see appendix B.5, B.7, and B.8
- Mateus Halbe Torres is a student and Business Consultant, see appendix B.3 and B.8.
- Giullia do Couto Machado is a student at a public health college and an SLU intern, see appendix B.4 and B.6.
- Daniel Arias Martijena is an industrial engineer student at the University of Brasília and currently work as an intern for the SLU, see appendix B.2 and B.6
- Jens Myrup Pedersen is an associate Professor at Aalborg University, see appendix B.1

Each expert is explained in a footnote the first time they are presented in the report. The group would like to give thanks to; the collaborators in Brazil, the team behind EPIC, and the experts who participated in the interviews in the report. This report hasn't been possible without you.

Chapter and section references are indicated by numbers in the report. Additional decimals refer to paragraphs and subsections. It is clear from the text whether references are made to a section, figure or a table.
Figure and table are numbered with the first digit relative to chapter, and then numbered in order. Figures and tables have explanatory text attached. Before the bibliography a list of figures and tables with references to, the pages the figures or tables can be found on.
Sources are referred to in the report using the Harvard method. The sources can be found in a bibliography at the end of the report.
Appendixes are listed alphabetically after the bibliography. These are referred to in the text with letters. To the report an attached appendix can be found. The content of the attached appendix is listed in appendix G. The attached appendix is referred to in the text as; appendix G.3(attached appendix).

Contents

Chapter 1

Introduction

In 2018 the world's second largest dumpsite located in Brazil, closed. The Estrutural dumpsite (Lixão da Estrutural) in Brasilia was up to the closure, a workplace for about 1200 people who made their livelihood by scavenging the trash for goods and recyclable materials[Cruvinel et al., 2019, Purchase, 2018]. These people, referred to as waste pickers, had the opportunity to transfer to new recycling centres established by the Brazilian government when the dumpsite closed. The new recycling centre, see figure 1.1 also known as Solid Waste Recovery Installation (SWRI) would improve the waste pickers working conditions in several ways. At SWRI, the waste pickers were obligated to wear personal protection equipment and their ergonomic working conditions were improved[Purchase, 2018].

(a) Relocation of garbage **(b)** Sorting of garbage

Figure 1.1: Photos from SWRI in Brasilia, which was taken during UN Sustainable Development Goals (SDG) Summit 2019. Photographer: Giajenthiran Velmurugan.

Health issues, quality of life and the removal of illegal activities were the main reasons for closing the dumpsite. According to Purchase [2018] Serviço de Limpeza Urbana do Distrito Federal (SLU)[1] had registered 47 accidents from 2009 to 2017. These accidents range from burns to more serious cases, such as a truck overturning on waste pickers and deaths [Purchase, 2018]. Another reason for closing the dumpsites is to improve the environment and health conditions of the general population. In the report "A Roadmap for Closing Waste Dumpsites" by the International Solid Waste Association (ISWA), the Estrutural dumpsite is highlighted, as one of the world's largest and most threatening to human health. Thereby, the closing of the dumpsite contributes to the implementation of the UN Sustainable Development Goals (SDG) [ISWA, 2017]. However, most if not all waste pickers, have resentment towards the SWRI, caused by the reduced earnings.

[1]Serviço de Limpeza Urbana do Distrito Federal, translated to Federal District Urban Cleaning Service (SLU) is an autarchy of the government of the Federal District linked to the State Secretariat of Infrastructure and Public Services. Its purpose is the management of urban cleaning and the management of urban solid waste [Serviço de Limpeza Urbana do Distrito Federal, 2020]

Mateus Halbe: *So, to ask another question. What is the verdict, do you prefer to work here or in the dump?*
Waste picker: *Dumping ground.*
Waste picker: *Dumping ground.*
Waste picker: *Dump site with certainty.*
Maria: *Here everyone is for the dump site*
Mateus Halbe: *Is this serious or are you all joking?*
Waste picker: *Seriously! There, I worked three days and I already supported the entire month*
- Quotes from [Britze and Nielsen, 2019, p. 95]

To gather knowledge for the development of the app, the waste pickers attitude towards SWRI and the education programs were gathered. For this purpose, structured interviews were conducted by e-mail correspondence with five experts, see appendix B. The selection of the experts was based on their previous experiences working with waste pickers in various projects. Each expert's connection to the waste pickers is described in a footnote the first time they are mentioned by name.

1.1 Mobile Education Platform

The waste pickers have been used to living from one day to the next and some have never had a bank account. Now they are payed once a month and therefore need to plan ahead, which they aren't used to. In 2019 two groups of students form Aalborg University (AAU) began an international project to help the Brazilian waste pickers. The project was part of a bigger project, where students work together across borders to solve the SDG's. The SDG's exist to ensure a better future for all people and the environment on earth [Sander, 2019]. The project was highly supported from Brazil, where local students and their advisers cooperated with Grupo Gestão[2] which made local involvement possible. Furthermore the project was supported by the Danish embassy in Brasilia, UN Development programme (UNDP), the Brazilian central bank, UnB and the managing director of the SWRI [Sander, 2019].
Two reports were made by the team from AAU, one focused on health issues and the other was developing an IT-system. The IT-system was made in the project by Britze and Nielsen [2019] to help the waste pickers with mathematical education and through that help the waste pickers managing their finances. The current project addresses, a further development of the project from 2019 by Britze and Nielsen [2019] which was the development of an educational IT-system for the waste pickers. The current project works on the same overall topic but from a different angle and contributes to two SDG's. Goal 10: "Reduced Inequality" and goal 12: "Responsible Consumption and Production" [United Nations, 2020].
In the work done by Britze and Nielsen [2019] it became clear, that after the closing of the dumpsite, a lot of the waste pickers were left in a difficult situation financially. In Britze and Nielsen [2019] it was clear that most of the waste pickers didn't have an understanding of finances. Therefore Britze and Nielsen [2019] decided to create an educational platform that would help the waste pickers manage their finances. It was chosen by Britze and Nielsen [2019] that the educational platform should be developed as an app, because smartphones are beginning to become more and more widespread even among traditionally poorer communities. In fact, [Britze and Nielsen, 2019, p. 9] found that 85% of Brazilians in the age of 18-34 own a smartphone in 2018. In their field research interview, all interviewed waste pickers owned a smartphone.

[2]Grupo Gestão is a consulting company created by the students at University of Brasilia (UnB). Where projects are managed by professors from the University or experienced professors with a doctor's degree [Gestão, 2016].

The initial idea behind the Mobile Education Platform is investigated based on the interview with Jens Myrup Pedersen [3], see appendix B.1. The initial idea behind the app was to help the waste pickers obtain different basic skills, to make their everyday life easier.

> *The idea was to complement the already existing capacitation projects, by giving the waste pickers skills they could use in everyday life such as basic math (for home finances)... The app would provide not only "learning content", but could also have functionality to help them in every day life...* - Jens Myrup Pedersen from appendix B.1

Jens Myrup Pedersen further stresses in the interview that when designing for the waste pickers it is important to have in mind that they don't think in long-term options. Jens Myrup Pedersen got the comprehension from previous encounters with the waste pickers and their spokespersons that the waste pickers themselves don't see the need for education. Jens Myrup Pedersen states that from the waste pickers point of view it was more external factors that should be improved, such as more and better sorted waste. Thereby the waste pickers believe that internal factors like education is not the best way of solving their financial problems. The fact that some of the waste pickers don't see the need for an education, can cause problems in terms of reluctance towards the final app. Therefore, the learning material and the app should be useful to the waste pickers not only as a learning platform for courses, but as a help in their everyday lives.

1.2 Previous field research

To understand the waste pickers point of view the project [Britze and Nielsen, 2019, p. 92-96] made an interview with a group of waste pickers and a manager of administration. Because a manager was present throughout the interview, the waste pickers quotes might be biased. However in the interview, the waste pickers are not afraid to speak their mind in regards to how their situation has changed in both good and bad terms in front of the manager. Thus it is chosen to use this interview as an inside to the waste picker's opinions. In addition the statements from the previous interview are supported by the five expert interviews.
In the interview the waste pickers express their discontentment with SWRI. The waste pickers expressed in the interview that they all preferred working at the dumpsite, because they earned more money back then. The reason for the discontentment could be a result of the waste pickers mindset. Many of them are only thinking about making it to the next day. One of the waste pickers describes that "I can not keep thinking about my future. Because it is already difficult to eat today" [Britze and Nielsen, 2019, p. 96]. The waste pickers aren't able to look at the benefits they get from their new situation such as better working conditions and pension savings, because they need to provide for their families. Some of the experts form appendix B explain that the transferring from the dumpsite where they had no restrictions to SWRI where there is restrictions, was difficult for some of the waste pickers. The new restrictions prevent the waste pickers to work overtime and be in danger in their work environment. Mateus Halbe Torres[4] explains in appendix B.3 that in the past, the waste pickers would go to the dumpsite with the entire family including children to maximise their gain. This meant that it was an advantage for the ones that worked more, and the income was proportional to their results. Now that the income is distributed equally among all the waste pickers, some feel cheated and "the biggest challenge for them is to survive on a salary that is three times lower than before... In Brazil the salary that they receive now is less than the minimum wage"

[3] Jens Myrup Pedersen is an associate Professor at Aalborg University, see appendix B.1
[4] Mateus Halbe Torres is a student and Business Consultant, see appendix B.3

Giullia do Couto Machado[5] from appendix B.4.
Furthermore, from the perspectives of the waste pickers it's fundamental that their families are doing well "I think family is the most important, if family is well Everything is fine... For me today my biggest problem is my family." [Britze and Nielsen, 2019, p. 95]. In order to support their families and children the waste pickers have to work for many years "I'm old enough to retire and I can not retire" [Britze and Nielsen, 2019, p. 94].
Additionally, another important aspect to take into consideration is that the waste pickers are illiterate. Some of the waste pickers are only able to write their own name. A waste picker called Maria can only sign her own name "the only thing I know is to sign my name. Nothing else." [Britze and Nielsen, 2019, p. 93]. According to a study by Cruvinel et al. [2019] the waste pickers health were outlined right before the closure of the dumpsite. 27,3% of the waste pickers that participated had no education and 47,7% had only attended primary school. Based on their limited education it can be assumed that without any, or limited mathematical skills their abilities in managing finances might be compromised "I do not know how to make head or paper calculations. But I do everything in the calculator just fine." [Britze and Nielsen, 2019, p. 92]. To educate the waste pickers, the government was paying them R$ 300 per month to attend different classes 12 hours each month, see interview with Tatiana Marins Caiado[6] in appendix B.5. At the time of this project, no educational program is offered to the waste pickers. But Daniel Arias Martijena[7] and Giullia do Couto Machado, states that there will be in the near future, see follow-up interview in appendix B.6. It was only possible for the people at SLU to follow the waste pickers education when it was mandatory, explains Tatiana Marins Caiado, see appendix B.5. Through this education the waste pickers received support from the government. She elaborates further that the waste pickers do not write or read properly, and they would like to improve their skills. However she also explains that it is difficult for them to manage studies when they need to provide for their family at the same time. Therefore, education is not a priority compared to earning money.
Another focus in the interview is to figure out what kind of smartphones the waste pickers use and how they use them. In this case the waste picker Maria shows the interviewer her smartphone, which is a Samsung, the type and version is unknown. It emerges that some of the waste pickers use audio recording to communicate through WhatsApp "I listen to audio and record the audio." [Britze and Nielsen, 2019, p. 94]. With this insight of the life of the waste pickers from the above interview, the following points are taken into consideration for the app's further development.
In conclusion, the previous field research and expert interviews show that the waste pickers' families are one of their main concerns and priorities. Thereby they are more oriented towards their daily life here and now, and some have a hard time prioritising their future. Some of the waste pickers cannot read, write and do simple mathematics. They have done well in the past without being able to do these things, and thereby cannot see a point in using their resources to learn new knowledge.

[5]Giullia do Couto Machado is a student at a public health college and a SLU intern, see appendix B.4
[6]Tatiana Marins Caiado is a production engineer and has been working with recycling and circular economy towards sustainable production-consumption, see appendix B.5
[7]Daniel Arias Martijena is an industrial engineer student at the University of Brasilia and currently work as an intern for the SLU, see appendix B.2

1.3 Purpose

The purpose of the current project is to achieve an understanding of how an education platform can be designed for the waste pickers. The goal is to design a solution that support the waste pickers to learn how to manage their personal finances and think in a long term solution in relation to their finances. Due to the low level of education, which means many of them are illiterate, the app should be designed to accommodate the waste pickers according to their knowledge and perspective. The current project addresses the case of the Brazilian waste pickers at the SWRI in Brasilia, Brazil.

1.4 Initiating problem statement

How can an app help the Brazilian waste pickers gain knowledge on their personal finances?

1.5 Learning methodologies

This section revolves around how illiterate learn and obtain new knowledge in order to adapt the learning methods to this project. Additionally, the education the waste pickers received from SLU is investigated.

However first a clarification of the different levels of illiteracy is defined and a continuum can be made from illiteracy to literacy. At the 20th session of UNESCO [1979] general conference in 1978, the following definitions were made for literacy:

- "A person is literate who can with understanding both read and write a short simple statement on his everyday life" [UNESCO, 1979].
- "A person is illiterate who cannot with understanding both read and write a short simple statement on his everyday life" [UNESCO, 1979].
- "A person is functionally literate who can engage in all those activities in which literacy is required for effective functioning of his group and community and also for enabling him to continue to use reading, writing, and calculation for his own and the community's development" [UNESCO, 1979].
- "A person is functionally illiterate who cannot engage in all those activities in which literacy is required for effective functioning of his group and community and also for enabling him to continue to use reading, writing, and calculation for his own and the community's development" [UNESCO, 1979].

From the above definitions it is chosen to focus on three levels of illiteracy in the further work of this project; Illiteracy, Functional illiteracy and literacy.

In relation to the education provided by SLU, the different classes is accounted for in the following. This is done to clarify the teaching methods, the subjects that were taught and how the waste pickers responded to it. However the materials provided in the classes could not be obtained for this project.
According to follow-up interview with Daniel Arias Martijena and Giullia do Couto Machado in appendix B.6, the previous educational program contained courses related to: Cooperativism, safety

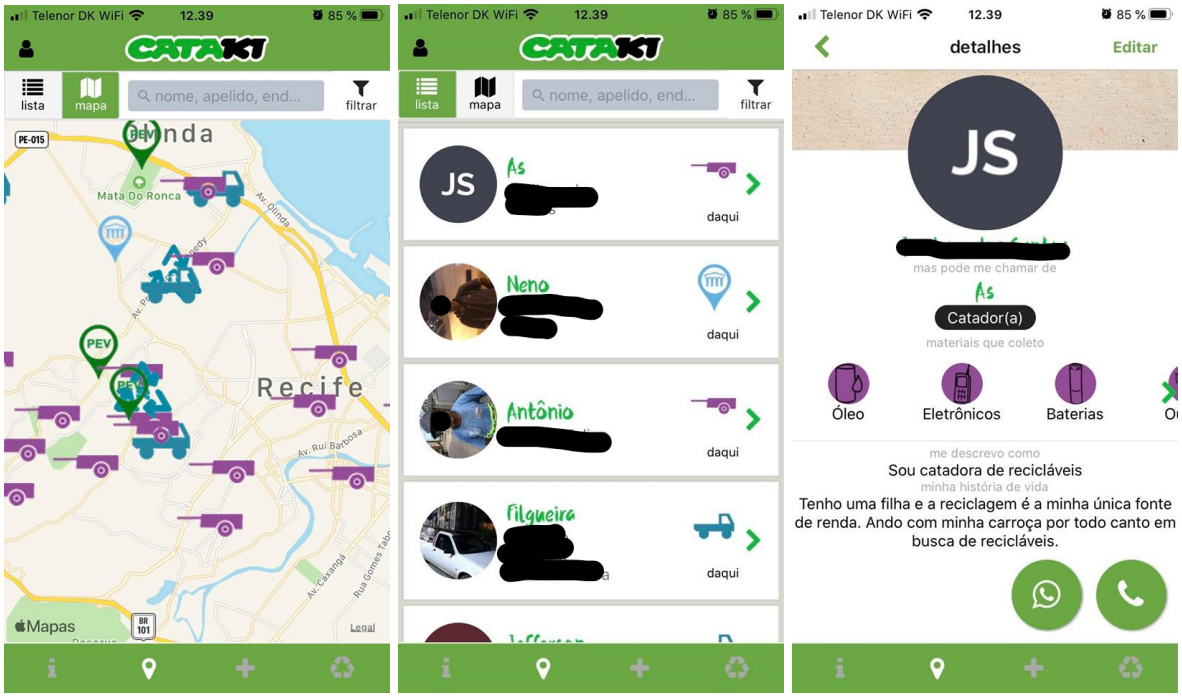
in the workplace, solid waste management and personal finances. As some of the courses e.g. Personal finances was arranged for more than 400 people at the same time and held in a relatively small room, this type of teaching was not efficient. Furthermore no exercises were provided during the classes and no examines were required afterwards. In addition, the waste pickers were paid for showing up to the classes, and not for their amount of active participation. Therefore it is assumed that the waste pickers motivation and engagement were low. To investigate learning methodologies used in other ethnic groups two studies are examined.

In [Fanta-Vagenshtein, 2008, p. 30, 32], it is investigated how illiterate learn and obtain new knowledge. The article is based on illiterate immigrants from Ethiopian and how they learned new things when they first arrived in Israel. People with reading and writing difficulties use *informal frameworks* to acquire knowledge. *Informal frameworks* are learning through experience, practice, trial and error and from other more experienced people etc. Informal learning is taught through inductive reasoning and always in a context. Inductive reasoning is going from a specific example to a generalised idea. Contrary, the primarily learning method in a school setting is deductive reasoning where topics are learned through general rules before connecting it with specific examples.
In the research made by [Fanta-Vagenshtein, 2008, p. 30-32], five different learning channels that by-passes traditional literacy based learning are examined; Visual learning, Apprenticeship, Trial and error, Practice and Enacting. In the study the most frequently used channel by the participants (the illiterate immigrants from Ethiopian) were the visual followed by the apprenticeship. However, the data indicates that the participants used more than one learning channel when they acquired new knowledge. Another observation made by [Fanta-Vagenshtein, 2008, p. 48], is how access to technological aids can help people with illiteracy or functional literacy. With this access, they can learn new things in new ways, and not having to store the knowledge in their mind, but access it through technology. In terms of the waste pickers, this could be the access to their smartphones, which creates the ability to e.g.; communicate with others orally, receive visual feedback, get pieces of text read aloud from various sources like street signs, internet pages and applications.

Besides taking into account that some of the waste pickers are illiterate, also their background and culture should be considered when designing the application, this is further investigated in section 2.1. Head [2014] focus on how active learning can help the Native American students to gain knowledge and skills in financial understanding. This is done by incorporating unique and relevant cultural experiences and situations into the content. An example is that the Native American will face a conflict when traditional savings methods are introduced. One of the Native American subcultures called the Sioux society, do not see a need to save money in order to help themselves. However, generosity is very important for them. It is more relevant for the Sioux society to look at savings as a way to help others. Such understanding for the specific ethnic group can be achieved by e.g asking the group to write a story or draw a picture that describes a time when something was saved [Head, 2014].
Head [2014] concluded that to develop an understanding of the basic financial terminology, the ethnic group needs to associate what they already know to the new knowledge, in order to construct their own comprehension. Head [2014] used active learning to help the ethnic group construct their own comprehension. Active learning involves the students personalise an idea, a concept, or a solution by connecting it to something they know. Active learning strategies can be used to incorporate cultural characteristics that address specific needs of a group. However all ethnic groups are unique and does not place the same meaning to topics. This is due to the understanding of themselves, the world around them, and what they value Head [2014].

1.6 Existing app for waste pickers

An app called Cataki has been developed for waste pickers. These waste pickers are not the same as them this report aims to design for, but the ones who collect waste in cities. The Cataki app was developed to help the waste pickers in the cities to find places with garbage to retrieve. Cataki helps connecting people that have waste like paper, aluminium, plastic etc. with the waste pickers that can pick it up and recycle it. Residents in the cities make contact with their local waste pickers to organise waste collection and other services.
Cataki mimics the functionality of consumer apps like Uber and Tinder. Waste pickers create an online profile completed with photos and a personal history, which can be found via the map and a list, see figure 1.2. The app was designed by the street artist Thiago Mundano, who aimed to connect people in possession of waste, with people who could collect it and recycle it. The app would be like Tinder in future versions, so the people could post photos of their rubbish, and the waste pickers could accept or reject it by swiping right or left [Paulo, 2017]. Many of the waste pickers are unable



(a) Map **(b)** List **(c)** Profile

Figure 1.2: On figure 1.2a different icons can be seen describing different people and locations. The trucks and wagons visualise waste pickers with various means of transport. The other icons visualise cooperatives, PEV (Point of voluntary delivery) and junkyards. The app is in Portuguese and all screen shots are from 27-03-2020 and from a personal profile.

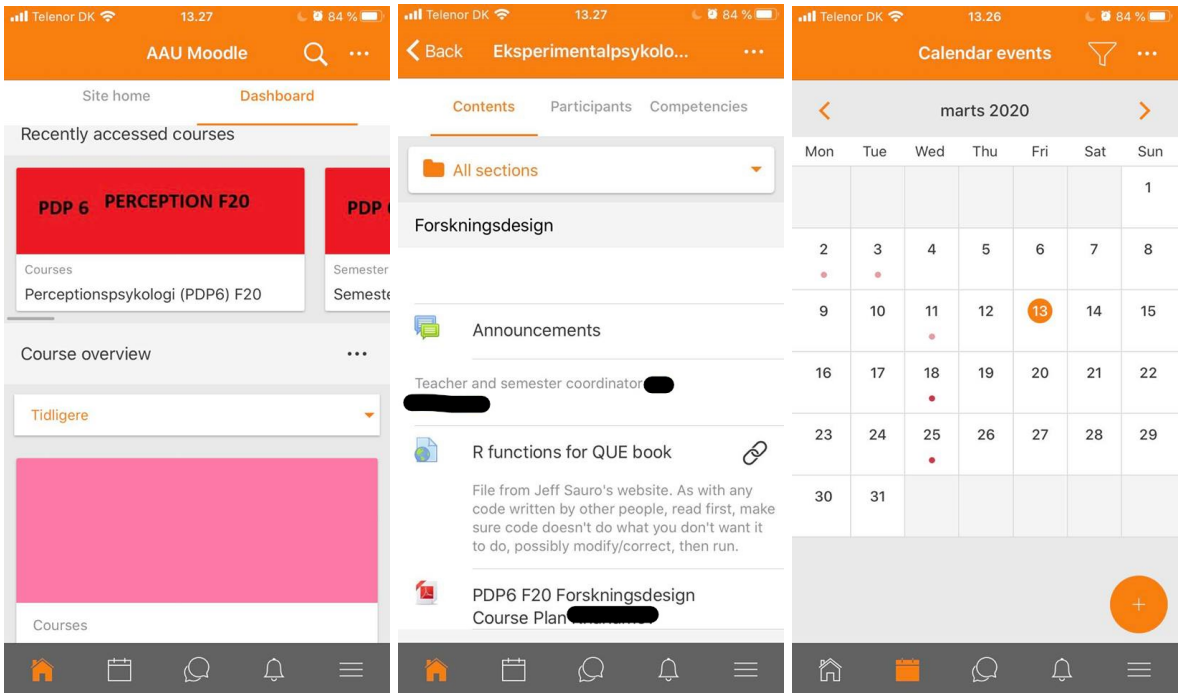
to access the app. Using Cataki is particularly a problem for the waste pickers who are illiterate, homeless, don't own a smartphone or don't have a stable phone number. However, the developers of Cataki expect the problem to resolve itself due to smartphones becoming cheaper and the waste pickers digital literacy is improving every year [Parkin, 2018]. Although this app does not take into account that some waste pickers are illiterate and the target group is different, this project can still be inspired by Cataki as it is used by some waste pickers in Brazil.

1.7 Existing learning platforms

The following section, investigates current learning platforms in order to select aspects that should be part of the project's learning platform. The section only serves to outline the current state of affairs and should not be considered as an in-depth analysis.

1.7.1 Moodle

Moodle[8] is a learning platform used by various learning institutions, such as Aalborg University. This is in order to investigate a learning platform that can handle many different types of courses and learning materials. Moodle is a learning platform and course management system. It is a free open source software package designed to help educators create effective online education [Moodle, 2020].



(a) Front page **(b)** Course page **(c)** Calendar

Figure 1.3: An overview of some of the sub-pages in Moodle. All screen shots are from 13-03-2020 and from a personal profile of one of the project's contributors. All the names have been removed.

Moodle is a service that accommodates many different types of courses. Moodle is able to do various things such as displaying course material, calendar and messages, see figure 1.3. However, it can also make Moodle's content seem confusing, as it is not customised to the course topic or material. In this project the focus is on what information the waste pickers need in the moment. Therefore, options that may not be relevant for the waste pickers are hidden away. Here, a *less is more* approach may be more beneficial.

[8]This investigation will be based on the Moodle Mobile version 3.8.0 from 13-03-2020.

1.7.2 Money Advice Service

The Money Advice Service is a website provided by an independent organisation in the UK. It is a nationwide free service to help people manage their personal finances. The Money Advice Service aims to help everyone make the most out of their money. The Money Advice Service is based on the Financial Services Act 2010 to deliver 'public awareness' [The Money Advice Service, 2020].

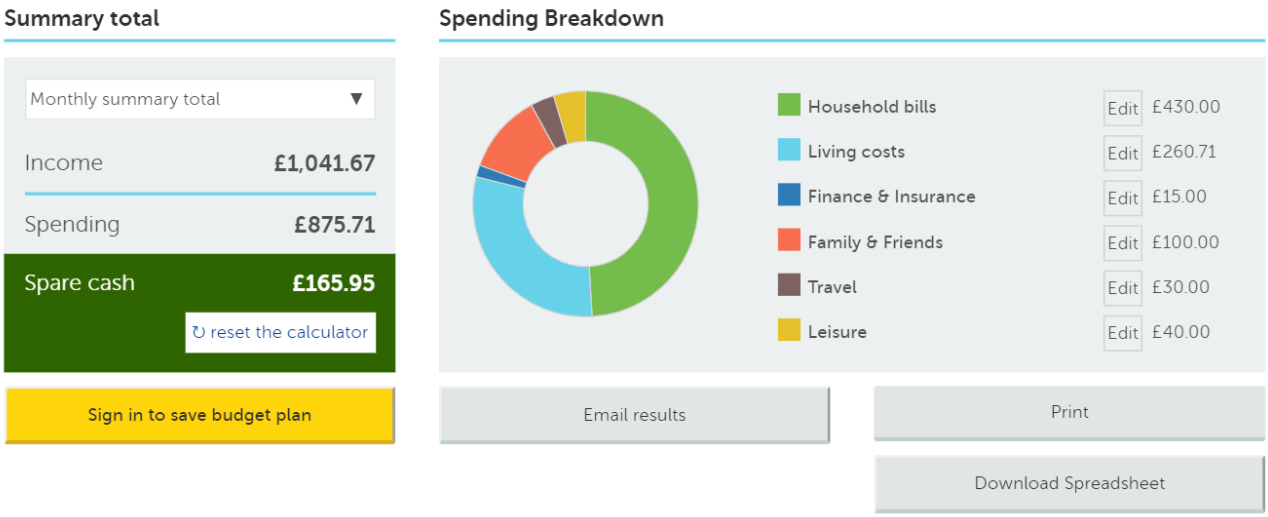


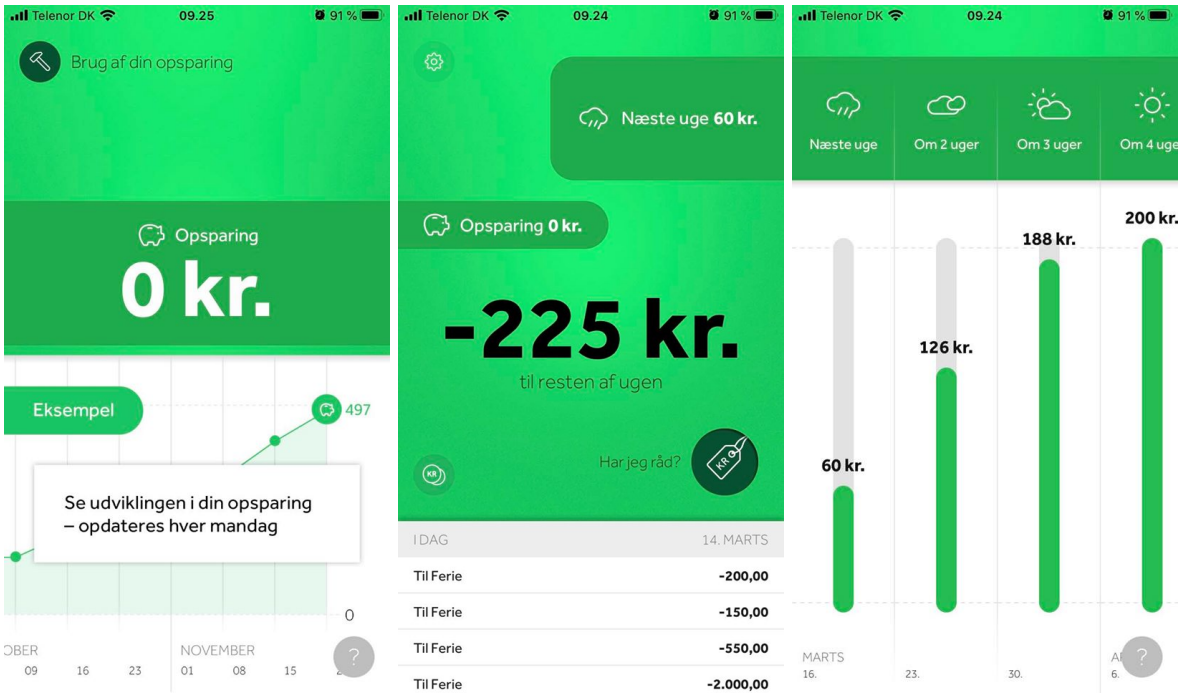
Figure 1.4: Screen shots of the Budget planner tool by The Money Advice Service [2020].

It is examined what The Money Advice Service [2020] focuses on when teaching budget management. The Money Advice Service [2020] has several pages describing how to keep a good budget, but most refer to the Budget Planner. In Budget Planner, income and expenditure are entered into different categories. Thereafter, a summary of consumption is shown with an overview of whether one has profit or deficit each month based on the given information. An example is based on a budget where there is a profit every month, see figure 1.4. However, if there is a deficit it is illustrated by making *Spare cash* red. In conclusion, The Money Advice Service [2020] uses a practical approach to budgeting rather than making learning material about budget management. This hands-on approach is therefore considered for this project's learning platform.

1.7.3 Weekly

Weekly[9] is designed to help customers in Jyske Bank to understand and keep track of their finances [Jyske Bank, 2020]. The analysis is done to investigate an app specifically to financial management. Weekly is designed to manage ones finances on a weekly basis to make sure money is available at the end of the month [Jyske Bank, 2020].
On the front page of Weekly, the available amount of the week is displayed, see figure 1.5b. If one spends less than one's available weekly amount, it is transferred to savings, see figure 1.5a. Additionally, Weekly provides the opportunity to see the impact one's daily consumption has on the budget, the following days and weeks, see figure 1.5c. This feature can be helpful when deciding what to purchase and how to plan ahead. To illustrate the progress, an analogy is incorporated in the design of Weekly. A weather forecast is illustrating the users financial situation in terms of a sunny, cloudy or rainy day.

[9]This analysis will be based on the Weekly app version 2.3.2 from 14-03-2020.



(a) Savings **(b)** Overview **(c)** Budget forecast

Figure 1.5: The main features in Weekly. Figure 1.5b is the main page and from there one can slide horizontal in both directions which shows figure 1.5a or figure 1.5c depending on which side one slide to. The app is in Danish. All screen shots are from 14-03-2020 and from a personal profile of one of the project's contributors.

The implementation of an analogy is considered in the app for the waste pickers as well. In the previous section 1.5, it was found that one of the methods illiterate and functional illiterate use to acquire new knowledge, is through visual learning. Therefore, an app with visual content, such as a visual analogy could be used to show the impact of the waste pickers daily choices on their financial situation. Further, an analogy could be used to explain new concepts or more complex matter by drawing parallels to situations or context, already familiar to the waste pickers [Gleitman et al., 2010, p. 369].

1.8 Approach

The goal of this project is to develop the first steps towards a prototype that supports the waste pickers in managing their personal finances. In this development process, waste pickers as a target group are first examined through a user research in chapter 2. This is done to create an understanding of the waste pickers and their needs. This results in the user requirements that the app aims to accommodate.
Secondly, an approach to motivate the waste pickers could be by implementing active learning, as used in the study by Head [2014]. Further, active learning correlates with the *informal framework*, which is the learning method the illiterate and functional illiterate use. The experience with the previous learning material, see section 1.5, shows the waste pickers' motivation to attend and participate in the courses provided by SLU, in general is low. Therefore an analogy is developed in chapter 3, with inspiration from Weekly, see section 1.7.
Thirdly, a prototype is developed in chapter 4. When designing and developing an app to the waste pickers, it's important to take into account that some are illiterate and functional illiterate. There-

fore, it is considered to use inductive reasoning and focus on the visual learning channel. However, alternative methods of communication, such as audio is investigated as well. Due to the period of this project and the limitations on graphic design skills, only a prototype of the application is created. As this project focuses on the prototype, only features and content is investigated. The long term use of the Mobile Education Platform require a more refined high-fidelity prototype before conducting such tests. Therefore, this is for a future project. Thus, the experiment in chapter 5, focus on investigating which areas of the prototype needs to be changed in future projects. Thereby, the following problem statement is examined throughout the project.

1.9 Problem statement

Which elements should be a part of the design of the prototype to help the Brazilian waste pickers learn how to manage their personal finances?

Chapter 2

User research

This chapter analyse various aspects of the target group that must be examined before the prototype can be created. Firstly, the waste pickers are analysed as a target group for the prototype of the project. The waste pickers are analysed based on demographics and to gain a basis for developing a persona that is drafted subsequently. The persona forms the basis of a scenario that provides an understanding of where and how the prototype can help the user, as well as their motivation to use it. The user needs is analysed in relation to the development of the prototype using a *Value Proposition Canvas*. Finally *User Requirement* is concluded based on the findings from this section.

2.1 A cultural approach

To get a better understanding of the waste pickers and Brazilians in general, the next section clarifies some of the differences between the Danish and Brazilian culture. Thereby pin-pointing potential pitfalls that could arise when working on a cross-cultural project and how to avoid them. When designing and developing products for new markets, it's important to investigate and understand the target group and their culture. In Schumacher [2010], some key aspects on what to be aware of when conducting user research in different cultures, in this case with the focus on Brazil, is elucidated. Regarding Brazilians, Schumacher [2010] points out that they in general are talkative and forthcoming and that the research conductor sometimes have to work to keep the participants focused on the task he or she is doing. Additionally, Schumacher [2010] also point out that when testing on interfaces it is common practice to use the local language, in this case Brazilian Portuguese dialect. According to Schumacher [2010] it is possible to find Brazilians that can understand and read English, but in general Brazilians commonly do not speak English. This is especially something that should be considered carefully when conducting user tests on the waste pickers, as they have a low level of education [Cruvinel et al., 2019].
Another approach that can be helpful when conducting user tests and designs between two or more cultures are the Hofstede Cultural dimensions approach. Based on six different dimensions of culture, proposed by Hofstede and Hofstede [2020] it is possible to get a general understanding of which cultural aspects that could have an impact on the execution of the user tests and in the end, the design of the app. The six dimensions are: Power Distance, Individualism, Masculinity, Uncertainty Avoidance, Long Term Orientation, and Indulgence. The article Walsh et al. [2010] is an example of use Hofstede's six dimensions. Here used as support and a way of investigating the impact culture might have on the user experience with smartphones. They found that overall their data could be correlated with the six dimensions.
However when using Hofstede's cultural dimensions, some reservations must be taking into account. One of these should be that the dimensions are an overall view on the cultures in the study. Meaning that the scores represent the average of the respondents that have participated in the study. Therefore, when applying these dimensions, the designer should have in mind that nuances and subcultures might be left out. In cases, such as this one, where the target group is a specific subgroup it should be considered to make additional analysis in order to accommodate this. However

in this report Hofstede's culture dimensions are only used to provide a cultural overview and will not be used to conclude anything without the validation of other methods.
To investigate potential pitfalls that can occur with a cross-cultural project, this project examines the six dimensions with focus on the differences between Denmark and Brazil. This is done to accommodate the differences between the two cultures and give awareness to how the prototype and experiment needs to be adjusted according to the Brazilian culture. From Hofstede Insights [2020], it is possible to see how the two countries are weighted on the six different dimensions and make a comparison. The dimensions are weighted between 1 and 100 in a questionnaire completed by people from the two countries. The graph on figure 2.1, shows the comparison of the scores between Brazil (blue columns) and Denmark (purple columns). In dimensions where two countries are rated oppositely on the scale would indicate a cultural gab and imply that extra care should be taken to meet any challenges in this area when designing. At Hofstede Insights [2020], it is not possible to see the number of respondents to the questionnaire and thus contributed to the data. However, it is stated that the scores from each country is gathered through multiple studies over the years and that it keeps being updated.

Figure 2.1: Snippet of a graph of the country comparison from Hofstede Insights [2020]. The blue columns are Brazil and the purple columns are Denmark.

Power Distance, an indicator on how well people accept an unequally distribution of power in society. From the graph 2.1, it is possible to see that there is a big difference between the two countries in order of Power Distance. Brazil has a score on 69, which is high compared to the Danish score 18. This means that in Brazil there is a much stronger and more strict hierarchy within the society than in the Danish. Additionally this cultural analysis indicates that the waste pickers will react differently in e.g. experiment or interviews if there are someone with a higher social status present. *Individualism*, Is the people's self-image in society whether they define themselves as an individual or as part of a group e.g. the family. When it comes to *Individualism* the Danish score is 74, and are higher than the Brazilian score on 38. This indicates that group affiliation towards ones family and next of kin, plays a larger role in Brazil than in Denmark. This is reflected in the examination of the interview in section 1.2. The term family is very important for the Brazilians, which should be taken into account when researching the waste pickers. Brazilians have a collective family view, because of that it's important to understand that the waste pickers need to provide for the whole family and not just themselves. Therefore, it's important to consider the family situation and not just the individual.

Masculinity, gives an insight in what way the society is driven. Where a masculine society gives a high score and a low score gives a feminine society. If the society is described as masculine it is build on a competitive environment where people want to be the best. A feminine society on the other hand is when people are more focused on caring for others and use the quality of life as a measure of success. The Brazilian society had an average score on 49 which indicates that they in some areas could be very competitive and in other areas keen on helping others. Whereas in Denmark the score is low with a score of 16 meaning that the society intent on having a good work and life balance and when conflicts arises negotiation and compromises are made.
Uncertainty Avoidance, describes how well the society cope with uncertainties and the prospects of changes in the future. Here the Danes have a score on 23 which points to a society that adapts fairly quickly to changes. In Brazil the score is 76 which means a higher need for a more structural and unambiguous everyday life.
Long Term Orientation, is how the society copes with changes. Are they more tradition bound and suspicious about the future or are they embracing progress and changes as a mean to prepare for the future? The Brazilians with the score 44 are in the middle of the scale. The Danes have a lower score on 35, which indicates that they have respect for their traditions but are living in the moment.
Indulgence, describes if people in general are more reticent about their feelings, desires and impulses or outgoing and more indulgent of their feelings. In this dimensions, both countries have a high score meaning that when it comes to feelings and impulses, both societies have a straightforward approach. A general tendency is a positive and optimistic attitude.

In conclusion, four dimensions are standing out: Power distances, individualism, masculinity and uncertainty avoidance. This means that in Brazil there is a much stronger and more strict hierarchy within the society. They have a stronger group affiliation towards ones family and next of kin. Some people could be very competitive in one area and keen on helping others else were. Also they have a higher need for a more structural and unambiguous everyday life. Therefore it's important to be aware of these differences when moving forward in the report.

2.2 Waste pickers' socio-economic status

To be able to create a prototype for the waste pickers it is necessary to not only know the general culture in Brazil, but also their socio-economic status. Looking at waste pickers in Latin America, they have been excluded from society for many years. They are often poor, socially marginalised and don't have a voice politically. In the end of the twentieth century, cooperatives for the waste pickers were made to secure their human rights. In 2005 Latin American Wastepickers' Network was formed by the waste pickers. It was created to share knowledge, make awareness of the waste pickers contributions to society and to proponent the inclusion of the waste pickers in the society [Marello and Helwege, 2018].
From the article Gutberlet [2019] a socio-economic survey was conducted with 21 cooperative organisations where the waste pickers work, from the region of São Paulo in Brazil. The study shows that it becomes clear that waste pickers that are organised and working collectively have a chance for a higher income. Through waste picker cooperatives, underprivileged waste pickers have the possibility to have a livelihood without hunger, poverty, discrimination and where they are not exploited.
According to Gutberlet [2019] the minimum monthly salary for the waste pickers is R$ 937,00[1].

[1] R$ 937,00 is equal to 146,78 euro. According to Numbeo [2020] a four-person family's monthly costs is R$ 8200,93 (1284,69 euros) without rent and a single person's monthly costs is R$ 2295,67 (359,62 euros) without rent.

However, not all the cooperatives generate enough revenue to support the waste pickers with that minimum wage. The revenue is a mix of both the economic support from the local governments and the profit from the recycled waste at the SWRI. For the waste pickers that are working at the SWRI in Brasilia "the biggest challenge for them is to survive on a salary that is three times lower than before." Giullia do Couto Machado from appendix B.4. Before the closure they earned an average of R$ 2500,00 (530 euros) per month and after some of the waste pickers earn R$ 800,00 (170 euros) per month. The salary they receive now is less than the minimum wage in Brazil. When the waste pickers are part of an organisation, they are entitled to social support. In the socio-economic survey by Gutberlet [2019], 10 cooperatives out of 21, acknowledge that some of the waste pickers have been or are in difficult situations, like single parent or health issues. Within the cooperative the waste pickers are getting the support they need.

2.3 User demographic

To gain an understanding of the demographics of the users, a study by Cruvinel et al. [2019] is used as a reference point. The research article was published May 16 2019, and their main focus was to investigate the health conditions of the waste pickers that worked on the Estrutural dumpsite. 1083 waste pickers were included in the study, representing 94.6% of the total who worked at the dumpsite Cruvinel et al. [2019].

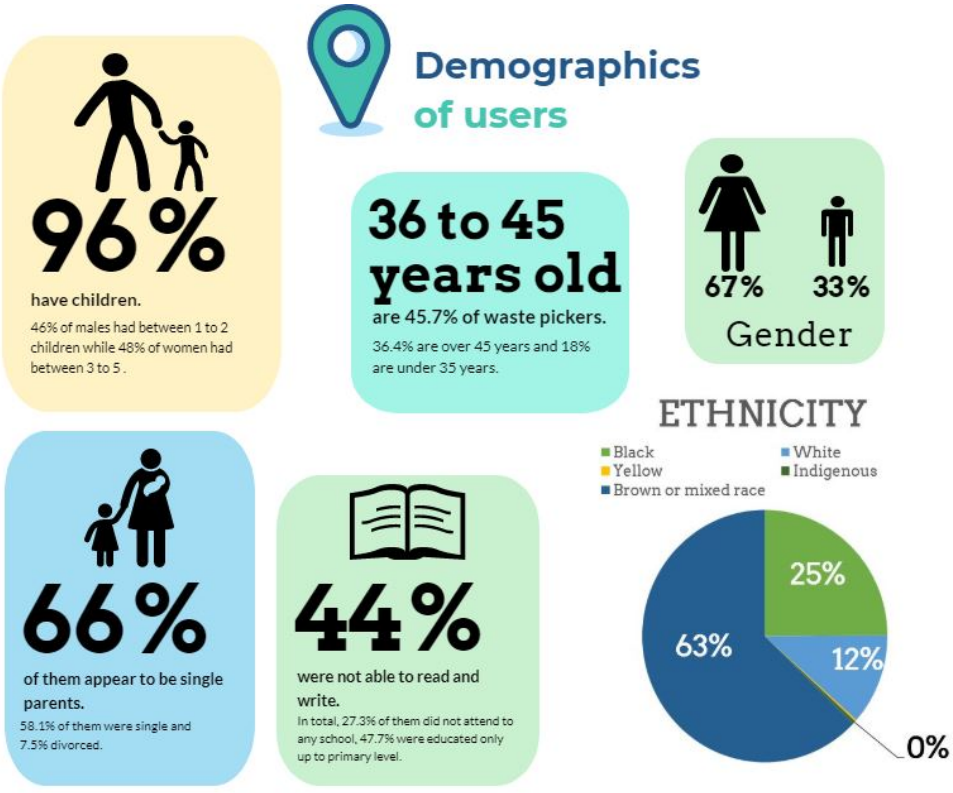


Figure 2.2: Infographic of the user demographic based on data from Cruvinel et al. [2019], where user refers to the participants involved in the study.

The majority of participants in the study are 36-45 years old (45.7%), and 96.0% have children, here women represent 67.0%. According to marital status, the majority of the participants were single (58.1%) or divorced (7.5%) and 66.0% of the participants appear to be single parents. In the group

of men, the majority of participants (46.0%) had between 1 and 2 children while the majority of women (48%) had between 3 and 5 children. In terms of ethnicity, 62.8% of the participants were brown or mixed race. A more detailed outline of demographics can be found on the infographic on figure 2.2. Furthermore the data by Cruvinel et al. [2019], collected during their research, contained information about the level of education the participants had. In total, 27.3% of the participants did not attend to any school, 47.7% were educated only up to primary level and among them, 44.0% were not able to read and write.

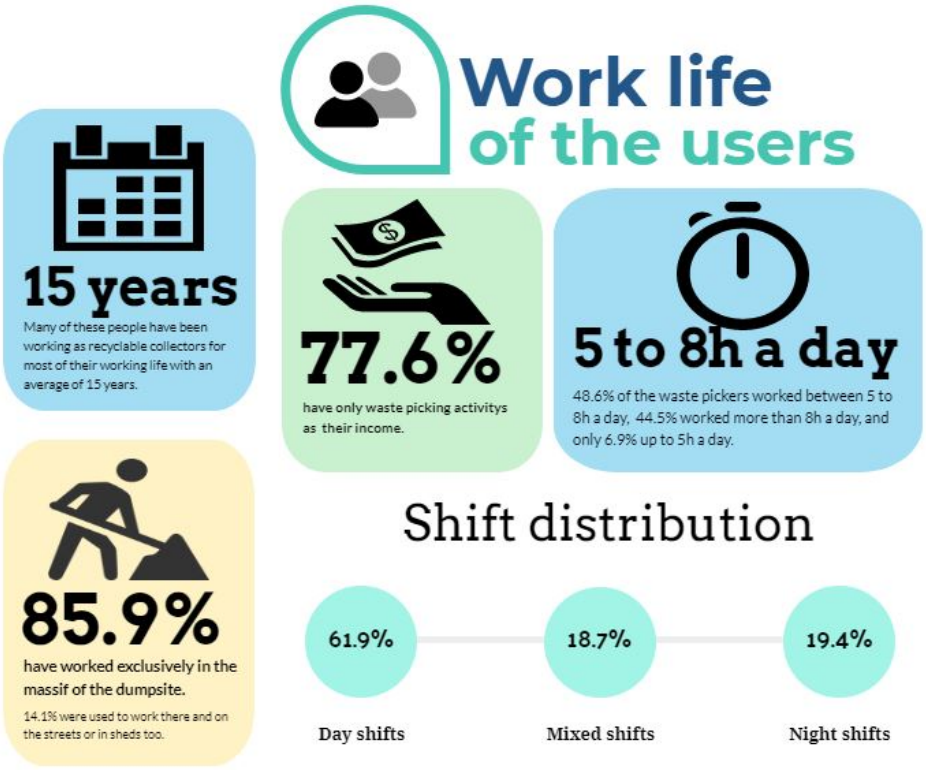


Figure 2.3: Infographic of the users' work life, based on data from Cruvinel et al. [2019], where user refers to the participants involved in the study.

The participants working lives is also investigated to gain a greater understanding of their everyday lives. Many of these people have been working as recyclable collectors for most of their working life with an average of 15 years. The waste picking activity was the only source of income for 77.6% of the participants. 85.9% have worked exclusively in the massif of the dumpsite, whereas the rest were used to work there, on the streets or in sheds too. In relation to the distribution of working hours, 48.6% of the participants worked between 5 and 8h a day, whereas 44.5% worked more than 8h a day and only 6.9% up to 5h a day. The majority of 61.9% worked in day shifts in the time span 8 am to 6 pm, whereas 19.4% worked at night and the rest worked mixed (day and night) shifts. In the study, it was found that they work 6 days a week. An outline of the working shifts of the participants can be found in an infographic on figure 2.3. In conclusion, the waste pickers are hard workers and spend a lot of their time at the Estrutural dumpsite earning money. The majority of the waste pickers have never worked with anything else than waste picking on the Estrutural dumpsite.

2.4 Persona

The purpose of the persona is to make a representation of the user behavioural patterns found in the collected data. Personas are based on real-world observation, such as expert interviews, user demographics or observations of potential users. Here, every aspect of a persona must be traceable back to a user statement or behaviour. [Cooper et al., 2007, 77-83] encourages that supplementary data cannot replace direct user interviews and observation. Thereby should a persona be build upon both desk and field research to ensure that the persona is representing an archetype of the user and not a stereotype. In the ideal world, several interviews with the waste pickers would be conducted in the research phase. Afterwards behavioural variables would be identified from the interviews. Unfortunately due to the circumstances with the pandemic COVID-19, see appendix A.2, it is not possible to collect new field research, but instead the field research with the waste pickers collected in the previous project by Britze and Nielsen [2019] is used. Therefore, a provisional persona is developed. Provisional personas are structured like a real persona, but are based on available data and assumptions about behaviour, motivations and goals. The provisional persona, here after referred to as the persona, is based on expert interview from appendix B, interview from previous project with waste pickers from Britze and Nielsen [2019], user demographics from section 2.3 and cultural analysis from section 2.1. The development of personas is based on [Cooper et al., 2007, p. 97-105], which has an approach to the development of a persona with eight principle steps.

Behavioural variables

Firstly, behavioural variables are identified based on the data from expert interviews etc. Here 16 different behavioural variables were found and divided into 6 different categories. These behavioural variables is visualised on figure 2.4 as a continuous scale of behaviour with two different poles that have been considered descriptive for the behavioural variable. Subsequently, the development of each behavioural variable is described.
The first category *personality/culture* is based on the cultural analysis in section 2.1. It is represented by five of the elements from Hofstede Cultural dimensions based on Brazil in section 2.1. These five elements have been selected, as they describe more about the individuals in Brazil than the society in general. On the ranging of each of the five behavioural variable one can see an icon showing Brazil's placement, see figure 2.4. The next five categories is from [Cooper et al., 2007, p. 98] and the behavioural variables are based on expert interviews from appendix B, an interview from the previous project with waste pickers from Britze and Nielsen [2019] and user demographics from section 2.3.
The category *motivation* describes why the user is engaged in the product domain. Based on the information from expert interviews, see appendix B, and the previous interview from Britze and Nielsen [2019], the *motivation* category is divided into family and income, as these two elements are important for the waste pickers. It is essential for the waste pickers that their family is doing well. They associate well being with their ability to provide for their family through the income. In appendix B.5 Tatiana Marins Caiado describes income as the waste pickers biggest concern, since they still need to figure out a way to earn more money and increase their quality of life. The two behavioural variables *family* and *income* on figure 2.4, is shown as important for the waste pickers in general.
The category *activities* describes what the waste pickers do in their everyday lives focusing on frequency and volume on the activity. Based on the demographic in section 2.3 it is found that waste pickers work between; less than 5 hours to over 8 hours a day, but mostly around the 8 hours and over, which can be seen in figure 2.4.

The category *aptitudes* describes what education and training the waste pickers have. This category

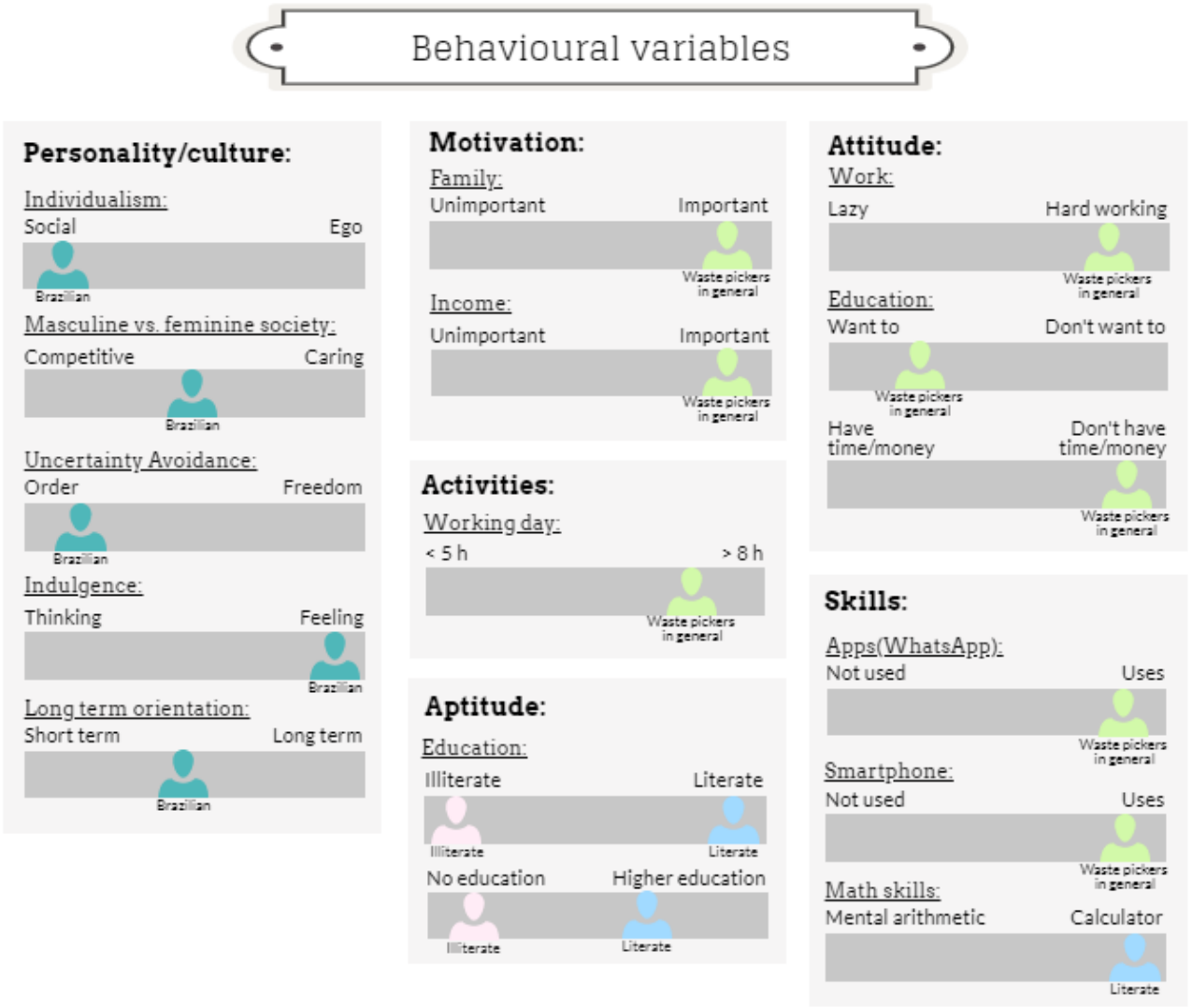


Figure 2.4: Overview of behavioural variables. There are 4 different types of icons for different groups of people; Brazilian (turquoise), waste pickers in general from Brazil (light green), illiterate (form the group of waste pickers, light pink), and literate (from the group of waste pickers, light blue).

focuses on the waste pickers education and is divided into the level of education and their ability to read and write. One waste picker in the previous interview from Britze and Nielsen [2019] explains that the individual finished high school, and that only a minority of the waste pickers have a high school education. On the other hand some of the waste pickers are illiterate or can only write their name. Here the waste picker on figure 2.4 is divided into illiterate and literate, as the waste pickers have different basis in relation to *aptitudes*.

The category *attitudes* describes the waste pickers attitude towards work and education in general. The waste pickers attitude is based on the intentional understanding based on expert interviews and previous interview. At the same time, it is also based on the demographics of the waste pickers working life, where they in general work many hours a day and have typically worked many years of their lives at the dumpsite, see figure 2.3. Here it is assessed that the waste pickers are hard working people, which is reflected on the ranking on figure 2.4. In relation to the waste pickers education, Tatiana Marins Caiado describes, in appendix B.5, that it is a trade-off for the waste

pickers. They would like to improve their skills in writing and reading, but it is difficult for them to manage studies and work at the same time. Therefore, the behaviour variable *attitude* are divided into two, the waste pickers desire for education and their resources for an education. The ranking on figure 2.4 reflects the assessment based on the statements from Tatiana Marins Caiado.
The category *skills* describes the waste pickers abilities related to technology and their mathematical skills. These behaviour variables are based on the previous interview, describe in section 1.2 with the waste pickers where it was found that everyone in the interview had a smartphone and used WhatsApp. Additionally, one of the literate surveyed waste picker told that the individual isn't able to do mental arithmetic, but can use a calculator.
Based on the different behavioural variables, it was estimated that there are two different groups of waste pickers to draw up the persona from. Therefore, two personas are created, literate and illiterate. The behavioural variables together with the data from expert interviews etc. is compiled into characteristics and goals for the personas. Based on that two persona narrative are created to extend and describe the personas behaviour and attributes. However, firstly the personas' goals are described.

Goals of the personas

All humans have motivations that drive their behaviour and it is important that personas capture these motives in terms of goals. [Cooper et al., 2007, p. 100] describes that product design should address three different levels of cognitive and emotional processing: visceral, behavioural, and reflective. Visceral is the most immediate level of processing and is where we respond to a product's visual and other sensory aspects. Here quick decisions about what is good, bad, etc. happens. Behavioural is the middle level of processing and allows us to control simple, everyday behaviour. Reflective is the least immediate level of processing and allows us to reflect on past experiences.
From these three levels of processing three types of goals can be made; experience goals, end goals

Processing level	Goal type	Goal	Which persona?
Visceral: is the most immediate level of processing and is where we respond to a product's visual and other sensory aspects.	Experiential goals: express how one will feel when using a product, or the quality of the interaction with the product.	It shouldn't take too much time out of their everyday life to use the app.	Both
		It should not be necessary to be able to do mental arithmetic when learning personal finance management.	The literate persona
		It should be possible to use a product even as an illiterate.	The illiterate persona
Behavioural: is the middle level of processing and allows us to control simple, everyday behaviour.	End goals: represent the users' motivation for performing the tasks associated with the use of a product.	They can receive education and at the same time prioritise supporting their families	Both
		Learning personal financial management to get more out of their income and thus has a better basis for supporting their families.	Both
Reflective: is the least immediate level of processing and allows us to reflect on past experiences.	Life goals: represent the users' personal aspirations.	To create a secure and stable foundation for the family in their everyday lives and give their children a better basis for their future.	Both

Table 2.1: Summery of the personas' goals. Processing levels and goal types are based on [Cooper et al., 2007, p. 100].

and life goals. The goals described here are only guesses and are not verified with the target group, but have been compiled from the behaviour variables, expert interview etc. Experiential goals are connected to visceral processing and express how one feels when using a product, or the quality of the interaction with the product. The experiential goal for both personas are that it shouldn't take

too much time out of their everyday life to use the app. The literate persona has the experiential goal that it should not be necessary to be able to do mental arithmetic when learning personal finance management. The illiterate persona has the experiential goal that it should be possible to use a product even as an illiterate. End goals are connected to behavioural processing and represent the user's motivation for performing the tasks associated with the use of a product. Both personas have two end goals; they can receive education and at the same time prioritise supporting their families, and learning personal financial management to get more out of their income and thus have a better basis for supporting their families. Life goals are connected to reflective processing and represent the users' personal aspirations. These goals typically go beyond the context of the product and represent deep drives and motivations. Both personas have the end goal to create a secure and stable foundation for the family in their everyday lives and give their children a better basis for their future. A summary of the goals can be found in table 2.1.

Visualisation of persona

From the behavioural variables and goals, two personas are developed. The primary persona is based on an illiterate woman whom is inspired by the interviewed individual "Maria" from the previous interview, Britze and Nielsen [2019]. This persona is called Alexandra De Oliveira Cardoso and is a single mother of 4 children, see the persona on figure 2.5.

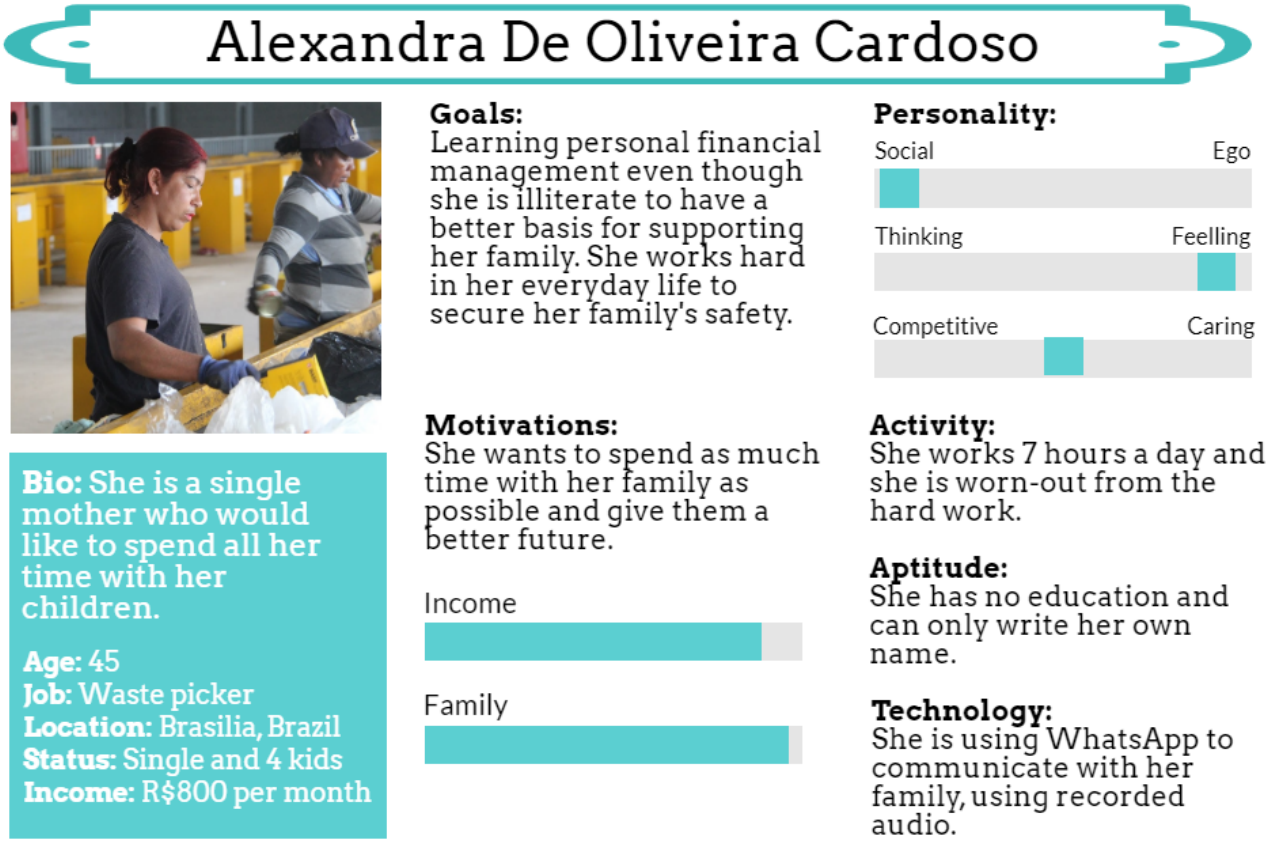


Figure 2.5: The primary persona is called Alexandra De Oliveira Cardoso and is a single mother to 4 children. The information on the persona is based on the information presented in sections 2.4. The photo is from SWRI in Brasilia, which was taken during the SDG Summit 2019. Photographer: Mateus Halbe Torres.

The secondary persona is based on a literate man inspired by the other interviewed waste pickers from previous interview from Britze and Nielsen [2019]. It is unknown how many waste pickers are being interviewed, because some of them are referred to as "waste picker". However it is estimated that at least one of them are literate, and based on one statement. This persona is called Pedro Abreu De Melo who is a single father with one kid, see the persona on figure 2.6.

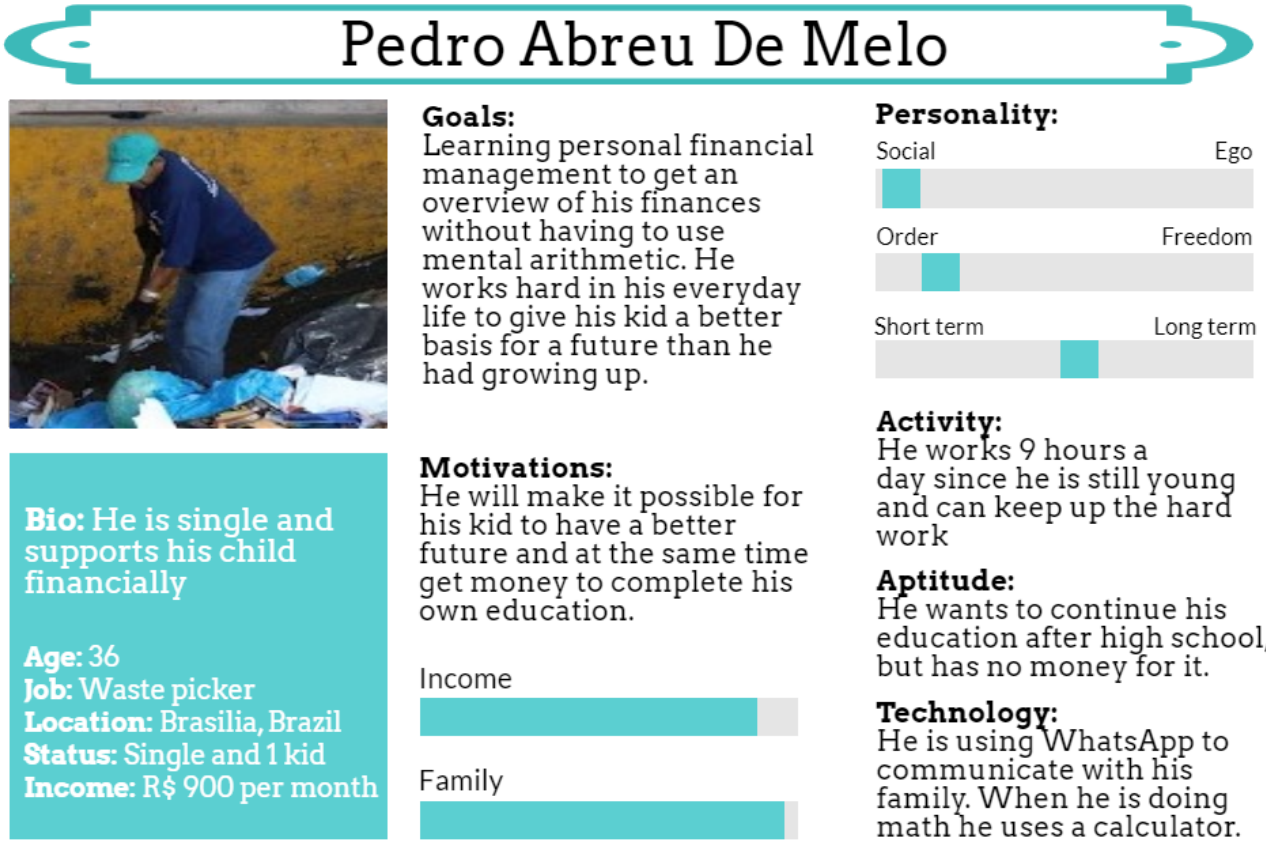


Figure 2.6: The secondary persona called Pedro Abreu De Melo is a single father with one child. The information on the secondary persona is based on the information presented in sections 2.4. The photo is from SWRI in Brasilia, which was taken during the SDG Summit 2019. Photographer: Giajenthiran Velmurugan.

2.5 Context Scenario

In this section, a scenario is developed based on [Cooper et al., 2007, p. 119-121]. Persona-based scenarios are short stories of one or more personas using the product to achieve their goals. Scenarios provide an opportunity to start the design process focusing on people and how they think and behave. It is chosen to use a context scenario, which explores how the product can meet the personas needs. A context scenario is written from the perspective of the persona and focuses on human activities, perceptions and desires.
The following outlines one scenario, describing how the primary persona Alexandra would ideally interact with the Mobile Education app. The focus is not on the features or technological feasibility of the solution. The scenario outlined below are one possible scenario, and it serves to display the ideal use. The scenario includes; who the user is, why the user uses the product, the goals of the user and how the user can achieve her goals with the product.

Alexandra's context scenario:

1. Alexandra is 6 hours into her shift and she is very tired after a day's hard work.
2. She is thinking of her family as she often does. She thinks about how much she loves her kids and want to do everything for them. Then she remembers that Mary her youngest daughter's birthday is coming up. Alexandra doesn't even know if they could celebrate it. She doesn't even know if they have enough money to get food at the end of the month.
3. It frustrates Alexandra that she is not in control of her finances now that she is managing it for a whole month instead of a daily basis as she was used to. It was much easier with the old system before the centre was build.
4. She makes a deal with herself that she must find a way to manage her finances again so she can have money to her children throughout the month.
5. When her shift is over, she talks to Sofia, who is her friend and also a waste picker. Sofia tells that she had the same problem as Alexandra, but then start using an app called Mobile Education. Here she could learn about finances and get an overview of her finances, she tells Alexandra.
6. Sofia can't read just like Alexandra and she tells her that she can still use the app, even if she can't read.
7. Alexandra downloads the app on the way home on the bus. She immediately uses it and is surprised of how easy it is to use. After a short time, she has an idea of how much money she can spend each day.
8. Soon after, she is home with her family. She proudly tells Mary that there probably will be money for her birthday if they spend less money the rest of the month.

An illustration of the scenario can be seen on figure 2.7. From the scenario, it can be concluded

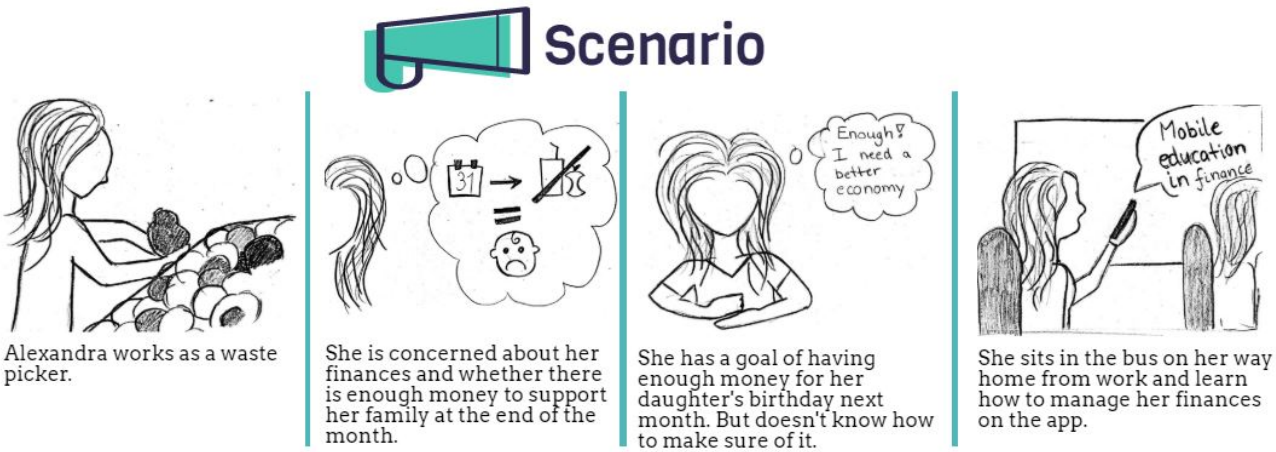


Figure 2.7: Context scenario.

that the Mobile Education app should be easy to use and provide a flexible system compared to the class room courses. As the user would rather prioritise earning money and spend time with their family. To obtain more knowledge about the pains and gains of the users described in the persona, a Value Proposition Canvas is created in the next sections.

2.6 Value Proposition Canvas

The Value Proposition Canvas is a tool, which can help ensure that a product or service is positioned around what the customer values and needs. Here the customers are the waste pickers. In this section when referring to a customer it is the user and the personas, described in the previous sections. *The Value Proposition Canvas* has two sides. The square is the *Customer Profile*, where the understanding of the customer is clarified and the circle is the *Value Map* describing the intend to create value for the customer [Osterwalder et al., 2014]. *The Value Proposition Canvas* was developed with the collaborators from Brazil and the expert Tatiana Marins Caiado, see figure 2.8.

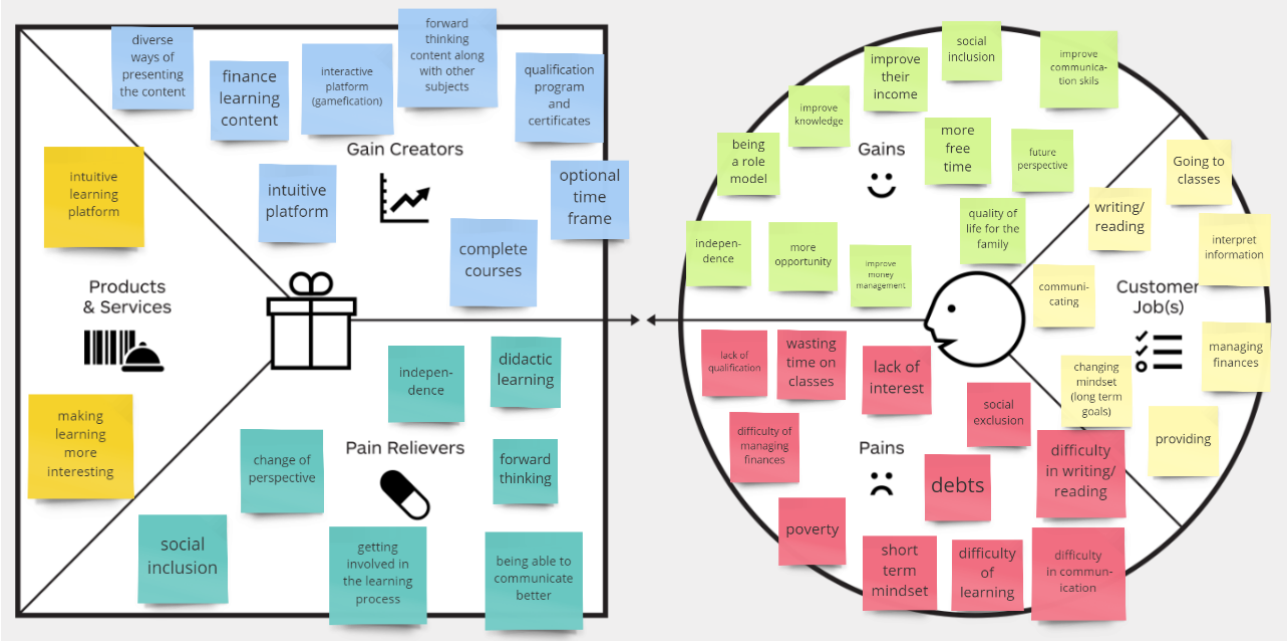


Figure 2.8: Value Proposition Canvas.

Customer Profile

The Customer Profile describes the specific target group in a more structured and detailed way. It breaks the customers down into their *jobs*, *pains*, and *gains* [Osterwalder et al., 2014]. A ranking of each part of the customer map can be found on figure 2.9 based on our assessment of the users' priority. *Customer Jobs* describe what the customers are trying to get done in their work and in their lives [Osterwalder et al., 2014]. In the development of this part, the focus was on users' obligations in relation to work and their education. When it comes to their work life, the items listed was: providing, communicating and interpret information. In relation to their education some of the items were: writing/reading, going to classes, managing finances and changing mindset as a long term goal. *Pains* describe bad outcomes, risks, and obstacles related to customer *jobs* [Osterwalder et al., 2014]. In relation to their working life some of the items were: poverty, social exclusion, difficulty in communication and debts. In relation to their education some of the items were: wasting time on classes, lack of qualification, lack of interest, difficulty in writing/reading, difficulty of learning and short term mindset. *Gains* describe the outcomes customers want to achieve or the concrete benefits they are seeking [Osterwalder et al., 2014]. In relation to their working life some of the items were: improve their income, more free time, social inclusion, improve communication skills and quality of life for the family. In relation to their education some of the

items were: future perspective, improve money managing, more opportunity, independence, being a role model and improve knowledge.

It can be concluded from figure 2.9 that in relation to *customer jobs*, it's important for the user to be

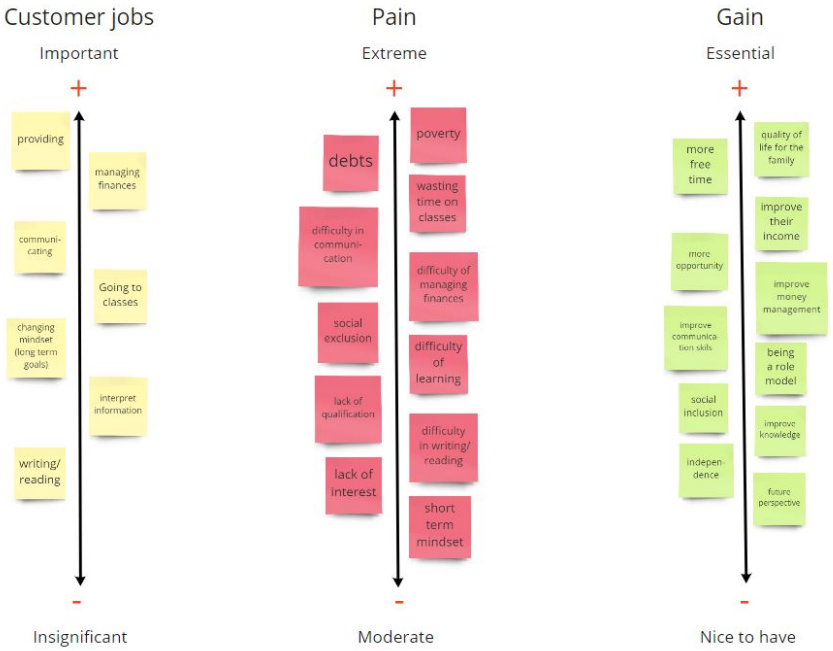


Figure 2.9: Ranking of *customer jobs*, *pains* and *gains*.

able to manage their finances so they can provide for their family and spend time with them. Their *pains* in this context are poverty, debt and wasting time on classes. The users think that time not spent on getting the family out of poverty or socialising with their family is a waste of time. Thus, their *gain* is to improve their income, more free time and managing finances, which this project has to provide for them.

Value map

The Value Map describes the features of a specific value proposition. It breaks value proposition down into products and services, pain relievers, and *gain creators* [Osterwalder et al., 2014]. A ranking of each part of the value map can be found on figure 2.10 based on our assessment of the users' priority. *Products and services* are a list of all items the *Value Proposition Canvas* is built around [Osterwalder et al., 2014]. The *products and services* for this value proposition is: intuitive learning platform and that makes learning more interesting. *Pain Relievers* describe how *products and services* alleviate customer *pains* [Osterwalder et al., 2014]. In relation to learning some of the items were: getting involved in the learning process, being able to communicate better and didactic learning. In relation to providing a learning platform some of the items were: independence, forward thinking, change of perspective and social inclusion. *Gain Creators* describe how *products and services* create customer *gains*[Osterwalder et al., 2014]. In relation to learning some of the items were: diverse ways of presenting the content, finance learning content, forward thinking content along with other subjects and complete courses. In relation to providing a learning platform some of the items were: qualification program and certificates, optional time frame, interactive platform and intuitive platform.

It can then be concluded from figure 2.10 that the most important thing for *products and services* is to

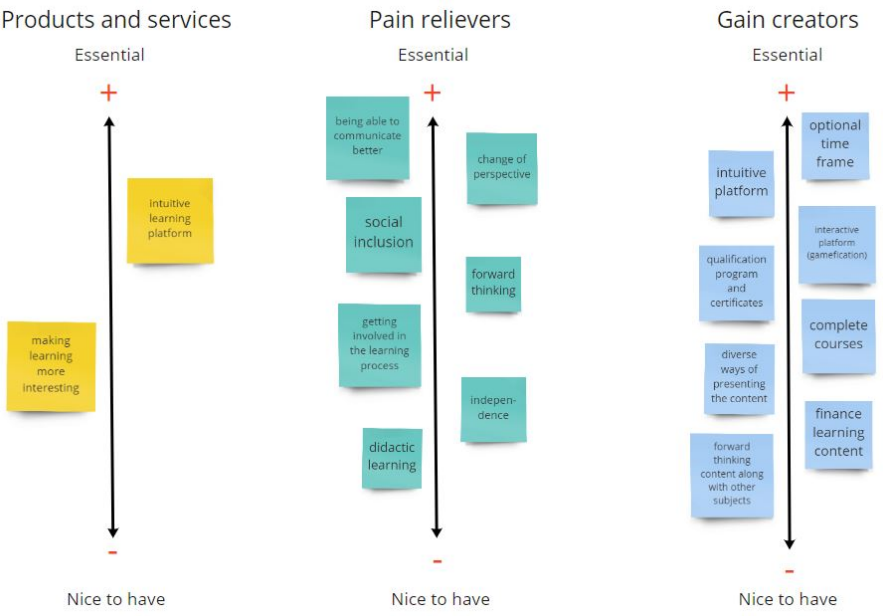


Figure 2.10: Ranking of *products and services*, *pain relievers* and *gain creators*.

create an intuitive learning platform, with focus on usefulness. Thereby, the *pain* of the customers can be removed by better communication and change the perspective of the waste pickers. *Gain creators* make it possible to optimise customers' time and provide them with an intuitive platform for the waste pickers.

2.7 User Requirement

The requirement determines how the app should be designed so the personas can achieve their goals. Requirements define what the prototype should be able to do. The user requirements have been identified based on the previous sections' partial conclusions and is an attempt to answer what is needed for the personas to achieve their goals.

- The product should provide learning material about finance management that can be used directly in the waste pickers everyday lives.
- The app should create flexibility for the waste pickers, so the waste pickers can prioritise their time to support their families.
- The app and courses should meet the waste pickers abilities and therefore it should be possible for the waste pickers to operate the app and learn even though they are illiterate.
- Mental arithmetic should not be necessary to learn personal finance management.

These user requirements form the basis for developing the prototype of this project.

Chapter 3

Development of an analogy

As described in section 1.8 an analogy is developed for the prototype. From section 1.5, it was pointed out that illiterate and functional illiterate use *informal learning*, and the visual learning channel is one of the most prevalent [Fanta-Vagenshtein, 2008]. In the process of making the prototype applicable for the waste pickers it is chosen to implement a visual analogy. Inspiration is found from the Weekly app, as described in section 1.7. Weekly focuses on managing ones disposable finances one week at a time instead of keeping track of the whole month at once. However at first, this report focuses on financial management on a daily basis, as the waste pickers normally control their finances, one day at a time, as described in section 1.1. Thus, it should be visible for the waste pickers how much money they have available each day and how their actions affect their future economy. If a user spends more than they should one day, it has a negative impact on their finances and thereby less money is available for the rest of the month. On the other hand, if they spend less money it has a positive effect for another day and thus more money to spend the rest of the month. Therefore, the analogy for this project is developed from the context of the positive and negative changes in the waste pickers day-to-day finances.

3.1 Defining an analogy

In Hey et al. [2008], an analogy is defined as “illustration of an idea by means of another familiar idea that is similar or parallel to it in some significant features” [Hey et al., 2008, p. 283]. Further, it is described in Hey et al. [2008], that an analogy is a comparison of situations from one domain to another and that one of the characteristics of analogies is the relation and structural similitude. Analogies are very helpful when facing a difficult problem. Problems are often solved by recalling a similar problem and applying its solution to the current problem, e.g. a business manager might solve today’s crisis by remembering the solution of a similar crisis they have managed before [Gleitman et al., 2010].
In Gleitman et al. [2010], a study is describing how an analogy can be used in problem solving. In the study, the participants were given a problem about a patient with an inoperable stomach tumour. Rays can destroy the tumour if the intensity is large enough, but at this intensity the rays will destroy the healthy tissue surrounding the tumour as well. How can the tumour be destroyed without damaging the healthy tissue? In this experiment, 10% of the participants were able to solve the problem only with this information. Another test group got a story before solving the problem. This story was about a general, who hoped to conquer a fortress. The roads leading to the fortress were planted with mines, which only made it safe for small groups of soldiers to travel at once. The general acquired the fortress, by dividing his army into small groups that simultaneously attacked the fortress through different roads. The story helps solving the tumour problem, because the solution in both case is to "divide and conquer", so the force enters from several different directions at once.
In a test group, about 80% did solve the problem, as they were given the fortress story and told that it would help them. Thus, the analogy was quite helpful, compared to those who didn’t get the

story and a hint. In another condition, only 30% solved the tumour problem. Here the participants read the fortress story but there was given no indication that the story was relevant. Thereby it is not enough to just read the fortress story. The participants also had to realise that the story was important when solving the given problem[Gleitman et al., 2010].
From the summary above, it can be derived that the implementation of an analogy could help the waste pickers understand their personal finances if the analogy is carefully adapted. It must be very clear to the waste pickers that the analogy have a connection with solving their problem. Therefore, the analogy should revolve around something the waste pickers know well and encounter in their every day life.

3.2 Analogy brainstorm session

To establish a new analogy to a known user context, a brainstorm on key attributes from the user context can be conducted. The brainstorm session in this context is a way of structuring the development of an analogy and involve the stakeholders from Brazil. In Liedtka et al. [2019] the session is divided into four steps:

1. **User context:** The concept from which the new analogy should be based upon.
2. **Key attributes:** Words or concepts that's associate with the user context.
3. **Analogies:** The new analogies developed from the user context and afterwards defining the analogy as a wild or mild concept.
4. **Adaption:** How the new analogies can be adapted into the real world.

First, the user context is described. As the focus of this report is financial management on a daily basis, the goal is to find an analogy that is associated with it. Hence, the user context for the brainstorm session is: "Budget management on a daily basis". The next three steps are made in cooperation between the respondents. From the user context, key attributes are extracted and should be used as the base of the brainstorm to develop new analogies. The new analogies are afterwards rated on a scale from *mild* to *wild*, by the respondents. *Mild* analogies are closely related to the user context where *wild* analogies are more abstract. The fourth part of the session is Adaption which is used in problem solving. The new analogies can be used to tackle the problems in new and alternative ways. In this part, the chosen analogy is adapted to the prototype.
Before the brainstorm session was carried out, pilot studies were conducted as an iterative process to ensure that the brainstorm session was performed as intended and to accommodate any errors or omissions before the final test. Four sessions were completed with six participants from Denmark. The pilot studies can be found in appendix C.
In the ideal setup where access to the waste pickers were an option the following things would be done differently. After the pilot studies made with the Danish respondents, another pilot study would be conducted with the collaborators from Brazil to fine-tune the test even more before finally conducting the brainstorm session with the experts and people whom work close to the waste pickers on a daily basis. This would ensure that the analogies generated from the session would be based on something the waste pickers could relate to and understand. Finally, the generated analogies should be tested on the waste pickers to find the one that should be implemented in the prototype. However this could not be executed and the analogies was developed in cooperation with the collaborators from Brazil and the expert Mateus Halbe Torres, as a work around. The manuscript for the brainstorm session can be found in appendix C.2. The data from the brainstorm session can be found in the attached appendix G.1.

3.2.1 Results

The results of the experiment is found on figure 3.1. Eight analogies were developed within the user

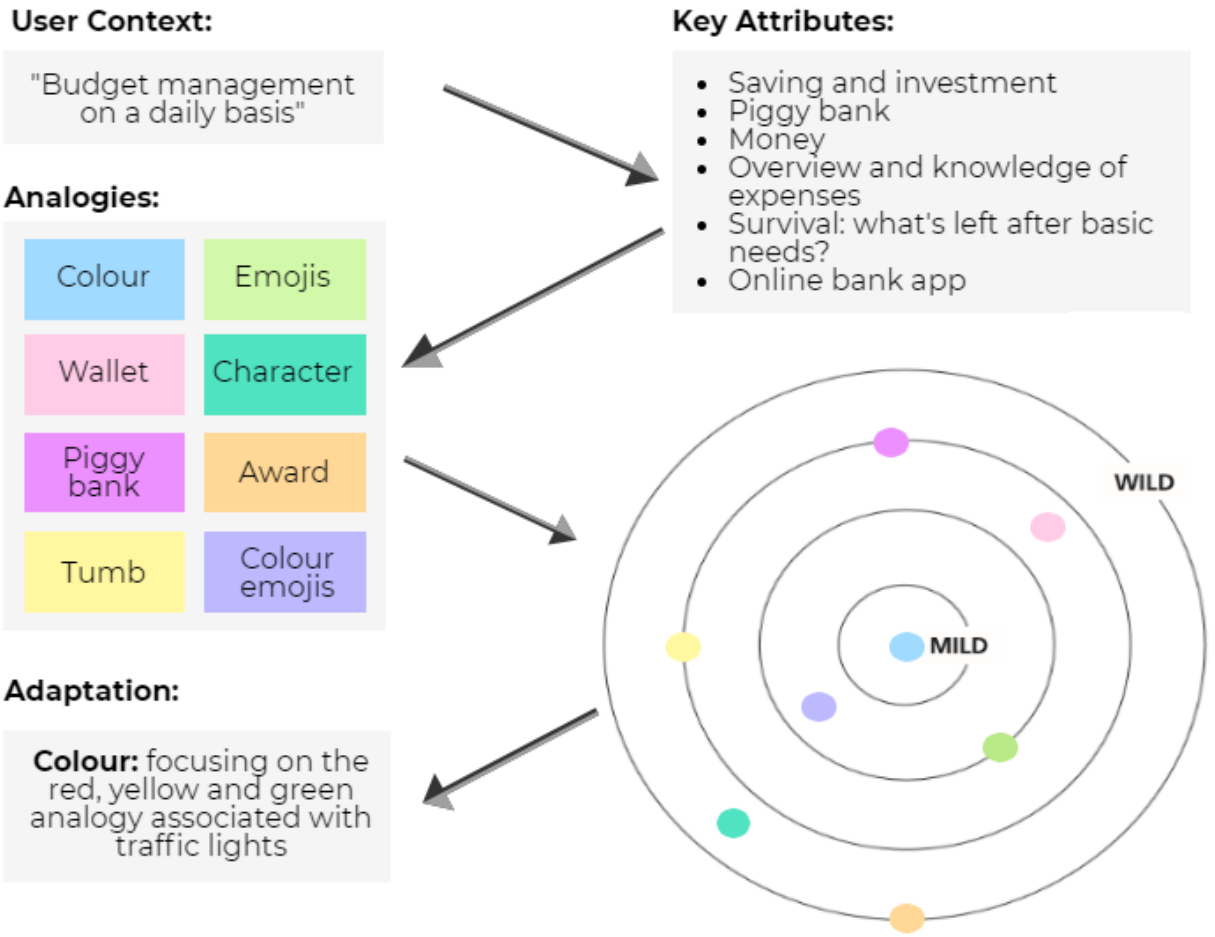


Figure 3.1: Results from the brainstorm session

context; "Budget management on a daily basis". These analogies were then assessed for where they fit on the target. The analogy *award* lies furthest towards wild, which can be seen on figure 3.1. It is assumed that it would be difficult to understand it without the user context. The *award* analogy is based on the concept of gamification. The waste pickers will get a reward based on their economy behaviour. However, it can be argued that it is not an analogy, but more in the area of gamification. A little closer to the middle lies the *character* analogy. This analogy is based on a small avatar that would illustrate the user. Here the avatar would be affected by the decisions of the user. Therefore, if there is money, the avatar would be happy, if all the money has been spent the avatar would be sad. A little closer towards the middle lie the analogies *piggy bank* and *thumb*. The *piggy bank* analogy is based on filling ones piggy bank with money, so a fat pig contains a lot of money. Thus, the development of using more or less of the daily amounts will be illustrated by either a fat or thin pig. In the *thumb* analogy, the financial situation is shown by thumbs up, down or in between. These two analogies were placed towards wild in the circle because not all layers of the society in Brazil are assumed to have the same understanding of thumbs up and thumbs down or the use of a piggy bank. This is the same with the *wallet* analogy, which illustrates the same as the piggy bank. Here it is assessed that a wallet is more common than a piggy bank, therefore the wallet analogy

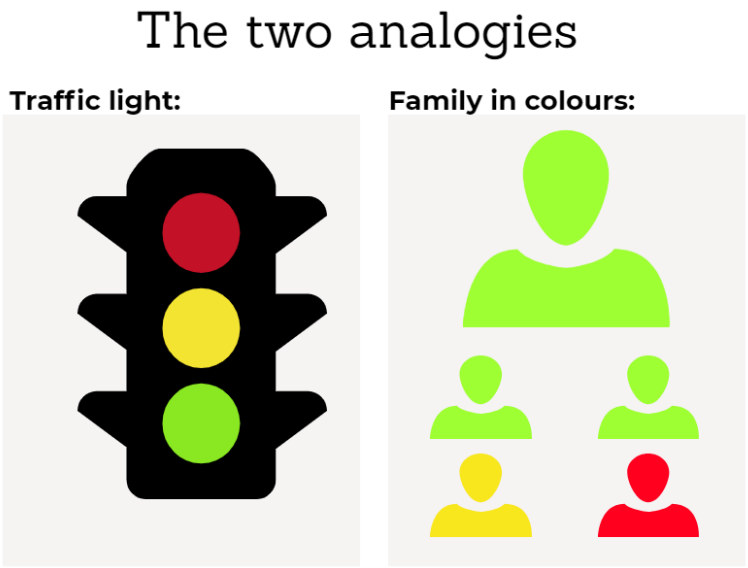


Figure 3.2: Visualisation of the two selected analogies.

is closer to the middle. The *emoji* analogy is the same as the *character* analogy. Each emoji shows whether it is angry or happy with the decision that has been made. It was considered that the *emoji* analogy was more understandable and simple. However, there was disagreement between the respondents about the perception of the the emoji for the poor financial decision. The emoji could be angry, sad, scared or alert. It is not the intention that the waste pickers should have a bad feeling or conscience when using the prototype. The *colour emojis* analogy was also mentioned in which the colours red, yellow and green were added to the emoji. However the same problem regarding the facial expression occurs. In addition the mixed emojis and colours, could create misunderstanding as some green emojis indicate that they are sick and not happy. Right in bull's eye are the *colour* analogy, which is based on the colours red, yellow and green in relation to a traffic light.
From the brainstorm session, it was chosen to work with the *colour* analogy. From the above, different ideas is drawn up for the display of the *colour* analogy.

3.2.2 Display of the analogy

To illustrate the *colour* analogy, different designs were created. A brainstorm within the project group was made with the focus on how to display the analogy, and two ideas were selected; *The traffic light* and *The family of colours*. These are visualised in figure 3.2. *The traffic light* shows a "simple" analogy that illustrates when the financial decision is good, middle or bad. The middle symbolised by yellow, is the threshold of the amount available each day. Red above the threshold and green below the threshold. This is also the initial idea and description given in the test with the respondents group. *The family in colours* was generated by the project group after the brainstorm session. This idea originate from the waste pickers strong family connections, as described in the persona in section 2.4. Here, it shows the number of family members that need to be supported and depending on the way the finances is spend, the colour of the family members change. If the available daily amount is met, then the entire family is green. If the daily amount exceeded, the family members start to turn yellow and in worst case red. However, this analogy is not selected as it could be perceived as offensive. The analogy is not meant to scare or upset the user but to encourage them to make better financial decisions. Therefore, the *traffic light* analogy is implemented in the prototype.

Chapter 4

Design of the prototype

Based on the knowledge developed in chapter 2 and 3, the prototype is developed. To get an idea of the design in the app, WhatsApp is investigated. Firstly, an examination of the distribution of WhatsApp in Brazil is made. Afterwards, icons in WhatsApp are investigated and considered for an icon library for the prototype. Then a framework is developed for the design of the prototype.

4.1 Analysis of WhatsApp

In 2009, the messaging service WhatsApp entered the market and people gravitated towards the platform. It allowed users to send messages to one another for free and regardless of the phone company [Saboia, 2016]. WhatsApp announced in February 2020 that the messaging app is used actively by more than 2 billion people worldwide. According to Bucher [2020] Latin America is one of the strongest market regions for WhatsApp. 60% of the population in Latin American countries use WhatsApp, see figure 4.1. In January 2017 Statista Research Department [2020] found that

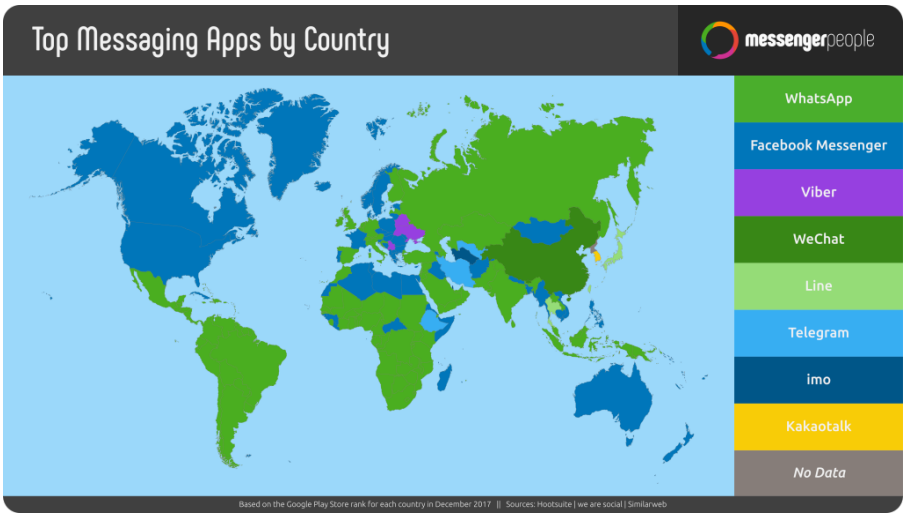


Figure 4.1: This illustration from Bucher [2020] shows that WhatsApp is the most used messaging app in Latin America. Currently, the world's highest distributed messaging app is WhatsApp [Bucher, 2020].

WhatsApp is used by up to 98 % of Brazilian smartphone users. This makes WhatsApp the most popular platform in Brazil. Brazilians use WhatsApp extensively and 92% of the users in Brazil use the app daily and are active throughout the day [Bucher, 2020]. In the expert interview it was expressed that the waste pickers also use WhatsApp "usually they use more visual resources as photos, videos and others, or audio message ... Whatsapp is one of the most used app for them" Tatiana Marins Caiado from appendix B.5.

This information establishes that WhatsApp is used by the waste pickers in Brazil. Thereby it is assumed that the waste pickers understand the various aspects of WhatsApp. Therefore, WhatsApp

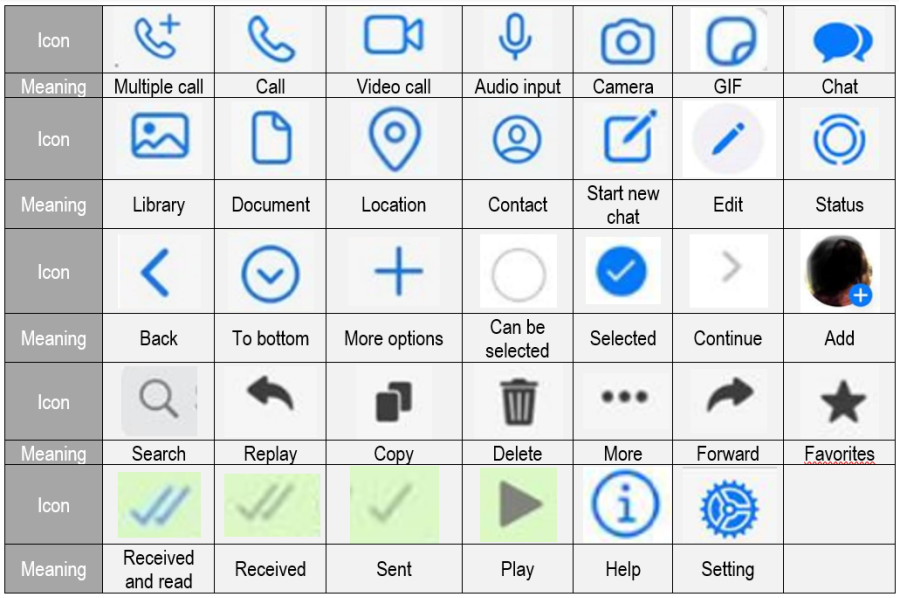


Figure 4.2: Icon library based on WhatsApp's icons, except icons from the setting page. The description of each icon is developed in the analysis of WhatsApp in the project.

[1] is investigated, in order to gain an understanding of WhatsApp, and use it as inspiration when designing the prototype. A description of WhatsApp's feature can be found in appendix D.1. The features of WhatsApp is used to inspire the structure and the navigation in the prototype. Here the navigation method and the icons can be used in the development of the prototype. Therefore, an icon library is made to visualise which icons are found in WhatsApp. The icon library consists of images of the icons from WhatsApp, as well as a brief description. On figure 4.2, all icons from WhatsApp is shown except the ones used in the setting feature. These icons are deselected as it is not certain that setting function are used often enough for the waste pickers to understand the meaning of these icons. Figure 4.2 shows the icon library that is used to develop the prototype.

4.2 Defining the interaction framework

This section revolves around the structure and behaviour of the prototype in order to meet the user goals, described in section 2.4. Here, a top-down approach is used, where the overall design solution is in focus and afterwards the specific designs. This allows the focus on the fundamentals of serving the personas' goals and requirements. The framework is focusing on interaction design and not visual- or industrial design. The interaction framework is based on scenarios and requirements to create ideas for the design and the expected behaviour of the user. The development of the interaction framework is based on [Cooper et al., 2007, p.125-136], which is described in the next sections.

4.2.1 Define form factor, posture, and input methods

The form factor of a product is designed for e.g. a web application that is viewed on a high-resolution computer screen or an app viewed on a small and low-resolution smartphone screen [Cooper et al., 2007, p.127]. In this project, it is chosen to work on an app on a smartphone, as mentioned in

[1] WhatsApp version 2.20.22 from 18-03-2020

section 1.1. It is important to think about the possibilities and limitations of the various devices when designing. A design for a smartphone should be e.g. small, in low-resolution, and visible in both the dark and bright sunlight. It is chosen in this project to limit the screen to a vertical display so the user can hold the smartphone in one hand and use the other hand to provide input on the screen. However, in future designs, the prototype could have other display options like horizontal screen setup.
The posture describes how much attention a user gives when interacting with the product, and how the prototype behaves in responds to the attention from the user [Cooper et al., 2007, p.127]. Based on the scenario in section 2.5, the user spends a short period of time, when using the prototype. This is taken into consideration when designing the prototype e.g. it should be easy to leave the prototype and come back again without losing any data and it should not be complicated or time consuming to understand the prototype's features. It should also be possible to change mistakes made by the user in the prototype.
The input method describes the user interaction with the product [Cooper et al., 2007, p.127]. This is affected by the *form factor* and *posture* as well as the personas' attitudes, characteristics and preferences described in section 2.4. The user input is through a touch screen as the *form factor* is a smartphone. To compensate for the primary persona, who is illiterate the written input must be minimised. Therefore, voice recognition is considered, which allows the waste pickers to enter amounts through audio input.

4.2.2 Define functional and data elements

Functional and *data elements* represent the functions and data displayed to the user on the interface. *Data elements* are typically the fundamental object of interactive products e.g. photos and e-mail. Data elements are objects that the user need to answer, referred to, or handle. *Functional elements* are the operations that can be performed with or to the *data elements* [Cooper et al., 2007, p.128]. The development of *data elements* and *functional elements* are based on the user requirements from section 2.7. This is to ensure that every aspect of the prototype has a clear purpose and is related to the user requirements. Table 4.1 shows an overview of the different user requirements, solutions, *data elements* and *functional elements*.

User requirement	Solution	Data element	Functional element
The product should provide learning material about finance management that can be used directly in the waste pickers everyday lives.	Analogy	Visualisation of the analogy	The entered daily consumption
	Future finances	Visualisation of the future finance	The entered daily consumption or the amount of the purchase entered
	Testing future finances	Visualisation of the future finance	The entered purchase
	Savings	Visualisation of the savings	The entered desired savings amount
The app and courses should meet the waste pickers abilities and therefore it should be possible for the waste pickers to operate the app and learn even though they are illiterate	Read aloud	Icons used as buttons	Pressing the button activates the read aloud
Mental arithmetic should not be necessary to learn personal finance management	Calculate daily available amount in the prototype	Visualisation of both the spent amount and an option to enter new spendings	The input of the spent amount

Table 4.1: The table shows an overview of the different user requirements, solutions, *data elements* and *functional elements* described in section 4.2.2.

In regard to the user requirement "the product should provide learning material about finance management that can be used directly in the waste pickers everyday lives", see section 2.7. To teach the users to manage their daily finances, the *traffic light* analogy from section 3.2.2, is included to explain and illustrate budget management on a daily basis. The analogy changes according to the input from the user i.e. the traffic light change colour according to the daily consumption. Thus, the *data element* are the analogy and the *functional elements* are the daily consumption entered.
Furthermore, to teach the users to think in long term about their future finance, a feature needs to be implemented to show the user how their daily purchases affect their finances on the following days or month. Inspiration was found in the Weekly app described in section 1.7, which shows a financial forecast which teaches the user to think ahead when spending money. This feature shows the positive and negative impact the user's actions have on the future. Thereby, the *data element* is a visualisation of the future finances and the *functional elements* is the daily consumption entered.
Moreover, it is possible to test a purchase and see the impact it has on the future finances. E.g. if a user wants to buy a new television, the *data element* would show the impact the purchase have on the user's future finances. Here the *functional elements* is changed to the amount of the purchase entered. The aim is to teach the user to think ahead.
Furthermore, it should be a possibility to make a saving for e.g. buying the television. Here the user can make a saving and the feature calculates the daily amount that needs to be saved, in order to reach the goal. Thereby, the *data element* is a visualisation of the saving and the *functional elements* is the entered desired savings amount.

In regard to the user requirement "the app and courses should meet the waste pickers abilities and therefore it should be possible for the waste pickers to operate the app and learn even though they are illiterate", see section 2.7. To take the primary persona from section 2.4 into account, other communication tool than text must be considered, such as read aloud. The *data elements* are icons used as buttons. The *functional element* is when a button is pressed the text is read aloud.

In regard to the user requirement "mental arithmetic should not be necessary to learn personal finance management", see section 2.7. The prototype needs to calculate the amount the waste pickers have available each day. This means that the waste pickers don't have to enter anything else than the amount spent, when they buy something or their income and fixed expenses change. The *data elements* are a visualisation of both the spent amount and the opportunity to enter new spendings. The *functional elements* are the input of the spent amount.
If the user possesses a credit card, and the information is stored in the app, the purchases made with the credit card is automatically transferred into the app. Through a follow-up interview with Tatiana Marins Caiado in appendix B.7 it was discovered that in poor neighbourhoods many commercial stores in Brazil do not accept credit card. This means that the waste pickers most likely use cash instead of credit card. Even though they might have both credit cards and cash. Therefore, an option to enter the spent amount manually should be provided.
Here, the manual input options by voice control, numbers, and pictures are considered. Firstly, voice control can be used to enter the amount spent, as described in section 4.2.1. Secondly, an option where the waste pickers can enter the amount as numbers on a calculator. However, if the waste pickers have the same difficulties with numbers as reading and writing, it can create a problem. Therefore, it has been considered to make a function where different Brazilian reals (R$) are illustrated so the waste pickers can click on them and thereby enter the amount they have spent.

4.2.3 Determine functional groups and hierarchy

A mind map is created to visualise the five functional groups; *calculate daily availability amounts*, *analogy*, *daily consumption*, *savings*, and *Future economy*. The mind map can be found in figure 4.3. The hierarchy and the data flow between the different functional groups are illustrated with black arrows. e.g. *daily consumption* sends information to the *analogy*.

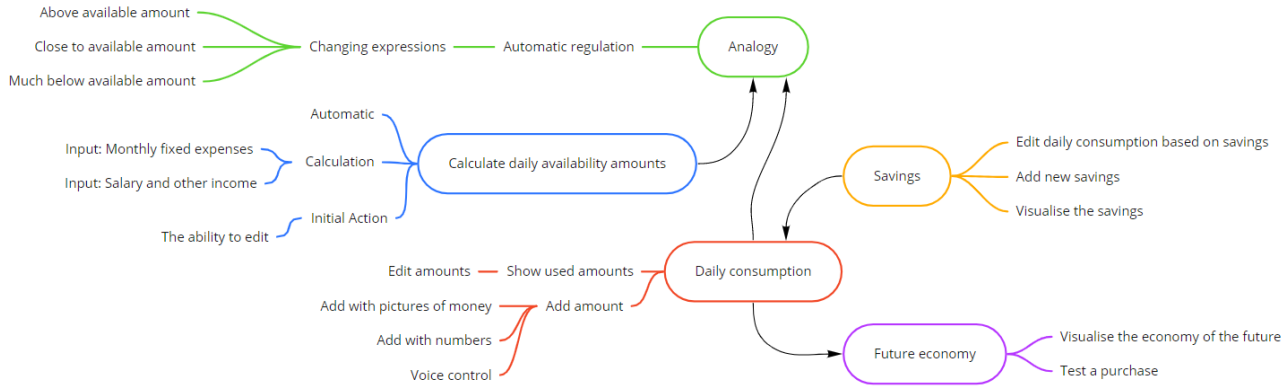


Figure 4.3: The mind map illustrates the functional groups and hierarchy based on section 4.2.1 and 4.2.2.

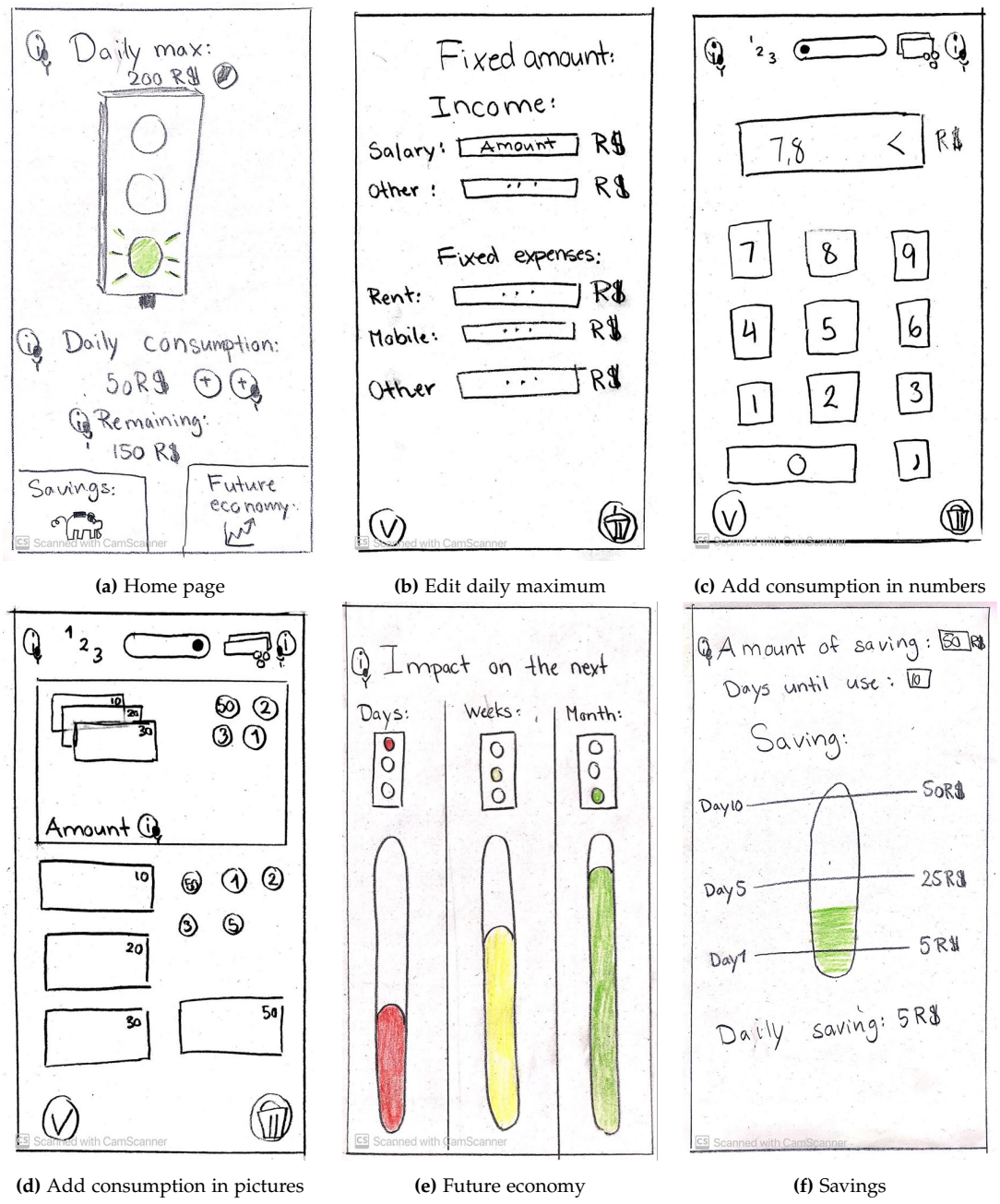
The functional group *calculate daily availability amounts* is based on the secondary persona's minimal skills in mental arithmetic described in section 4.2.2. Therefore, information about income and fixed expenses must be collected to enable the prototype to calculate the daily available amount. From the information, the following calculation can be made in the prototype:

$$\frac{Income - monthly\ fixed\ expense}{number\ of\ days\ in\ the\ month} = amount\ available$$

The waste pickers needs to insert their income and fixed expenses the first time they use the app. However as stated in the follow-up interview in the appendix B.7, the waste pickers income changes frequently and therefore it should be possible to change and adjust the information accordingly in the prototype. The functional group *calculate daily availability amounts* transfers information to the functional group *analogy*.
The functional group *daily consumption* displays the daily amount spent and adjust according to the waste pickers given input. The three different input methods to enter the spent amount are; voice control, numbers and pictures of the money. The functional group *daily consumption* transfers information to the functional groups *analogy* and *future economy*.
The functional group *analogy* is displayed by images and possibly sound. The *analogy* is automatically adjusted according to the information from the functional groups; *daily consumption* and *calculate daily availability amounts*. Here the *analogy* shows whether the *daily consumption* is above, below or close to the available amount.
The functional group *future economy* should display the future economy based on the information from *daily consumption*. Another possible option should be to test an amount of a purchase, before buying. This allows the user to assess whether the purchase is ideal for their finances.
The functional group *savings* should display the savings. Here it should be possible to create new savings. The daily available amount needs to change according to *savings* and therefore the functional group *savings* transfers information to the functional group *daily consumption*.

4.2.4 Sketches of the prototype

The first sketches of the interface are outlined on figure 4.4. These sketches are an indication of the layout and design of the prototype. However, this is an initial development and the prototype has to be further developed and tested, to ensure that the idea works in relation to the users and whether to add or remove features. Figure 4.4a shows the home page which has an overview of the



(a) Home page **(b)** Edit daily maximum **(c)** Add consumption in numbers

(d) Add consumption in pictures **(e)** Future economy **(f)** Savings

Figure 4.4: First sketches of the prototype.

daily maximum amount and daily consumption. In relation to the analogy of the traffic light, it is chosen to change from green to yellow light, when 80% of the available amount is spent. When the daily available amount is exceeded with 5% the traffic light changes from yellow to red light. An example of this could be; if the available amount is R$ 200,00 the traffic light switches to yellow,

when R$ 160,00 is spent and to red when R$ 210,00 is spent.

The daily maximum displayed on the home page on figure 4.4a can be edited on the screen on

(a) Home page **(b)** Future economy **(c)** Savings

(d) Daily consumption **(e)** Daily maximum **(f)** Add with pictures of money

Figure 4.5: Final sketches of the prototype.

figure 4.4b. This screen can be entered through the icon placed to the right of the R$ 200,00 which is based on the *edit* icon form WhatsApp, see the icon library figure 4.2. In the final app, it would be ideal if a first time user had to enter the income and fixed expenses in the app before use. The app needs this information to calculate the daily available amount and it is not certain that users would know this and find where to insert the information when first using the app.

Daily consumption together with the remaining amount of the day is displayed on the home page, see figure 4.4a. A purchase can be entered manually through the *add* icon from figure 4.2. There is two options to enter the amounts manually, which is displayed on figure 4.4c and 4.4d. In addition,

it is also possible to use voice recognition through an icon, which is a fusion of the *add* and *audio input* icon from figure 4.2. On the home page, it is possible to get the text read aloud by pressing the icons to the left of the text. This icon has its origin from the WhatsApp library on figure 4.2. The icon is a fusion of the *help* and *audio input* icon, to illustrate the options of getting audio information read aloud.
In addition, there is two icons in the bottom of the home page. To the left are savings that leads to the screen in figure 4.4f and the icon to the right is future economy that leads to the screen in figure 4.4e. Future economy is an overview of the impact of a financial decision and shows the available amount for the next day, week and month. In case of deficit, the negative impact on the finances is shown on the bars. Here the user can follow the impact for the next day, week and month and see when the deficit is settled. Savings provide the opportunity to save up for specific purposes. The idea is that a number of days and the requested amount can be inserted, whereafter the prototype calculates the amount that should be set aside each day until the predefined date.

In co-operation with the collaborators in Brazil, the experts Mateus Halbe Torres, and Tatiana Marins Caiado, was the design evaluated and corrected based on their feedback. The read aloud icon read on the home page was evaluated. It was pointed out that the icon was associated with the symbol for audio recording and not audio playback as intended. To continue using the icon library 4.2 from WhatsApp the *play* icon was chosen. However, this icon was unclear for the purpose and was also deselected. Therefore, a new icon with a speaker was chosen, even though it is not a part of the icon library in WhatsApp. In addition, it became clear that the design seemed cluttered when using a read aloud icon for every text bit in the prototype. Therefore, either the number or size of read aloud icons had to be reduced. However, if the icons were smaller it would be difficult to use them as buttons. Thus, it was chosen to insert one icon on each page, see figure 4.5a, which would then read the entire page aloud. It would be beneficial if the part read aloud was highlighted to visualise the different parts of the page. This is a method used in multiple read aloud programs e.g. CD-ord which is a read aloud tool for dyslectic.
Additionally, it was considered that it is ideal if all sub-pages e.g. future economic had a return-button, see figure 4.5b, to make it possible to leave the sub-page. Furthermore, on figure 4.4c and 4.4d the slider that illustrated the switch between the two different input options was not clear and therefore removed and replaced by two buttons instead.
In the design of the home page, the gestalt law of proximity was used to indicate that certain elements belong together, e.g. daily consumption and the edit icon. In the Gestalt laws of organisation, proximity means that things that are close together are grouped together[Bruce et al., 2003]. However, this could lead to the misconception that the elements *daily consumption* and *remaining* belonged together and not two different features. At the same time it could create a misconception of the possibility of editing the *remaining* amount. Instead, it was chosen to use the law of closure to group the elements that belong together.
It was also considered that the analogy on the home page was not clear. Therefore, it was decided to apply dollar signs in the traffic light to indicate a connection between the used amount and the traffic light. Furthermore, it was indicated that the three time perspectives, day, week and month, in the future economy, was unclear about the distribution of money. Therefore, with the knowledge about the waste pickers day-to-day perspective, it was chosen to replace the day, week and month, with an overview of the next three days.
Based on the sketches and feedback some new designs were created, see figure 4.5.

4.2.5 Key path scenarios

A key path scenario describes how the primary persona interacts with the product based on the interaction framework. These scenarios describe the primary path through the interface. Key path scenarios are task oriented, but without ignoring the goals and the persona. Key path scenarios must describe the behaviour of the essential interaction and provide a walk-through of important pathways [Cooper et al., 2007, p. 133].
A key path scenario is made based on the context scenarios from section 2.5. However, the focus is the primary persona's interaction with the various *functional* and *data elements* of the prototype. The scenario is based on the persona's first time using the prototype, where Alexandra investigates if she can afford to celebrate her daughter's birthday. Therefore, the key path scenario is based on a first-time use of the prototype:

1. Alexandra downloads the app.
2. She can't understand the meaning of the page on figure 4.5e, but then she sees an icon in the upper right corner which she taps. Everything is read aloud.
3. As she now knows what it says she has to enter her income and fixed expenses. Therefore, she presses the button below salary and a keyboard with numbers appears.
4. She has no idea of what her salary is in numbers. Therefore, she switches to another input method, where she can enter her income base on pictures of money.
5. She enters the information about her income and fixed expenses and presses the button approve.
6. She arrives to the home page on figure 4.5a and uses the read aloud feature to get an overview of the page.
7. She remembers that she bought grocery for R$ 160,00 this morning and tries to enter the daily expense. She presses the plus button and arrives at the daily consumption page on figure 4.5d. She enters the amount the same way, she entered her income. She can see that the traffic light turns yellow.
8. She gets curious and examines the other features in the app and looks at the icons at the bottom of the page. Here she can see that it is possible to explore the future of her finances and taps the button and arrives to the future economy page on figure 4.5b.
9. Alexandra uses the audio icon and gets the text read aloud. She sees on the page that she has more money for the next day, because she has spent less money today than she had available. The audio also tells her that she can enter an amount of anything she would like to buy and investigate what it would do to her finances in the future, if she buys it.
10. She remembers spending R$ 100,00 on her daughter's birthday last year and she enters the amount.
11. Here Alexandra can see that if she wants to celebrate her daughter's birthday, she has to spend less money for the next few days. According to the app she would be in the green zone again after 6 days. She thinks that this is possible.
12. Alexandra closes the app.

From this it can be concluded that all functions necessary for the persona is executed in the scenario in section 2.5.

Chapter 5

Experiment

In this chapter, two different experiments are discussed. The first experiment is the ideal experiment and the second is the conducted experiment. The ideal experiment was supposed to be conducted in Brazil with the waste pickers. However, due to COVID-19 it hasn't been possible, see appendix A.2, therefore the conducted experiment has been developed.

5.1 Protocol: The ideal experiment

This section accounts for the choices made in connections to the design of the ideal experiment as well as a description of the setup and execution. The experiment investigates the problem statement from section 1.9 and to validate the prototype's functionalities and design.

5.1.1 Purpose

The goal of this project is to develop the first steps toward a prototype that supports the waste pickers in learning personal finances. Therefore, the focus of the experiment is on investigating which areas of the prototype that would need to be changed in future projects. The purpose of the experiment is not to exhibit the waste pickers in terms of their finances, but to find design flaws that could be rectified or features that could be added to increase the user's experience.

5.1.2 Measurements

In the process of conducting the experiment different data collecting methods are conducted. The reason for using different collecting methods are to investigate the waste pickers interaction and use of the prototype from different perspectives. In this experiment both objective and subjective data are collected. Objective data consisting of clicks are collected in the experiment. Using clicks give an overview of the participants' interaction with the prototype, and make it possible to see tendencies across the different participants and see their behaviour in the prototype. In regard to the subjective data, the participants' perception of the prototype are collected through questions, which is clarified in section 5.1.4. This provides data on the subjective attitude of each participant towards the prototype and valuable feedback on areas that shall be improved or changed.

5.1.3 Participants

The participants are the working waste pickers at the SWRI in Brasilia, Brazil. When finding participants for the experiment an optimal sample would reflect the population working at the SWRI. This means that the experiment should aim towards an equivalent proportion of age, gender and the different level of literacy as defined in section 1.5 among the participating waste pickers. The user demographic is described in section 2.3. For example, the distribution between gender of the waste pickers are 67% women and 33% men. Therefore, the experimenter should strive towards seven women and three men for every ten participants, approximately.

Another aspect when collecting data is that the waste pickers have to know how to use a smartphone. As a result, the waste pickers taking part in the experiment need to have access to a smartphone, and use it on a regular basis. This ensures that the participants know how to operate it. Furthermore, it is preferred, if the waste pickers are accustomed with WhatsApp, as the prototype has some resemblance with the use of the icons.
To motivate the waste pickers to attend the experiment, they are financially compensated for their time. As stated in the follow-up interview by Tatiana Marins Caiado, see appendix B.8, it could be difficult to persuade the waste pickers to participate, if they don't get a benefit. Furthermore by giving them compensation it might result in more comprehensive answers.

5.1.4 Methodology

This section are elaborating the different methods considered for the data collecting in the experiment.

Group vs individual experiment

From the user demographic in section 2.3 it is known that the waste pickers have changing work schedules, where some work in the day and others work at night. Therefore, the possibility of making the experiment with the waste pickers before or after work are an option. It's very important to be aware of the fact that it's not possible to access them in their working hours, see appendix B.8. Another option is to make the experiment in their breaks, but their breaks only last between 15 min. to 30 min., and if the experiment last longer than that it isn't an option. Therefore, it's important to work together with SLU to know the waste pickers schedules. The experiment aims to last an hour or less, to fit the waste pickers so they e.g are able to pick up their children if needed.
Another point to consider is that it's common to give general information in groups of 30-50 waste pickers as Tatiana Marins Caiado mentions in the interview in appendix B.8, this ensures that the waste pickers know that they all are given the same information. Therefore, is it considered if the experiment should be conducted in small groups or individually. One option is to have a small group of around six participants, where each individual has a smartphone with the prototype installed. They are placed in the same room and get the introduction jointly but solve the tasks on their own smartphone. Here the participants have the opportunity to talk and discuss with each other during the experiment, which can provide valuable information. This method requires the experimenter to provide a smartphone with the prototype installed, to each participant and thereby more material needs to be available. In case only one or two smartphones with the prototype are available, the participants need to share during the experiment, which is not ideal. This method can result in either lost or misleading information, as it can't be insured that all participants have the same experience with the prototype. In addition, by conducting the experiment in a group the data concerning the difference between literate and illiterate waste pickers, are hard to investigate. Therefore, it's assessed that the optimal way of conducting the experiment is by introducing the waste pickers to the experiment jointly and afterwards conduct individual experiments with each waste picker. Through that subjective data is provided from each individual. Nonetheless, if pilot studies show that the waste pickers feel uncomfortable or are unwilling to participate, the group experiment can be used as an alternative.

Tasks and scenarios

It is considered to use a combination of scenarios and tasks. The purpose is to give the participants a context in which the prototype could be used. Adding a scenario gives the prototype a more realistic appearance and make the tasks more tangible and less abstract. In the making of the tasks it is discussed how to present the different opportunities the prototype support. One option is that the participants are asked to enter a given amount without any context. Another is to create a scenario based on the primary persona Alexandra see section 2.4, where they are presented with tasks in connection with a scenario. And a third is to ask the participants to fill in something they recently bought by themselves. When presenting a task without a context, it can be hard for the participants to relate, and thereby unable to see the connection and purpose between the task and the prototype. However, if the participants are given a set of tasks without a scenario, these tasks can be given in a randomised order to each of the participants and any carry over effect would be counterbalances. When using a scenario with the persona Alexandra, the participants are given a context they can relate to without getting in a situation where the participants feel uncomfortable and have to expose their personal finances. When given tasks with a scenario the story with Alexandra evolves and thereby a randomisation of the tasks are not possible as they are tied into the story. In section 1.5 it is described that people with reading and writing difficulties use *informal frameworks* to learn. As *informal frameworks* are always learned in a context, it has been chosen to use the scenario based task.
The waste pickers are presented with a scenario where the primary persona Alexandra from section 2.4 is using the prototype. The participants should then solve the tasks on behalf of Alexandra in the prototype. When the waste pickers are asked to solve the tasks and think on behalf of Alexandra, it is assumed that the waste pickers will find it more easy to talk about the subject finance, in contrary to talking about details of their own private finances and habits. However, it is possible that the participants use the prototype differently than Alexandra. Therefore complication might occur, if the participants aren't able to relate to Alexandra. However, this could be tested during pilot studies.

Familiarisation phase

Another thing to have in mind when introducing new technologies in an experiment to a user group, is whether there should be a familiarisation phase before the experiment. The familiarisation phase in this project consist of either a walk through of the prototype where the main features are introduced. Or give the participants time to investigate the prototype by themselves. Thereby the participants get an understanding on how to navigate before the tasks are introduced. The pros could be that the participants are familiar with the interface, and thereby have their focus on solving the tasks and not searching to find the different features. However, the experiment investigates how a first time user interacts with the prototype. Therefore a familiarisation phase, could bias the way the participants solve the tasks as they are familiar with functionalities of the prototype and pitfalls will be bypassed. This means that the inadequacies of the prototype is not noticed and therefore not redesigned. A way to determine whether a familiarisation phase is necessary could be during the pilot studies. If the participants are given the prototype without the familiarisation phase, and perform the tasks without giving up or having to ask the experimenter for advice, there would be no need for it. It is important to note that the familiarisation phase does not replace an elaborate description and introduction of the experiment at the beginning.

Evaluation of the experiment

In the experiment during the tasks, the method *think aloud* is considered. In the process of deciding if the method benefits the experiment, pros and cons are discussed. The pros in using this method is that it creates the possibly to follow the participants thoughts and understand some of their obstacles, confusions and on the other hand what they find easy. The subjective data from the participants provide valuable insight in any pitfalls or complications there might be in the prototype. The cons with using a *think aloud* method is that the experiment last longer than an experiment without the use of this method. Furthermore, the *think aloud* method is an unnatural process, because it forces the participants to talk aloud through the experiment and explain their every step. The participants have to talk through the experiment without reflecting on their actions, but this process can be difficult to accomplish, as people want to appear clever. When performing *think aloud*, it is a possibility that the participants ask themselves a question during their thought process. If the experimenter then clarifies this question during the experiment, the participants' behaviour can change, thereby results can be given that doesn't reflect the actual use of the design and thus lead to inadequate results. However, clarifications are sometimes necessary and therefore a skilled experimenter needs to avoid biasing the participants [Nielsen, 2012]. An aspect to have in mind is that the *think aloud* method can affect the cognitive process. If the tasks are demanding for the participants, adding the *think aloud* method might create an overload and disturb the verbal process. If the tasks are easy to solve, it might happen automatically and therefore it can be difficult to explain. Therefore it needs to be tested with the waste pickers, if the tasks and the *think aloud* method can be used at the same time without creating a cognitive overload [Charters, 2003]. To avoid a cognitive overload, it is chosen to deselect the *think aloud* method.

Another option is to evaluate the experiment by using a standardised evaluation method such as the System Usability Scale (SUS). However as the experiment is aiming to evaluate parts and more specific features of the prototype, this method has been opted out. A third option to consider is to ask the participants questions after each task about their experience and thoughts in regard to the specific task. However, this method can make the experiment longer and less fluent as the tasks are divided by the questions. A fourth option is to evaluate with an exit interview. This method evaluates all the tasks that the participants have been through. By doing so, the experiment becomes fluent and an evaluation of the whole experience of the prototype is achieved. The prototype is evaluated from the whole experience, and the context of the prototype's use might be more clear for the participants. On the other hand, waiting to ask the participants about specific tasks, can make them forget details or important points they thought about during the individual tasks. However, the questions after each task is deselected because it might influence the experience of the different tasks. Therefore, it is chosen to use an exit interview and thereby give the participants the possibility to focus on the tasks, when solving them and afterwards reflect on the tasks.

5.1.5 Materials

For the ideal experiment, the following materials are used:

- One smartphone with software to run the prototype
- Consent form
- Audio recorder
- Manuscript for the experimenter
- Interpreter / Local experimenter

Normally when collecting data during experiments, internet access is available. However when conducting experiments in Brazil, this might not be the case. From the follow-up interview in appendix B.8 with Tatiana Marins Caiado it is known that the internet access at SLU is limited. It is possible to get access to the internet, but because it's public it can be unstable. Therefore two options are available one is to buy access to an external internet source to improve the chances of stable internet. The other option is to use data collection methods that don't need internet access, when conducting the experiment.
An other point to be aware of when conducting the experiment, is the need for an interpreter. It is necessary to work with an interpreter or a local individual that know the language in terms of the waste pickers, to compensate for the language barrier as described in section 2.1, it is good practise in Brazil to conduct experiments in the local language and to make sure that no misunderstandings occur between the experimenter and the waste pickers. Thus the experiment, the prototype, etc. needs to be be translated into Brazilian-Portuguese. Furthermore, it is necessary that the experimenter follows a guideline and a manuscript in order to ensure a uniform experiment across the participants.

5.1.6 Guidelines for the experiment

This section provides a guideline for the experiment. As this is a theoretical experiment, adjustments may need to be made or reconsidered before conducting the experiment with the waste pickers. And therefore, pilot studies need to be conducted.

Step 1: The experimenter gives an introduction of the experiment to a group of 30-50 waste pickers. To make the waste pickers more comfortable the introduction will be made with a group of waste pickers. The joint introduction is an explanation of the experiment and the purpose of it. Further, it is stressed why they should participate in the experiment in order to give their feedback and thoughts about the prototype, as they are the ones that should benefit from the final app. An option to consider is using visual material to support the introduction. To find the group introduction see appendix E.2. The introduction can be given in advance or just before conducting the experiment.
Step 2: To make sure that the participant have understood the introduction with the group of waste pickers. The steps in the experiment is introduced to the individual. The joint introduction can be performed on another day than the actual experiment and therefore the waste pickers receive another introduction right before the experiment as well. The introduction can be found in the manuscript of the experiment together with step 4 to 7, see appendix E.3.

Step 3: After the introduction the participant gets the consent form, see appendix E.1, read aloud and if the participant has questions, they will be answered. Afterwards the consent form is signed and the questions written on the consent form is filled out with the help of the experimenter.
Step 4: The first task together with the scenario is read aloud by the experimenter and the participant solves the task.
Step 5: After the completed task the next task is read aloud and the same procedure is followed, until all six tasks are completed. The tasks and scenario can be found in table 5.1
Step 6: When all the six tasks have been conducted, a dialogue between the experimenter and the participant is done with the help of an exit interview that evaluates the participant's experiences of the prototype and the tasks.
Step 7: The participants are thanked for their participation and the experiment is finished.

No.	Scenario	Task
1	You now need to help Alexandra manage her finances. Alexandra has downloaded the app and she has been using it for a month. Last month she had an income of R$ 960,00 which gave her a daily maximum amount of R$ 32,00. However this month she got paid less and earned R$ 900,00.	Edit the monthly salary to R$ 900,00 in the app. When you are finished, tap the traffic light on the home page.
2	Alexandra has spent R$ 25,00 at the local marked.	Enter the daily consumption of R$ 25,00 in the app. When you are finished, tap the traffic light on the home page.
3	Alexandra forgot to buy tomatoes from the marked and needs to go back. She spent R$ 5,00 on the tomatoes.	Enter the extra daily consumption of R$ 5,00. Note that there is two options for the input, and try to explore both. When you are finished, tap the traffic light on the home page.
4	Alexandra wants to buy a new shirt, the price of the shirt is R$ 50,00 but she is unsure whether she can afford to buy it.	Use the app to examine how her future budget will look like if she uses R$ 50.00. When you are finished, tap the traffic light on the home page.
5	Alexandra wants to buy the shirt and needs to save. She wants to wear the shirt to a birthday in 10 days.	Make a saving for Alexandra of R$ 50.00 spread over 10 days. When you are finished, tap the traffic light on the home page.
6	Alexandra becomes impatient and buys the shirt.	Enter the extra daily consumption of R$ 50,00. When you are finished, tap the traffic light on the home page.

Table 5.1: Tasks and scenarios for the ideal experiment.

5.2 Protocol: The experiment conducted in this project

Due to the circumstance provided by COVID-19, it isn't possible to do any testing with the waste pickers. This means that the way of testing and the focus of the experiment is changed. Firstly, the available participants are all literate. Secondly, every experiment is conducted online and the feedback is written. Therefore, the protocol in section 5.1 won't be an option. However, some aspects are passed on to the conducted experiment.

5.2.1 Purpose

The purpose of the experiment is to develop the first steps toward designing a prototype that supports the waste pickers to learn personal finances. The focus is changed from the waste pickers use of the prototype to the functionality of the prototype in general. Therefore, the focus of the experiment is to adjust the prototype, and to clarify the problems with the design and the functionality of the different aspects of the prototype.

5.2.2 Measurements

Through the experiment, both objective and subjective data is collected. The objective data consists of clicks and time are collected in the experiment. Clicks and time give an overview of the participants' interaction with the prototype, and makes it possible to see tendencies and behaviour across the different participants. In regard to the subjective data, the participants' perception of the prototype are collected through questions after each completed task.

5.2.3 Participants

As a result of the online distribution of the experiment, the target group won't be limited to a specific group. Moving forward, when referring to the participants, it is the participant from the conducted experiment described in this protocol. The experiment was distributed across different media platforms, and was active for a period of seven days. During this time period 45 participants completed the experiment. Demographic information about the participants was collected[1], which is the base for this explanation by the participants. The average age of the participants was 30,8 years and 61% of the participants were women. There was participants from both Denmark and Brazil. 25 participants were from Denmark, 18 participants from Brazil and 2 was unknown. In relation to the use of smartphones with different operating systems, there was almost an even distribution between ISO and android. The figure 5.1 shows an infographic of the distribution of participants.

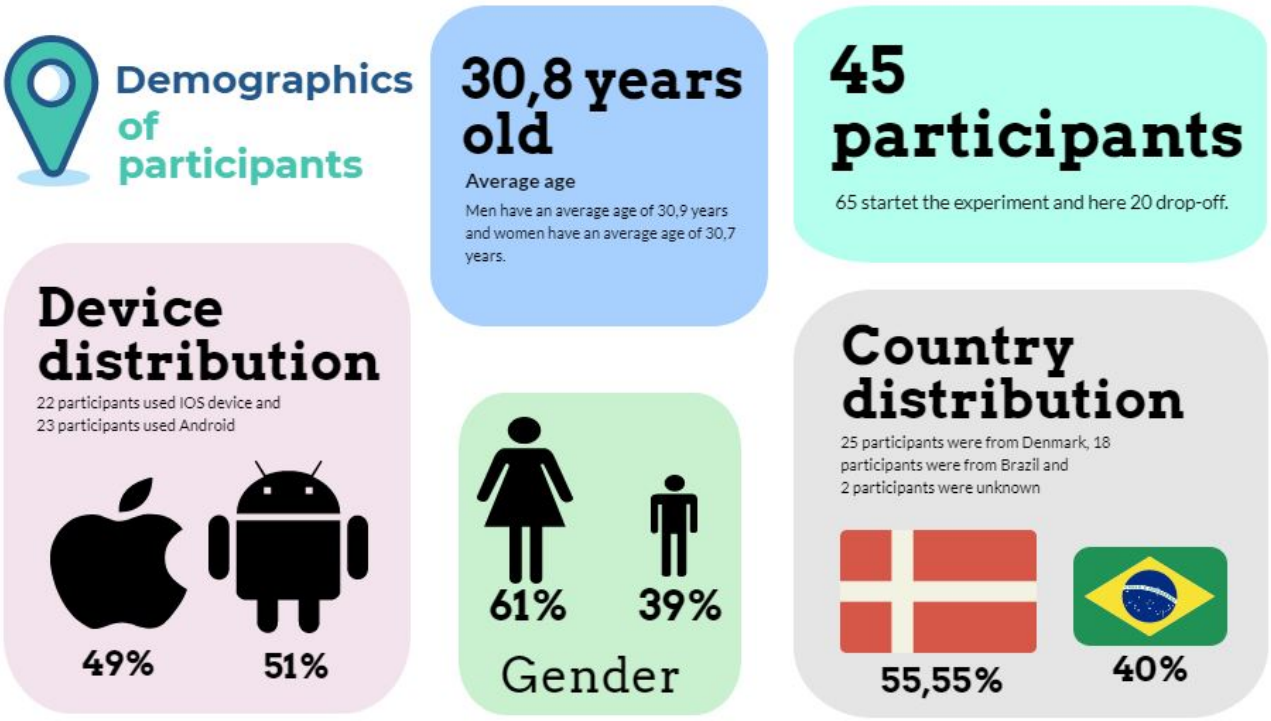
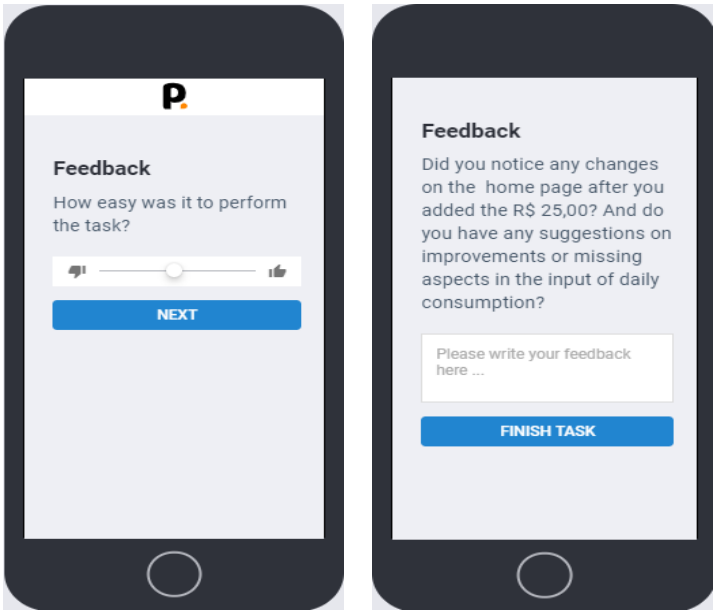


Figure 5.1: Infographic of the distribution of participants based on the information collected in the experiment.

[1]All participants could provide information about; age, gender, country and zip code. There was two participants who didn't chose to give information about; country and age, but, one provide information about gender. Additionally, Preely automatically collected information about: the time for each task and what type of smartphone was used.

5.2.4 Methodology

Due to the changes, the method from the ideal experiment from section 5.1, is modified. The big difference is that the conducted experiment is online and the participants have to read all the information and conduct the whole experiment without an experimenter. Another aspect is that instead of a consent form the participants have to sign, the participants give consent by taking part in the experiment, see appendix E.5. The six tasks with the scenario are the same as the ideal experiment. The exit interview has been replaced with a fixed question and a follow-up question after each task, see table 5.2. The fixed question "How easy was it to perform the task?" is answered on a rating scale with a slider from thumbs down to thumbs up, which is converted to a number from 0 to 10, see figure 5.2a. Here 0 is not easy to perform the task (thumbs down) and 10 is easy to perform the task (thumbs up). Each follow-up question is in a text box, where the participants can answer the questions on the table 5.2 after responding to the fixed question, see an example on figure 5.2b. The reason for this change is to make sure that each task is evaluated and in case the participants have problems with a question or a task, the root cause can be examined afterwards.



(a) Rating **(b)** Follow-up question

Figure 5.2: An example of the rating and follow-up question from Preely. Preely is elaborated further in section 5.2.6.

5.2.5 Guidelines for the experiment

This section provides a guideline for the experiment, where adjustments from the pilot studies have been incorporated, see appendix E.4. Four pilot studies were conducted with five participants with the focus on tasks and scenarios. The prototype can be accessed through the link: https://pree.ly/TH7hAJk7IUcZjLOPCBPn9QpM0Rm9g7 until December 2020.

Step 1: In the experiment, the participant reads an introduction before the tasks are introduced.
Step 2: The first task is shown together with a scenario. The participant solves the task and ends the task by clicking on the traffic light. The reason for finishing the task by clicking on the traffic light is to make sure that the participant returns to the home page in the prototype. Furthermore, this gives the participant the possibility to notice the chance in the traffic light.

Step 3: After solving the task a fixed question appears, where a rating of the task is made.
Step 4: A follow-up question is given and creates the opportunity to write feedback to the task.
Step 5: After the completed feedback the next task is given with the same procedure except for the follow-up question that changes for every task. This continues until all six tasks are completed and feedback is given, see table 5.2 to get an overview of tasks and questions. If the participant can't solve the task the option to skip the task is also possible.
Step 6: After all the tasks are solved and the last feedback is given, the participant enters demographic information, such as gender, age, country etc. After entering the demographic information a page thanking the participant for the participation is shown and the experiment is done.

No.	Scenario	Task	Fixed question	Follow-up question
1	You now need to help Alexandra manage her finances. Alexandra has downloaded the app and she has been using it for a month. Last month she had an income of R$ 960,00 which gave her a daily maximum amount of R$ 32,00. However this month she got paid less and earned R$ 900,00.	Edit the monthly salary to R$ 900,00 in the app. When you are finished, tap the traffic light on the home page.	How easy was it to perform the task?	Please elaborate if you have any suggestions on improvements or missing aspects you experienced in the app.
2	Alexandra have spend R$ 25,00 at the local marked.	Enter the daily consumption of R$ 25,00 in the app. When you are finished, tap the traffic light on the home page.	How easy was it to perform the task?	Did you notice any changes on the home page after you added the R$ 25,00? And do you have any suggestions on improvements or missing aspects in the input of daily consumption?
3	Alexandra forgot to buy tomatoes from the marked and needs to go back. She spend R$ 5,00 on the tomatoes.	Enter the extra daily consumption of R$ 5,00. Note that there are two options for the input, and try to explore both. When you are finished, tap the traffic light on the home page.	How easy was it to perform the task?	Which of the two options for the input do you prefer and why? And do you have any suggestions on improvements or missing aspects in the input of expenses?
4	Alexandra wants to buy a new shirt, the price of the shirt is R$ 50,00 but she is unsure whether she can afford to buy it.	Use the app to examine how her future budget will look like if she uses R$ 50.00. When you are finished, tap the traffic light on the home page.	How easy was it to perform the task?	Was the meaning of future economic clear? And do you have any suggestions on improvements or missing aspects in the future economic part?
5	Alexandra wants to buy the shirt and needs to save up. She wants to wear the shirt to a birthday in 10 days.	Make a saving for Alexandra of R$ 50.00 spread over 10 days. When you are finished, tap the traffic light on the home page.	How easy was it to perform the task?	Was the meaning of savings clear? And do you have any suggestions on improvements or missing aspects?
6	Alexandra becomes impatient and buys the shirt.	Enter the extra daily consumption of R$ 50,00. When you are finished, tap the traffic light on the home page.	How easy was it to perform the task?	Did you notice that the traffic light changed during the tasks, and if yes why? Do you have any suggestions on improvements or missing aspects in the app?

Table 5.2: Tasks, scenarios, fixed question and follow-up questions form the experiment conducted in this project.

5.2.6 Development of the experiment's prototype

Before the development of the prototype for the experiment, some delimitations are made. These delimitations do not mean that these deselected elements must be overlooked in relation to the final prototype, which should be developed in future projects. These delimitations are made as there are not enough time and resources to implement them in this project's prototype.
First, there has not been time for developing a voice control to insert the amount of money. Therefore, this is a task for future projects, as the idea itself is optimal for waste pickers as they are used

to communicate with audio messages to each other, as mentioned in section 1.2.
In addition, this project has unfortunately not the time to implement audio in the prototype. It was

Figure 5.3: The different screens and their interaction options. The red lines going between the screens show the interactions' possibilities between screens. Here, a dot at the end of the line shows a click.

intended that audio should be implemented for all the information icons in the upper right corner of the prototype. However, suggestions have been made for what to include in the audio on the various pages in appendix D.2. This is also an important part to implement in a future prototype if it should be tested on waste pickers, as some of them are illiterate and therefore not able to read the text. However, in this project it isn't possible to carry out experiments on waste pickers, due to COVID-19, see appendix A.2.
In relation to the development of the prototype, different methods have been considered. Here programming is deselected when developing the prototype due to lack of time and resources. However,

programming in later stages of the development is necessary. The prototype is still in the development phase and there should be a focus on testing and improving the prototype rather than developing a finished app. Therefore, another method of developing the prototype is chosen. In selecting a prototype development program, use of PowerPoint was first considered, as this platform was available and would be able to make the interaction needed in the prototype. As described in section 4.2 clicks are used to navigate in the prototype and therefore no features such as search or scrolling are needed. However, it would be advantageous in an experiment if the selected program could collect information about the participants' interaction, which PowerPoint is unable to. Therefore, it is chosen to develop a prototype in the online program Preely. Preely can create the same interaction possibilities as PowerPoint, but at the same time would be able to collect information about the participants. Here, the program collects information about clicks and the time spent performing a task. Preely needs screenshots of the prototype, where *hotspots* can be placed upon. The *hotspots* send the user from screen to screen. The screens were developed in the online program Piktochart. Figure 5.3 show an overview of the overall hotspots between the pages of the prototype.

Chapter 6

Data Interpretation

In this chapter, the data from the experiment is analysed. The data can be found in the attached appendix G.2.

In addition to the 45 participants who completed the experiment, 20 individuals dropped out of the experiment during one of the tasks. These 20 individuals are not included in the data in the next sections, but their behaviour are briefly explained here. 15 individuals dropped out during the experiment either; before task 1 or during task 1. Common for them all were the lack of feedback. Therefore, it is unknown why these 15 individuals dropped out of the experiment.
Furthermore, one individual drop out after using 27min. on task 1 with the explanation "I thought it was too difficult to continue"(unknown participant in task 1). Another individual completed task 1 after 2m11s and rated it with the score 2, with the explanation "det var svært lige at finde ud af, hvor jeg gik ind og ændrede den"[1] (unknown participant in task 1) after which the individual dropped out of the experiment. The three last individuals continued the experiment until task 4. Two of the individuals dropped out during task 4 using 4m20s and 2m23s before dropping out of the experiment. Prior to task 4, there was no indication of problems in the individuals comments as one had no comment and the other commented it as "easy" (unknown participant in task 3) in the feedback. The last individual dropped out after giving feedback to task 4, and used 1m1s to complete the task, gave a raking of 7 and then commented "no." (unknown participant in task 4).

Before analysing any data it is chosen to discard one participant with the ID no. 35707. The reason for the deselection is that the participant spent 4h43m12s in total on the six tasks, where task 1 and 2 lasted 3h40m48s in total. The participant's comment was that the controls didn't work, "forget the task and controls didnt work properly" (participant ID no. 35707 in task 2). This could mean that the prototype didn't work and was defective when this participant interacted with it. Another reason is that in task 5 the participant spends 57m3s on the task and still claims that it's easy, "since i understand it easy" (participant ID no. 35707 in task 5). In contrary to the other three task; 3, 4 and 6 respectively 29s, 50s and 4m31s, where the participant also claims that it's "easy to use" (participant ID no. 35707 in task 3). Due to the incongruences between the time and the subjective answers it is chosen to deselect this participant. This means that the analysis is conducted with 44 participants.

Two participants abandoned task 1, "I couldn't find where to change the monthly salary" (participant ID no. 54399 in task 1) and "after finishing task 1 I could not find How I could pass to Task 2" (participant ID no. 54990 in task 1). The participants used respectively 58s and 3m29s. One of these participants did also abandoned task 4 using 1m11s, "I could not type anithing because I'd already used ALL the money" (participant ID no. 54990 in task 4).

[1] Translated to: "it was hard to figure out exactly where I had to go in and changed it"

6.1 Objective data

The objective data consists of clicks and time collected in Preely during the experiment. Here, time spent on performing the tasks, the paths used in the experiment, and heatmaps of the screens in the prototype are analysed.

6.1.1 Time used per task

First it is investigated how the participants time are distributed in the boxplots in figure 6.1 for all the tasks.

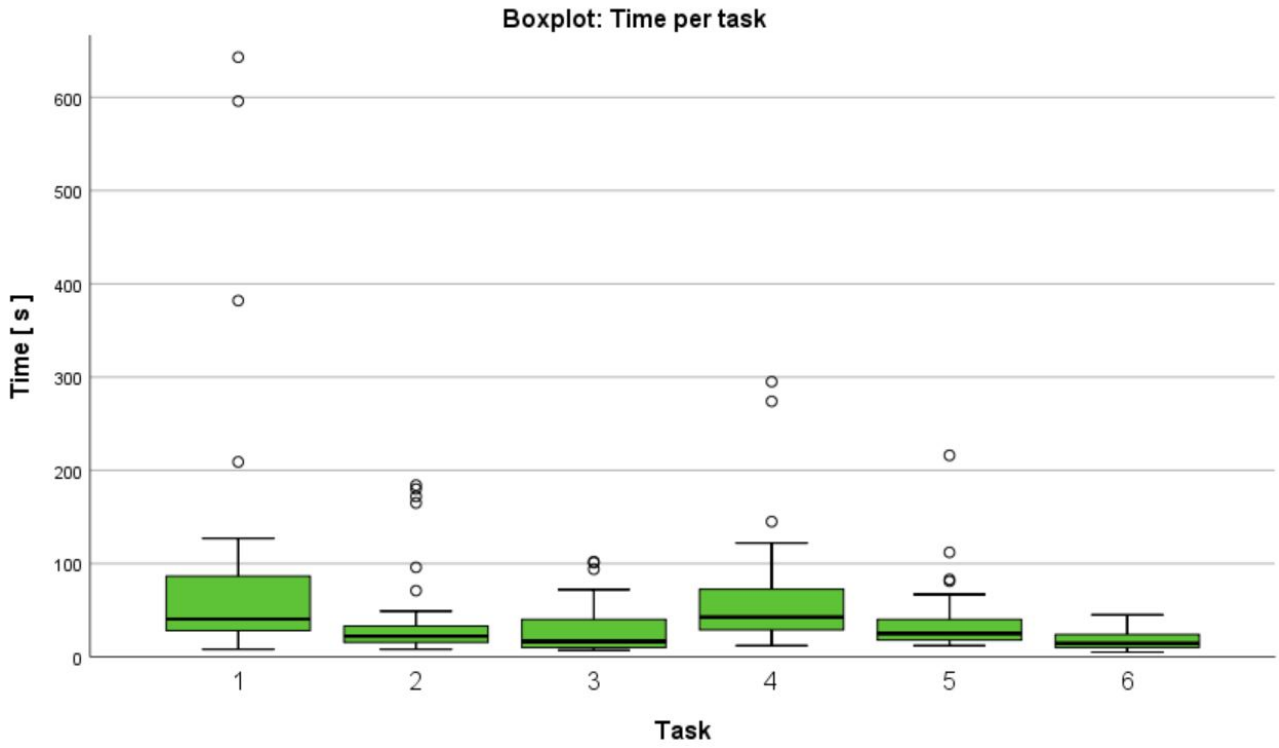


Figure 6.1: The six boxplots represent one task each. The six tasks are outwards the x-axis and upwards the y-axis is time in seconds.

From the boxplots a pattern occurs between the six tasks. From task 1 to 3 the time spend per task decreases, and at task 4 it increases again, then decreases at task 5 and 6. This pattern of the boxplots could mean that the participants become more familiar with the prototype, and due to the introduction of a new feature in task 4 the participants have to become familiar with it as well. After becoming familiar with task 4, it takes less time to solve task 5 and 6. However, this is discussed in chapter 7. Another thing to notice is that task 6 is the only task that doesn't have any outliers. This could be a result of the participants gained knowledge through the tasks. This is specified in the table 6.1, where the values of the boxplots in figure 6.1 are represented.

When comparing task 1 and 4 by the 1st quartile, median and 3rd quartile, they are quite similar. In 1st quartile they are only a second apart, in the median they are 2 seconds apart. In the 3rd quartile task 1 is 13 seconds larger than task 4. This could be explained by the fact that task 1 is the first task the participants are introduced to and are therefore not familiar with any of the features in the prototype. Another interesting aspect of the six tasks are that all tasks minimum and maximum on the boxplots follows the same pattern.

Task no.	1	2	3	4	5	6
Minimum	8	8	7	12	12	5
1st quartile	28	15.75	10	29	18	10
Median	40.50	22	16.50	42.50	25	14.50
Mean	86.91	38.43	29.11	60.95	36.75	17.36
3rd quartile	85.25	31.50	40	72.25	38.50	24
Maximum	643	184	102	295	216	45

Table 6.1: This table represents the six tasks' boxplots in figure 6.1. All number values are written in seconds.

6.1.2 Paths

Path is an analysis of the different paths taken by the participants in the prototype while solving the tasks. The screens are investigated in terms of the routes the participants take, but not what they do on the different screens. This section focuses on the number of screens visited as well as how many different paths the participants take.
Firstly, *Screens Visited Count* is investigated. *Screens Visited Count* is the number of screens each participant visits. If the screen is abandoned and then returned to, it is counted again. Since the number of screens that are visited depends on the task and the value the participant needs to enter. Therefore the distribution per task is investigated and not the development of change in relation to an improvement through the tasks. This is specified in the table 6.2, where the values of the boxplots in figure 6.2 are represented.

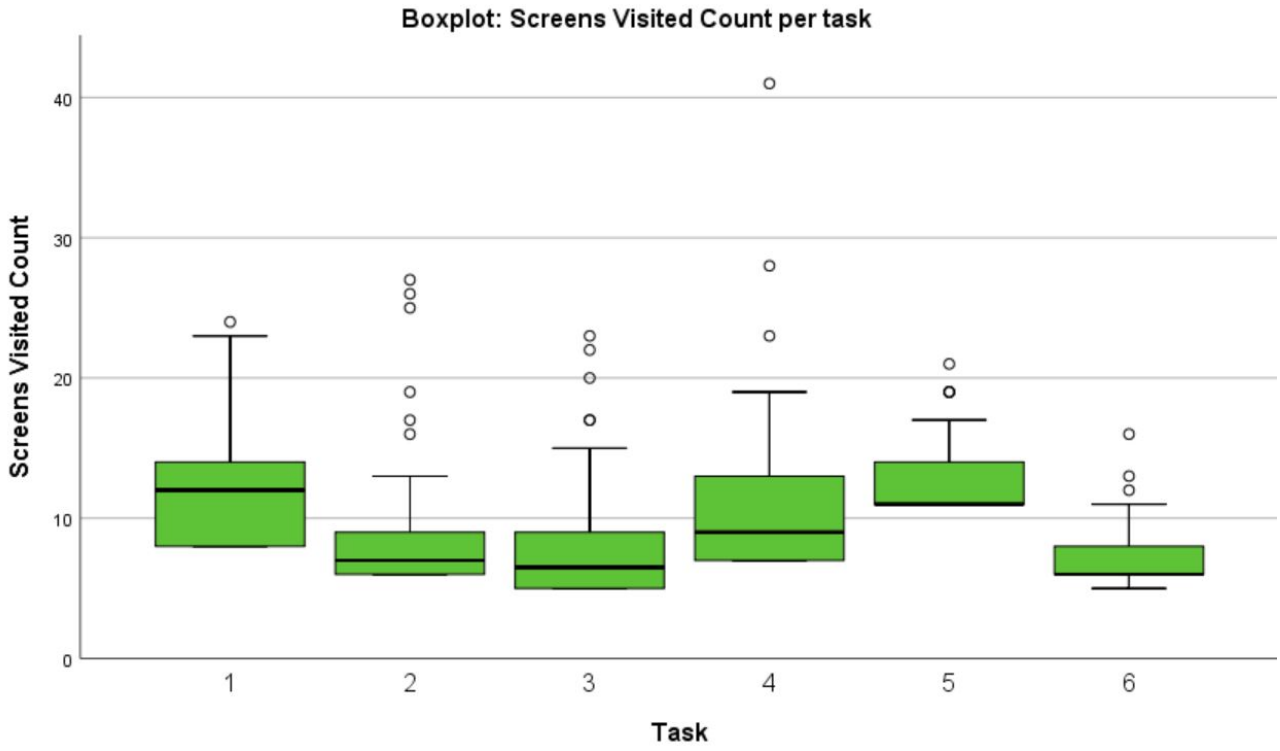


Figure 6.2: The six boxplots represent one task each. The six tasks are outwards the x-axis and upwards the y-axis is *Screens Visited Count*.

Secondly, it is investigated how many different paths the participants take. Here, the paths have been divided into three categories; *direct*, *investigating* and *special cases*. *Direct* path is the path

Task no.	**1**	**2**	**3**	**4**	**5**	**6**
Minimum	8	6	5	7	11	5
1st quartile	8	6	5	7	11	6
Median	12	7	6.5	9	11	6
3rd quartile	14	9	9	13	14.5	8
Maximum	24	27	23	41	21	16
Mean	12.32	9.16	8.23	11.20	12.80	7.05

Table 6.2: This table represents the six tasks' boxplots in figure 6.2. All number values are *Screens Visited Count*.

that performs the task directly. Since there is different ways of performing a task directly, the screen number may be different, for example, if the participant has to enter an amount, one can use pictures or the number keyboard and both solutions are a direct path. *Investigating* path is where the participants examine the interface of the prototype. This means that they examine other sub-pages before performing the task. The path has been categorised as an *investigating* path if several participants have taken the same path to investigate the sub-pages. *Special cases* paths are the path that only one of the participants take. This section only examines the categories: *direct* and *investigating*. Table 6.3 shows a distribution of the two categories. From the table, there is a majority of the participants who takes the *direct* path rather than the *investigating* path, and that the mean of the time used on the task is less than the time used on the *investigating* path. In the attached appendix G.3 an overview of *direct* and *investigating* paths can be found. A tendency is that the *direct*

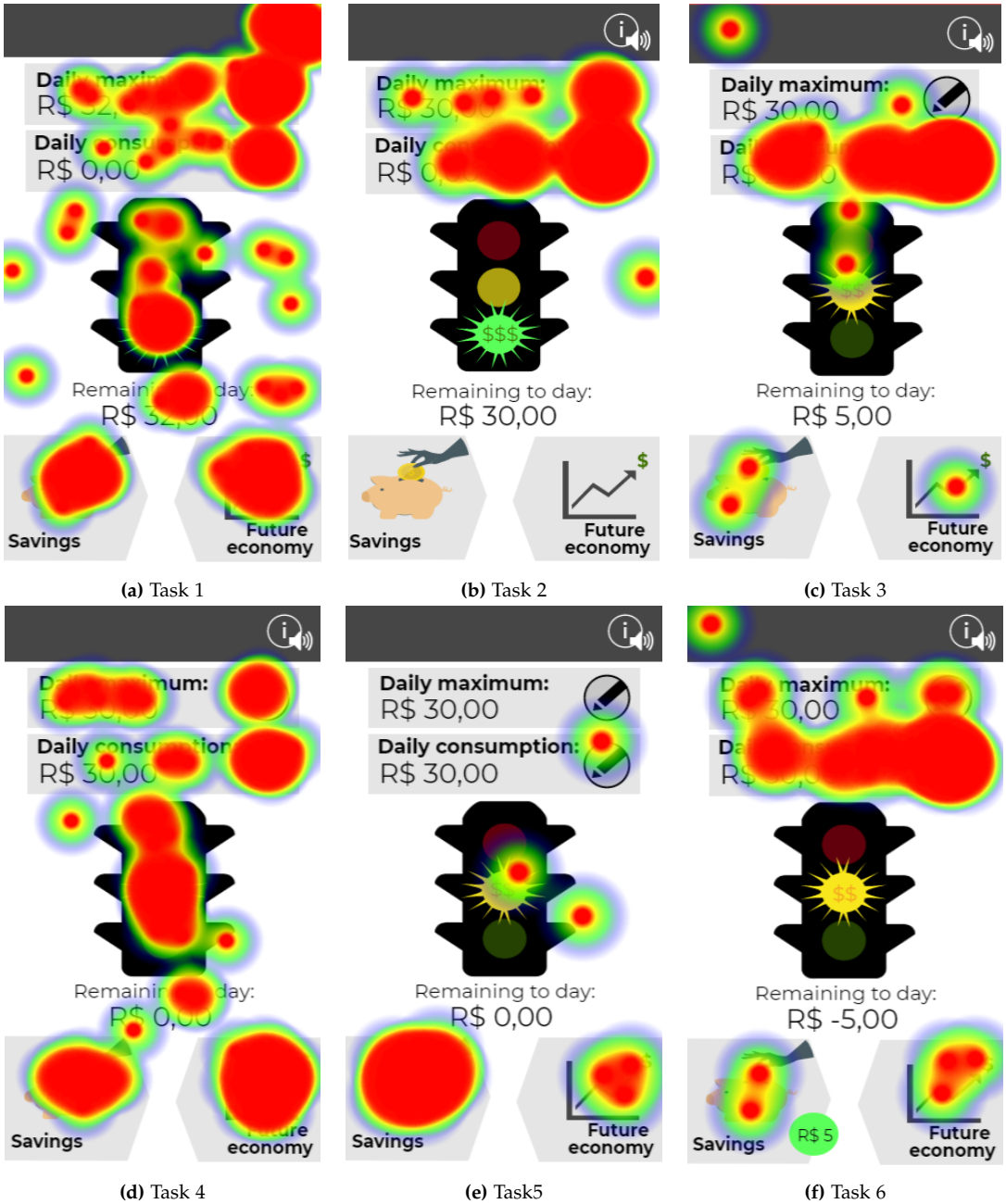
Task no.	Path	Number of screens in path	Number of participants	Percentage of participants	Mean of time	Maximum time	Minimum time
1	Direct	8	15	33.3%	22.2s	41s	8s
	Investigating	10-12	11	24.4%	52.1s	127s	14s
2	Direct	6-7	24	53.3%	30.2s	172s	8s
	Investigating	8	4	8.9%	40.9s	71s	17s
3	Direct	5	21	47.7%	13.2s	35s	7s
	Investigating	7	2	4.4%	16.1s	22s	11s
4	Direct	7	19	43.2%	32.7s	81s	12s
	Investigating	9	7	15.6%	32.8s	41s	28s
5	Direct	11	25	55%	24.2s	81s	12s
	Investigating	13	4	8.9%	37.9s	67s	17s
6	Direct	5-6	27	60%	12s	31s	5s
	Investigating	7-8	5	11.1%	24.8s	45s	15s

Table 6.3: Table of the various paths divided into *direct* and *investigating*. The column *Number of screens in path* can have different numbers of screens, as there may be different sub-pages or input methods that have been examined or used in the execution of the task.

paths correspond to the minimum and 1st quartile, whereas the *investigating* paths correspond to the median from the boxplots, see figure 6.2. *Direct* and *investigating* paths are consistent, where most cases being within the minimum and 3rd quartile on the boxplots, see figure 6.2. Here, the boxplots outliers consist of *special cases* paths.

6.1.3 Heatmap

The heatmap gives an overview of all clicks, swipes, and scrolls on each screen. This has been collected per screen per task. In this section it is chosen to focus on the home page on which each task is started, see figure 6.3. In task 1 the interaction was scattered across the entire screen, see figure 6.3a. Whereas the interaction is gathered around *daily maximum* and *daily consumption* in task 2 and 3, see figure 6.3b and 6.3c, after which it is spread out again in task 4, see figure 6.3d. In task 5, the interaction is gathered around *saving* and in task 6 it's *daily consumption*, see figure 6.3e and 6.3f. This indicates that the participants were more determined in their interaction in task 2, 3, 5 and 6. Whereas it indicates that the participants were more confused or investigative in task 1 and 4.



(a) Task 1 **(b)** Task 2 **(c)** Task 3

(d) Task 4 **(e)** Task5 **(f)** Task 6

Figure 6.3: Heatmap of the first home page the participants are introduced to in each task.

6.2 Subjective data

The subjective data consists of both feedback in the form of a rating from 0 to 10 and follow-up questions.

6.2.1 Rating

The participants were asked to rate each task on a scale with a slider from thumbs down to thumbs up, based on the question: "how easy was it to perform the task?". Afterwards the rating was converted to a score from 0 (thumbs down) to 10 (thumbs up). The distribution of rating for the various tasks can be seen on figure 6.4. On figure 6.4 task 1 and 4 have the lowest mean rating.

Figure 6.4: Ratings of the six tasks. The numbers in the blue boxes are the mean rating.

In addition, these tasks have the lowest number of participants rating the task a score of 10 by respectively 10 and 15 participants.

6.2.2 Follow-up questions

The subjective data the participants provide during the test with the prototype in Preely, is investigated with a thematic analysis. The analysis is conducted with an inductive approach where the data determines the themes. The analysis is done for each task performed in the prototype to find patterns and tendencies across the different participants. The Thematic analysis are based on the six steps developed by Braun and Clarke [2008]. The six steps are;

1. Familiarisation, Getting an overview of the collected data.
2. Coding, Highlighting sentences from the data and divide them according to their content and label theme with a code.
3. Generate themes, The codes from the previous step, should now be looked at to find patterns and themes.
4. Reviewing themes, Does the themes match the collected data?
5. Defining and naming themes.
6. Writing up, Summary of the findings.

The full thematic analysis is found in the attached appendix G.4. The prototype is distributed in Denmark and Brazil. In this regard, the participants are told they can answer the follow-up questions in danish or Portuguese even when the prototype and questions are in English. This is done in order to increase the amount of feedback and get more elaborate answers. Thus as a part of the familiarisation all the answers are translated to English. In the six different follow-up questions, the participants are asked if they have any suggestions for improvements or missing aspects. Therefore as a part of the first step, comments on improvements and design suggestions are separated from the data and can be found in appendix F. Further to eliminate noise from the data, answers like "No comment" and "okay" are sorted out. As a part of the last step, *writing up, summary of the findings, the codes have been counted*. This is done to get an overview of the distribution and to see which themes and codes are most common. It is not the answers that are counted, as one answer can contain more than one statement. Therefore, the different tasks are based on different numbers of participants, statements, codes and themes, an overview can be found on table 6.4.

Task no.	**1**	**2**	**3**	**4**	**5**	**6**
Number of participant providing feedback	32	33	35	37	30	37
Number of statements	41	35	46	43	37	41
Number of codes	8	9	13	8	11	7
Number of themes	4	4	4	3	3	3

Table 6.4: Overview of the number of participants, statements, codes and themes.

The distribution between the statements and themes for the six tasks are illustrated on the bar charts below see figure 6.5. The specific codes and statements can be found in appendix F. In task 1 four themes emerged; *intuitive*, *not intuitive*, *difficult to find* and *steep learning curve*. Here it was the theme *steep learning curve* that had the most statements, but overall the statements were "negative" towards the task and the prototype, in relation to the themes *not intuitive* and *difficult to find*. In task 2 four themes emerged; *easy to use*, *confusing*, *no change detected*, and *now it makes sense*. Here it was

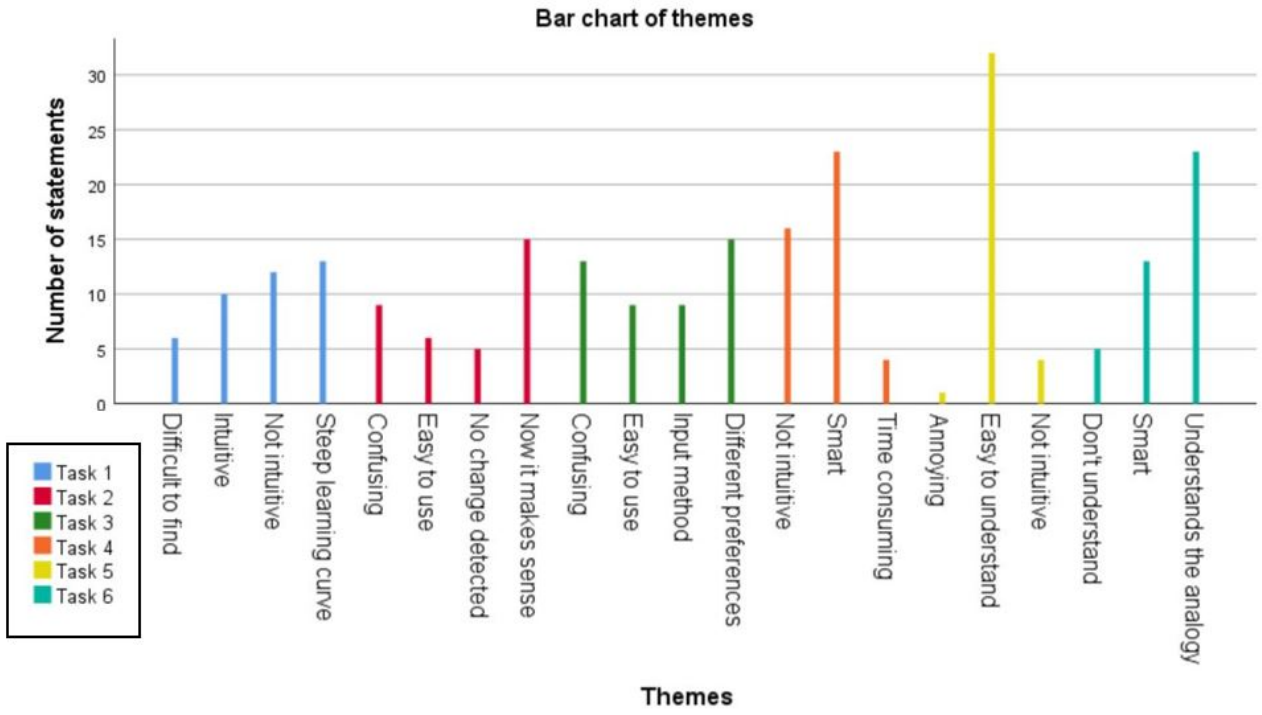


Figure 6.5: Bar charts of the distribution between the statements from each task divided into themes.

the theme *now it makes sense* that had the most statements. Task 3 is in regard to the two different input methods that can be used in the prototype. Here four themes emerged; *easy to use*, *confused*, *input method* and *different preferences*. Here the theme *different preferences* had the most statements because the participants answered which they preferred of the two input methods; numbers on a keyboard and pictures of money. In task 4, the participants are asked if the meaning of Future economic is clear. Here three themes emerged; *smart*, *not intuitive* and *time consuming*. Here the majority of statements were in the theme *smart*. However, there is also many statements in the theme *not intuitive*. In task 5 the participants are asked if the meaning of savings is clear. Here three themes emerged; *easy to understand*, *not intuitive* and *annoying*. Here, the highest number of statements are in the theme *easy to understand*. This is also the theme with the highest number of statements across all the tasks. The last question is in regard to the understanding of the analogy. The participants are asked if they notice that the traffic light changed during the tasks. Here three themes emerged; *understand the analogy*, *don't understand* and *smart*. Here the majority of statements were in the theme *understand the analogy*.

Chapter 7

Discussion

This chapter discusses the data collected in the experiment. In addition, sources of error are discussed in connection with the experiment. Firstly, the patterns that emerged from the data based on the six tasks is discussed.
In relation to time, from task 1 to 3 the time spent per task decreases, and at task 4 it increases again, then decreases at task 5 and 6. This pattern of time on boxplots, see figure 6.1 show that the participants become more familiar with the prototype, and due to the introduction of a new feature in task 4 the participants have to become familiar with it as well. After becoming familiar with task 4, it takes less time to solve task 5 and 6. This is also visible in relation to rating on figure 6.4, where the average of each rating is lowest to begin with, then it rises steadily, then drops at task 4 and then rises steadily again. When comparing the mean of rating of the tasks and the time spent per task, both means follow the same pattern, see figure 6.4 and table 6.1. This means that when a task was rated as less easy the time spent on the task is equivalently high and vice versa. Another aspect to notice is that task 4 falls in rating and the time spikes in time spent. The same pattern can also be detected on the heatmaps in figure 6.3. Here the interaction is very scattered at task 1, but becomes more concentrated around different points in tasks 2 and 3. Again, at task 4, the interaction is scattered widely and again concentrated around different points in tasks 5 and 6.
The pattern in the data can be explained by different things. This can either mean that task 1 and 4 gives the participants problems, i.e. it is difficult to change the amount of one's income and use the feature future economy. Or it could mean that there is a learning curve in understanding new aspects of the prototype. It is not known with certainty which of these factors have caused problems in these two tasks or if a third possibility is involved. The fact that the order of the tasks were not randomised or otherwise mixed, could have caused a carryover effect. It was deselected to randomise the orders of the tasks, because it would spoil the storytelling in the scenario. Therefore, it should be considered in future projects to randomise the order of the tasks. Through that, it would be more clear, if it's the function or the carryover effect that affects the results.
However, in the analysis of the follow-up question a steep learning curve was detected in task 1 as the majority of statements was in the theme *steep learning curve*. In task 2, the participants then started to understand the prototype as the theme with the most statements was *now it makes sense*. Therefore, it can be argued that the steep learning curve has an effect on the assessment in task 1, but it still cannot be said with certainty that it is the feature tested through the task that caused problems. A way to reduce the steep learning curve would be through a familiarisation phase with the prototype. Therefore, a point to consider in future developments is to create a familiarisation of the prototype. And for a final app create an introduction to the app, "put some navigation guides in the beginning, for the user to get a better flow of the app" (participant ID no. 35695 in task 6). Therefore, an option could be to create a walk-through of the app, when it is first downloaded.
In relation to task 4, it was discovered in the analysis of the follow-up question that the theme with most statements is *smart*, but not far behind is *not intuitive*. This indicates that the participants are divided in their feedback on task 4 "what a brilliant way to get an overview" (participant with the ID no. 35455), where another "easy to perform, but the graphs aren't very intuitive. The numbers

below didn't really make sense to me, at first" (participant ID no. 35695 in task 4). An argument for the different statements could be that the task in itself is easy to preform, and the concept makes sense, but the execution of the feature lack some clarifications to make it more understandable. One of the improvements that could be look into is to create a longer overview than the 3 days.
A way of improving the feature future economy could be by taking inspiration of the feature savings from task 5. From the analysis of the follow-up question in task 5, it emerges that 31 of 37 statements within the theme *easy to understand* and the answers towards the feature was positive "My previous answer suggests a functionality like this should be the focus instead of the "future economy". But since both exist, it's fine" (participant ID no. 35560 in task 5). Therefore, the idea of future economy could remain, but the visualisation of the distribution of money for the future could be displayed in another way. Since the feature savings makes sense for the participants it must remain as one of the features in the prototype, of course still with the premise that it needs to be tested on the target group as well.

Furthermore, it can be discussed if the analogy of the traffic light was understandable for the participants. From the analysis of the follow-up question in task 6 the majority of the statements was in the theme *understands the analogy*. This supports the choice of the analogy since 23 of 41 statements indicated that the analogy was understandable. In contrary a minority of statements was in the theme *don't understand* and here two statements in the code *notices the change in the light - but I did not understand it*. This could indicate that when the participants come across obstacles it isn't due to the analogy. However, a larger amount of participants haven't elaborated on the analogy, and therefore it is not known, if the rest of the participants understand the analogy or not. As a result, this should be investigated further. In addition, there was some suggestions to improve the analogy by implementing sound "beside that the traffic light turns red perhaps you should add blinking red light and/or warning sound" (participant ID no. 35519 in task 6). There was also suggestions on how to implement sound etc. in the savings function "when she reach to saving goal it would be interesting if the app "celebrated" " (participant ID no. 35685 in task 5). Therefore, it can be argued that in the future it could be investigated how to create a prototype that is more responsive to the actions made in it. But a balance has to be made, so the prototype doesn't become difficult to use, and still remains understandable to the participant. Furthermore in the analysis of the follow-up question in task 3, the participants were questioned which of the two input methods they preferred. Some participants who could not understand the use of money in pictures, as it either was not their kind of currency or that they thought it was easier to use numbers. This is influenced by the fact that the participants in the experiment aren't the right target group. Therefore, it is necessary to perform the ideal experiment in section 5.1 with the waste pickers.

7.1 Sources of errors

The following is a discussion on the sources of errors that could have had an impact on the experiment.

1. The experiment form: online vs face-to-face
2. Not using the right target group
3. Biassed tasks
4. Limitations in Preely

1. source of error: It is discussed, whether the experiment form could have had an impact on the data. Here, the focus is on whether there is any complications in relation to the data when the experiment is carried out online. By conducting an online experiment without an experimenter, the participants need to read and write a lot of text. Here, it could have occurred that participants had questions during the experiment, which couldn't be answered by an experimenter during an online experiment. However, in a face-to-face experiment, the participants would have an opportunity to ask the experimenter their questions. Another aspect is that when participants read the whole experiment they might not remember all the information given or they only skim the text. This was something that showed in the feedback. Here, some couldn't remember how to finish the task. In addition, it could have caused some problems when the participants provided written feedback. When distributing a task followed by a set of questions that the participants should answer in writing to provide feedback, the data is not always exhaustive. Even though different initiatives were incorporated to maximise the responses e.g. the participants were automatically transferred to the follow-up question after they finished the task and before they could proceed, they had to leave a comment. However, there was several participants who did not answer these follow-up questions. There may be several reasons for this. One could be that the participants don't want to answer the questions, which they are entitled to. Another aspect in conducting an online experiment is that some of the participants write an answer that isn't clear and can easily become the project group's interpretation of their answers. Another aspect when participants answer the follow-up questions after each task is that they chose not to elaborate their answers and the information that could have been useful is lost. This is one of the problems, when conducting an online experiment. In an online experiment it isn't possible to correct misunderstanding or elaborate parts in the experiment that confuses the participant. However, it can be argued that face-to-face experiment would have been performed if it had been possible to perform it on the target group.

2. source of error: This leads to the discussion of the impact of not using the target group when conducting the experiment. Not using the target group in the validation of the prototype affects the result. However, using other participants than the target group can be used to understand the functionality of the prototype, and correct mistakes, but it isn't possible to give an estimation of the target group's perception. Therefore, some of the conclusions made about the prototype might not be valid, when testing on the target group. This is due to the participants of the experiment are literate and are from a wealthy social class, and therefore their way of thinking and handling finances, can be very different form the waste pickers.

3. source of error: When looking at the given tasks the participants are given different clues in where to go to and solve the task. This could have caused the easy way of solving the task, but not always making it intuitive. However, a balance needs to be made to ensure that the participants understand the given tasks, but on the other hand, solve the tasks by themselves without getting all the answers through the tasks. If too many clues are given, the results are not a reflection of the participants interaction with the prototype, but rather a guided walk-through of the prototype. If that was the case the experiment wouldn't provide any useful data.

4. source of error: By using the software program Preely it allowed collecting data that could have been difficult to collect due to COVID-19, see appendix A.2. However, the program had it's limitations, when applying the design of the prototype in the software. One of the limitations was applying audio input, and thereby testing the option of getting the written text read aloud. The advantages by using a tool as Preely is that it allows the project group to collect data as clicks and

time with a low-fidelity prototype, and the possibility to conduct the experiment online. However, it can be argued that the app Preely wouldn't be a tool to use, when conducting experiments with the waste pickers in Brazil. Some of the features in Preely aren't controllable, because Preely has some standards that cannot be changed, such as having questions after each assignment. Therefore, it will be considered in future projects if a solution other than Preely is to be found.

Chapter 8

Conclusion

The purpose of the project is to achieve an understanding of how an educational platform can be designed for the waste pickers. The project develops the first steps towards designing a prototype that supports the waste pickers to learn how to manage their personal finances. The project addresses the case of the Brazilian waste pickers at the SWRI in Brasilia, Brazil. The waste pickers are part of the poverty in Brazil and many of them have little or no education, which means many of them are illiterate. The project revolves around the following problem statement:

Which elements should be a part of the design of the prototype to help the Brazilian waste pickers learn how to manage their personal finances?

The waste pickers are analysed as a target group to create an understanding of them and their needs. An analogy was developed for the learning material in the prototype. Then the design was developed in the prototype focusing on incorporating the analogy. To test the prototype, an experiment was developed and aimed to investigate the problem statement. Unfortunately, due to COVID-19 it was not possible to perform the experiment with the target group. Therefore, it was chosen to conduct the experiment online with Danes and Brazilians. Based on the experiment it could be concluded that the assessment of the tasks and thereby the functions may be influenced by a carryover effect. In the discussion, it was stated that the first task may have been influenced by a carryover effect, but there is a chance that task 4 has not been affected by it, although a new feature is presented. Therefore, it is relevant to examine how the function of future economy could be made more intuitive, since one of the themes of the thematic analysis of task 4 was *not intuitive*. Furthermore, when using other participants than the target group, the data can only be used to understand the functionality of the prototype, and correct overall mistakes, but it isn't possible to give an estimation of the target group's perception. Therefore, some of the conclusions are that the prototype might not be valid, when testing on the target group. This is due to the participants of the experiment are literate and are from a wealthy social class, and therefore their way of thinking and handling finances, can be very different from the waste pickers.
In conclusion, this project created the foundation for developing an interface for a personal finance prototype to the waste pickers in Brasilia, Brazil. However, it is necessary to conduct experiments with the waste pickers in order to conclude if these aspects are a valid representation of the target group.

Chapter 9

Reflection

This section reflects upon future aspects of the project. Here a description of possible supplements for both the prototype and the future app is considered. In addition, other considerations about the Mobile Education Platform is pinpointed.
Firstly, aspects of the prototype that were not possible to elaborate in this project, is reflected upon. In future developments of the project, one of the focus areas should be the implementation of audio. Audio was opt out of this project due to limited time and resources, see section 5.2.6. First, a read aloud function should be designed. This will ensure that even illiterate and functional illiterate will be able to understand the small text pieces in the prototype or get an explanation on the different functions. An icon that should illustrate the read aloud function was added in the prototype to investigate if the participants would use the function. On figure 9.1, the participants' first click in task 1 are illustrated with green dots. In the upper right corner of the figure, beneath the green dots, is an audio icon. It can't be concluded why the participants clicked on the icon, but it tells that the some participants are curious about the feature.

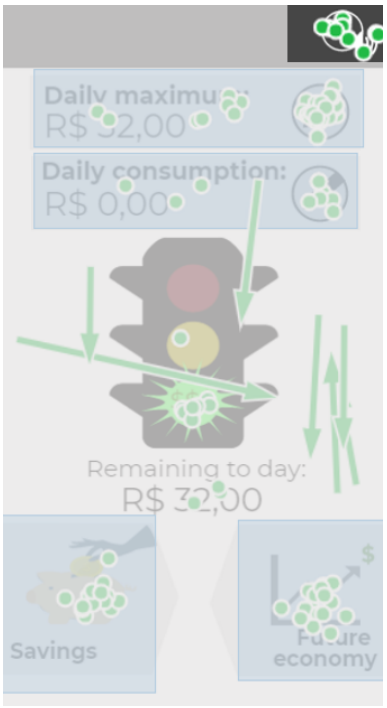


Figure 9.1: First click from the participants on the home page, Task 1

In addition, it could be relevant to investigate how to redesign the prototype without any or a limited amount of text to accommodate the illiterate waste pickers. Therefore, it could have been interesting to remove all the written text and replace it with other analogies or icons that would illustrate the purpose of the features. This would have made it clear, if icons could replace all text and through that create a more usable prototype for the illiterate waste pickers. Therefore, in future

experiments it could be interesting to investigate, how the content of the app would be perceived without any text and see where the problems would occur.
Additionally, another feature that would have to be implemented in the prototype would be using audio as an input method, see section 5.2.6. As an addition to the number input and the coin/banknote input, an audio input method would allow the waste pickers to use voice control, when inserting the amount they have used or want to save, etc.
Another aspect to consider in the prototype, is to develop and investigate the future economy feature, in terms of other ways to communicate how the future is affected by the spending "men det var ærgerligt, at jeg kun kunne se 3 dage frem. Det havde givet mere mening for mig at kunne se beløbet strukket sig fx ud over flere uger"[1] (participant ID no. 35626 in task 4). In the prototype the focus is on a daily basis, however for a future project it should be possible for the waste pickers to see the long term effect of the finances.
Furthermore during the project, gamification has been mentioned both in the development process of the analogy, see section 3.2.1, but also in the interview conducted with an expert "gamification and ways to interact among them could be an opportunity to engage the group" Tatiana Marins Caiado in appendix B.5. Therefore, another possible addition could be gamification to motivate and teach the waste pickers by alternative means.

Secondly, the aspects of testing the prototype in the longer term will be reflected upon. As described in section 1.8, the long term effect of the app should be investigated in the future. In the article by Maciel [2013], a usability test of a mobile application for adult literacy was conducted in Brazil. The participants had to use "The PALMA" which is a literacy tool that can help people learn basic skills in terms of reading, writing, mathematics etc. The usability test was conducted during one month where the researcher had ongoing contact with the participants where they received feedback. Here they learned that some of the main challenges when providing alternative learning material was the economic and social aspects, individual challenges there could be when using new technologies and the sometimes inadequate infrastructure of the internet [Maciel, 2013, s 236].
In addition, they mention in the article the impotency of doing the initial training with both the participants, but also their closest family and friends as they are the ones the participants contact when they need help or are in doubt [Maciel, 2013]. In the experiment conducted with the prototype in this project, a design suggestion was "some suggestions would be to, in the future, make it possible to share it with someone (as a viewer only) so they can help out" (participant ID no. 35695 in task 6). Furthermore from the cultural approach, see section 2.1, the Brazilian had a score on 38 on the dimension *individualism*. This indicates that the Brazilians as a society are family- and group orientated. All these findings points towards a more targeted inclusion of the waste pickers family and friends in future projects.

Finally, it will be pointed out that this project originated from the idea of a mobile education learning platform. The topic of this report revolves around one course that could be of value and interest for the waste pickers. However, to create and design a mobile education platform, more than one course should be developed and offered on the platform. One of the focus areas that should be further investigated when developing courses and content of these, are the use of analogies and other informal learning strategies.

[1] Translated to: But it was a pity that I could only look 3 days ahead. It had made more sense to me to be able to see the amount stretched for example over several weeks.

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Appendix A

The process of the project

This appendix describes the international collaboration with students from Brazil and the impact COVID-19 have had on the collaboration and the project in general.

A.1 International Co-operation

In the beginning of this project the project group went to Hamburg in Germany to participate in an EPIC seminar. EPIC is an Erasmus+ Strategic Partnership, that facilitate international student projects. Where students work together across disciplines and borders to solve real-world problems[EPIC, 2017]. However, the students from Aalborg University follow the usual semester structure, write a report as usual, and are evaluated according to the normal learning objectives. Therefore, the EPIC part of the project can be consider as an extra dimension to the semester project. In this particular project, the project extends the collaboration with Brazil, where the project group collaborate with students form the University of Brasilia. The project was developed by seven students, three from Denmark and four from Brazil, see table A.1. EPIC facilitate a joint seminar for all

Denmark

Name	Field of study	Semester
Anja B. Mejer	Engineering Psychology	6th
Emma B. Mortensen	Engineering Psychology	6th
Ina V. B. Rasmussen	Engineering Psychology	6th

Brazil

Name	Field of study	Semester
Yasmin R. Kalume	Production Engineering	11th
Isabel B. Alves	Production Engineering	4th
Julia S. Brito	Production Engineering	5th
Bianca M. de Oliveira	Production Engineering	11th

Table A.1: Overview of the members of the project from both Denmark and Brazil.

the students involved from the 10th to 14th February 2020. Together with the Brazilian students the project group was able to gain knowledge and create a co-operation agreement. It was agreed that the project group would travel to Brazil in the beginning of May to collect data for the prototype. The rest of the work was distributed as shown in table A.2. The collaboration continued online, however due to the COVID-19 the waste pickers were also in quarantine, which made it impossible for the Brazilians to get in contact with them. In addition the project group was not able to travel to Brazil in order to conduct field work as initially planned. The impact COVID-19 had on the project is elaborated in the following.

Milestones	Deadline	Responsible
Data analysis of the forms to analyse the problem	13th March	**Brazilians:** If new data is needed, it will be collected, researched, analysed and translated. **Danes:** doing analysis of data for report. If new data is to be collected, we need to help make material for it.
Relationship experiment with the mix and match (later updated to the brainstorm session to compose analogies)	3th April	**Brazilians:** get the tasks from Denmark around 30th March and latest on 3th April and make test with the waste pickers which has to be done by April 10. **Danes:** Create a task for the waste pickers, they can perform and send it to Brazil. Latest finished by 3th April, but preferably before.
Prototype and small test with the app	29th April	**Brazilians:** doing continuous testing with the mockup in Brazil. **Danes:** When data is processed from the relationship experiment, feedback is given about icons for the mockup.
Experiment in Brasilia	4th to 8th of May	**Brazilians:** schedule and arrange the meetings necessary to the experiment, previously talk to the people on SLU about the purpose of the project in order to get as much help as possible. **Danes:** hopefully able to go to Brazil. Sends information about trials before we hop on the plane.
Danish Report finish	27th May	**Danes:** making the report separately.
Presentation of the project in Brazil SDG	27th - 31th July	**Brazilians:** organising the presentation **Danes:** participate

Table A.2: Planned ideal distribution of work between Danish and Brazilian students from EPIC seminar 10th to 14th February.

A.2 COVID-19 impact on the project

Coronavirus (COVID-19) is a family of viruses that can cause mild colds, but also cause serious respiratory infections. The outbreak of the new COVID-19 started in China in December 2019, but quickly spread to surrounding countries and then to the rest of the world, including Denmark. On March 11, 2020, the World Health Organisation (WHO) declared the COVID-19 as a pandemic [Politi, 2020].
The COVID-19 had an impact on the project making it impossible to travel to Brazil and preform experiments. The Ministry of Foreign Affairs has advised against all unnecessary travel abroad and urges Danish travellers who are abroad to return home as soon as possible. COVID-19 is found in many countries around the world. Several countries have taken special precautions including closing the borders in relation to travellers from other countries.
In addition, it is not possible to talk to the waste pickers, as they are not working at the SWRI. Neither field studies in Brazil were possible. Denmark and many other countries in the world have taken various measures to eliminate the burden in the hospital system by ensuring the minimum contact between people. This is to reduce the rate of infection spread. Students in all public youth education and higher education etc. were sent home on March 11, 2020 and at the beginning for two weeks[Politi, 2020]. This means that the Danish students had to work from home separately. In Brazil, they were also sent home and were no longer able to talk to waste pickers. The development of the project and the COVID-19 situation can be seen in figure A.1.

Figure A.1: Timeline of the development of the project.

Appendix B

Expert interviews

Five interviews were made in the beginning of the project. The five experts all have knowledge about the project and the waste pickers. The interviews have been collected by e-mail, and are therefore written answers. These interviews are considered as expert interviews, as all the interviewees have different contact points with the waste pickers. Some have worked with them and others have visited the recycling centre and had the opportunity to talk and interview the waste pickers.

B.1 Interview: Jens Myrup Pedersen

A. What is your profession?

Associate Professor at Aalborg University.

B. What is your relation to the mobile education project in general? And to EPIC?

I was together with the students when they developed the idea of starting the mobile education project in response to the need of the waste pickers. Also, I was one of the people that helped in establishing the Danish-Brazil collaboration.

C. Do you know, where the idea behind the mobile education app comes from? And what the idea was?

The idea was developed in close collaboration between Danish and Brazilian students, during our second workshop in Brazil. The idea was to complement the already existing capacitation projects, by giving the waste pickers skills they could use in everyday life such as basic math (for home finances), but also in order to help them improve their skills in running the cooperatives more efficiently (and thus earn more money). The app would provide not only "learning content", but could also have functionality to help them in everyday life (again, both private finances e.g. spreadsheet and for running the cooperatives).
As far as I remember, the Danish group (Daniel and Robert) would work on the technical aspects of the app, while the Brazilians would be responsible for content. The "beautification" and user design was left to a later stage. The main focus of the Danish group was to create the app itself together with a "smart cache" functionality, which made it possible to load the content when close to wifi, so they did not have to use expensive mobile data on accessing the learning materials. This was especially important as many of the waste pickers have smart phones, but data is expensive (often e.g. WhatsApp and social media would be included separately).

D. What is your experience with the waste pickers?

a. Do you have any specific experience with them?

b. Do you have some experience with what is important for the waste pickers in their everyday life?

I have met them multiple times. My impression is that some of them are quire resourceful, and can contribute in driving a change. But it is hard for them to make strategies and long term plans for the cooperative facilities, and e.g. improve their businesses by coordinating and negotiating better deals with those who buy the trash. You can say that there is quite some "day to day" culture, and my impression was also that they were quick to blame SLU or the society when something did not work out as good as they would like to.
From their spokesperson, I got the impression that they did not themself identify a need for "education". In their understanding, it was more external factors that should be improved, e.g. that they could receive more waste or that the quality of the waste was better e.g. because the population would be better in sorting the waste. I don't know the reason for this, but it probably makes it important to be careful not to design the app in terms of "courses", but rather try to give advice and learning points that are useful for the waste pickers in the very short term. This is also why we discussed if we should make a "waste picker app", which was not only for "education", but also for e.g. work related communication between waste pickers, presentation of todays earnings from the sorting, visualisation of what waste is particularly useful/expensive etc., and then use that for smuggling in elements of teaching/training.

E. How do you think the waste pickers would receive the app, and would they use an online education tool?

I think it is important that there are short-term benefits in using the app, and that the waste pickers also can see these.

F. What do you think the biggest challenge for the mobile education app is?

To make it attractive to use it, for people who are not really motivated for education.

G. In terms of the last project, what do you think needs to be developed on the app before it can be implemented?

I think the whole content side and UX part needs to be designed, and I think it is important here to consider actual and realistic use cases.

H. What is your experience with the previous SLU project?

(The interviewee didn't provide an answer)

I. Do you have any knowledge about the waste pickers experience with the education programs provided by SLU? If yes, please elaborate.

(The interviewee didn't provide an answer)

B.2 Interview: Daniel Arias Martijena

A. What is your profession?

I'm an industrial engineering student at the University of Brasilia and currently work as an intern for the SLU.

B. In what ways did the waste pickers have to adjust their everyday lives after the closure of the dump site?

They used to work in the dumpsite with no restrictions and their working environment was extremely unsafe. Trucks would traffic the area recklessly, they had no working schedules, no individual protection equipment (IPE), some workers would take their children with them so they could also pick recyclable materials, etc. After the closure of the dumpsite, they started working in places specifically constructed for them, called Solid Waste Recovery Installation (SWRI). In these new installations, waste pickers are obligated to work using their IPEs, work 8 hours a day and the ergonomic working conditions are drastically better. With this new system, not only did the geographical location of where they used to work changed, the people the work with changed and their whole life too.

a. And what were their attitude towards it?

Unfortunately, most were very unhappy. Their monthly income decreased due to many factors and they were not cool about the SLU being so involved in their daily activities.

C. What is your relation to the waste pickers?

a. Do you have any specific experience with them? If yes, please elaborate.

Yes, I am participating in a project that consists of designing the layout of a warehouse. The warehouse will be operated by waste pickers so we frequently have meetings with them. However, the ones I talk to with more regularity are not actual waste pickers. The ones I talk to are usually the president of the Cooperatives or someone that works with the financial side of the Cooperatives. On more rare opportunities, I visit their workplace (SWRIs) and sometimes have the chance of talking with them. I usually go when an SLU employee asks me to go with him/her and every time I go, I learn something new. New problems are always on the come up and the waste pickers talk with SLU employees in order to solve it. You could say that some waste pickers (I'd say they are the minority) are much more motivated and hard-working than others.

b. Do you have some experience with what is important for waste pickers in their everyday life? If yes, please elaborate.

I once was present when Giullia (the other SLU intern you met in Germany) was applying a survey of working conditions. I initially thought they would be very interested since the results of the survey could improve their work life. Sadly, most of them were not interested, answered the questions vaguely or didn't make the effort of trying to understand any of the questions. Others simply preferred not participating in the survey. If I were to be completely honest, I'd say their primary goal is a steady income that requires the least effort possible. Of course, this is not the case for every person working as a waste picker. Some of them have a family too and some are very motivated and ambitious. The more hard-working persons usually make the most impact and create more results, as in any organization. I would suggest that you find a waste picker like that, eager to help you, talk with you and discuss the best possible outcome of your project. Developing the app together with the person that is going to use it is something app developers commonly do. I'm guessing your Brazilian friends are in an easier position to find this person.

c. What is the waste pickers attitude towards work and education?

I'd say most of them have a negligent attitude towards both. We have to keep in mind that they are in very poor financial situations so they are not very motivated all around.

D. If the waste pickers have trouble with reading and writing how are you communicating with them when verbal communication is not an option?

Luckily for me, the two waste pickers I mentioned before know how to read and write so I talk through Whatsapp with them or by telephone calls. I have never been in such a situation.

E. Do you have any knowledge about the waste pickers experience with the education programs provided by SLU? If yes, please elaborate.

Yes, I know they receive certain courses and lectures regarding different topics. They receive a financial incentive in order to attend those programs and if they didn't, they wouldn't bother. As far as if they actually learn something, my coworkers tell me they don't pay much attention and don't care that much about what is being presented to them. One of my coworkers suggested they are not used to sitting and learning as we do, they are more used and eager to learn through practice.

F. How do the waste pickers use their smartphones communicating with others, if they aren't able to read or write?

Most of them know how to read and write well enough to communicate through smartphones. I guess the very basics at least. I can very well imagine that if they don't know how to read and write they would be able to do a normal telephone call in order to communicate.

G. How do you think the waste pickers would receive the app, and would they use an online education tool?

They would only use the education tool if they were paid. I'm guessing they would prefer being evaluated in an online tool rather than having to physically go to one of the education programs mentioned before. I also think that they would answer the evaluation part as fast as possible just to get the money.

H. What do you think the biggest challenge for the mobile education app is?

The biggest challenge would be making an app that actually teaches something to the waste pickers and not something they can answer vaguely and fast just to get the money. Programs where they physically attend the lecture are not that efficient so I'm interested in seeing if an app would!

B.3 Interview: Mateus Halbe Torres

A. What is your profession?

Student and Business Consultant

B. In what ways did the waste pickers have to adjust their everyday lives after the closure of the dumpsite?

a. And what was their attitude towards it?

In many ways. In the past, they would go to the dumpsite with the entire family (including children) to maximize their potential of collection. They could work during the day and at night. They would have money proportional to their results. Now, with the closure, children can't work anymore and they all, in general, divide equally among the waste-pickers the amount of money. Limited time, no children and equal payment have in general reduced the money they earn, especially the ones that worked more. But also, they have much fewer problems with diseases and risks related to biological contamination, as well as mechanical risk (e.g., getting hit by trucks and all). They also have a space to eat and a bathroom, not having the degraded necessity to do these activities in the middle of the trash mountain.
Initially, there was strong resistance about the idea of closing the dumpsite. There were no alternatives though, and Paulo Celso and Tatiana were able to cool down spirits. When the dumpsite closed, there were the ones that hadn't accepted and wouldn't integrate the new Triage Centers. Others would. Among the ones who did, there is still the memory of the "golden dumpsite era when money was more abundant", but others (the majority, I could say) prefer the current situation, in which money is not the same, but the work conditions changed a lot.

C. What is your relation to the waste pickers?

My relation to the waste-pickers is part of the context of the UnB initiative to create projects that impact waste-pickers. I have coordinated two Global Students SDG Challenges focused on that and also courses at UnB with more than 14 projects related to it.

a. Do you have any specific experience with them? If yes, please elaborate.

I have made several visits to the Triage Centers and Dump areas. I talked and informally interviewed them.

b. Do you have some experience with what is important for the waste-pickers in their everyday life? If yes, please elaborate.

The main concern of their daily lives is money and their families. They accept to work with waste because this is their way to earn money and supply their families.

c. What is the waste-pickers attitude towards work and education?

They work with waste and some other casual simple works with what they learned from everyday life. They are not used to earn money from activities in which they aggregate value from a skill acquired in formal education. They don't have revenue progress from capacitation. They operate with the basics.

D. If the waste pickers have trouble with reading and writing how are you communicating with them when verbal communication is not an option?

It would be necessary to use pictures, symbols, and gestures.

E. Do you have any knowledge about the waste-pickers experience with the education programs provided by SLU? If yes, please elaborate.

I have watched one of the sections. They use to pay attention in some cases, but not all of them and all the time. Normally the oral communication, as well as pictures in ppt, are used.

F. How do the waste pickers use their smartphones communicating with others, if they aren't able to read or write?

Essentially using audio and phone calls.

G. How do you think the waste pickers would receive the app, and would they use an online education tool?

It would be necessary to train them so they can operate the app, stimulate the use by creating the habit and adding some financial stimulus (I particularly would suggest two main functionalities on that: 1. PROVE REAL PROGRESS: to make progress in the App, they must go through some quick questions or any content apprehension validation; 2. REAL-TIME MONEY EARNED PANNEL: how much money have you earned learning that (we gonna need the price of an hour paid by the government; this functionality is important for them to understand they are not losing time in the app))

H. What do you think the biggest challenge for the mobile education app is?

Make them understand they are not losing time in the app. (2nd. Not allow them to go through lessons pretending they are consuming the content, when they are just pressing play and doing something else)

B.4 Interview: Giullia do Couto Machado

A. What is your profession?

I am a student at a public health college and I am an SLU intern.

B. In what ways did the waste pickers have to adjust their everyday lives after the closure of the dumpsite?

a. And what was their attitude towards it?

For the best understanding I will explain how it worked in the dumpsite
At the dumpsite, the waste pickers worked alone, most of them were not represented by any institution or cooperative. Each collector was responsible for separating and selling what they found in the dumpsite . There is no workload and no limit of worked hours. Besides they were not required to wear personal protective equipment (PPE) so many didn't use it. Now the waste pickers work as a team and are represented by cooperatives contracted by SLU. All waste pickers separate and cooperatives are responsible for selling the materials and sharing the earnings with the cooperatives members. They workload is 8 hours a day and are required to use (PPE's). The biggest challenge for them is to survive on a salary that is three times lower than before. They earn an average of R $ 2500 (530 euros) and today some cooperatives earn R $ 800 is (170 euros). In Brazil

the salary that they receive now is less than the minimum wage.
Many didn't agree with the change and abandoned the service in the cooperative, some waste pickers complained about having to use personal protective equipment and even today they do not use it, they do not accept that there is someone to supervise the service and there's resistance to any type of change in the sheds. Despite this, some people reacted well, even though it important to have protective equipment and a place that is covered and that gives them more security.

C. What is your relation to the waste pickers?

I have been working with waste pickers since 2017 as part of a college project called Pare Pense e Descarte (Stop Think and Dispose) . With this project, I had the opportunity to help collecting data on the epidemiological diagnosis that happened before the dumpsite was closed. In this diagnosis I was able to conduct interviews with the collectors and participate in health actions.

a. Do you have any specific experience with them? If yes, please elaborate.

In 2019 I started to carry out a comparative study that aims to find out if health and working conditions have improved since the dumpsite closure. In order to carry out this study, I had to prepare a questionnaire based on the previous one in 2017. The study continues to be carried out by myself as an SLU intern.

b. Do you have some experience with what is important for the waste-pickers in their everyday life? If yes, please elaborate.

I couldn't understand the question, if you can explain I would be grateful, thanks

c. What is the waste-pickers attitude towards work and education?

Do you want to know about education at work or about the two selected?

D. If the waste pickers have trouble with reading and writing how are you communicating with them when verbal communication is not an option?

I never needed to use any form of communication other than verbal, so I believe this will be a very big challenge for you. Even if you use images and colors that in our view are self-explanatory maybe for them will not be so easy to understand, so you will need to take this into account. An alternative to the application would be to have written and spoken questions, similar to the tool that Google translator uses.

E. Do you have any knowledge about the waste-pickers experience with the education programs provided by SLU? If yes, please elaborate.

During the period of adaptation to the new workplaces, training was carried out through a Cooperation Agreement between SENAI, SLU, SEDESTMIDH and FIBRA on Cooperativism, Personal Attitudes, Work Safety and Equipment Maintenance, Solid Waste Management, Notions Production Processes, Entrepreneurship, Administrative and Financial Management and Basic Informatics.

F. How do the waste pickers use their smartphones communicating with others, if they aren't able to read or write?

Not all waste pickers have cell phones, but those who do usually know how to read and write. Those who do not know how to read or write use calls to communicate or communicate through recorded audio from applications such as WhatsApp, or ask for help from someone to use the device.

G. How do you think the waste pickers would receive the app, and would they use an online education tool?

I believe that the app can be well received if you can make a good explanation about what the app is, about what the goal is and especially about the benefits that this app will bring to them. I don't know if they would use the online education tool because of some factors that can make it difficult to access this platform. The factors that hinder this access are: time required for this purpose, lack of access to the internet or even not having devices to use this type of tool.

H. What do you think the biggest challenge for the mobile education app is?

I believe that the biggest challenge will be the adhesion of the collectors and the language used in this application. There is a group of people who cannot read or write but there is also a group that can read and write so you need to think of some way of looking at both groups.

B.5 Interview: Tatiana Marins Caiado

A. What is your profession?

I am production engineer and I have been working with recycling and circular economy towards sustainable production-consumption.

B. In what ways did the waste pickers have to adjust their everyday lives after the closure of the dump site?

Since the dumpsite was closed, the waste pickers needed to learn how to work in different conditions. The reference number is 1200 waste pickers working regularly there before the clousure. Some cooperatives left the dumpsite to provide public service of sorting recyclables at recycling facilities (around 700 waste pickers). Other waste pickers decided to find new jobs or work informally on the street, we do not have accurate number about them. In the recycling facilities they had a building to work, there are toilets, common area for eating time, equipments to use, meeting rooms and some time classroom. This new working conditions includes rules to work together, to clean the area, working hours and duties. Another important issue, in the dumpsite they were working more individually, and now, they need to work collectively, as cooperative institution should be.

a. And what were their attitude towards it?

All cooperatives had to discuss among their cooperators and with the public authority responsible for the recycling facilities (SLU) to adjust working conditions and common rules. Also, there are 2 cooperative network (Centcoop and Rede Alternativa) that helped the process to build a new environment for them, specially the ones who were sharing areas (2 or 3 cooperatives using the same building).

C. What is your relation to the waste pickers?

a. Do you have any specific experience with them? If yes, please elaborate.

First, I was part of the technical group to discuss, plan and build the transition from the dumpsite to the recycling facilities. During the year of 2017, we had more than 300 meetings with waste pickers and their representatives ("cooperative presidents") to define the most suitable way to ensure their inclusion after the clousure. Then, when the dumpsite was closed, I was the operational coordinator of all 5 recycling facilities, with 700 waste pickers, 8 cooperatives and 100 ton/day of input material (recyclable waste from cusrbide collection). Afterwards, I was managing the recycling collection for 1.5 million people in Brasilia, and ensuring the distribution of materials for waste pickers at those recycling facilities.

b. Do you have some experience with what is important for the waste pickers in their everyday life? If yes, please elaborate.

The income for the is biggest concern usually. Since they came from the dumpsite, they still need to figure out a way to earn more money and increase their quality of life and working skills.

c. What is the waste pickers attitude towards work and education?

We could only follow their education when it was mandatory to earn the support frm the government (R$300/month for 12 hours of study per month). Talking informally with them, we know that they do not write or read properly somethings, and they would like to improve it. However, it is difficult for them to manage studies when they need to work to feed their family. It is a trade-off for them.

D. If the waste pickers have trouble with reading and writing how are you communicating with them, when verbal communication is not an option?

Pictures, icons and videos would be useful and more ludic for them. As simple as possible, but at the same time, interesting and not language for kids, for instance. Gamification and ways to interact among them could be an opportunity to engage the group.

E. Do you have any knowledge about the waste pickers experience with the education programs provided by SLU? If yes, please elaborate.

The education programs they had with the local government were related to the skills they would need to improve their work such as production process, safety procedures, basic computer tools, communication and finance. They had classes and more dynamic activities, divided in modules. The content was part of capacity plan we developed in 2017 before closing the dumpsite to improve their qualification.

F. How do the waste pickers use their smartphones communicating with others, if they aren't able to read or write?

Usually they use more visual resources as photos, videos and others, or audio message. They also use their phone to listen music while they work, and record important meetings. Whatsapp is one of the most used app for them.

G. How do you think the waste pickers would receive the app, and would they use an online education tool?

Online education that needs WIFI or 4G could be a challenge, because sometimes they do not have enough money to pay monthly for the service. Also, they change phones very often, so sometimes it is difficult to make sure they still have the same number, for example.

H. What do you think the biggest challenge for the mobile education app is?

I would say the content. It is difficult to develop an app without the content, and it should suit the interface, resources and need for the users, as well as language. It should be helpful for them.

B.6 Follow-up interview: Education

The e-mail interview has been conducted with Giullia do Couto Machado and Daniel Arias Martijena whom are working as interns at SLU. The follow-up interview is conducted to gather knowledge about the waste pickers education, which has been provided by SLU.

A. What is the agreement in relation to the education the waste pickers have now? And how many hours do they spend on the education?

B. What kind of learning methods are used? For example group work, problem solving, blackboard teaching, etc.

C. What topics do they learn? Do they have about financial management?

D. If the waste pickers have topics about financial management, maybe we can get some of that learning material?

E. What is the agreement in relation to the education the waste pickers have now? And how many hours do they spend on the education?

F. What kind of learning methods are used? For example group work, problem solving, blackboard teaching, etc.

G. What topics do they learn? Do they have about financial management?

H. If the waste pickers have topics about financial management, maybe we can get some of that learning material?

Hello I am writing this message together with Giullia and will be as short as possible because we are short on time,
Currently they have no agreement and spend 0 hours on education. However, in the near future there will be another education program. In the past program, they received lectures related to cooperativism, safety in the workplace, solid waste management, and personal finances. They received 300 reais to participate in a 12 hour per month lecture that included the topics mentioned earlier. In relations to finances, they received courses on personal finances that covered the very basics. The course was not all that efficient because it was given to about 400 people in a very small room and they only needed to be present in order to get paid. No exam or practical exercise was given. We do not have that material, sorry.

B.7 Follow-up interview: Waste pickers budget management

The e-mail interview has been conducted with Tatiana Marins Caiado. The follow-up interview is conducted to gather knowledge about the waste pickers budget management.

A. Do you know how the waste pickers are paid? Are they paid in cash or do they have a type of credit card? Or is it in a third way?

There are both systems, sometimes they get cash and sometimes bank account transactions. We recommend them to use only bank accounts because it keeps register the money transferred, but we know they prefer by cash. Also, some cooperatives pay weekly, biweekly or monthly. There is no standard for this. The only standard is the money they earn from the public contracts, when they get paid monthly by the government. The cooperative receive the money, and manage the expenses and distribution among cooperators. Usually

the week day for payment in cooperatives is Friday. Another important issue, it that in Brazil is different than Denmark that is a cashless. Many commercial stores here do not accept credit cards, specially in poor neighbourhoods, which means they do need to have money in cash. Besides the fact that they might not know how to use bank account apps, and how to manage those expenses in credit cards.

B. Do you know how the waste pickers administered their finances?

a. Do they have an envelope where they divide their money in terms of the weeks?

I don't think so, but it is better to validate it.

b. Are they spending what they receive without thinking on the last couple of days in the month?

I would say so. What we hear is that they spend the money when they get it, than they need to wait to get the following payment to buy what is missing. What also happens is the deficit, when they spend the money they don't have, and keep debts for the next month. In Brazil, it is usual to buy stuffs in quotes, for example, you buy a TV now and pay for the next 12 months a small amount of money plus interest. In this sense, they can afford product that they couldn't if they need to have the full amount of money at the moment they want to buy.

c. Or do they have another type of budget management to keep track of their expenses?

I don't think so. But here, sometimes they manage their budget as a family, putting all the money together. Sometimes they get pension or pay for children out of marriage, and help others in the family, like parents and grandchildren. It is the collective feeling and thinking as family. Most of them have "benefits" from the government, to support their family if they are really poor (CAD Unico is the system to provide "Bolsa Família", for example).

C. When the waste pickers were transferred to the new recycling centres, a part of their salary was deducted to pensions and insurances. Is that correctly understood? And if they are saving for their pension when can they retire?

It is corrected and made by the contract the cooperatives have with government. It is a condition for them to work as public service providers. The retirement process in Brazil is being discussed by politicians because they want to make some changes. For nor, they need to "contribute" for at least 30 years, there are some conditions that might vary, and minimal age is 60 years old for women and 65 for man. This is the overall, but there are some especial cases and different rules for health issues. This is the website (www.inss.gov.br)

B.8 Follow-up interview: Experiment

Online interviews have been conducted with Mateus Halbe Torres and Tatiana Marins Caiado. The interviews have been done separate, but have been gathered. The interviews are conducted to support the execution of the experiment. The following are notes taken during the interviews.

A. When the waste pickers are attending experiments are they usually compensated? If yes, how much and when are they paid? Or do they receive a gift or?

Mateus: *all most sure that we could get access to a class, where the waste pickers would be paid for going.*
Tariana: *Only done health test, have to go to hospitals don't need to pay, have to see the benefits in the things they take part in. So yes need to pay them. A guess from work at a concert per day 100-120 (6 hours) per day of work + money for the sortet trash. To get proper answers give money, or other benefits. Could have the benefits you get this amount of money how would you spent them in the app.*

B. When do you usually have access to the waste pickers, when conducting experiments? E.g. is it in their breaks? Is it possible to access them at other times?

Mateus: *Normally contacts is mostly in their breaks, where they will eat. Impossible to talk to them when working.*
Tariana: *usually 6-8 working hours a day. Breaks 15 min. work form 8-14 have a break of 15 min or 30 min. Could arrange a meeting before and after work, depending on their work schedule. 30-60 min should be more or less ok. But need to take the time in mind if they need to pick their children up.*

C. What is a realistic number of waste pickers taking part in the experiment, and how long can the experiment be before it gets difficult to get participants?

Mateus: *2-3 hours section. Had experiment with groups, around 40 people.*
Tariana: *30-40-50 people, it's easy to do it with everyone. Normally everyone is stopped an instructed at the same time, it's more comfortable. More comfortable in groups, not so comfortable when one by one. Smaller group is better. Bad idea with individual. usually the whole group together.*

D. Do all waste pickers have their own smartphone or are there some who "share"?

Mateus: *They have a smartphone that runs WhatsApp. Smartphone aren't the best, but it works.*
Tariana: *Usually they have their own phone. They change their phone often, because they often get robbed, or they loses their phone. They change their phones as they change their cloths.*

E. Is there internet access in the area around SLU where the experiments are to be carried out?

Tariana: *The wifi is limited to waste pickers. the waste pickers don't use the wifi. But possible for being able have wifi access when conducting the experiment. public internet so don't know about the access, need to buy access if you have to be sure of it working.*

F. Are there any language use we have to be aware off?

Tariana: *They lie, they try to adjust the money to get more benefits. The waste picker change the numbers of money at the dumpsite they said they got less (were poor). At the new place they said they didn't get enough money. They would need to know if the data, is used or stored. Good idea with a notification to see if they have enter the used amount that day. A concern for the waste pickers would be, if the data was given to the government. You should be able to explain in more than one way, to make sure everyone understand the message.*

Appendix C

Brainstorm session to make the analogy

This appendix contains a description of the pilot studies of the brainstorm session used in the development of the analogy. Furthermore, the manuscript used during the brainstorm session described in section 3.2.

C.1 Pilot studies

To find an analogy, that can be used in a course in budget management for the waste pickers, a brainstorm session, as applied in Liedtka et al. [2019] was developed. In the initial process of collecting data, pilot studies were conducted. First the brainstorm session was tested by the members of the project group and to avoid misunderstandings the method was reviewed step-by-step. Furthermore, in the process of collecting online data the following methods can be used either on their own or in different combinations; video with audio, audio, online texting in real time, and offline texting. One of the advantage in online communication is the ability to communicate with people from different places and countries, in this case Denmark and Brazil. This allows the project to continue despite the limitations COVID-19 has introduced. Some of the disadvantages of not doing face-to-face interviews is the loss of nonverbal signals when communicating. Without that the interviewer won't be able to catch the respondent's expression that might contribute to important information. However this can be evaded by adding video to the interview [Baxter et al., 2015, 323-324]. When making an analogy test audio or audio and video are the chosen way of collecting data. Furthermore the number of respondents had to be considered. When conducting an online group test it has to be a small group with around six respondents. This is to insure that all the respondents have the opportunity to express their opinions. This is especially beneficial when brainstorming [Baxter et al., 2015, 356-357].
Next a manuscript was developed and the method was tested again through two rounds with six respondents in total. The respondents were Danes, and the tests were therefore conducted in Danish. They were informed that the analogies would be created for the waste pickers, who has limited reading and writing skills. This information was provided to the Danish respondents to give them a context in which the analogy should work. Three respondents, divided into two groups took part in the first round of the pilot studies. It was found that both tests provided several analogies and thereby the desired outcome. In the next round of pilot studies the respondents had no problem in the tests, but adjustments had to be made in the manuscript. The final manuscript can be found in section C.2. During the pilot study it was found that the oral testing would be preferred to ensure that the process would be fluent, and to avoid misconception. In addition this gives the respondents the option to ask question during the experiment.

C.2 Manuscript for analogy development

Introduction

This experiment is conducted to find an analogy for budget management to the waste pickers. An analogy is a familiar concept that explains an unfamiliar concept.
The goal of this session is to find one or more analogies that can be correlated to how a person manages a budget on a daily basis. The template is divided into four steps; A user context, finding key attributes from the user context, make the analogies and finally place the analogies according to how they fit the user context, mild or wild. When it's mild the analogy is close to the concept budget management and when it's wild it's more abstract and far away from the known concept.

User Context

The user context in this case will be based on the following topic: "Budget management on a daily basis".

Key attributes

The next step is to find the key attributes from the user context. What is it that characterises a budget? and what do you associate with a budget?

Analogies

What kind of analogies can explain or be relate to the user context with the key attributes in mind? An example of an analogy is a weather analogy for budget management.
The concept should illustrate how well a person is managing his or her budget. The goal is to keep the sun shining (equal to a balanced budget or even a surplus). If there should be a deficit in the budget, clouds or thunder would appear.
And now we are going to fill in the analogies in the circle. Every analogy has been given a letter and should be placed as following; A mild analogy is close related to the user context and will be placed close to the centre of the circle, whereas a wild analogy is a lot more abstract and should be placed further away from the bull's eye.

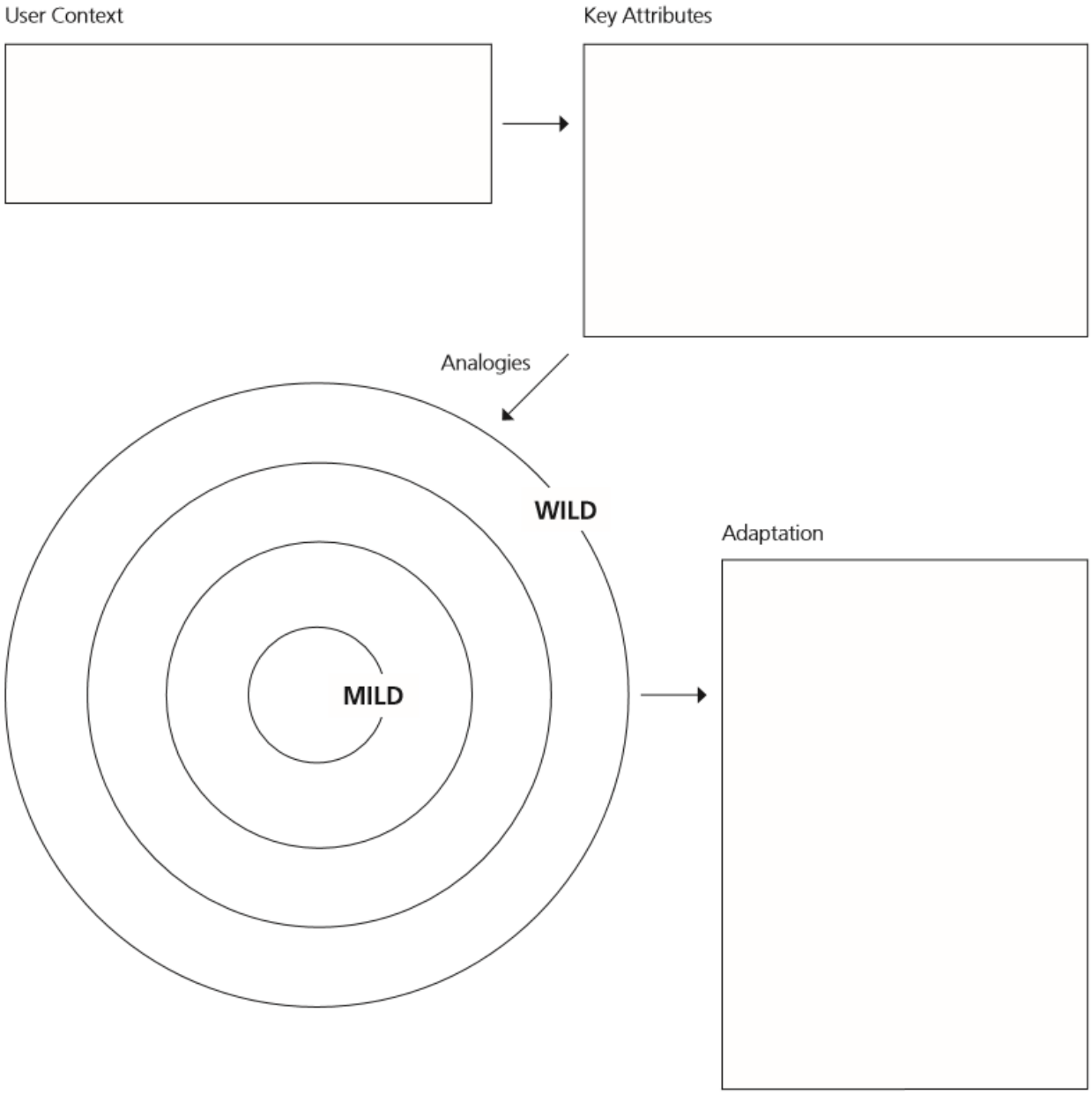


Figure C.1: The template for the brainstorm session used to find analogies, Liedtka et al. [2019].

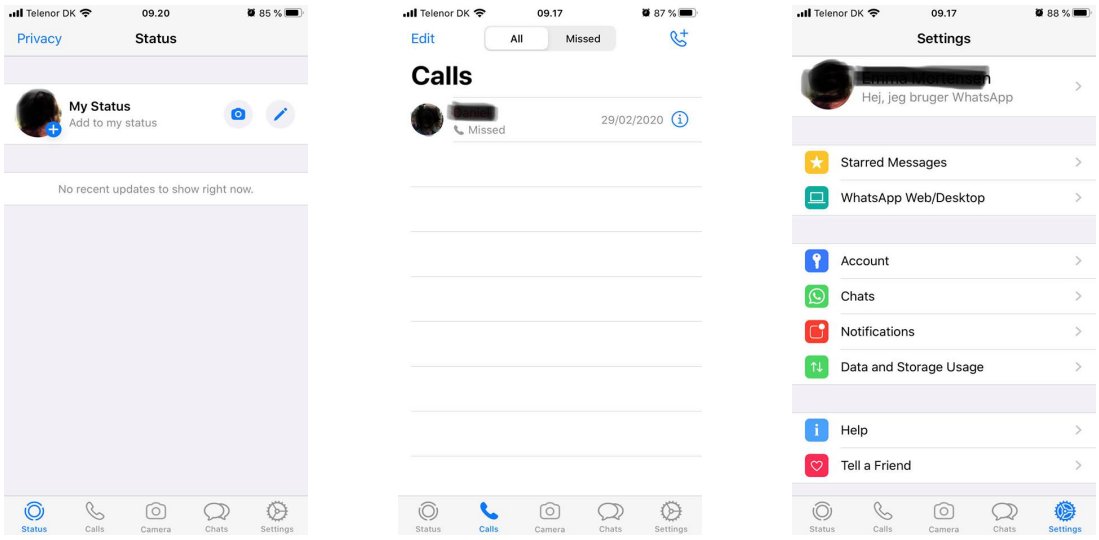
Appendix D

Development of prototype

This appendix contains a description of WhatsApp, as well as a draft of the audio information that can be implemented in future versions of the prototype.

D.1 Description: WhatsApp

This description is based on WhatsApp[1].
WhatsApp's layout consists of five pages linked by a menu bar at the bottom of the screen. This is



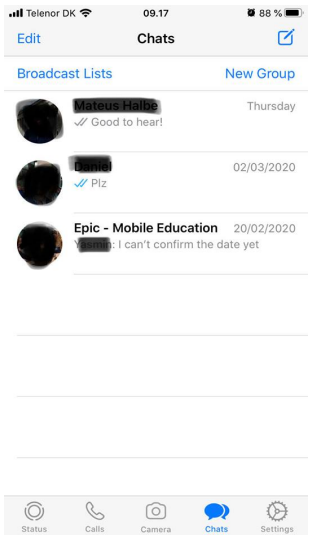
(a) Status **(b)** Calls **(c)** Settings

Figure D.1: An overview of some of the features of WhatsApp. All screen shots are from 18-03-2020 and from a personal profile of one of the project's contributors. All the names have been removed.

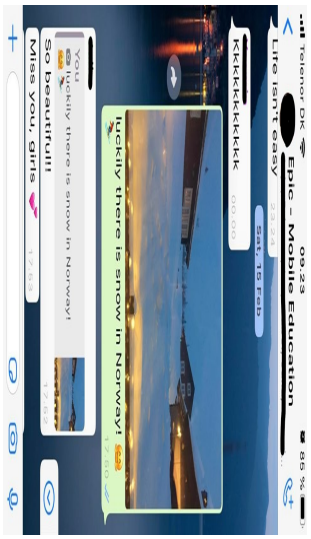
visible in all five pages, unless one visits a secondary page on one of five main pages e.g a personal chat. Status allows one to share text, photo, video and GIF updates that disappear after 24 hours, see figure D.1a. In calls it is possible to see the call history and call the contacts, see figure D.1b. This can also be done from the personal chats directly, see figure D.2b. In the camera function it is possible to take pictures and send to the contacts. Settings provide an option to edit in one's account, see figure D.1c. There will be paid extra attention to the functionality of the chat page, which is important for WhatsApp. When the chat page is entered, an overview of one's conversations can be seen. Chats can be edited or a new conversations can be created through the icon in the upper right corner, see figure D.2a. After choosing a chat, one can write with others just like other message apps. Inside the chats text, pictures, videos and audio etc. can be send, see figure D.2c. One can also respond to other messages as shown on the figure D.2b on the message where it says "You".

[1]WhatsApp version 2.20.22 from 18-03-2020

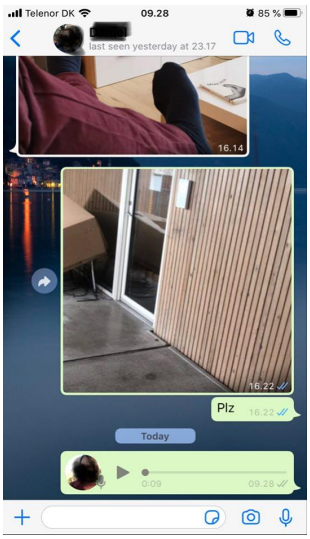
When pressing the text panel at the bottom, a keyboard will appear that matches the settings for language, see figure D.3a. Here it can also be chosen to write or send other forms of communication e.g. audio. Selecting " + " more options for sending communication, e.g. location appears, see figure D.3b. If one continues pressing a message in the conversation the opportunities for e.g. replay or delete the message, see figure D.3c. This makes it possible e.g. to respond to a specific message, as shown in the figure D.2b.



(a) Chats

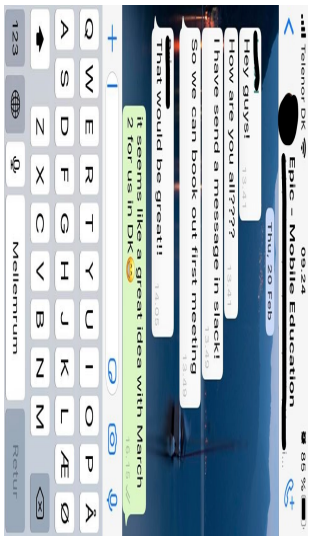


(b) Example chat



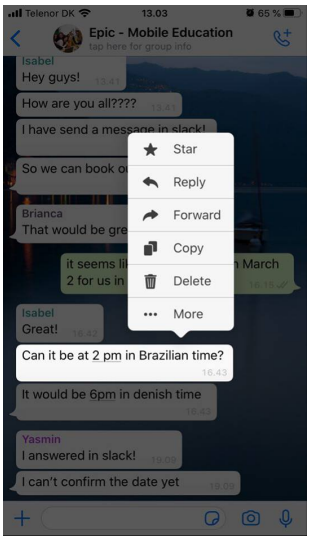
(c) Example audio

Figure D.2: An overview of the chat feature in WhatsApp. All screen shots are from 18-03-2020 and from a personal profile of one of the project's contributors. All the names have been removed.



(a) Keyboard options

(b) More



(c) Response to message

Figure D.3: An overview of various features of the chat. All screen shots are from 18-03-2020 and from a personal profile of one of the project's contributors. All the names have been removed.

D.2 Audio manuscript for future projects

This audio manuscript is an example of what could be said on the home page, if the read aloud icon is pressed. It should be said that this manuscript are merely an example and not a guideline, as it has not been tested on the target group. This is only to verbalise the idea behind these read aloud icons.
On the home page visualised on figure D.4, the following should be recorded in an audio recording:
Daily maximum shows how much you have available each day. This can change based on your salary and fixed expenses that you can edit if you press the edit icon right next to it.
Daily consumption shows how much you spent each day. Here you can add new amounts by pressing the edit icon next to it.
Remaining today shows you how much money you have left today. This is also shown with the help of the traffic light which shows you whether you can continue buying stuff or need to stop.
You can make savings if you need some money to buy something. Here it tells you how much money you have to put aside each day to reach your goal. In addition, it also regulates your daily availability amount, so you remember to save.
Future economy tells you what your future economy looks like. Here you can also get an overview of what a purchase will do to your finances.

Figure D.4: Home page

Appendix E

Experiment

This appendix contains supportive material for both the ideal experiment and the conducted experiment.

E.1 Ideal experiment: Consent form

By signing the consent form you will allow us to use your data in our 6th semester report.
The experiment will be audio recorded and transcribed. The data will be handled anonymous and cannot be traced back to you afterwards. Statements and short quotes may be analysed and used in the report.

[The next part should be updated if the experiment is to be conducted]
This report will be handed in the 27th of May 2020 and published at https://projekter.aau.dk/projekter/ afterwards. This consent may be withdrawn at any time before 20th of May 2020, after which the material will be deleted.

Written information:
Age:
Gender:
Level of education:
For how long have you been working as a waste picker:

Signature:
Data:

E.2 Ideal experiment: The group introduction

[The group of waste picker are gathered, and the experimenter is ready to give the introduction]

Hello everyone, My name is [name] and I'm from [place]. We are making an app that can help you with your finances. The app should contain options to give you a daily overview of your expenses, help you plan your future finances and help you make a saving if that is what you want. We would like you to participate in our experiment to get your point of view on the functions and design as the app should support you in the best possible way. The data we collect through the experiment will only be used to evaluate the app and not you. It will not be possible to trace your answers and data back to you when the experiment is done. We hope that you will help us with our experiment.

[After the introduction the waste pickers can ask questions, and if the experiment is conducted another day then appointments are made.]

E.3 Manuscript for the ideal experiment

Thank you for taking part in the experiment, you will receive [amount of money] for your participation. In the experiment you test a prototype of an app on this smartphone. The app you are testing is in relation to the topic budget management. In the experiment you will meet the character Alexandra, who is working as a waste picker. In the following tasks, you will help Alexandra perform six tasks that she encounter in her use of the app. After completing all the tasks an exit interview is conducted. The experiment will last [time] minutes. If you have any questions please let me know.

[Wait to see if the participant has any questions else continue.]

Then will you sign this consent form and answer the question?

[The consent form is read aloud for the waste picker and signed.]

Now let us begin with the first task.

[One task at a time will be presented to the participant. Read the scenario and task aloud and wait until the participant have solved the task.]

You now need to help Alexandra manage her finances. Alexandra has downloaded the app and she has been using it for a month. Last month she had an income of R$ 960,00 which gave her a daily maximum amount of R$ 32,00. However this month she got paid less and earned R$ 900,00. Your task is to edit the monthly salary to R$ 900,00 in the app. When you are finished, tap the traffic light on the home page.

Alexandra has spend R$ 25,00 at the local marked. Your task is to enter the daily consumption of R$ 25,00 in the app. When you are finished, tap the traffic light on the home page.

Alexandra forgot to buy tomatoes from the marked and needs to go back. She spend R$ 5,00 on the tomatoes. Your task is enter the extra daily consumption of R$ 5,00. Note that there are two options for the input, and try to explore both. When you are finished, tap the traffic light on the home page.

Alexandra wants to buy a new shirt, the price of the shirt is R$ 50,00 but she is unsure whether she can afford to buy it. Your task is to use the app to examine how her future budget will look like if she uses R$ 50.00. When you are finished, tap the traffic light on the home page.

Alexandra wants to buy the shirt and needs to save up. She wants to wear the shirt to a birthday in 10 days. Your task is make a saving for Alexandra of R$ 50.00 spread over 10 days. When you are finished, tap the traffic light on the home page.

Alexandra becomes impatient and buys the shirt. Your task is enter the extra daily consumption of R$ 50,00. When you are finished, tap the traffic light on the home page.

[After the participant has finished all the tasks, you will conduct the exit interview to evaluate the tasks and the prototype.]

Now I would like to ask you, some questions to evaluate your experience of the prototype and a few follow-up questions:

- *Do you have any questions or concerns regarding the experiment?*
- *Did you encounter any problems during the tasks?*
- *How was the prototype to use? Was it easy or difficult, and why?*
- *Did you notice the changes in the traffic light? If yes, why did it change?*
- *Do you have any suggestions on improvements or missing aspects in the input of daily consumption?*
- *Do you have a preference, when entering money in the prototype? Meaning the calculator or the banknotes.*
- *What do you think about the function Future economy?*
- *What do you think about the function savings?*
- *Please elaborate if you have any suggestions on improvements or missing aspects you experienced in the prototype.*
- *Can you write your name?*
- *Can you read and write to support your everyday life?*
- *If this prototype becomes a real app, would you use it? Why/ why not?*

[After the exit interview, the participant is thanked and paid the remuneration.]

E.4 Pilot studies of the project's experiment

The pilot studies were conducted through video calls with five participants. Here, the participants were asked to carry out the trial through Preely and had to clarify problems and give feedback along the way. Here, in-depth questions were asked; if the tasks, the questions and the app itself made sense to the participants. The focus was on finding problems in the experiment and flaws in the prototype that should be corrected.
First, a pilot study was conducted with two participants. It was made clear that the first task in the app was confusing. They thought it was confusing to get from a page with information about income to a page with a lot of information without knowing anything about that page before hand. Therefore, it was chosen to start the task from the home page rather than where the income is added. This is done in order for the participants to make an overview of the home page before starting the task and thereby have a better basis to understand the context. In addition, the wording needed to be revised in the follow-up question, task 1 and 2, as they caused confusion among the participants. Both the future economy and the savings pages had to be redone as the chosen setup caused confusion in the task.
Secondly, a pilot study was conducted with one participant. It became clear that more constraints should be made in the prototype. The participant misinterpreted the task and performed another task meaning the participant was trapped in the "future" of the app and thus was unable to reach the end goal. While performing task 1-3, it is not possible to e.g. solve task 3 within task 1, but task 4-6 overlap on the home page, and thereby makes it possible to e.g solve task 6 within task 4.

Thirdly, a pilot study was conducted with another participant. The participant only had trouble performing the first task. Whereas the participant could easily perform the other tasks. This is a repetitive pattern, that the participants encounter problems during the first task, however, these enable them to solve the following tasks some what easier. Over the previous pilot studies, changes have been made to the first task to provide clues to the participants, but it needs to be acknowledged that the first task can be influenced by the participants' learning process.
Fourthly, a pilot study was conducted with one participant. The participant did not have significant problems in performing the tasks other than a brief learning period in the beginning. The participant only had feedback on design aspects, which was taken into consideration and addressed in the prototype.

E.5 Written material for the experiment in Preely

This section contains the written prototype material developed in Preely. This is the prototype used in the experiment for this project.

Introduction

Thank you for participating in our experiment. We are a 6th semester group studying Engineering Psychology from Aalborg University in Denmark who collaborate with students from Brazil. In our project, we are developing an app for Brazilian waste pickers who are living in poverty and have difficulty managing their finances. The experiment will last about 5-10 minutes and you are done when you have entered your demographics information. During the experiment, you have the full right to skip a question or leave at any given point.
In our project we have, created a character named Alexandra, who is our version of the "ideal waste picker". In the following, you will help Alexandra perform six tasks that she encounter in her use of the app. After each task, you will receive some follow-up questions.
The focus of the experiment is to identify different problems in the app. Therefore, we are not examining your performance, but the functionality of the app. It is a prototype, not all features of the app are operative.
We use the collected data for our 6th semester project report and by continuing with the experiment you automatically give, your consent that we may use your data in our project report. If you wish to withdraw your consent, you can do so by email to emorte17@student.aau.dk before 20 May 2020. Please note that we will use personal information anonymously in the report.

Scenarios and tasks

Task 1
Scenario: You now need to help Alexandra manage her finances. Alexandra has downloaded the app and she has been using it for a month. Last month she had an income of R$ 960,00 which gave her a daily maximum amount of R$ 32,00. However this month she got paid less and earned R$ 900,00.
Task: Edit the monthly salary to R$ 900,00 in the app. When you are finished, tap the traffic light on the home page.

Task 2
Scenario: Alexandra have spend R$ 25,00 at the local marked.
Task: Enter the daily consumption of R$ 25,00 in the app. When you are finished, tap the traffic light on the home page.

Task 3
Scenario: Alexandra forgot to buy tomatoes from the marked and needs to go back. She spend R$ 5,00 on the tomatoes.
Task: Enter the extra daily consumption of R$ 5,00. Note that there are two options for the input, and try to explore both. When you are finished, tap the traffic light on the home page.

Task 4
Scenario: Alexandra wants to buy a new shirt, the price of the shirt is R$ 50,00 but she is unsure whether she can afford to buy it.
Task: Use the app to examine how her future budget will look like if she uses R$ 50.00. When you are finished, tap the traffic light on the home page.

Task 5
Scenario: Alexandra wants to buy the shirt and needs to save up. She wants to wear the shirt to a birthday in 10 days.
Task: Make a saving for Alexandra of R$ 50.00 spread over 10 days. When you are finished, tap the traffic light on the home page.

Task 6
Scenario: Alexandra becomes impatient and buys the shirt.
Task: Enter the extra daily consumption of R$ 50,00. When you are finished, tap the traffic light on the home page.

Questions

Fixed question
The question; "How easy was it to perform the task?" was asked after completing each task. This was answered using a rating scale from thumbs down to thumbs up.
Follow-up questions
After the fixed question, some follow-up questions are asked specifically for the task.
Task 1: Please elaborate if you have any suggestions on improvements or missing aspects you experienced in the app.
Task 2: Did you notice any changes on the home page after you added the R$ 25,00? And do you have any suggestions on improvements or missing aspects in the input of daily consumption?
Task 3: Which of the two options for the input do you prefer and why? And do you have any suggestions on improvements or missing aspects in the input of expenses?
Task 4: Was the meaning of future economic clear? And do you have any suggestions on improvements or missing aspects in the future economic part?
Task 5: Was the meaning of savings clear? And do you have any suggestions on improvements or missing aspects?
Task 6: Did you notice that the traffic light changed during the tasks, and if yes why? Do you have any suggestions on improvements or missing aspects in the app?

Appendix F

Thematic analysis of follow-up questions

This appendix encompasses the thematic analysis on the subjective data gathered through the questions from the prototype. The six steps; Familiarisation, Coding, Generating themes, Reviewing themes, Defining and naming themes and a summary of the findings are conducted for each of the six tasks. The completed data set of all the comments and the associated coding can be found in the attached appendix G.4.
Familiarisation is done by extracting the answers from the six tasks in Preely. Afterwards the answers are examined and an overview is gained. As the answers are provided in text, the answers provided in Danish and Portuguese are translated. Afterwards the answers are sorted and divided. However, not all the participants provided feedback in regard to the questions. Comments like "No" [Don't want to answer the question], "Okay" and dots, are sorted out. Also comments that indicates that the participants haven't read the guidelines for the task are sorted out e.g. from task 1 "After finishing task 1 I could not find How I could pass to Task 2". The design suggestions are the last type of answers that are deduced. These are provided in a separate table to each task.

F.1 Results from task 1

Follow-up question: Please elaborate if you have any suggestions on improvements or missing aspects you experienced in the app.
In total 32 participants provided answers that contained feedback in regard to the task and from them 41 statements is withdrawn. From the statements the following eight codes are found; Easy, Intuitive, not intuitive, difficult to find, misleading, doubt, trial and error, needs clarification, time consuming, confusing and not clear. From the codes, four themes are generates; Intuitive, Not intuitive, Difficult to find and Steep learning curve. The distribution between the statements, the codes and themes are illustrated below on the bar chart, see figure F.1. Feedback from this task also includes the following design suggestions:

- The headline in the top could Maybe be more precise
- It can be dangerous to display an edit pencil next to a text field if that functionality brings the user somewhere else
- Usability over learnability, which may well make sense in your context, just be conscious.
- I would prefer ok button at right and cancel to the left.
- I don't know if pressing the traffic light is necessary in the real situation (I don't think so, as it shouldn't be). Besides that, inserting that functionality in the first page is an option to consider.
- Maybe have it as it's one icon. [Monthly income and the change functions]

- I think if you put another space where the waste pickers could change just your monthly salary, would be better than a space for a daily maximum amount where you have to tap for edit your monthly salary.
- Maybe add a symbol beside it to show that it can be edited (like a pencil or a plus)
- Maybe the shown income could be the monthly payment, not the daily, it would be more intuitive to edit.
- It would make sense that there was a menu just like saving [Entering of salary]

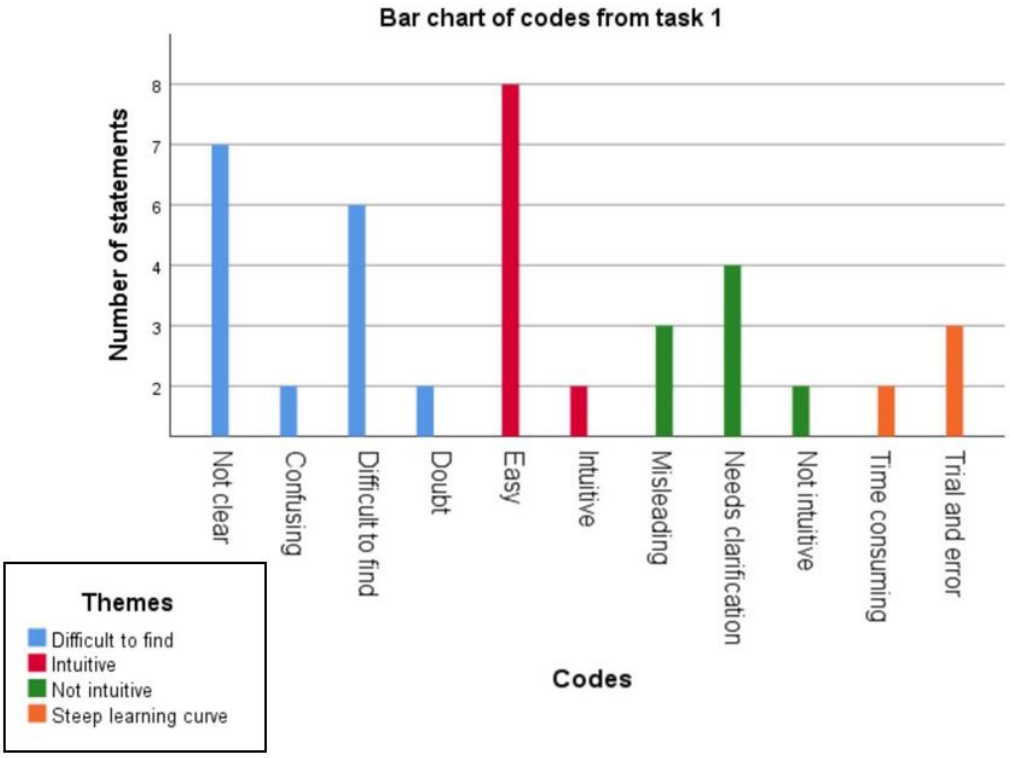


Figure F.1: The bar chart illustrates the distribution between the statements, codes and themes from task 1.

F.2 Results from task 2

Follow-up question: Did you notice any changes on the home page after you added the R$ 25,00? And do you have any suggestions on improvements or missing aspects in the input of daily consumption?
In total 33 participants provided answers that contained feedback in regard to the task and from them 35 statements is withdrawn. From the statements the following nine codes are found; Easy to use, Clear, Confusing, Not able to press all coins/banknotes, Confused about the two input, Don't understand the change of the traffic light, It starts to make sense, Noticed the traffic light turned yellow, Did not notice a change. From the codes, four themes are generates; Easy to use, Confusing, Now it makes sense, and No Change detected. The distribution between the statements, codes and themes are illustrated below on the bar chart, see figure F.2. Feedback from this task also includes the following design suggestions:

- When I see a calculator I think I have to figure something out, maybe another symbol would be better
- In the daily consumption page, I missed a clearer button or text to tell me where should I press in order to insert the amount
- Maybe the first button could be the money one, because it'll be an app for people who don't know how to read, and it could be more intuitive to choose coins and currency instead of writing the value down. [Change the default method to coin/banknotes]

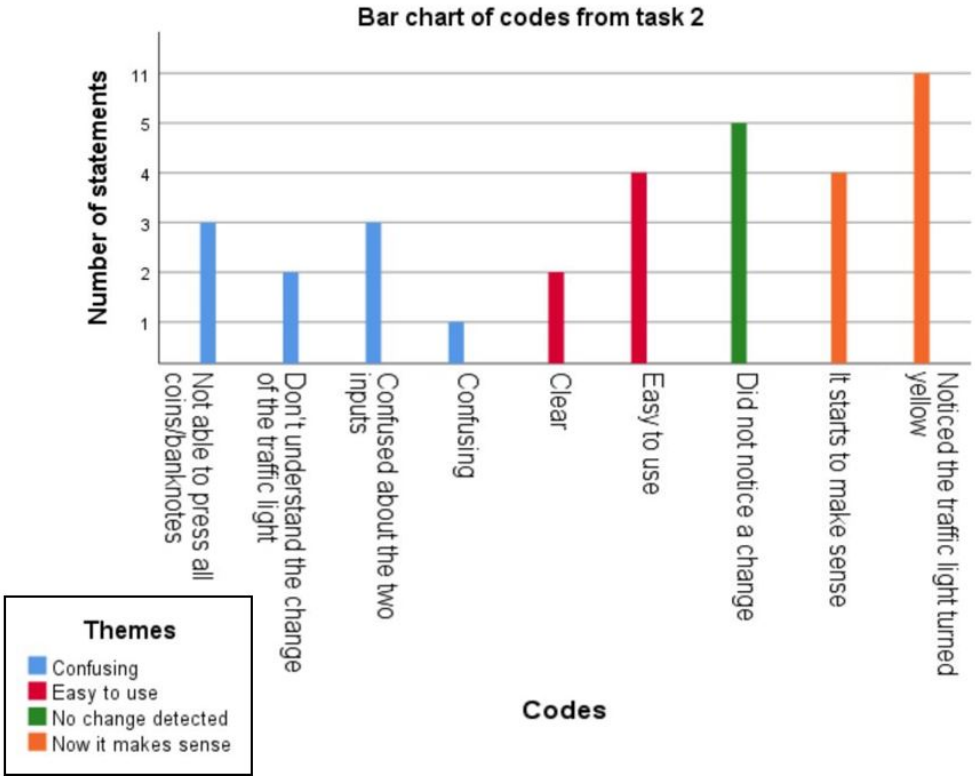


Figure F.2: The bar chart illustrates the distribution between the statements, codes and themes from task 2.

F.3 Results from task 3

Follow-up question: Which of the two options for the input do you prefer and why? And do you have any suggestions on improvements or missing aspects in the input of expenses?
In total 35 participants provided answers that contained feedback in regard to the task and from them 46 statements are withdrawn. From the statements the following 13 codes are found; Easy to use, Clever, Good overview, Found two input method, Could only find one input method, Not intuitive, Redundant, Confused, Coins/banknotes input was confusion – Not my currency, I couldn't change input method, Prefer input via coins/banknotes, Input method – No preferences, Prefer calculator design. From the codes, four themes are generates; Easy to use, Input methods, Confusing, Different preferences. The distribution between the statements, codes and themes are illustrated below on the bar chart, see figure F.3. No participants had design suggestions for Task 3.

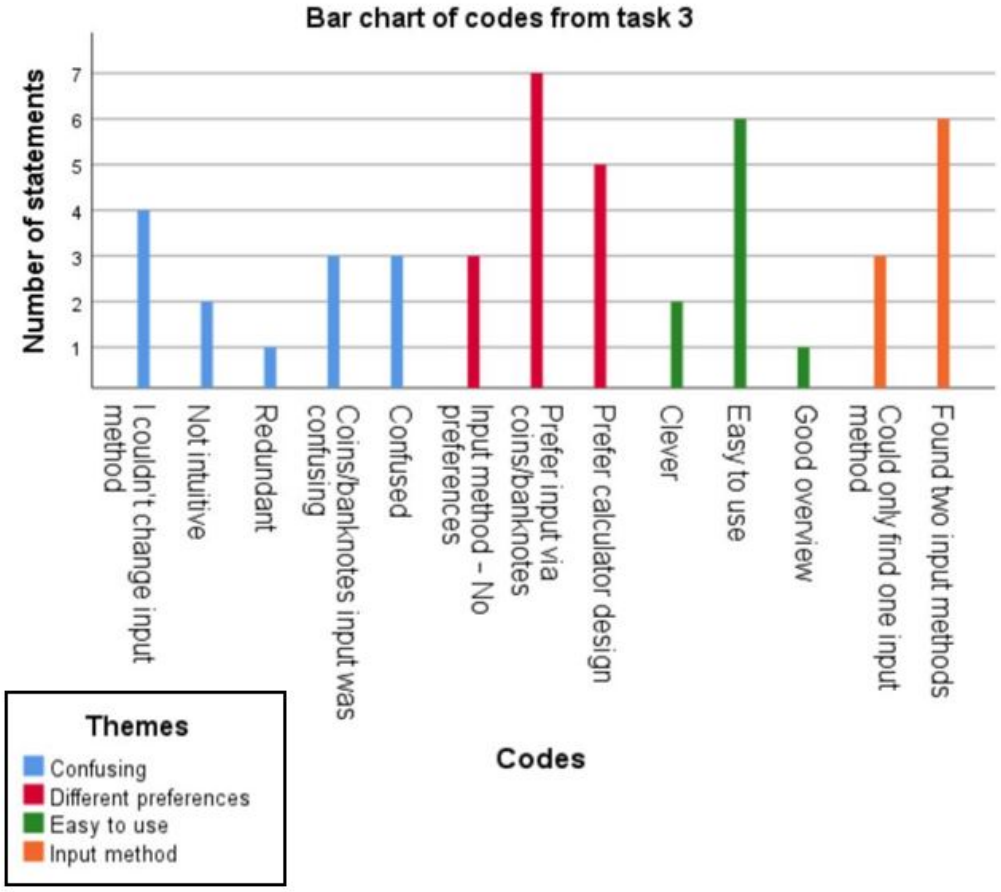


Figure F.3: The bar chart illustrates the distribution between the statements, codes and themes from task 3.

F.4 Results from task 4

Follow-up question: Was the meaning of future economic clear? And do you have any suggestions on improvements or missing aspects in the future economic part?
In total 37 participants provided answers that contained feedback in regard to the task and from them 43 statements are withdrawn. From the statements the following eight codes are found; Smart, Clear, Good overview, Easy to use, Not intuitive, Not clear, Very hard to understand, Takes time to understand. From the codes, three themes are generates; Smart, Not intuitive and Time consuming. The distribution between the statements, codes and themes are illustrated below on the bar chart, see figure F.4. Feedback from this task also includes the following design suggestions:

- Although it's just a perception of the moment, something like "sacrifice to buy" or "make a big purchase". But the ideal would be to teach them to have a lower budget than (income)/(days in a month). In that way, they keep saving money TO buy and not saving AFTER buying.
- But it was a pity that I could only look 3 days ahead. It had made more sense to me to be able to see the amount stretched for example over several weeks

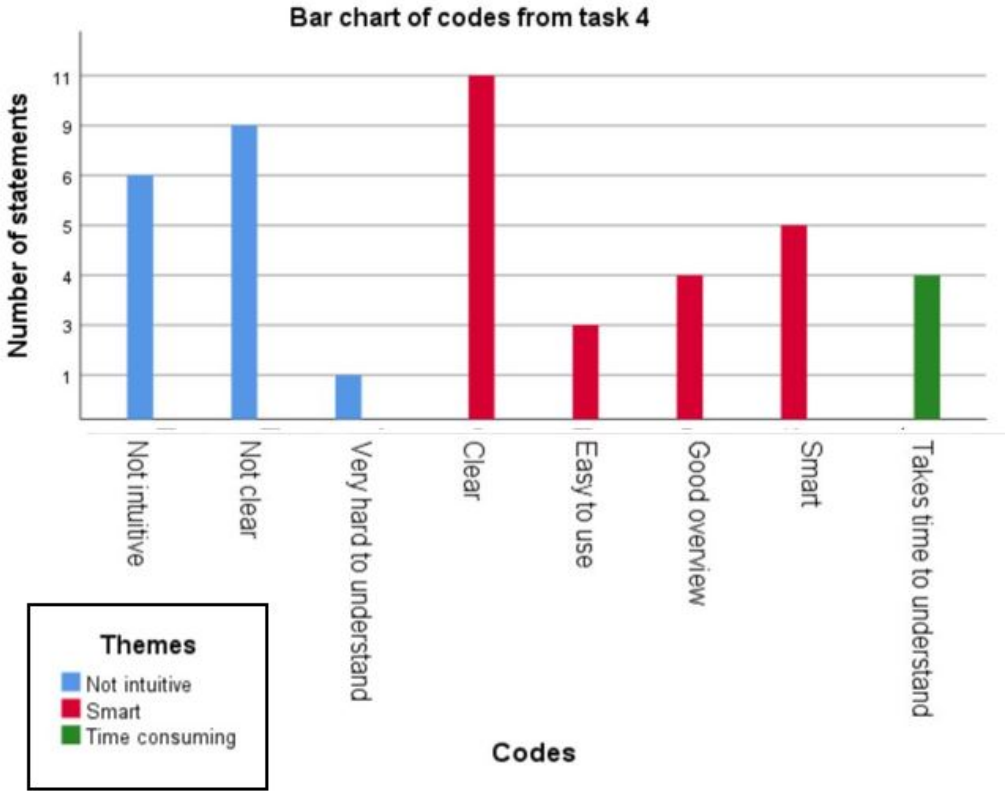


Figure F.4: The bar chart illustrates the distribution between the statements, codes and themes from task 4.

F.5 Results from task 5

Follow-up question: Was the meaning of savings clear? And do you have any suggestions on improvements or missing aspects.
In total 30 participants provided answers that contained feedback in regard to the task and from them 37 statements are withdrawn. From the statements the following 11 codes are found; Easy to understand, Best function of all, Nice feature, Great, Clear, Smart, Intuitive, simple to interpret, Not intuitive, Confusing, Annoying. From the codes, three themes are generates; Easy to understand, Not intuitive, Annoying. The distribution between the statements, codes and themes are illustrated below on the bar chart, see figure F.5. Feedback from this task also includes the following design suggestions:

- I would also suggest using the phone's own keyboard for the number input, when using the calculator.
- Maybe the daily maximum should reflect that less money can be used per day when saving up
- This part really is rather clever, though. I see the appeal in being able to save up for something - probably something more expensive like the down payment for a house or something similar
- It could be great to have other graphics, you could choose from as well, so if it motivated one to see the green at the top or to the side, you could change it to another kind of graph.
- When she reach to saving goal it would be interesting if the app "celebrated"

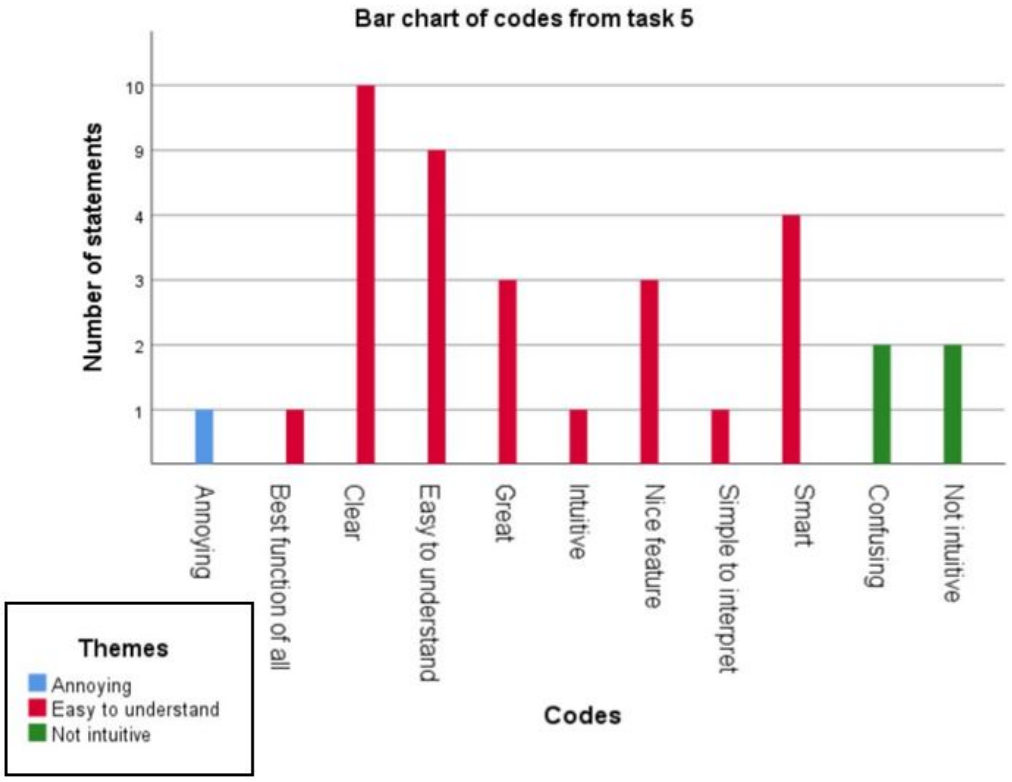


Figure F.5: The bar chart illustrates the distribution between the statements, codes and themes from task 5.

F.6 Results from task 6

Follow-up question: Did you notice that the traffic light changed during the tasks, and if yes why? Do you have any suggestions on improvements or missing aspects in the app?
In total 37 participants provided answers that contained feedback in regard to the task and from them 41 statements are withdrawn. From the statements the following seven codes are found; The traffic light make sense, Don't understand, Notices the change in the light - but I did not understand it, Confusing, Not easy to change the input, Smart, Easy. From the codes, three themes are generates; Understand the analogy, Don't understand, Smart. The distribution between the statements, codes and themes are illustrated below on the bar chart, see figure F.6. Feedback from this task also includes the following design suggestions:

- Maybe make an easier way of making purchases. Maybe build it into a menu with savings and future.
- I think it could be very interesting if the group would think at some "gamification" for who is actually engaged to the app! So something to really stimulate the person to use it everyday.
- If the main feature is to input your daily consumption, I think it should be on the front page, instead in a second view
- Beside that the traffic light turns red perhaps you should add blinking red light and/or warning sound.
- Besides it changes to red i think you should have a dialog box telling you are over budget and need to do some changes else you ran out of money. Very explicet.

- The thing of stimulating continuous savings, instead of only when there are specific goals, is one thing that could be interesting.
- I have some suggestions for improvement. You could:
  - Make it easier to read the future planning, maybe some descriptions
  - Put some navigation guides in the beginning, for the user to get a better flow of the app
- Some suggestions would be to, in the future, make it possible to share it with someone (as a viewer only) so they can help out.
- I really liked the concept, easy to get and if done correctly can help out a lot.

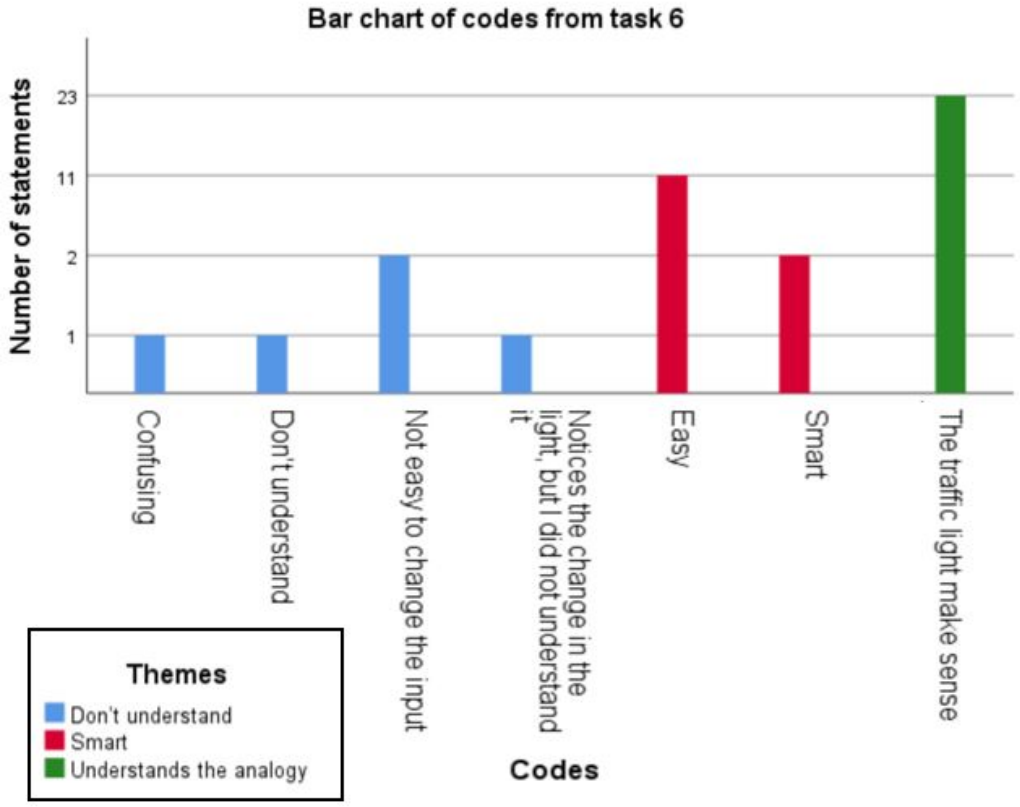


Figure F.6: The bar chart illustrates the distribution between the statements, codes and themes from task 6.

Appendix G

The attached appendix

The following is a list of the attached appendix.

G.1 Brainstorm session

This attached appendix contains data from the brainstorm session which is used in section 3.2.
The attached appendix can be found in the folder which is attached to the report. It can be found under:
Attached appendix -> G.1 Brainstorm session

G.2 Data from experiment

This attached appendix contains data from the experiment which is used in chapter 6.
The attached appendix can be found in the folder which is attached to the report. It can be found under:
Attached appendix -> G.2 Data from experiment

G.3 Path: direct or investigating

This attached appendix contains pictures of the direct and investigating path described in section 6.1.2.
The attached appendix can be found in the folder which is attached to the report. It can be found under:
Attached appendix -> G.3 Path: direct or investigating

G.4 Thematic analysis

This attached appendix contains the thematic analysis which is used in section 6.2.2.
The attached appendix can be found in the folder which is attached to the report. It can be found under:
Attached appendix -> G.4 Thematic analysis