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Universal Design of ICT

**Evaluating dietary apps from the
perspective of universal design**

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OSLOMET

Preface

Technology has been a big part of my life and still is today. This is one of the main reasons why I have chosen a technology-based education. I learned about the term universal design when I started my bachelor's degree and from that day, I have been thinking about it daily. As the world becomes more digitalized and technology is being integrated into our daily lives. Everyone should have the possibility to use the technology. Another part of me is passionate about health and being healthy. This thesis let me explore more of universal design in a health-related app. I believe that the works I have done will contribute to the universal design and health community.

I could not have done this without my supervisor, Bong Way Kiat. Thanks to him, I had the opportunity to research in a field that I'm passionate about. Not only has he given me advice and pushed me to improve academically, but he has also helped me get out of my comfort zone. Special thanks to all the participants that volunteered and were willing to spend their spare time evaluating dietary application with me. Lastly, I will thank my parents for supporting me with love and always being there for me. Thank you all for your support.

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Do Kha Nguyen

Abstract

Our health is becoming more and more important over the years. Not because we are getting older, but because our lives are becoming more and more sedentary. Ways to improve our health are exercising, eating healthy, and maintaining healthy body weight. In this study, we evaluate three different dietary applications from the perspective of universal design using ten participants with diverse backgrounds.

The study was conducted under the covid-19 pandemic in Oslo, and a different testing approach was used. The method that was used to evaluate the dietary applications was remote usability testing. The usability testing was split into three parts: pre-interview, usability testing task, and post-interview. The usability testing tried to figure out different issues and areas of improvement that the dietary applications had. Information about the participant's experience with dietary applications, attitude towards dietary applications, and their feedback on the evaluated dietary was sampled. The result of the usability testing was that the dietary applications had two main issues in common. This was navigating to change "current weight" and check how many calories have been eaten. The participants suggested different areas to improve on each of the dietary applications.

The result from the usability testing was used to make a prototype that showed how an improved dietary application could look. The age group of the participants was from 20 to 50 years old, and 50% of the participants had used a dietary application before. The study shows different dietary application issues and that the participants had a positive attitude towards dietary applications.

Table of contents

Preface.....	1
Abstract	2
List of Figures.....	6
List of Tables	8
1. Introduction.....	9
2. Literature Review.....	11
2.1 Universal Design	11
2.1.1 Universal Design in the past and now	11
2.1.2 Universal design in dietary applications.....	13
2.2 Mobile Applications.....	14
2.2.1 What do users not like about different applications?.....	14
2.2.2 Health App Users	14
2.2.3 Dietary app and nutrition apps	15
3. Methodology	17
3.1 Usability testing.....	18
3.1.1 Choice of applications	18
3.1.2 Recruitment.....	19
3.1.3 Tools.....	19
3.1.4 Pre-usability testing.....	19
3.1.5 During the usability testing	20
3.1.6 Post usability testing.....	22
3.1.7 Analyzing the data	22
3.2 Prototype design	23
3.2.1 Making the prototype	23
4. Results	24
4.1 Participants.....	24
4.2 Changes made to testing tasks	25
4.3 Usability test.....	28
4.3.1 Task 1	29
4.3.2 Task 2	32
4.3.3 Task 3	33

4.3.4 Task 4	33
4.3.5 Task 5	34
4.3.6 Task 6	35
4.3.7 Task 7	35
4.3.8 Summary of issues and areas of improvement.....	37
4.4 Prototype.....	40
5. Discussion	46
5.1 The prototype that has been designed.	46
5.2 About the participants	49
5.3 Remote usability testing.....	51
5.4 Limitations and future work.....	53
6. Conclusion	54
7. References	55
8. Appendix.....	57
8.1 Consent form.....	57
8.2 Background information questions	58
8.3 Usability testing tasks version 1	58
8.4 Usability testing tasks version 2	59
8.5 Interview after usability testing	59
8.6 Chosen dietary applications	60
8.7 Link to Figma project	60
8.8 Summary of post-interview answers.....	60

List of Figures

Figure 3.1: Setup using a laptop with an integrated camera.	21
Figure 3.2: Setup using a standalone webcam.	21
Figure 4.1: (A) MyFitnessPal uses the wording “Current weight” (B) MyNetDiary uses the wording “Current weight” (C) Lose It uses the wording “weight”.	26
Figure 4.2: (A) MyFitnessPal uses the wording “Goal weight” (B) MyNetDiary uses the wording “Target weight” (C) Lose It uses the wording “Goal weight”.	27
Figure 4.3: (A)(B)(C) All the dietary applications save previously used food options.	28
Figure 4.4: Diet app: Lose it, four interfaces the user needs to use. (A) Go to “goals”, (B) click on the graph, (C) click on the cogwheel, and (D) scroll down to weight.	29
Figure 4.5: Diet app: Lose it, three interfaces the user needs to use. (A) Go to log, (B) click on the number under budget and (C) scroll down to weight.	30
Figure 4.6: Diet app: MyNetDiary, four interfaces the user needs to use. (A) Click on the hamburger menu, (B) click on “my plan”, (C) click on the weight & calories, and (D) click on current weight.	30
Figure 4.7 Diet app: MyNetDiary, three interfaces the user needs to use. (A) Click on “coach”, (B) click on “Weight Plan” and (C) click on current weight.	31
Figure 4.8 Diet app: MyFitnessPal, three interfaces the user needs to use. (A) Click on “Me”, (B) scroll down and click on Update Goals and (C) click on current weight.	31
Figure 4.9 Diet app: MyFitnessPal, three interfaces the user needs to use. (A) Click on the hamburger menu, (B) click on Goals and (C) click on current weight.	32
Figure 4.10 (A)MyFitnessPal (B) MyNetDiary (C) Lose It. “Current weigh”t and “goal weight” are in the same interface.	33
Figure 4.11 (A)MyFitnessPal (B) MyNetDiary (C) Lose It. The search function in the three dietary applications.	34
Figure 4.12 (A)MyFitnessPal (B) MyNetDiary (C) Lose It. How the screen looks like when using the barcode scanner function.	34
Figure 4.13 Dietary application: MyFitnessPal, (A) “calorie limit – calories consumed + exercise = remaining calories” way, (B) graphical way.	36
Figure 4.14 Dietary application: MyNetDiary, (A) graphical way, (B) “calorie limit – calories consumed + exercise = remaining calories” way.	36
Figure 4.15 Dietary application: Lose It, (A) graphical way, (B) “calorie limit – calories consumed + exercise = remaining calories” way.	37
Figure 4.16 MyFitnessPal’s search function	38
Figure 4.17 MyFitnessPal, the different serving options that the user can choose from.	39
Figure 4.18 The user has the option to change current weight and log weight in the same interface.	41
Figure 4.19 The user can see the word” current weight” and using edit weight goal to change “current weight”.	42
Figure 4.20 The user had the option to change “current weight” in “edit Profile”.	42
Figure 4.21 Improved graphical calorie summary.	43

Figure 4.22 Improved calorie summary..... 43
Figure 4.23 Barcode scanner 44
Figure 4.24 The tutorial interface when the user login to the application. 45

List of Tables

Table 4. 1 Demographic information of the participants 24
Table 4. 2 Result from the post-interview. 40

1. Introduction

The world we live in today is under technological changes all the time, which has impacted our daily lives in many ways. A regular day for a person can be split into different activities: (1) Sleep, (2) work, (3) eat, and (4) leisure time (Ortiz-Ospina, 2020). Technology has changed how we communicate, pay bills, entertainment, and transportation. It has changed how we live in and outside our home. We have amazing tools and resources at our fingertips. The revolution of technology has come a long way considering that every multifunction device like smartphones, smartwatches, and computers is becoming faster, more portable, and high-powered. This is just the start of the technological revolution. Everyday technology is being developed, innovated, and implemented into our daily life faster than ever.

With all the life improvement and changes technology have made, we still need to look at the negative side. One of the sectors that have changed a lot is how we work and spend our spare time. The work has become less physically demanding and more sedentary in many sectors. Statistics from 2017 showed that 39% of people employed in the European Union (EU) carried out their work sitting down, 20% spent most of their time standing, 30% has some moderate physical effort, and 12% is involved in heavy physical effort (Eurostat, 2019). This is an average, and it may differ from different EU countries. Statistics show that our lifestyle has become less physical at work and we are getting more sedentary over the years.

A report from WHO stated that having a sedentary lifestyle increased all causes of mortality, doubling the risk of cardiovascular diseases, diabetes, and obesity and increasing the risk of high blood pressure, depression, and anxiety. 60-80% of the people in the world from both developed and developing countries lead sedentary lifestyles (WHO, 2002). A study done in Denmark showed that physically demanding jobs are linked to shorter working lives, more sick leave, and unemployment. The researchers pointed out that other factors were not accounted for in the analysis, like lifestyle factors such as obesity and smoking (BMJ, 2020). In 2020, the Covid-19 pandemic hit Norway and changed how we live even more, home office, digital education, closed gyms, and avoiding contact with each other. This pandemic forced us to have a more sedentary lifestyle and less active. To conclude, we see

that every work sector has some health issues and with the restrictions under the pandemic, our health has gotten worse.

Keeping a healthy lifestyle has become more important over the years. There are many different solutions to fix the problem with a sedentary lifestyle and obesity. It can be exercise, be aware of the situation you are in, nutrition and diet. In this study, we are going to focus on the dietary side. Using a dietary app, users can track their food intake and get provided different tips and information on the nutritional value of foods. Through monitoring food intake, it is hoped that the user becomes more aware of their consumption and helps them to change into healthier eating habits. It has been estimated that one in five early deaths worldwide is associated with poor dietary habits (Abrahams & Matusheski, 2020). We can use a digital tool to help individuals improve their dietary habits.

When people want to change their diet or start a new one to improve their health, they need a platform to track their diet. This is where dietary applications become the tool for people so they can achieve their goals. There are many different types of dietary applications on the market. They are designed differently, have various features, specialize in different fields, and have their pros and cons. A study conducted in the United States found out that a significant portion of the population did not use any health apps. Half of those who had used some health app stopped using them due to high data entry burden, loss of interest, and hidden costs (Krebs & Duncan, 2015). There have been many studies on the use of dietary and health applications, but there is little research focusing on the aspect of universal design on dietary applications.

This study looked at three popular dietary applications on the android and IOS market and evaluated them from the perspective of universal design. The method used to evaluate these dietary applications were usability testing with ten different participants. Since this study was conducted under the Covid-19 pandemic, some restrictions that had to be followed. In Oslo, the government has prohibited us from meeting each other, therefore local testing was not an option. The workaround for the restrictions was conduction the usability testing remotely, which means that the usability testing will be conducted and communicated with the participants over the internet. The findings under the usability testing were used to develop a prototype. Developing this prototype demonstrate how the current design could be improved based on the feedback from the users.

2. Literature Review

2.1 Universal Design

2.1.1 Universal Design in the past and now

The meaning of Universal Design is to make the design of buildings, products, or environments accessible to all people, regardless of age, disability, or other factors. There are seven principles of Universal Design that can be applied to any design process in any realm: physical and digital.

These are the seven principles:

1. Equitable Use. The design is useful and marketable to people with diverse abilities.
2. Flexibility in Use. The design accommodates a wide range of individual preferences and abilities.
3. Simple and Intuitive Use. The design is easy to understand, regardless of the user's experience, knowledge, language skills, or current concentration level.
4. Perceptible Information. The design communicates necessary information effectively to the user, regardless of ambient conditions or the user's sensory abilities.
5. Tolerance for Error. The design minimizes hazards and the adverse consequences of accidental or unintended actions.
6. Low Physical Effort. The design can be used efficiently and comfortably and with a minimum of fatigue.
7. Size and Space for Approach and Use. Appropriate size and space are provided for approach, reach, manipulation, and use regardless of user's body size, posture, or mobility.

A journal written in 1998 wrote about how to achieve universal design in different areas, how to evaluate the new and existing design and the future of universal design. When talking about applying the principles of Universal Design, the author wrote: "While the Principles of Universal Design are a landmark achievement in communicating the concept of universal design and all of its varied aspects, more must be done to make them easier to apply" (Story, 1998). This journal was written in 1998 and if we look at how it is today, so much has been done to make universal design more understandable and applicable. A

google search on universal design will result in many different sources to apply universal design in various fields such as education, applications and mobiles.

The goal of Universal Design is to design anything for as many people as possible. This goal is challenging to achieve considering all the different types of disabilities and those with severe disabilities. This is the reason why assistive technology will always be needed in some cases. While it can be challenging to design something for everyone, the journal written by Molly Story shows the other benefits universal design has to offer (Story, 1998).

- Reduce the cost of a device due to greater economies of scale realized by mass production.
- Longevity of a device that continues to serve people even as their ability changes.
- Better reliability of devices that were mass produced.
- Inclusion of a person with a disability in using the same tools as everyone else in the family for everyday activities; and
- Lack of stigma associated with devices that are used by everyone.

The last topic in the journal by Story (1998) is about the future of universal design. How we only understand Universal Design in the research and academic communities. To make a change in individual's quality of life, the industry should try to accept and adopt the concept of Universal Design. The industry needs to do three things: Gather statistical justification of practicing universal design, a set of measures of universal design performance measures which to judge their designs for use by a diverse consumer base and guidance to market their products appropriately. The author concludes that: "The most significant benefit to the proliferation of universal design practice is that all consumers will have more products to choose from that are more useable, more readily available and more affordable".

This journal was written in 1998 and looking at newer research, we can see the development of Universal Design. Research written in 2012 shows that universal design provides a framework to contribute, potentially, to a progressive politics of disability based on reducing inequalities of access related to poorly designed environments. The Universal Design movement has made us understand the interrelationship between physical and emotional changes in life. There is still the problem of using universal design as a part of institutional processes, including the production, dissemination, and circulation of ideas

about design, disability and access (Imrie, 2012). We now see how universal design has evolved over time and how much more we want to implement the concept, but we still have the problem of making it easier to achieve Universal Design.

2.1.2 Universal design in dietary applications

There haven't been many studies about universal design in dietary applications, but some studies talk about the topic. One study conducted in spring 2014 (Farsjø & Moen, 2017) developed a tablet application for nutrition, presenting dishes, enabling registration of food choices and notification about meal times called APPETITT. Under this study, they had four elderly people testing the application for four weeks. With focus group interviews, data was collected on how the informants used the application APPETITT and feedback on the application. The result for the study found out that informants considered the app APPETITT easy to use. When looking at the different features and functions, each informant had different preferences. Two informants found that reporting food choices increased awareness, while two saw little need for this function. Only one of the informants had paid attention to notifications. Even if the app APPETITT was developed specifically for the elderly, there were areas of improvement.

Universal design is about design of products usable to as many people as possible. A study was conducted where the main focus was to review the usability of current iPhone and Android diet-tracking apps (Ferrara et al., 2019). The top seven diet-tracking apps were downloaded from the iOS iTunes store and Android Play online store and used over two weeks by three users. Each of the applications was independently scored by the user using the System Usability Scale (SUS). The result was at all the dietary applications scored well with respect to usability. One of the limitations to the results was that the users testing these diet applications were technology-savvy and trained in nutritional science. Therefore, the usability score for the diet applications may not generalize to the population who don't have any training in nutrition. This shows that further studies need to be done with a more diverse user group to test the usability of dietary applications.

2.2 Mobile Applications

2.2.1 What do users not like about different applications?

Looking at a research paper named “What Do Mobile App Users Complain About” (Khalid et al., 2015). They picked the 20 most popular IOS apps that were free to download and collected the reviews from each app. Then they categorized the reviews down to 12 categories: (1) app crashing, (2) compatibility, (3) feature removal, (4) feature request, (5) functional error, (6) hidden cost, (7) interface design, (8) network problem, (9) privacy and ethics, (10) resource-heavy, (11) uninteresting content, and (12) unresponsive app. With every review categorized, they could rank each category on their frequency.

The categories mostly related to universal design and usability are nr two compatibility, nr three feature removal, nr four feature request and nr seven interface design. The researchers found out that most of the complaints were written after the application was updated. Then the researchers wanted to see if there were a relationship between updates and complaints. They found out that around 20% of the complaints were after they have updated their application. Then they split up the complaints into three parts to see which stakeholder could fix the issue. 45.6% of the complaints were development-related complaints like app crashing, functional error, network problem, resource-heavy and unresponsive app. 22.7% of the complaints were related to knowledge of the project and priorities like feature removal, feature request, interface design, and compatibility.

These 22.7% of the complaints are complaints that are mostly related to universal design and accessibility. This study was done with a small sample of apps from the iOS market and might not generalize to every app. We can conclude that dietary applications should have at least some complaints related to universal design and accessibility.

2.2.2 Health App Users

When looking at the study “Health App Use Among US Mobile Phone Owners” (Krebs & Duncan, 2015), we can see who uses health apps and why they chose to do it. This study was a national survey where over 1600 participants complete the survey. They found out that over half of the participants have downloaded a health-related mobile app. Fitness and nutrition was the most common category of health apps used. Those that had downloaded a

health-related app used them daily. The other half of the participants did not use any health apps because of lack of interest, cost and concern about apps collecting their data.

When looking at the demographic that used a health app, they tend to be younger, have higher income, be more educated, be Latino/Hispanic, and have a BMI higher than average. These users agreed that the app has helped them improve their health, but half of them stopped using the application over time. They stopped using the application due to high data entry burden, loss of interest and hidden cost (Krebs & Duncan, 2015).

Many factors need to be looked at on why a user stop or uses a health app. A study (Ghalib et al., 2020) looked at 35 different dietary-related applications and evaluated them after the user's requirement for a user interface. What the user required for a user interface was: (1) Two user dashboards, (2) Application design, (3) User-friendliness, and (4) Tutorial page. The application design should be simple, have fewer data entry steps, have icons, and have good font size and colors. The application should have a tutorial on the introduction page to guide users on how the application works to increase the application's usability.

When almost everyone in the world has access to a mobile phone, not everyone will use a health-related app for various reasons. Those who use any health-related app tend to quit because of the data entry burden and loss of interest. To make people use any health-related apps, the apps need to be developed with the user in mind and develop the application with help from professionals.

2.2.3 Dietary app and nutrition apps

Diet and nutrition can have the same definition, but in some cases, they are very different. Diet is what kind of food and drinks a person consumes daily. Nutrition is about that the food that we consume are made of. Our body needs nutrition to function. The quality of nutrition determines how optionally our body works. Diet is what we consume, and the quality of nutrition depends on the quality of our diet. The word diet is often used for weight management. When it comes to dietary applications and nutrition applications, there is a difference. Dietary application has the focus to track what the consumer eats and their weight. Nutrition applications look at our diet and tell the user if they are getting enough nutrients. In this study, we evaluate dietary applications and the focus is to evaluate

functions and features related to tracking food, calorie consumed, and logging/recording weight.

3. Methodology

The goal of this study is to evaluate three dietary applications with universal design in mind. The evaluation will give a better overview of various problems and areas for improving on these dietary applications. We designed a prototype to show how an improved, more user-friendly, and accessible dietary can look like with this knowledge.

The first methods were interviews and observations with the participants under a usability test where the writer was the test leader. There are many ways to conduct usability testing, such as field usability testing, laboratory testing, and remote usability testing. Field usability testing and laboratory testing are methods where the participants were observed by evaluator(s) while performing the testing tasks, both being physically in the same location. With the situation in Norway with Covid-19 and the restrictions, physical meetings were not safe and therefore not recommended. Therefore, remote usability testing was a better and safer alternative for both parties. Research has shown that remote usability testing works as effectively as traditional testing (Thompson et al., 2004).

Remote usability testing required that the participants and the test leader prepare more before conducting the usability test. The time used to conduct each usability test was around 30-45 min, considering longer remote testing could exhaust the participants. Some of the preparation was to install the diet apps and login into an existing account. This was done to make the usability testing as smoothly and stress-free as possible for the participant. In section 3.1.4 pre-usability testing, a more in-depth explanation about the actions will be found.

The number of participants that were chosen was ten people with a diverse background. These participants were evaluating two different dietary applications. When analyzing the result, we looked for common problems and issues observed and common areas of improvement. After analyzing the result, we understood the problems with these dietary applications and where it can be improved. This knowledge was applied to the prototype to show how an improved dietary application can look. The prototype was built on a wireframe tool called Figma described in 3.2.1 Tools.

3.1 Usability testing

3.1.1 Choice of applications

In this study, we had chosen to evaluate three different dietary applications on the mobile market. Due to the time limit set for each usability test and the number of participants used, three dietary applications were a good number for the study. Some requirements had to be met for the dietary application to be used in this study. These are the requirements used:

- Be available on the iOS or android market.
- Free to use.
- Having the option to input some nutrition data.
- Having the feature of barcode scanner.
- Weight planner.
- Option to input weight.
- Able to make an account.

If the applications were available on both operative systems, that would be a plus. This gave us the freedom to test any of the dietary applications with any participants. We focused on free dietary apps because findings have shown that the majority do not pay for any mobile app at all (Honary et al., 2019). The app could have the option to pay for more functions and features. The requirements about logging different nutrient data, barcode scanner, weight planner, and logging weight are related to diet and health in general, therefore crucial that these diet apps meet these requirements. To reduce the stress for the participants, having the option to make an account is essential. An account was made before the usability testing, and this will let the participants skip the long process of creating an account. The test leader has access to this account and the inputs were deleted before every usability testing to ensure that every participant completed the same tasks with the same conditions. Many dietary applications fitted these requirements and three were only chosen. The dietary apps that were chosen were MyFitnessPal, Lose It! and MyNetDiary. The logo of the different diet applications can be seen in Appendix 8.6 Chosen dietary application.

3.1.2 Recruitment

In this study, ten participants were recruited for usability testing. There were some criteria and requirements that the user needed to meet to participate in this study. The study's goal was to evaluate different dietary applications with universal design in mind and having a diverse group was important.

The first step of the recruitment was making a consent form that would tell potential participants what they were going to do and background information about the study. These consent forms were sent out with an invitation to different people. Some requirements were needed to be filled in to be a part of the study.

Requirements for participants:

- Age group: Young adult or adult
- Language: English or Norwegian.
- Access to an iOS or Android smartphone.
- Have a computer or laptop with a webcam.

3.1.3 Tools

Usability testing was conducted remotely and mobile was one of the tools that had to be used to test out the different dietary apps. Other physical tools that were needed for the usability testing were a computer or laptop with a webcam. The participants needed to have a webcam because this was the only way for the test leader to observe what the participants were doing on the diet app. To communicate with the participants, Zoom, Discord, Google Hangout, or Microsoft Teams were used. All these communication tools are popular, and participants had different experience levels with these communication tools. Having many options that the participants could choose from would reduce their stress level if they had prior experience. Remote testing could be stressful, and it was important to give the participants the smoothest experience.

3.1.4 Pre-usability testing

For the usability testing, there were three parts: Pre-interview, usability testing tasks and post-interview. In the pre-interview, background information was gathered like age, gender, type of phone, education level, their ICT skills, thought about diet and experience

with diet applications. The questions that were asked can be found in Appendix 8.2 Background information questions.

The tasks that were made were related to the requirements of the dietary applications used. A diet app needs to be able to track your food consumption and weight. Seven different tasks were made that covers a big field of functions. The tasks can be seen in Appendix 8.4 Usability test tasks version 2. The estimated time to complete a usability test was 30-45 min and seven tasks fitted the time requirement. The usability testing was planned to be finished around 30-45 min because longer than that might exhaust the participants. The test leader tested out the tasks to ensure that the usability testing was not longer than 45 mins and that each task was possible to complete on each dietary application.

Before conducting the usability testing with the participants, a date was needed to be scheduled. A message was sent out to all the participants to find out when they had time to conduct the usability testing and what communication program they preferred to use. To save time before the usability test, an instruction file was sent to the participants with the message. In the instruction file, participants got information on how to download the different diet apps and which one they needed to download before the usability testing. The participant was also given an account used to log in to the diet apps. If the user needed some help, they could contact the test leader or wait until the scheduled usability testing date to get help. In some cases, the participants chose to get help on the scheduled date and 5-10 minutes were used to download the applications and help them to get logged in. The consequence was that the usability test became longer than expected.

3.1.5 During the usability testing

The participants got a link to the selected communication tool and when they connected to the video call, the usability testing started. To ensure that the participant was comfortable, the examiner always had the camera on. The participants had the option to show their faces. The pre-interview started and the examiner asked the questions. Before the usability testing tasks, the examiner asked the participants if they had installed the diet apps. If not, the participants would get help to install them. When everything was ready, a picture was sent to the participant to show them how to position their body, camera, and phone.

Figure 3.1 and figure 3.2 show two different ways to position depending on what camera tool they are using.

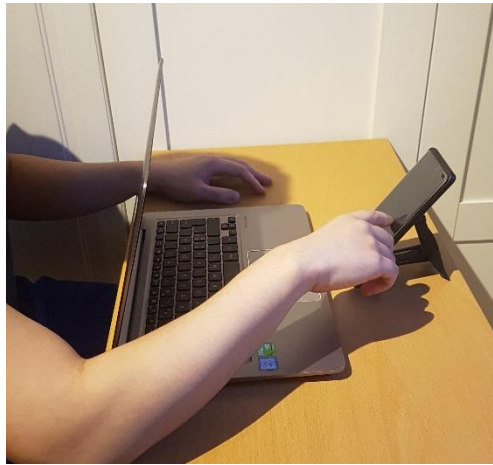


Figure 3.1: Setup using a laptop with an integrated camera.



Figure 3.2: Setup using a standalone webcam.

When the participants were in position, the test leader told the participants what they would do in the diet app and some instructions.

The instructions were: “Now you are going to open one of the apps, which one you would like to start with. You will be given seven different tasks that I will read up for you. Try to do these tasks to the best of your ability. You can explore and click around to figure out how to complete the tasks. If you are doing the tasks wrong, I will tell you. If you are stuck and can’t complete the task, I will give you some hints. If you need to hear the task again, you can ask me to repeat it. When doing the tasks, I want you to think out loud, explaining your thought process, what you are clicking and what you are looking for. Just relax and do your best. I will be here to guide you.” The examiner read the instructions for the participant.

When the participant had completed the tasks on the first app, they moved on to the second app. After the seven tasks were completed on both apps, the post-interview started. In this section, the participants were asked some questions about their experience and thoughts about the dietary application. The questions can be found in Appendix 8.5 Interview after usability testing. In this post-interview, the participants had the freedom to explore more of the diet apps to give a better answer.

In the pre-interview, the test leader asked the questions and noted down the participants' answers. Under the usability test, the test leader read up the tasks for the participant. While the participants were doing these tasks, the test leader had to listen, observe, and note down any observations and problems the participants had when executing the tasks. The post-interview had some open-ended questions that led the participant and test leader to further understand the participant's user experience.

3.1.6 Post usability testing

After the usability testing tasks were completed, a post-interview was conducted to get a more in-depth understanding of the participant's experience with the different dietary apps. Most of the questions were yes or no and rate from 1-10 questions. The goal of these questions was to get a concrete answer from the participants and lets them start thinking about those two dietary apps they just tested. There were a few open-ended questions that allowed the participants to express themselves more. From these open-ended questions, problems and improvements were found.

There were only a few tasks that were needed to be done after the usability testing. After every usability test, the test leader needed to reset all the applications to the wanted state to give every participant the same settings and environment. A new link for the communication tool was made for the next participant if they preferred another communication tool.

3.1.7 Analyzing the data

The notes taken under the usability test were not structured and only in keyword form. Every answer from the post-interview was sampled together and structured to get a better analysis. The answer from the post-inter can be found in Appendix 8.8 Summary of post-interview answers. Some of the things that were looked for were common problems

that the participants had and improvements they commented on. How the participants navigated the different diet applications were analyzed to understand better how they wanted/preferred to navigate.

3.2 Prototype design

3.2.1 Making the prototype

The tool that was used to make the prototype was a wireframe tool called Figma. The first sketch was drawn on paper to increase the speed of the designing phase. When the sketch was drawn, then it would be made in Figma. There was an option to develop the prototype with a programming language. The problem with this was the time and resources needed to develop the app from scratch. There were not enough resources to develop a fully functional app in this study, making a wireframe prototype was the better option. There are many different wireframe tools on the market, but Figma was used because of prior experience with the software.

4. Results

4.1 Participants

Ten participants took part in the usability testing in this study. The age of the participants was from 21 years old to 50 years old and the average age of the group was 29.1 years old. There were five male participants and five female participants. Six of the participants were using an android phone and four were using an iPhone. Their level of education varied from high school to master's degrees. When asked about how concern they are about their diet, every participant that rated themselves five or more had prior experience with dietary applications except for participants P2 and P10. Participants P2 and P10 and the other participants that did not have any previous experience with dietary application had the same reason. They have not used any dietary application before because they have not thought about using it before and have not had the need to use one till now. Table 1 below summarized the information about all participants.

Participant Nr	OS	Age	Gender	Education	ICT level	Diet	Prior experience
P1	iOS	27	Female	Master	7	8	Yes
P2	Android	26	Male	High School	7	6	No
P3	Android	50	Female	High School	2	4	No
P4	Android	23	Female	Bachelor	7	3	No
P5	iOS	28	Female	Master	7	8	Yes
P6	Android	31	Male	Bachelor	6	9	Yes
P7	iOS	21	Male	High School	7	4	No
P8	iOS	30	Male	Bachelor	6	5	Yes
P9	Android	34	Female	Master	8	6	Yes
P10	Android	21	Male	High School	4	7	No

Table 4. 1 Demographic information of the participants

4.2 Changes made to testing tasks

The first usability test was a test run to ensure that the setup, tasks, and questions were easily understandable for the participants. This made the usability test longer than expected. The usability test took around 1 hour and 30 minutes, double the expected time. Because the first usability test was expected to be longer than the other one, a participant that had more time was asked to participate in the first usability test. Participant P1 used a USB-webcam and a desktop instead of a laptop with an integrated webcam. The pre-questions and post-questions were understandable and nothing changed.

When it comes to the usability testing tasks, there were some issues. Task one had the goal to make the user change their current weight in their profile/app. The text read to the participant was: "Change your weight in my profile to be 85 kg". The participant went into the where you log or record your weight for today and entered 85 kg. This was the wrong action to do and the task needed to be changed to specify that the participants need to change their current weight, not recording or logging their weight for today. The difference between "current weight" and just "weight" is that "current weight" is a term used in the goal interface and "weight" is used in the logging/recoding weight interface. The wording "current weight" were used in the diet app and the task was changed to include this word. This would help other participants when completing the same task. Figure 4.1 shows what type of word the different dietary apps have used.

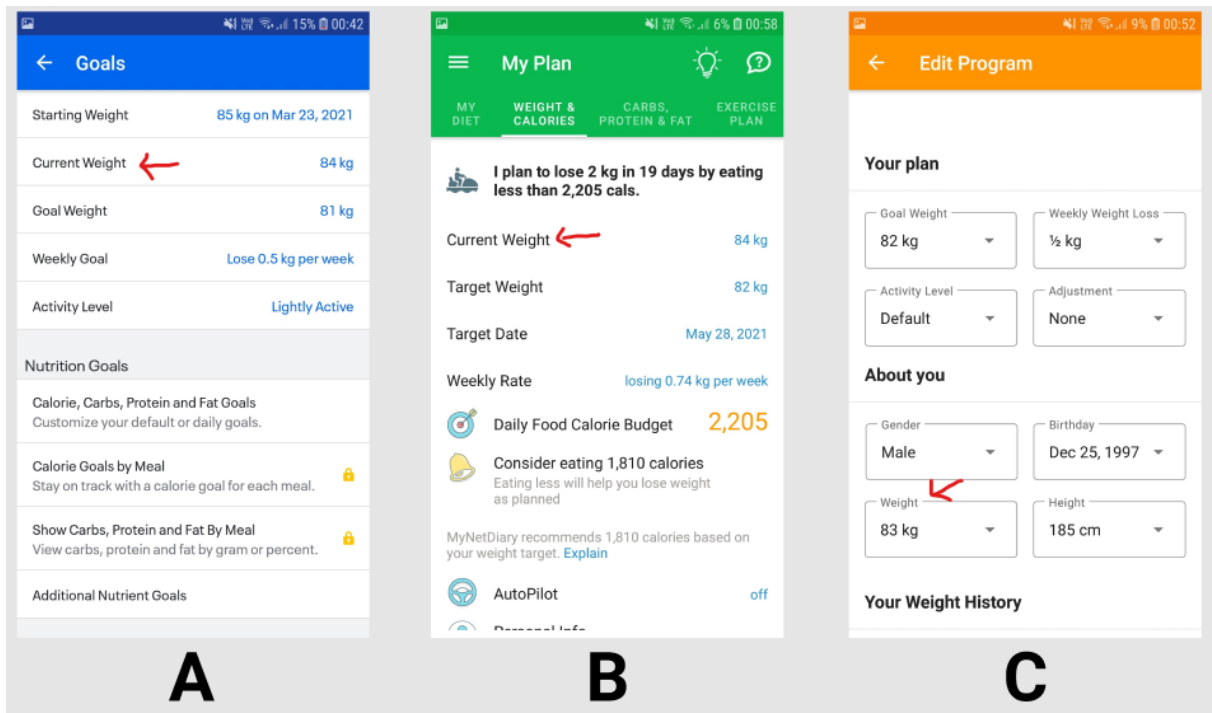


Figure 4.1: (A) MyFitnessPal uses the wording “Current weight” (B) MyNetDiary uses the wording “Current weight” (C) Lose It uses the wording “weight”.

The goal for task two was to change their weight goal to be 81 kg in a set timeframe. This was proven hard from the first usability test. The task test was: “Change your goal/plan to be weight loss to 81 kg over a timeframe of 8 weeks from today”. This was a long task compared to the other ones and required the participant to do some calculations. Considering that this participant had prior experience with dietary apps, she still had difficulty completing this task. It was changed to only changing your weight goal or target weight to be 81kg to simplify the task. The wording “goal weight” and “target weight” were used because this was used in the diet applications. In figure 4.2 below shows what wording the different dietary apps have used.

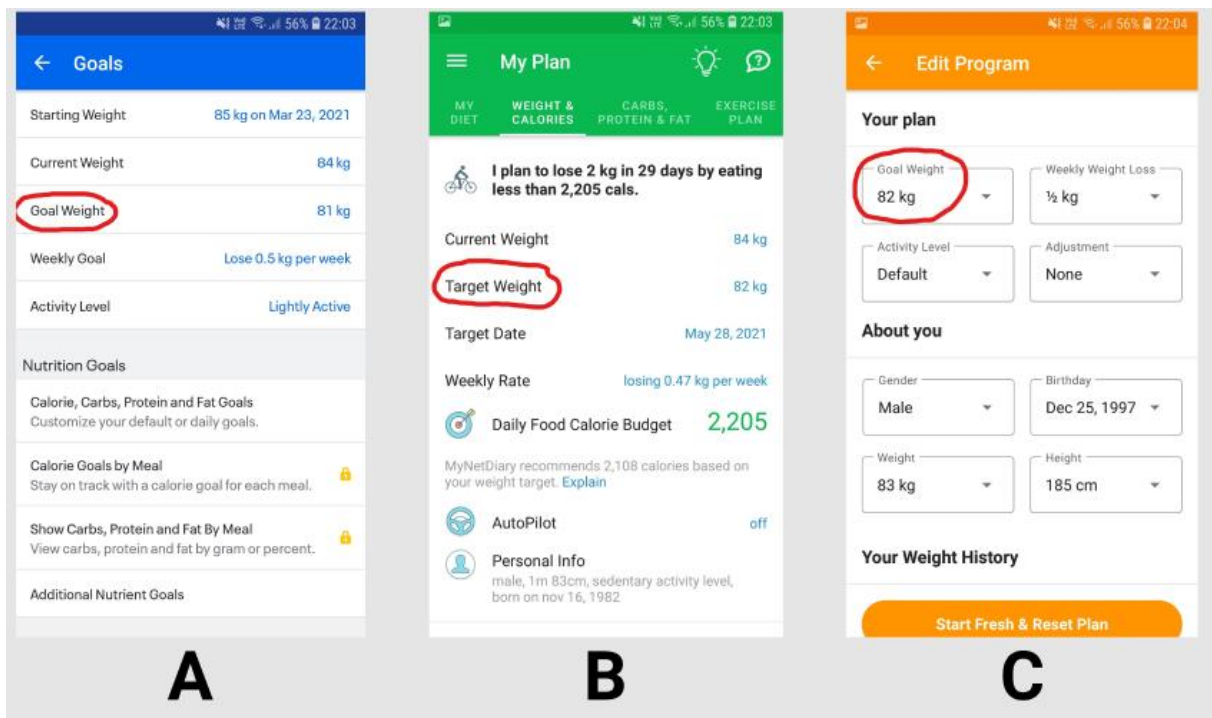


Figure 4.2: (A) MyFitnessPal uses the wording “Goal weight” (B) MyNetDiary uses the wording “Target weight” (C) Lose It uses the wording “Goal weight”.

Task three was changed to log their weight for today and the correct wording was used for the different dietary apps. Task four was one of the tasks that were changed the most. The goal for this task was for the participants to search for foods with different portion sizes and add/ log them into a meal. The task text was to add/log breakfast where they had one glass of orange juice, one large egg scrambled and two pieces of baron. When the test leader conducted the usability test, the food options used were saved in history. When the first participant was doing this task, they used the food options that were saved in history. This defeats the purpose of the task where the participants are supposed to search and selected the food they thought was right. The test leader didn't find any option to delete the food options from history and had to change the test. It was changed to adding/log one glass of beverage, one large something, and 200 grams of something. The test leader preselected these types of foods before every usability test to ensure that every participant had to use the search function and select an option. Figure 4.3 shows the different food options in history.

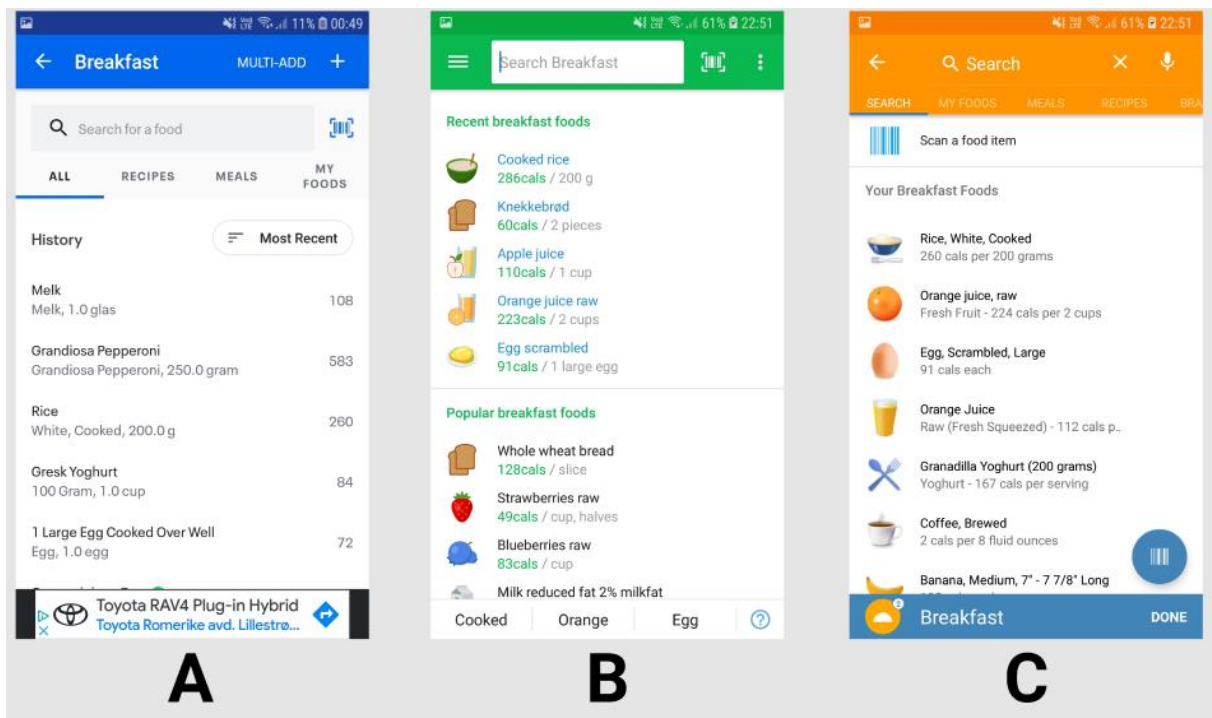


Figure 4.3: (A)(B)(C) All the dietary applications save previously used food options.

Task five had the same problems as task four, where the food was saved in history. The task text was “you had one whole pizza 500gram and used the barcode scanner to scan the food”. Under the first usability testing, the test leader observed that the participants tried to complete the task when the task was read up. In this case, the instructions were to go to dinner, add 500 grams of pizza, and use the barcode scanner. The participant just chose the saved option before hearing that they should use the barcode scanner. To fix this problem, the instructions were changed to go to dinner, add pizza with barcode, and the amount is 500 grams.

Tasks six and seven had no significant issues but got improved to give better instruction of the tasks. With these changes, the usability testing became more understandable for the participants. The original usability tasks and the change usability tasks can be seen in Appendix 8.3 Usability testing tasks version 1 and Appendix 8.4 Usability testing tasks version 2.

4.3 Usability test

In this section, observations of the participants are presented.

4.3.1 Task 1

This task was the hardest one of all the tasks. Some of the reason for it is because the task asks the user to change their current weight in their profile to 85 kg and many participants confused it with logging/recording weight for today. They had to get a message from the test leader that they were on the wrong track. Eight participants got stuck in one or both dietary applications and needed some help to complete the task. Two of the participants completed this task without any help, one of them had prior experience with dietary applications and the other had none. All the dietary applications had two ways to complete the task. The two participants that completed the task without help used the longer way to complete the task. The reason for participants getting stuck was that the change “current weight” option was not in the category they thought it would. The figures below show two different ways to change “current weight” in each dietary application.

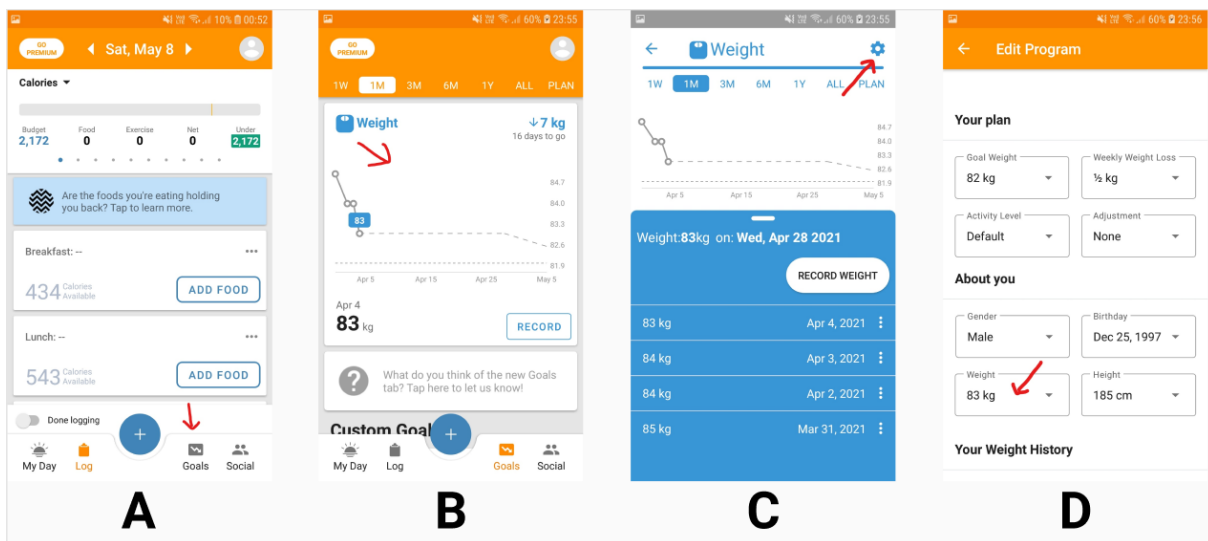


Figure 4.4: Diet app: Lose it, four interfaces the user needs to use. (A) Go to “goals”, (B) click on the graph, (C) click on the cogwheel, and (D) scroll down to weight.

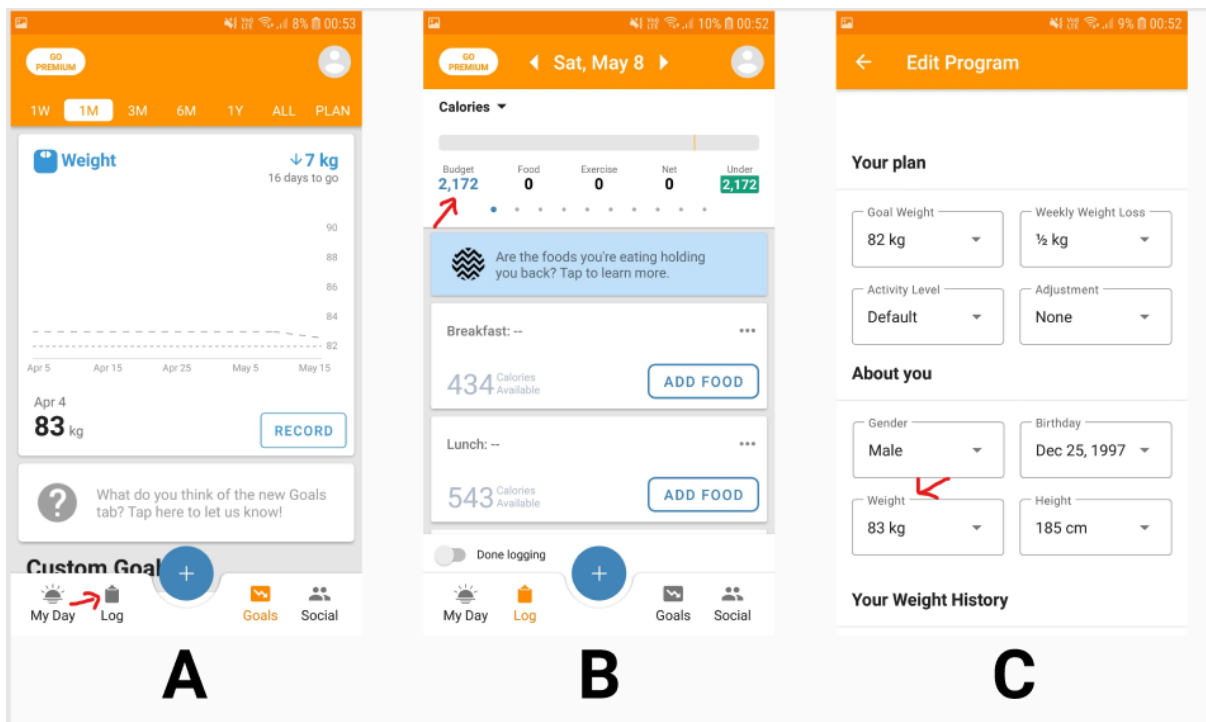


Figure 4.5: Diet app: Lose it, three interfaces the user needs to use. (A) Go to log, (B) click on the number under budget and (C) scroll down to weight.

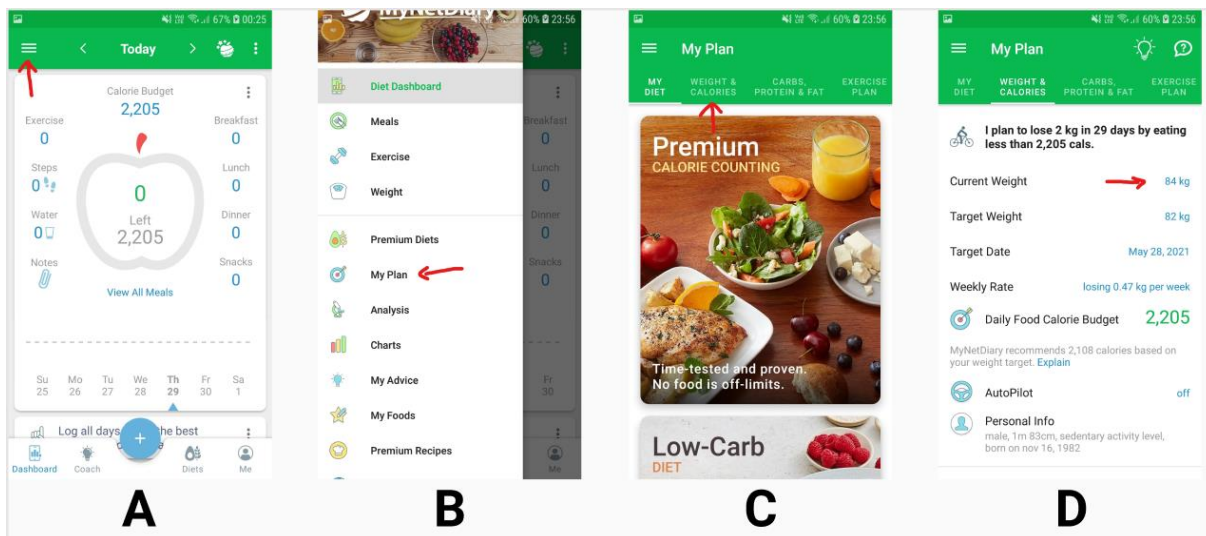


Figure 4.6: Diet app: MyNetDiary, four interfaces the user needs to use. (A) Click on the hamburger menu, (B) click on “my plan”, (C) click on the weight & calories, and (D) click on current weight.

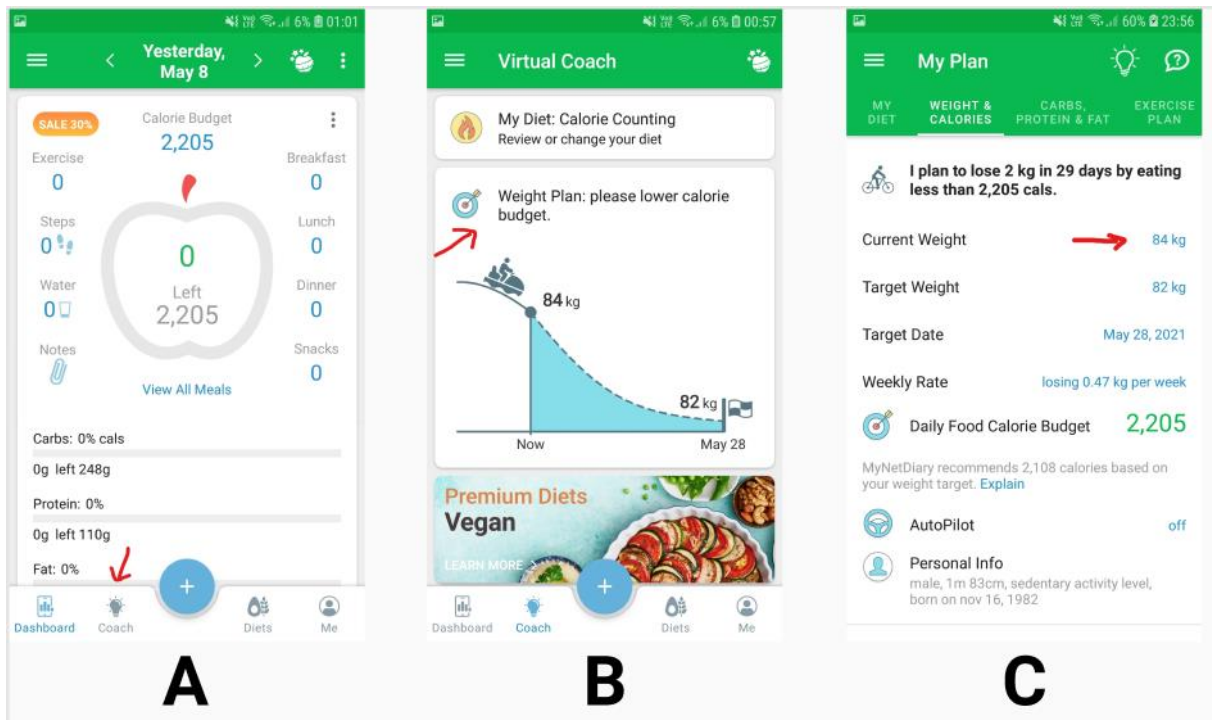


Figure 4.7 Diet app: MyNetDiary, three interfaces the user needs to use. (A) Click on “coach”, (B) click on “Weight Plan” and (C) click on current weight.

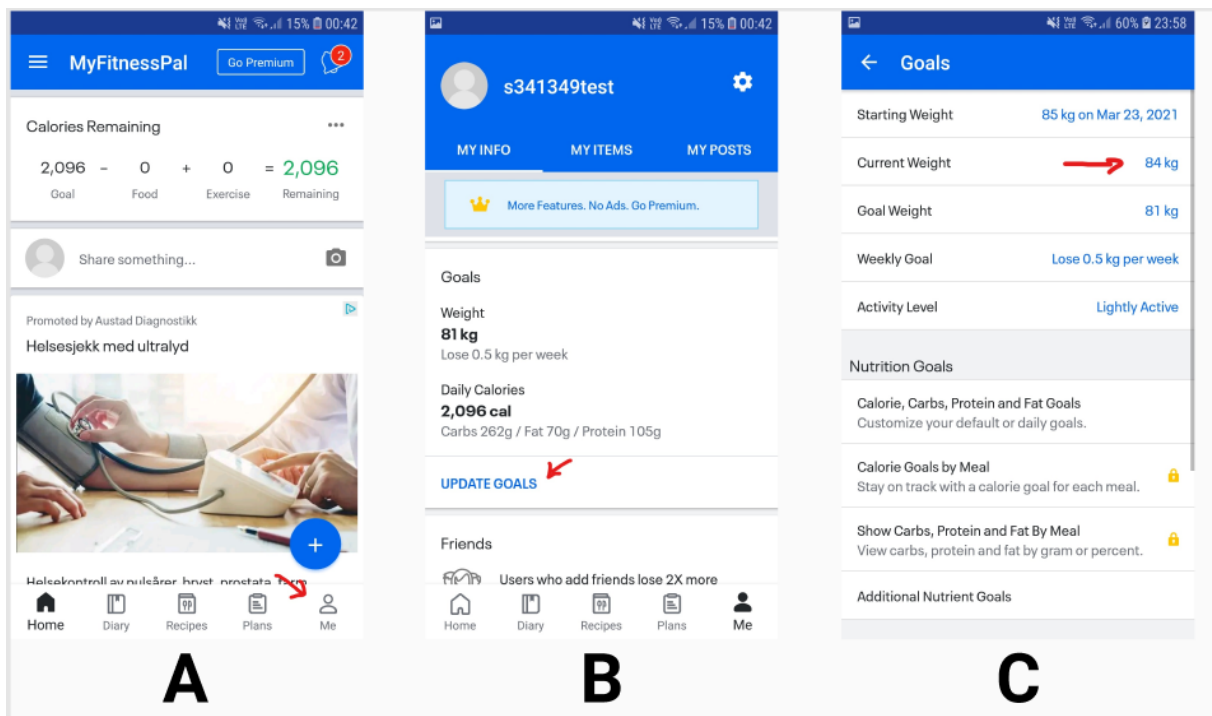


Figure 4.8 Diet app: MyFitnessPal, three interfaces the user needs to use. (A) Click on “Me”, (B) scroll down and click on Update Goals and (C) click on current weight.

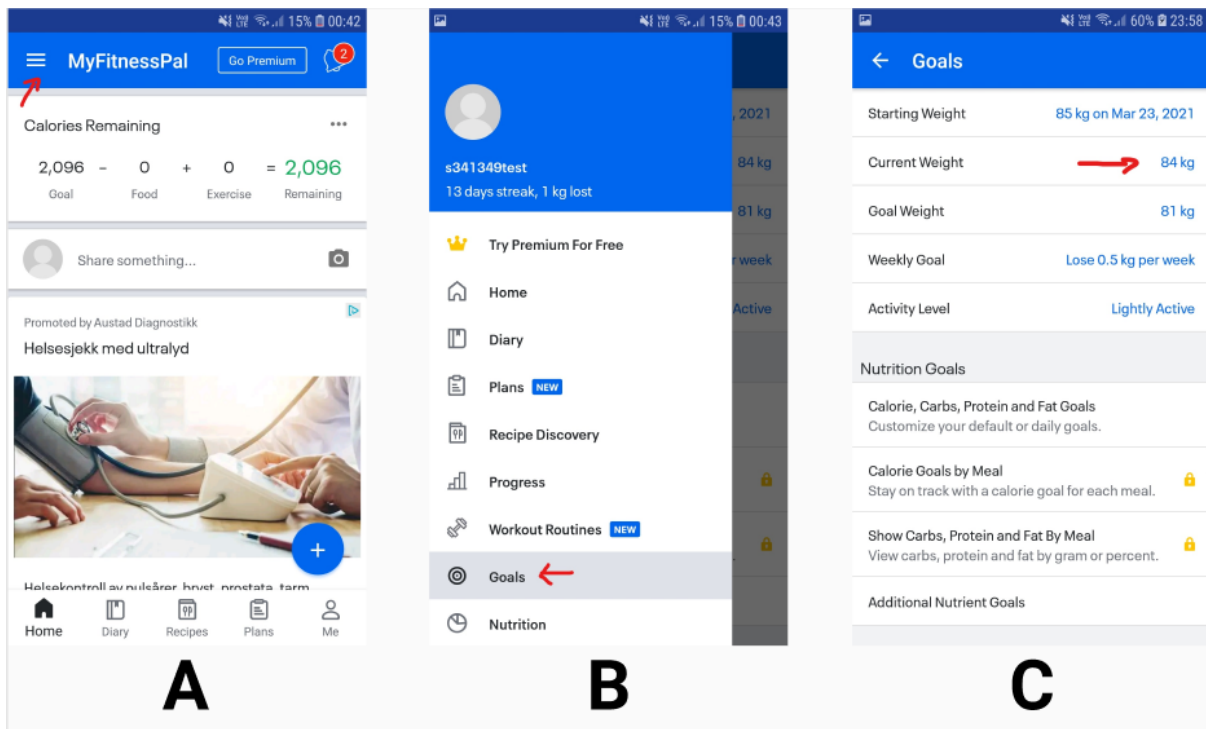


Figure 4.9 Diet app: MyFitnessPal, three interfaces the user needs to use. (A) Click on the hamburger menu, (B) click on Goals and (C) click on current weight.

4.3.2 Task 2

This was easy because when the user comes to the section to change their “current weight”, they are already in the correct interface to change the weight goal. Figure 4.10 shows “target weight” and “weight goal” are in the same interface. Some of the users went to the dashboard each time they finished a task and had to figure how to go back to the last interface they were on. These participants had a hard time getting there, but they figured it out after thinking and clicking around.

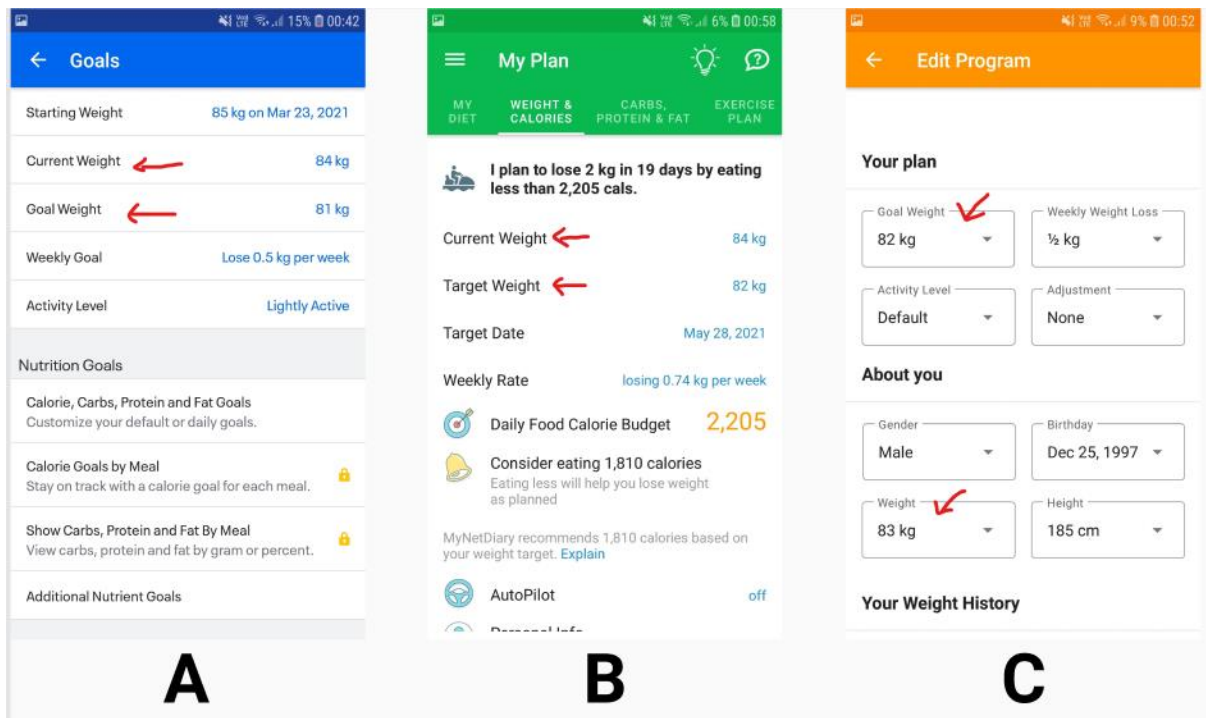


Figure 4.10 (A) MyFitnessPal (B) MyNetDiary (C) Lose It. “Current weight” and “goal weight” are in the same interface.

4.3.3 Task 3

This task had a different result than expected. It was supposed to be a simple and easy task to do. The result was affected by task one, where the participants had to be stopped because they thought log/record weight was the same as changing current weight. These participants already understood where they needed to navigate to complete these tasks. The two participants that did not get confused on task one used some time to finish this task.

4.3.4 Task 4

This task was different for all the participants. Some of the participants found out exactly what they needed to add. Some of them were confused because of the many options they could choose from, and some has issues adding the right amount of food. After some time, everyone finished the task without help. There were some problems with using the search function that was observed when the participants carried out the task. Lose it and MyFitnessPal had low contrast between the search box and the background and one participant did not see the search button. In Figure 4.11 below show that (A) and (C) has low contrast between background and text.

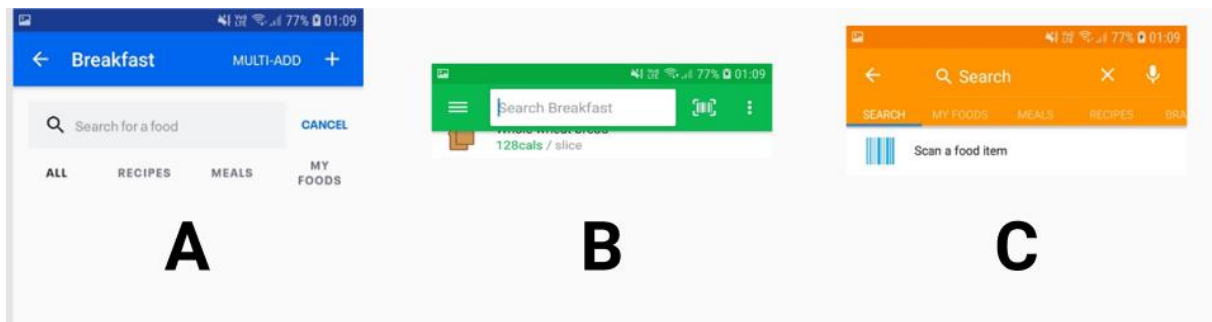


Figure 4.11 (A) MyFitnessPal (B) MyNetDiary (C) Lose It. The search function in the three dietary applications.

4.3.5 Task 5

Some of the participants were not sure where to click to open the barcode scanner at first. They just needed to click around to figure it out. At last, everyone figured how to scan the barcode. Participant P8 did not have the option to turn off the flash on MyFitnessPal on his iPhone and had a hard time scanning the barcode. With many attempts with different angles, participant P8 completed the task. Looking closer at each dietary app, MyNetDiary did not give the user the option to turn off the flash when using the barcode scanner. The design of the barcode scanner was different for each participant because of the mobile and operative system used. Figure 4.12B below shows that there is no option to turn off the flash.

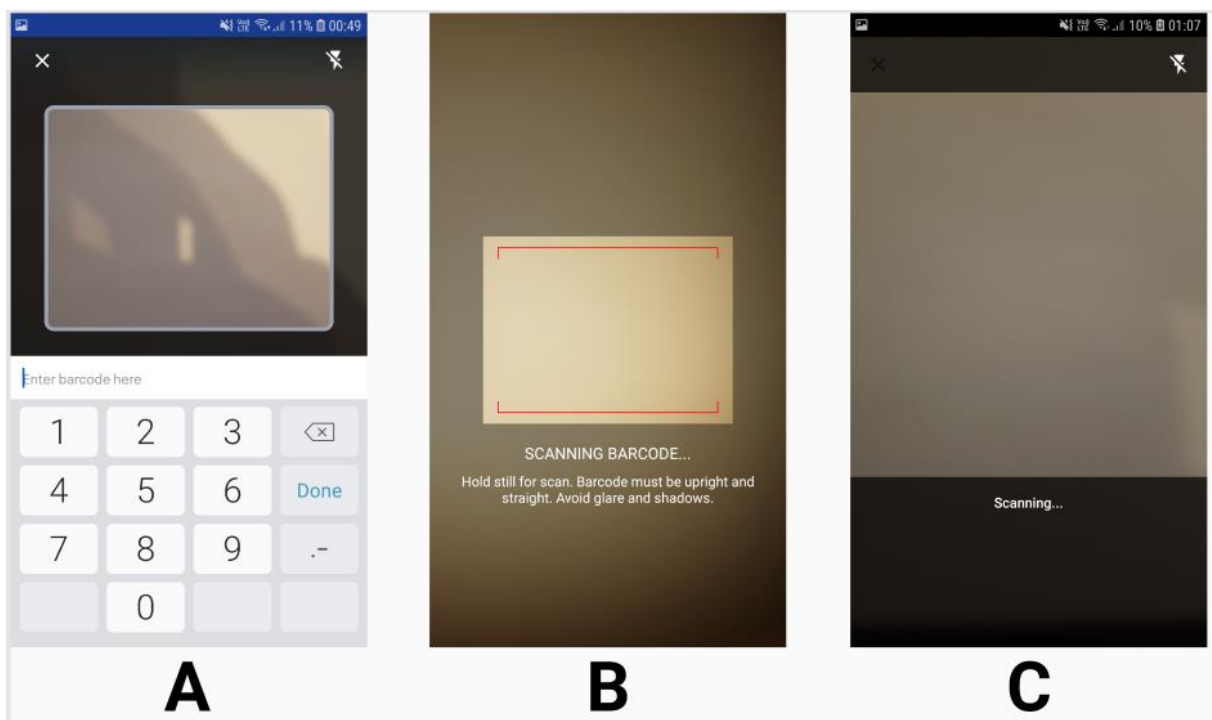


Figure 4.12 (A) MyFitnessPal (B) MyNetDiary (C) Lose It. How the screen looks like when using the barcode scanner function.

4.3.6 Task 6

All the participants were used to changing the amount of food from task four and understood where they needed to click to complete it. None of the participants had any issues with this task.

4.3.7 Task 7

A few found the correct answer quickly, but most participants needed to look for it even when the answer was on their screen. Each dietary application has two ways to complete the task. The first way is with the function “calorie limit – calories consumed + exercise = remaining calories” with the respective number for each category. The second way was with some graphical content. The problem with both ways was that the description for each number was too small, had low contrast or unrelatable. Some of the participants did not understand how the function worked out in the first place. After some thinking and looking around, the participants completed the task. The figures below in this section show two ways of checking calorie consumed in each dietary app.

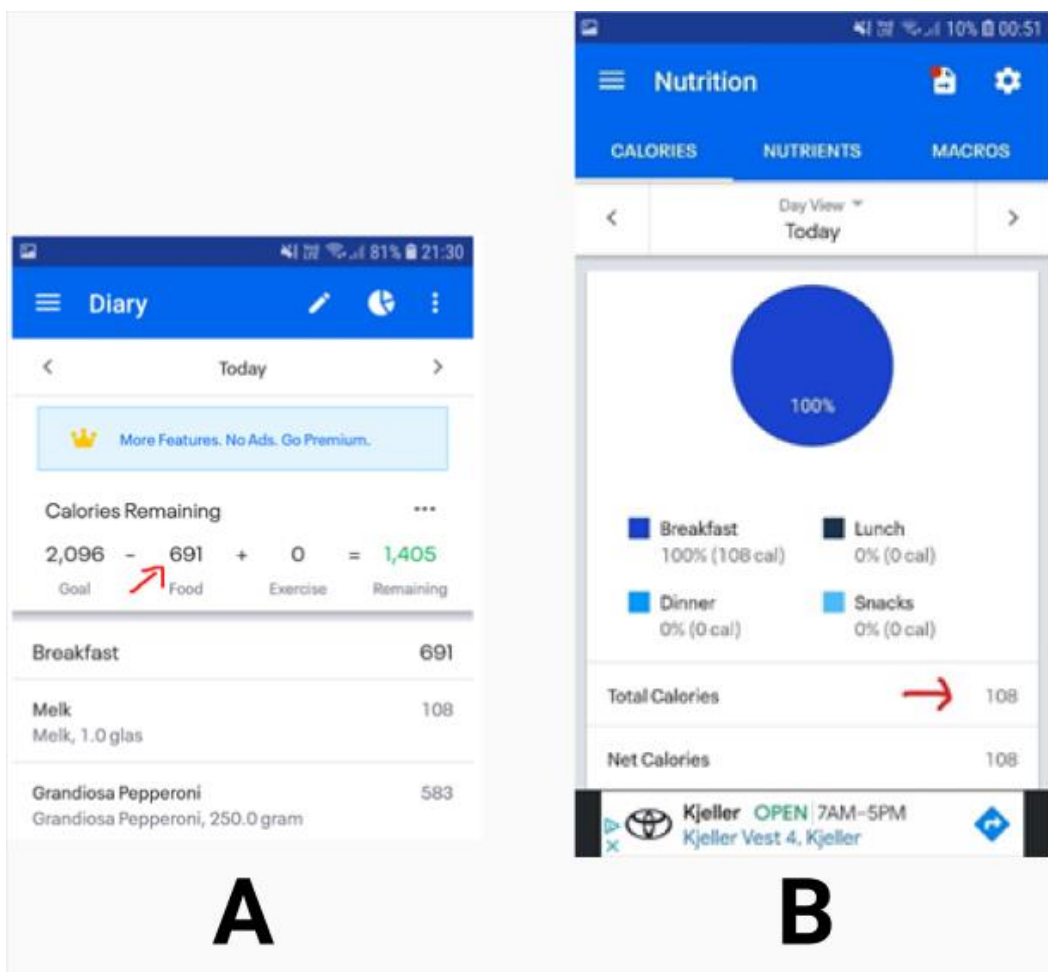


Figure 4.13 Dietary application: MyFitnessPal, (A) “calorie limit – calories consumed + exercise = remaining calories” way, (B) graphical way.

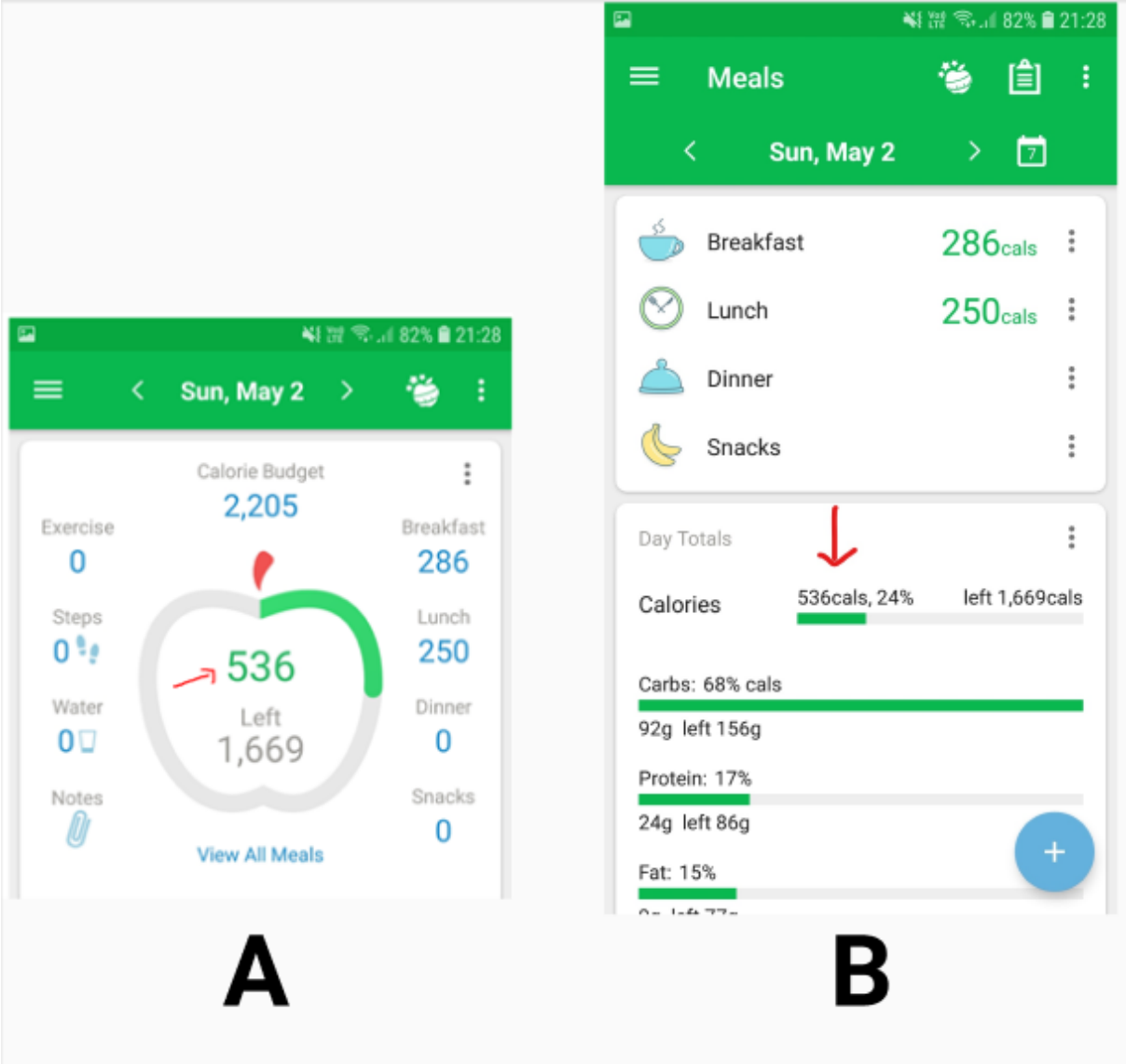


Figure 4.14 Dietary application: MyNetDiary, (A) graphical way, (B) “calorie limit – calories consumed + exercise = remaining calories” way.

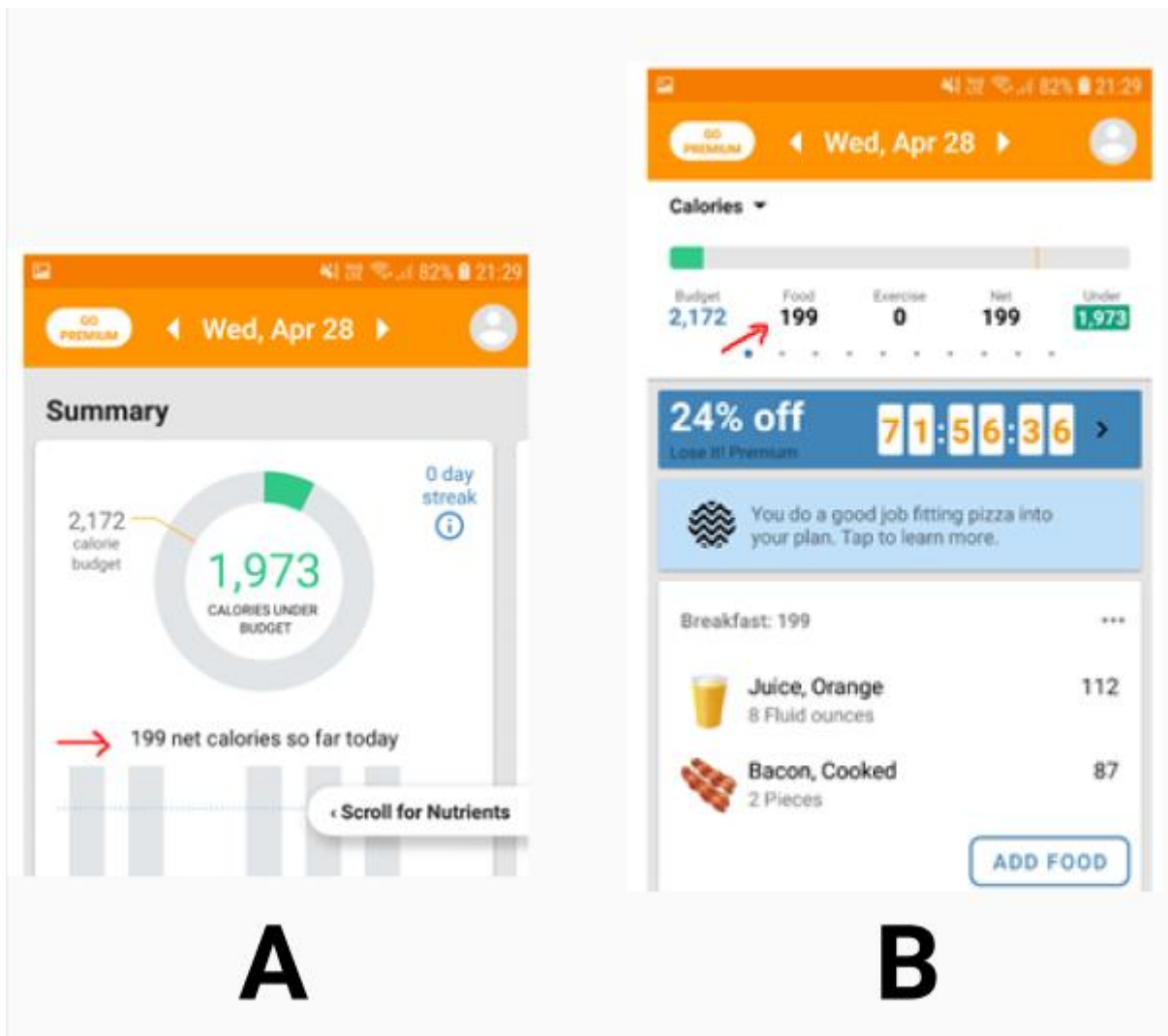


Figure 4.15 Dietary application: Lose It, (A) graphical way, (B) “calorie limit – calories consumed + exercise = remaining calories” way.

4.3.8 Summary of issues and areas of improvement

There are some problems/issues and areas of improvements that the test leader observed under the usability testing. Looking at the result from task one to task seven, the problems mentioned are solved in the prototype. The post-interview questions three and nine were about what the participants liked and disliked and improvement on each dietary application. Each participant wanted that the dietary applications to improve in many ways. These improvements can be rated back to the principles of universal design. The list below contains improvements that the participants suggested for the dietary applications.

MyFitnessPal:

- Instructions on how to use the barcode scanner.

- Automatic search result when using the search function. Figure 4.16 shows that milk is written but no results is shown. The user must click on the search button for it to show a result.

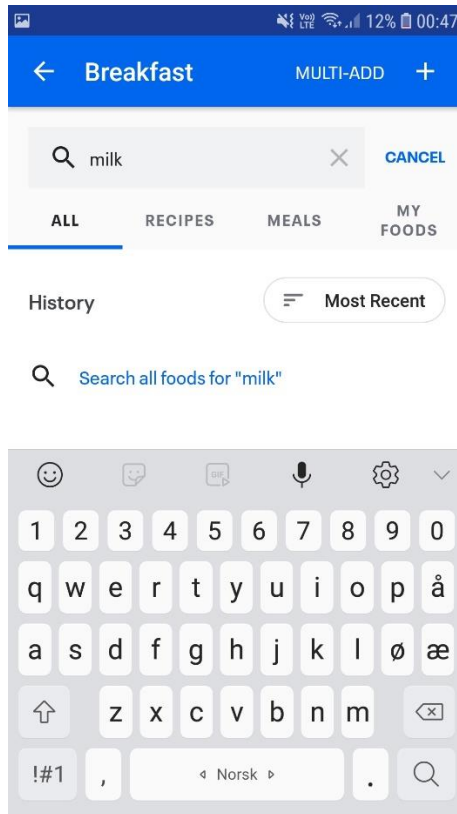


Figure 4.16 MyFitnessPal's search function

- Some of the portion size options were not available. Figure 4.17 shows that there are only five serving options for milk.

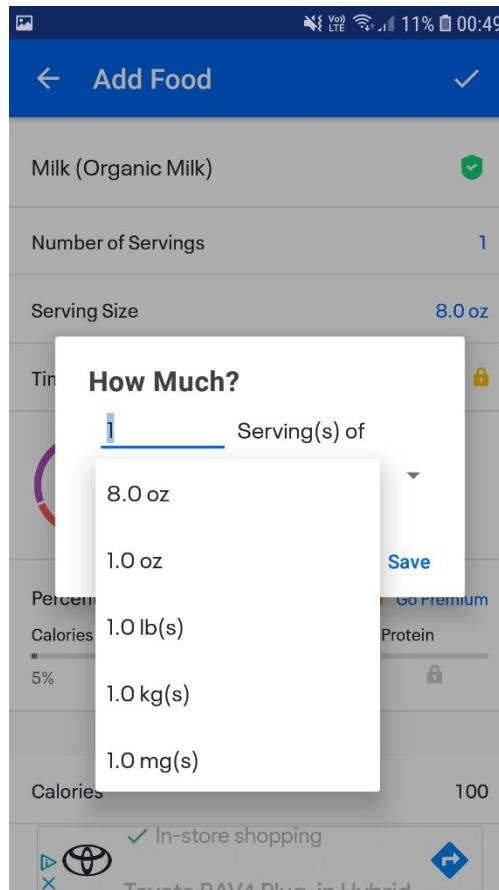


Figure 4.17 MyFitnessPal, the different serving options that the user can choose from.

- Could not turn off the flash when using the barcode scanner on iOS. Figure 4.12.

MyNetDiary:

- Things were scattered around too much.
- Option to change current weight in “My Profile” interface.
- Need better categorization.
- Hard to see clickable options. For example, in figure 4.6C, the weight & calorie option is hard to see.
- Needs better description of the data shown. For example, in figure 4.14A, what does the green number display.

Lose It:

- Remove unnecessary clutter on the screen.
- Option to change current weight in “My Profile” interface.
- Make clickable options more visible and understandable for example, in Figure 4.4B, the user must click on the graph to go to the following interface.

- Need a tutorial for basic features.
- Keyboard popping up when entering add food section without using the search function.

The table below shows the different dietary applications each participant evaluated, their performance score, if they wanted to use diet apps in the future and if diet apps can change and improve eating habits and health.

P#	App nr 1	App nr 2	Score nr 1	Score nr 2	Preferred Diet App	Future use	Improve health
1	MyFitnessPal	Lose it!	8	7	MyFitnessPal	Yes, MyFitnessPal	Yes
2	MyFitnessPal	MyNetDiary	3	5	MyFitnessPal	No	Yes
3	MyFitnessPal	Lose It!	3	2	MyFitnessPal	No	N/A
4	MyNetDiary	Lose It!	8	8	MyNetDiary	No	Yes
5	MyFitnessPal	MyNetDiary	7	8	MyNetDiary	Yes, MyNetDiary	Yes
6	MyNetDiary	Lose It	7	6	MyNetDiary	Yes, MyNetDiary	Yes
7	Lose it!	MyFitnessPal	7	6	Lose It!	Yes, MyFitnessPal	Yes
8	MyNetDiary	MyFitnessPal	5	6	MyNetDiary	Yes, MyNetDiary	Yes
9	Lose It	MyNetDiary	5	6	MyNetDiary	No	Yes
10	MyFitnessPal	MyNetDiary	7	6	MyFitnessPal	No	Yes

Table 4. 2 Result from the post-interview.

4.4 Prototype

With the findings gathered from the usability testing, a prototype was made in Figma. Figma is a wireframe tool that has the option to create a prototype with transitions. There

are some limitations with this tool, like inputting data and updating states in this case. Considering the limitations, the prototype was built to show how an improved dietary application can look.

To address the issue with changing “current weight”, we added multiple ways to complete the task. The three dietary applications had two ways to complete the task. The prototype has three different ways: the weight interface, the goal interface, and the last one, my profile interface. The two participants that completed the task without any help used the goal interface. Therefore, the option to change “current weight” in the goal interface should be included in the prototype to accommodate existing users. The participants that needed help navigated to the weight interface to log/record weight. Which were wrong and therefore needed help in the end. To prevent this issue from happening for other users, the option to change current weight was added in the weight interface. Both option to log/record weight and change current weight is shown to show that these two actions are different. One of the things that the participants wanted was the option to change “current weight” in the “my profile” interface.

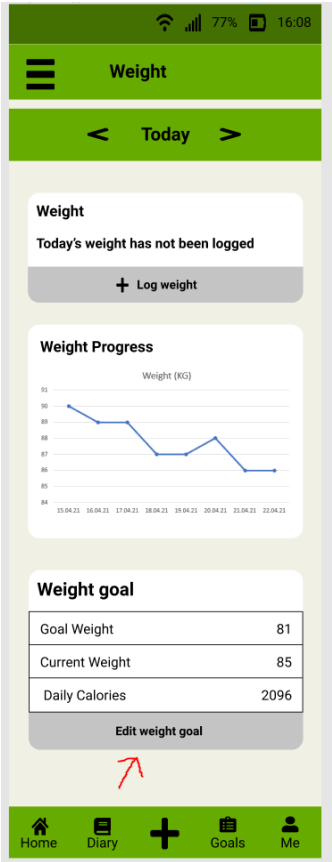


Figure 4.18 The user has the option to change current weight and log weight in the same

interface.

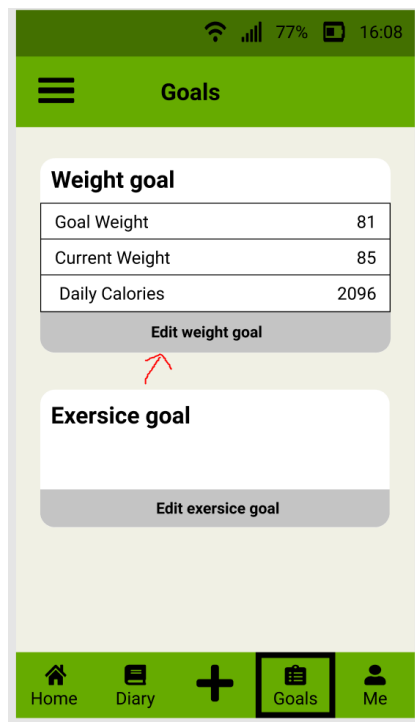


Figure 4.19 The user can see the word "current weight" and using edit weight goal to change "current weight".

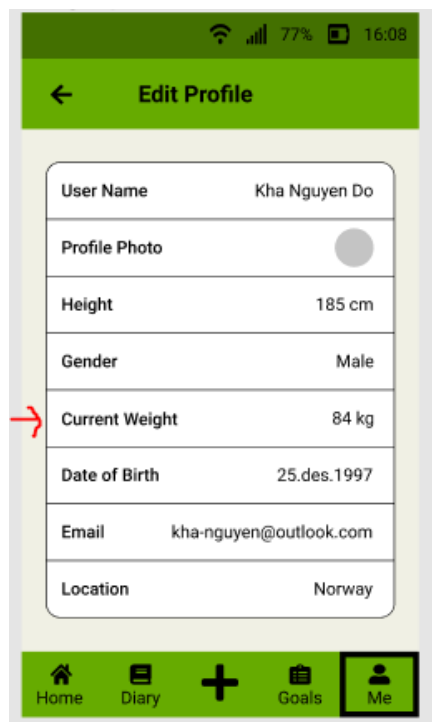


Figure 4.20 The user had the option to change "current weight" in "Edit Profile".

Another improvement areas was the calories summary, where the user had problems understanding what was shown on the screen. To fix this issue, the prototype has removed some data points and make the font bigger.

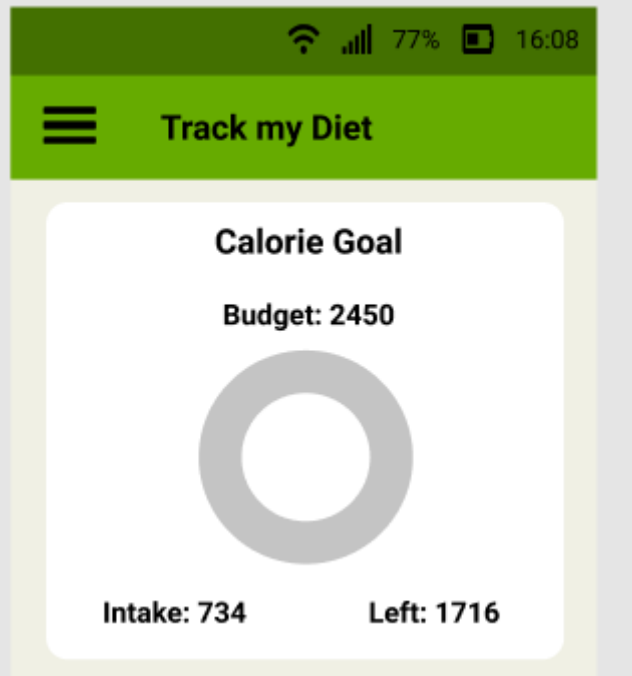


Figure 4.21 Improved graphical calorie summary.

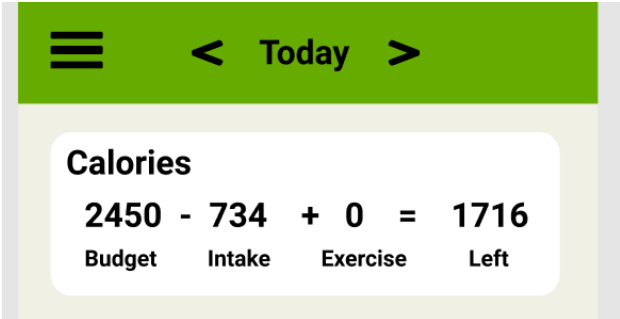


Figure 4.22 Improved calorie summary.

The prototype has implemented some of the suggestions that the participants commented on. A more detailed description was added to show users how to use the barcode scanner in the barcode interface.

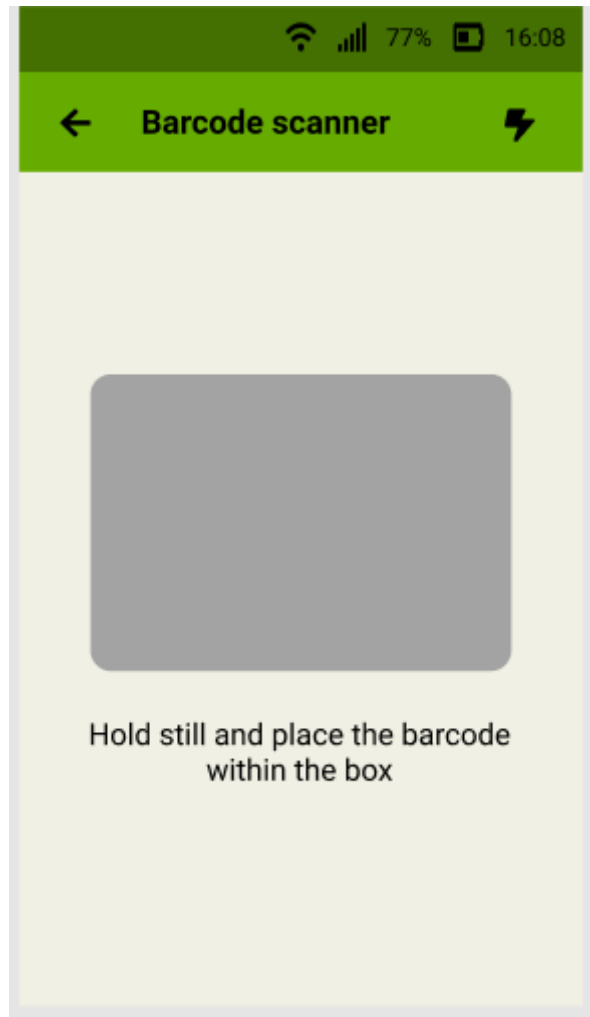


Figure 4.23 Barcode scanner

Another thing that one participant commented on was having a tutorial when opening the app to show users the basics features and functions. New users or existing users can use a tutorial, but we added the option to skip the tutorial if wanted.



Figure 4.24 The tutorial interface when the user login to the application.

In the end, this prototype is to show how an improved dietary application can look like with feedback from observations and usability testing. The prototype has been improved in areas where common problems were found in the evaluated dietary applications. In the list about improvements in 4.3.8, there are some cases where only one diet application needs to be improved, where the other one does not. Even if only one app has improvement areas or problems, the prototype has improved or found a potential solution. The prototype is a combination of improved functions and features from the evaluated dietary applications. The principles of universal design have been used when designing this prototype. This is the link to the Figma Project: <https://www.figma.com/file/9SPJHSqFzFcClgo0di8RFW/Master-thesis-design?node-id=1%3A2> . In the Figma project, interactions between the interfaces are possible to make the prototype usable to some degree.

5. Discussion

5.1 The prototype that has been designed.

In the usability testing, many problems were found and the two main problems were changing “current weight” and checking calorie intake. Looking at the problem with changing “current weight”, the participants had difficulty finding out where they should navigate and where they should click. There were two different ways where the participants could navigate to change “current weight”. Having multiple ways to complete the same task is important because of the flexibility it gives. An article by Laubheimer (2013) shows the importance of having multiple ways to complete a task. Users have different knowledge on how to use an application and have different preferences. Therefore, it is important to have multiple ways to complete a task to accommodate all users. New users often require more guidance when using a new system. The expert knows how the system works and uses faster and less guided ways to complete a task. Having multiple ways can make the application more efficient. All the evaluated dietary applications have multiple ways to complete the task of changing “current weight”.

The problem was that these navigation methods were not easy for the participants to understand or find in the first place, therefore they got stuck. Prior study has analyzed that “ease of use” and “usable for all” are significant attributes that should be included in diet mobile phone apps (Zaidan & Roehrer, 2016). As seen in figure 4.5B, one way to change “current weight” was to click on the budget number in the calorie summary. In figure 4.7B, the user must click on the title of the box. These two ways shown in the figures were not perceptible and intuitive to use for the participants. Principle three: simple and intuitive and principle four: perceptible information (Imrie, 2012), focuses on making the design easy to understand and communicates necessary information to the user. One of the participant’s problems was understanding the difference between “log/record weight” and “change current weight”. The two terms were not used in the same interface and made the participant think they were the same. Rule number four in 10 Usability Heuristics for Interface Design (Nielsen, 2020) says that the user should not have to wonder whether different words or actions mean the same thing. The actions “log/record weight” and “change current weight” are added to the weight interface to let the user know that there is a difference between those actions.

The other main problem that was observed was checking calorie intake. There were two ways to check how many calories the participants had eaten for the day: in the home interface and meal/diary interface. From task one to task 6, the calorie summary showed up multiple times on the participant's screen. When doing task seven, participants had a hard time finding the correct information and understanding it. In the end, with some thinking, every participant was able to complete the task. In the post-interview, some participants commented that there was so much clutter on the screen and got information overload. One of the basic principles for a good interface is reducing the cognitive load (CMARIX, 2018). One way to reduce cognitive load is not to make a design with visual clutter and small chunks of information. A lot of information and clutter on the screen forces the participants to process all the information. In the prototype, the focus was to make the information more visible and reduce the information given to the user. Reis et al. (2016) carried out an experiment involving 69 students, where they tested two different versions of the same interface. The first interface was the standard interface, the second interface hides advanced and extraneous features to minimize cognitive load. The student's performance was slightly better on the second interface. They found out that reducing cognitive load can lead to more usability.

In this study, the different dietary applications had different places they need to improve on. A list is provided in 4.3.8 Summary of issues and areas of improvements, where improvements for each dietary application are listed. The barcode scanner was designed differently in the dietary application, some of them had a more detailed description than others and the option to turn on/off the flash. One of the attributes that should be included in a dietary mobile application is barcode scanning (Zaidan & Roehrer, 2016). All the dietary applications follow the principle of matching between the system and the real world (Nielsen, 2020). In the real world, when using a scanner, the barcode should be located where the laser is pointing. In the dietary app, the barcode should be placed in the box shown in Figure 4.12. One of the problems is the description of how to use the barcode scanner and turning on/off the flash. MyNetDairy has the best description of the three diet apps but does not give any information on where to place the barcode. MyFitnessPal's description can mislead the user because the description is "enter barcode here" and a keyboard is shown. Lose It's description is only "scanning" and nothing more. This goes back

to the 4th principle of universal design: Perceptible information, where the focus is to give users the necessary information (Imrie, 2012). MyFitnessPal's description might mislead users to write in the barcode number instead of using the camera. This is where principle five tolerance of error has not been taken into consideration. The design should minimize accidental actions (Imrie, 2012).

MyNetDiary and Lose It had the problem where the user did not know if the element were clickable in some cases. In figure 4.4B and 4.7B, a graph about the user's weight progress. The problem was that there were multiple clickable elements in the div box. In figure 4.4B, the user can click on the graph and the record button. Many participants did not know that the graph was clickable and only used the record button when doing task one. In figure 4.7B, the user can click on the graph or click on the title. Clicking on the title lets them do tasks one and two. None of the participants used this option to complete the tasks. The 10th principle for interaction design is about providing the necessary documentation to help the user understand how to complete their tasks (Nielsen, 2020). This is an area where MyNetDiary and Lose It can improve on. They have provided some instruction on using different functions and features but needs to add instructions for functions and features that don't have it. This will give new users information on how to use the dietary application.

We observed that a few participants didn't see clickable option due to low contrast in the usability testing. Figure 4.6C shows the interface where the user must click on "Weight & calories". The text color and the background have too low contrast and were not visible enough. Using a color contrast checker, we found out that the color combination was not up to the WCAG standard. The standard for presentation of text should be 4.5:1 (W3C, 2018), the color contrast of the used colors was 1.82:1. MyFitnessPal failed the WCAG standard for the colors used on the search button shown in figure 4.11A. The contrast between the text and background was only 2.45:1.

Some of the other improvements that were made were visibility on the selected category. When a category is selected in the three dietary apps, the color of the icon changes. To improve this, a black bar will appear on the selected category in the prototype. A tutorial has been added when the user opens the prototype, with a function to skip the tutorial. The search button is bigger and more visible on the prototype. In general, all the user interfaces were made less cluttered.

With usability testing, we found some issues more significant than others and many small areas to improve on. We have mentioned some cases where the seven principles of universal design and usability heuristics can be applied and where the WCAG standard has not been achieved. The prototype that has been made, shows how an improved dietary application can look like when the principles are applied to some degree. The prototype is not a fully functional dietary application, but the interaction between the interfaces is possible. This can be done for future research, developing an actual dietary application with working functions and features. As the prototype is now, there would be possible to conduct usability testing and compare it against MyFitnessPal, MyNetDiary and Lose it to some degree.

5.2 About the participants

Ten participants were recruited for this study. Most participants were from the age group of 20-30 years old and one participant was over 50 years old. 50% of the participants had prior experience with either health, diet, or nutrition-related applications. In a national study by Krebs and Duncan (2015) conducted in the US, 1604 people were asked about their use of mobile health apps. The age group for the national study was 18-81 years old. 934 (58.23%) of 1604 people had downloaded a health-related mobile app. Our study found out that 50% of the participants had prior experience with dietary applications, suggesting that the distribution can be the same as in the US.

For those participants with prior experience with dietary applications, we found that they either had a bachelor's degree or a master's degree. The age range for these participants was from 27 to 34 years old. This study supports evidence from previous study (Krebs & Duncan, 2015) that individuals that were younger and having greater than high school education are more likely to have used or using a health-related app. Except for participant P4, the only participant that had a higher education level than high school that did not have prior experience with dietary applications.

The first participants that are different from the other are P2. His performance score was higher on MyNetDiary than MyFitnessPal, but he still preferred MyFitnessPal over MyNetDiary. The typical result was that the highest score was the most preferred diet app to use. When P2 was asked why he chose MyFitnessPal over MyNetDiary, but the score was higher on MyNetDiary. The answer was that since this was the first time P2 had used a

dietary app and MyNetDiary was the second diet app that was tested. Since he already had tested MyFitnessPal before MyNetDiary, he got some experience on what to look for and what to do. The follow-up question was if the diet apps were swapped for the testing, would the second app you tested be rated higher than the first one. The answer from P2 was “probably yes”. P2 perceived that MyNetDiary to be easier than MyFitnessPal, based on the experience in the testing. Meaning that the sequence of the diet app tested affected the score/result. When asking why P2 likes MyFitnessPal over MyNetDiary, the answer was because it was simpler and easier to use.

When looking at which dietary app that was preferred, MyFitnessPal and MyNetDiary are the most preferred ones. The only participant that did not prefer any of these was P7, and he preferred Lose It over MyFitnessPal. When looking at the performance score, P7 preferred the diet app that was rated lower. The reason was the same as for P2, where experience had a role. When asking P7 why he preferred Lose It over MyFitnessPal, he felt Lose It was simpler and easier to use than MyFitnessPal.

Two participants preferred a more complex layout than a simple layout. These two participants were P5 and P8. P5 rated their performance score on MyFitnessPal a seven and MyNetDiary an eight and preferred MyNetDiary. Like most participants, P5 preferred the diet app with the highest performance score. P8 scored MyNetDiary a five and MyFitnessPal a six but preferred MyNetDiary. When asked why they chose MyNetDiary over MyFitnessPal, both participants had the same answer. They liked a more complex layout, more information, and how the diet app looked. Both participants had prior experience with diet app before, but first time using the evaluated dietary applications.

Overall, when looking at what the participants preferred, eight of ten participants chose the dietary app that was easiest and simplest. Only two of the ten participants preferred the dietary app that was more complex and more informative. Prior study (Hakobyan et al., 2016) has shown that ease of use and perceived usefulness play a considerable role in participant’s use of the dietary application. Another study by Zaidan and Roehrer (2016) analyzed many different dietary applications on the Australian mobile phone apps store (iTunes and Google Play) and found that ease of use was a significant attribute that should be included in diet phone apps. It can be assumed that most dietary application

users prefer a simple and easy-to-use layout. However, some users that prefer a more complex layout.

In the usability testing, two questions were asked to find out about the participants attitude towards the tested dietary application and their attitude towards diet applications in general:

1. Will you use any of these dietary applications in the future?
2. Do you think dietary applications can help you get into healthier eating habits?

From question one, 50% of the participants said that they would not use any of these dietary applications in the future because they did not see the need to or have not thought about it. In a previous study (Krebs & Duncan, 2015), the common reason for not having downloaded any health-related app was the lack of interest, cost and concern about apps collecting their data. A few participants mentioned that they would not use the evaluate diet app because of the cost. None of the participants were concerned about the app collecting their data. However, we can see that most people who do not have used any health-related application is because of lack of interest and not seeing the needs.

Question two, participants P3 were the only participants who did not give a clear answer and counted as N/A. If we ignore that P3 did not have a clear answer for question two, all the participants had the same answer. They thought that dietary application could help them get into a healthier eating habit and improve their health. A study (Wang et al., 2016) found out that diet and personal assistance apps effectively promote healthy eating and exercising. They also found out that app usage facilitated healthy eating and increased exercising and maintenance of healthy behaviors. The last question indicates that people think the dietary application can improve health and eating habits.

5.3 Remote usability testing

The study was conducted under the Covid-19 period and there was a restriction that people should not physically meet each other. One of the methods used to evaluate the dietary application was usability testing. There are two types of usability testing: lab usability testing and remote usability testing. Since lab usability testing requires the participants to meet the test leader, this was not an option and remote testing was a more suitable

alternative. When comparing lab and usability testing, there are many similarities except how to communicate and the test location. Prior studies have compared remote testing and lab testing to see what works (Thompson et al., 2004; Tullis et al., 2002). In both studies, participants that were recruited had to complete different tasks on a webpage. The conclusion was that remote testing could be as effective as traditional testing, but both have some pros and cons.

One of the advantages of remote testing is the time saved because of not needing to travel. This gives the option to have a larger number of users that can be more diverse. The user is being tested in their natural environment and leads to more in-depth feedback. Lab testing has the advantage that the test leader can observe the user more closely. If there is a problem that occurs, the test leader can help the user.

In our study, the focus was to evaluate mobile dietary applications. Figure 3.1 and 3.2 shows how the user should position their body, camera and mobile. The camera is pointing at the mobile to let the test leader observe what the participants are doing and if they are doing the right task. One of the limitations of this setup is that there is not possible to observe the participant's body language.

In the study where remote testing and lab testing are compared (Thompson et al., 2004; Tullis et al., 2002), they do not mention any problems with equipment. We encountered some problems under the usability testing: screen glare, camera quality, angle of the camera, bad internet connection, and audio and microphone issue. The problem with screen glare and camera angle can be fixed if a mobile simulator and the participants sharing their screen. This gives the option to use the camera to observe the user's body and facial expression.

With remote testing, more preparations are needed before conducting the usability testing. The test leader could not help the participants if they had some problems. The last restriction was assistive technology. To reach a certain group of users, assistive technology is needed. With remote testing setting up and solving problems is already time-consuming and complicated. Adding assistive technology would make it more time and resource consuming.

5.4 Limitations and future work

The limitations for our group of participants were that most of the participants were in the age group of 20-30 years old and had only one participant over 50 years old. We have no feedback on the dietary applications from the age group of 40. In further work, participants recruited should form a more diverse group in terms of age and education level.

When it comes to the usability testing tasks, seven tasks were design, testing out a limited number of features and functions in the dietary app. Many of the tasks were related to the first-time user. A user who has used or is using the app will not change their target/goal weight at first and does not need to search for food because it has been saved in their history. To better evaluate the dietary applications, more functions and features should be tested. The participants had 30-45 minutes to evaluate two different dietary applications and answer questions. The problem with evaluating two dietary applications was that users could get some experience. With a mixed sequence in evaluating two apps, we found out that experience affected the results. There should be a pause between evaluating the dietary apps or just having one participant test one dietary application in further research.

The prototype was designed to show how an improved dietary application has not been evaluated. We do not know if the prototype is an improvement at all. There are some limitations when it comes to Figma. There is no way to save data, input data or send messages to the user. The prototype has only the required interfaces to complete the usability testing tasks. Comparing a fully working dietary application to this prototype can give misleading results. With the feedback from the usability testing, a fully functioning diet app should be developed. The participants can evaluate the developed prototype to show that the prototype is an improved dietary application.

6. Conclusion

In this study, we evaluated three dietary applications from the perspective of universal design. The dietary applications that were evaluated were MyFitnessPal, Lose It, and MyNetDiary. These dietary applications have a high rating on the mobile app store and were recommended on the internet. The method that was used to evaluate the dietary application was remote usability testing. The usability testing shows that these high-rated and recommended dietary applications have usability issues. Many of these issues can be fixed when designing with universal design in mind. The result from the usability test was used to design a prototype, and this prototype shows how an improved dietary application can look. The second significant finding was that most people have a positive attitude toward dietary application and think it can improve health and eating habits. But many people don't use a dietary application because of a lack of interest or have not thought of using one.

The thesis has provided a deeper insight into universal design used in dietary applications and people's attitudes toward dietary applications in general. Despite the limitations, the study has given more information on improving usability for first-time users. Further research should be carried out to understand how dietary applications can be improved and how we can get people to use dietary applications.

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8. Appendix

8.1 Consent form

Evaluating dietary applications from the perspective of universal design

You are invited to take part in a research study. Before deciding if you want to take part or not take part in this research study, I would like to brief you about my project.

Introduction

This research study is a part of my master's in Applied Computer and Information Technology at OsloMet, Oslo. This study aims to get insight and feedback of users using dietary applications from the perspective of universal design.

What do you have to do?

If you agree to participate in this study, you will be asked some questions about yourself and your experience using dietary applications. Then you will be asked to complete some tasks using two predetermined dietary apps. In the end, there will be an interview to understand more about the user's experience with the dietary app. The study will be done remotely and with your own devices. You need only to download the dietary apps and have either Teams, Google Hangouts, Zoom or Discord for communication. The total time of the study is around 30-45 min.

Confidentiality

This research study is voluntary, and you can freely withdraw at any point of the study. You can request to stop if there is any discomfort during the session. We are not collecting any personal and/or personally identifiable data. The study result will be represented using pseudonyms to protect your confidentiality.

Please do not hesitate to contact me at s341349@oslomet.no if you have some questions or require more information.

Participant Consent

I have read the information above and consent to participate in this research study.

Name of the participant: _____

Signature: _____

Date: _____

8.2 Background information questions

Age: What is your age?

Gender: Male / Female

Education level: Junior high school / Highschool / Higher education (3 years or more)

ICT skills: Rate from 1 to 10. 1 is the worst and 10 is the best.

Concern about diet: Rate from 1 to 10. Where 1 is not concerned and 10 is very concerned.

Experience using dietary apps: Do you have any experience with using dietary applications (Yes/No)

Follow-up question: If no, ask why? If yes, ask which and what was it used for?

8.3 Usability testing tasks version 1

1. Change your weight in my profile to be 85 kg.
2. Change your goal/plan to be weight loss to 81 kg over a timeframe of 8 weeks from today.
3. Record your current weight (85 kg) for today.
4. Add your breakfast for today. For breakfast, you had a glass of raw orange juice, 1 large egg scrambled and 2 pieces of cooked bacon.
5. Add dinner for today. For dinner, you had one whole grandiose pizza (500grams) and uses the barcode scanner to scan the food. (The barcode will be shown on the screen)
6. You inputted that you ate the whole pizza, but you only ate half of it. You need to change it on the app.
7. See how many calories that you have eaten today.

8.4 Usability testing tasks version 2

1. Change your current weight in my profile/app to be 85 kg.
2. Change your target weight or goal weight to be 81 kg.
3. Record weight/weight in for today, 84kg.
4. Adding breakfast for today, you had one glass of one type of beverage, one large something of food and 200 grams of something.
5. Adding dinner for today, you ate a pizza and decided to use the barcode scanner to log the food. You are logging that you ate 500 grams of that product.
6. In the end, you did not eat 500grams of that pizza for dinner, but you only ate 250 grams. Now you need to change the amount.
7. See how many calories that you have eaten so far today.

8.5 Interview after usability testing

1. Rate your own performance from 1-10 where 1 is bad, to 10 very good in completing the different tasks on both dietary apps.
2. Which of the dietary application did you prefer the most?
3. What did you dislike and like about the different dietary apps?
4. How hard was it to change your current weight in both apps?
5. How hard was it to change your weight goal in both apps?
6. How hard was it to add/log different types of food in both apps?
7. What do you think about using the barcode scanner?
8. Did you prefer searching or using the barcode scanner to add/log food?
9. What do you think needs to be improved in both apps?
10. Will you use any of these two dietary applications in the future?
11. Do you think dietary apps can help you get into healthier eating habits?

8.6 Chosen dietary applications



MyFitnessPal



MyNetDiary



Lose it!

8.7 Link to Figma project

<https://www.figma.com/file/9SPJHSqFzFcClgo0di8RFW/Master-thesis-design>

8.8 Summary of post-interview answers

Q2. Which of the dietary application did you prefer the most?

User 1: MyFitnessPal and Lose it! -> MyFitnessPal

User 2: MyFitnessPal and MyNetDiary -> MyFitnessPal

User 3: MyFitnessPal and Lose it! -> MyFitnessPal

User 4: MyNetDiary and Lose It! -> MyNetDiary

User 5: MyFitnessPal and MyNetDiary -> MyNetDiary

User 6: MyNetDiary and Lose It! -> MyNetDiary

User 7: MyFitnessPal and Lose it! -> Lose It!

User 8: MyFitnessPal and MyNetDiary -> MyNetDiary

User 9: MyNetDiary and Lose It! -> MyNetDiary

User 10: MyFitnessPal and MyNetDiary -> MyFitnessPal

Q3. What did you like and dislike about the different apps?

User 1:

- MyFitnessPal:
 - Like: Easy to use, simple to use, easy navigation.
 - Dislike: Some of the functions are not free and limited.
- Lose it:
 - Like: Picture/Icons for the food.
 - Dislike: To much advertisement and texts, social functions are not relevant, too much information, pictures, and colors.

User 2:

- MyFitnessPal:
 - Like: The app was clearly with how the tabs were setup. The tabs were setup in steps so you can go up and down the different steps to find what you are looking for.
 - Dislike: Some of the wordings were confusing and location of different tasks.
- MyNetDiary:
 - Like: The wording, what you clicked on were the thing you wanted to click on.
 - Dislike: Thing were to spread out and you had to take some time to look for a certain thing. Thing were not categorized.

User 3:

- MyFitnessPal:
 - Like: Easy to put in different types of foods. Easy to use, better description over what you are looking for.
 - Dislike: Changing the amount of food category, can't enter in grams but need to calculate from portions.

- Lose it:
 - Like: Entering the number of foods (grams, ounce, and portions).
 - Dislike: Keyboard popping up when adding food. To many steps to find what you want to do, for example changing your current weight. To many buttons and needed to scroll around.

User 4:

- Lose it:
 - Like: Easy to use, organized, easy to navigate, convenient with the plus button.
 - Dislike: To many options when searching for generic food options.
- MyNetDiary:
 - Like: The layout, control of what you want to see, appealing to see what you have eaten.
 - Dislike: Change current weight was not under the right category in my opinion.

User 5:

- MyFitnessPal:
 - Like: Easy to use.
 - Dislike: Didn't have any figure and pictures.
- MyNetDiary:
 - Like: The layout, colors and how the application looked.
 - Dislike: It was to complex.

User 6:

- MyNetDiary:
 - Like: The apple layout to see your calories intake. can type in the number for amount of food.
 - Dislike: Current weight settings was deep into the application that made it difficult to change the weight. Personal settings had to many sections.
- Lose it:
 - Like: Summary of the week in from of calorie intake and different charts that can be used.
 - Dislike: Number scrolling for adding amount of food, changing your current weight was deep into the application that make it hard to find.

User 7:

- Lose it:

- Like: The color scheme, black theme with good contrast, the app was tidy and make it easier to use. Simple to change and edit everything when thinking about the tasks.
- Dislike: A bit confusing at the start, so much different content in my profile. Didn't know where to navigate. Writing the amount of food.
- MyFitnessPal:
 - Like: It was translated to Norwegian. Simple to use, everything was clearly laid out and understandable. Good contrast on the weight graph.
 - Dislike: Too bright. Editing food was harder than Lose It. Some of the foods had only portion size as an option. Writing the amount of food.

User 8:

- MyNetDiary:
 - Like: Dark mode. Bigger nutrition content and more information in general. Good layout.
 - Dislike: Changing my current weight option was hard to find.
- MyFitnessPal:
 - Like: More clear indication of budget of calorie intake.
 - Dislike: A lot to scroll to put in what you have eaten. No dark mode option. Can't take of flash when using the barcode scanner. Boring layout that makes it not catchy.

User 9:

- Lose it:
 - Like: There was nothing that made me like the app.
 - Dislike: Hard to find the option to change my current weight in my account.
- MyNetDiary:
 - Like: Easy to navigate and user friendly.
 - Dislike: Hard to find the option to change my current weight in my account.

User 10:

- MyFitnessPal:
 - Like: Easy design and good interface.
 - Dislike: Not that much on the home screen to make it appealing.
- MyNetDiary:
 - Like: More information but in some areas, it can be too much.

- Dislike: How to move around in the application.

Q4. How hard was it to change your current weight in both apps?

User 1:

- MyFitnessPal: Very easy.
- Lose it: Very hard first time.

User 2:

- MyFitnessPal: A bit hard, but it worked out in the end.
- MyNetDiary: Very hard, hard to search for it and needed some assistance in the end.

User 3:

- MyFitnessPal: A bit hard.
- Lose it: A bit harder than MyFitnessPal because you need to go deep into the application.

User 4:

- Lose It: Very fast and easy.
- MyNetDiary: A bit harder than Lose It because of the category it was located in.

User 5:

- MyFitnessPal: Easy.
- MyNetDiary: Time consuming and hard, got lost in the app.

User 6:

- MyNetDiary: Very hard.
- Lose It: Very hard.

User 7:

- Lose it: A bit hard.
- MyFitnessPal: A bit easier than Lose It because of the layout.

User 8:

- MyNetDiary: Easy.
- MyFitnessPal: Easy.

User 9:

- Lose It: Complicated.
- MyNetDiary: Complicated.

User 10:

- MyFitnessPal: Easy.
- MyNetDiary: A bit hard.

Q5. How hard was it to change your weight goal in both apps?

User 1:

- MyFitnessPal: Very easy.
- Lose it: Easy but MyFitnessPal easier.

User 2:

- MyFitnessPal: A bit hard.
- MyNetDiary: Hard.

User 3:

- MyFitnessPal: A bit hard.
- Lose it: Hard.

User 4:

- Lose It: Easy.
- MyNetDiary: Hard.

User 5:

- MyFitnessPal: Not hard or easy, somewhere in the middle.
- MyNetDiary: Not hard or easy, somewhere in the middle.

User 6:

- MyNetDiary: Not that hard.
- Lose It: Not that hard.

User 7:

- Lose it: Easy.
- MyFitnessPal: Easy.

User 8:

- MyNetDiary: Easy.
- MyFitnessPal: Easy.

User 9:

- Lose It: Complicated.

- MyNetDiary: Complicated.

User 10:

- MyFitnessPal: Easy.
- MyNetDiary: Hard.

Q6. How hard was it to add/log different types of food in both apps?

User 1:

- MyFitnessPal: Easy but finding the correct one was hard because of too many like option with different calories.
- Lose It: Easier to find the correct one that fitted my thinking on Lose it than MyFitnessPal.

User 2:

- MyFitnessPal: Hard first time because of knowledge, but easier when understanding the different functions.
- MyNetDiary: Hard first time because of knowledge, but easier when understanding the different functions.

User 3:

- MyFitnessPal: Easy.
- Lose it: Easy but a bit more complicated than MyFitnessPal.

User 4:

- Lose It: Easy.
- MyNetDiary: Easy.

User 5:

- MyFitnessPal: Easy.
- MyNetDiary: Easy but hard to change the amount.

User 6:

- MyNetDiary: Easy.
- Lose It: Easy.

User 7:

- Lose it: Easy.
- MyFitnessPal: Easy.

User 8:

- MyNetDiary: Easy.
- MyFitnessPal: A bit harder than MyNetDiary because of the locked portion size option.

User 9:

- Lose It: A bit convoluted but not difficult.
- MyNetDiary: Easy.

User 10:

- MyFitnessPal: Easy.
- MyNetDiary: Okey, but a bit confusing.

Q7. What do you think about using the barcode scanner?

User 1: Easy to use.

User 2: Very easy to use.

User 3: Easy to use.

User 4: Good and easy.

User 5: Had some problems at the start but it worked in the end.

User 6: Good because it saves a lot of time.

User 7: Easy to use.

User 8: Good alternative when you can't search for the product you want.

User 9: Good because I use it.

User 10: Ok.

Q8. Did you prefer searching or using the barcode scanner to add/log food?

User 1: Barcode scanner.

User 2: Barcode scanner because it is easier to log your food.

User 3: Barcode scanner when I have the option, but if the product doesn't have a barcode, then I must use the search option.

User 4: Depends on what you eat, if the food has a barcode, then I will use the barcode scanner. Searching when it comes to homemade food.

User 5: With experience I will use the barcode scanner because its quick and easy.

User 6: Depends on the case, if the new product has a barcode, then it is more convenient. If it already in the system, then searching is way faster.

User 7: Barcode scanner when it possible to use.

User 8: Search first, if can't be found then barcode scanner.

User 9: It depends on the amount of food that I'm consuming.

User 10: Searching function because not comfortable with the barcode scanner.

Q9.What do you think needs to be improved in both apps?

User 1:

- MyFitnessPal: More functions to be free, less option for the same food.
- Lose it: Simplify the design because of too much clutter on the screen. Does not know what to click on or not. Tutorial for basic features.

User 2:

- MyFitnessPal: Option to change current weight in my profile.
- MyNetDiary: More categories, remove things that I don't want to use. Make it easier to see that buttons and options you can click.

User 3:

- MyFitnessPal: Not too much to improve.
- Lose it: Reduce the steps needed to complete a task. Make the information more visible because didn't know if it was clickable or scrollable. Make the app more accessible.

User 4:

- Lose It: Make it more exciting, make the layout better, more appealing and motivation.
- MyNetDiary: Nothing.

User 5:

- MyFitnessPal: Adding instructions on how to use the barcode scanner. Auto correction when you have written something wrong in the search area. Voice command.
- MyNetDiary: Adding headings. Need to categorize more because information was to spread out. Sound or music to make it more motivation when adding food or doing some tasks. Notifications when you are over your calorie limit.

User 6:

- MyNetDiary: Weight setting needs to be easier to change, make it changeable in my profile. Settings in my profile had too many categories and need to be simpler.
- Lose It: Weight setting needs to be easier to change, make it changeable in my profile. The calorie display needs to be better.

User 7:

- Lose it: Tutorial and better descriptions on what you should do.
- MyFitnessPal: Tutorial and better descriptions on what you should do.

User 8:

- MyNetDiary: Better description on the different types of data, for example the apple calorie counter.
- MyFitnessPal: More catchy layout, and dark mode.

User 9:

- Lose It: More user friendly, change my profile to contain items that is about me and categorize better.
- MyNetDiary: More user friendly, change my profile to contain items that is about me and categorize better.

User 10:

- MyFitnessPal: Icons connected to information, make it easier to navigate.
- MyNetDiary: Make some of the information more understandable. Bigger font to make it easier to read the information because information overflow.

Q10. Will you use any of these two dietary applications in the future?

User 1: Yes, MyFitnessPal.

User 2: No.

User 3: No now, but if I had to then I would use the app to track my diet.

User 4: No, because I'm not on a diet.

User 5: Yes, maybe MyNetDiary when there are some improvements.

User 6: Yes, because it will reduce my food intake and prevent weight gain.

User 7: Yes, because it's effective and easy to have control over what you have eaten.

User 8: Yes, when I am going on a diet.

User 9: No, not these two apps because there are better out on the market.

User 10: No, if I had to go in a diet, I would find a better app than these two.

Q11. Do you think dietary apps can help you get into healthier eating habits?

User 1: Yes, helping on the motivation, you can set goals and be motivated to work towards the goal.

User 2: Yes, if you had a goal then you can use the app to log the progress and that has an impact on you.

User 3: Don't know because need to see proof before answering the question.

User 4: Yes, because you can keep track on what you are eating and that makes you more aware.

User 5: Yes, you become more aware of what you are doing in terms of fitness and health. The apps can notify you about things that you need to do to improve yourself.

User 6: Yes. Shows us what we ate for that date and if we have eaten too much the app can notify us so we can cut down on the intake.

User 7: Yes, when you have an overview over what you are eating, you tend to be aware to eat healthier.

User 8: Yes, because you get an overview over what you have eaten and if they are disciplined, they will stick within their calorie limit.

User 9: Yes, because then you have some form of control of what you're eating.

User 10: Yes, because you have an overview on what you are eating and then you can improve over a period.

