Feed The Movement

A food waste reduction app



Supervisor: Alma Schaafstal (UT) Critical observer: Job Zwiers (UT)

> Floor Kuipers 5th of July 2019

Abstract

Currently, one-third of the food in the world is wasted annually. In this project a Food Waste Reduction app was created, to contribute to the solution to this problem. This was done together with a co-developer, Alexandra Țițiu. The aim of this research was to enhance the knowledge of the users, households with at least one child, on their food waste behaviour and how to better it. The focus of Alexandra's research is on motivating and engagement of the user through the use of a gamified app, where the focus of my research was on how to change food waste behaviour through the use of technology. This resulted in an app concept called Feed The Movement, which was concluded to, to a certain degree, contribute to the enhancement of knowledge about food waste reduction among households with at least one child.

Acknowledgement

To start, I would like to thank Alexandra Titiu for the good cooperation and her input for the project.

Next, I would like to thank our first supervisor, Alma Schaafstal. She always provided a critical view on the ideas we put forward and she made sure we stayed on track. Furthermore, her expertise on research design was really helpful in the process.

Our critical observer Job Zwiers also deserves a thank you, as he provided us with a lot of feedback on the ideas and process as well.

The clients of this project, Anke Janssen and Rene de Wijk of the Wageningen University of Research provided us with a challenging and interesting assignment. They regularly took the time to have meetings with us to discuss whether or not we were still on the same page about the vision of the project and they also provided us with useful feedback.

Finally, I would like to thank my father, Lourens Kuipers, for proof reading my paper, for always being open for a discussion on which steps to take next, and keeping me motivated.

Table of content

Abstract
Acknowledgement
Table of figures 7
Table of tables 7
1. Introduction
2. State-of-the-art on food waste reduction technologies
2.1 Why do people waste food?
2.2 How can this behaviour be changed?
2.3 Use of technology
2.4 Conclusion of State-of-the-art
3. Methods and techniques
3.1 Creative Technology Design Process
3.1.1 Ideation
3.1.2 Specification
3.1.3 Realisation
3.1.4 Evaluation
3.2 Requirement Elicitation and Categorisation
3.3 Usability testing
4. Ideation
4.1 Mind map
4.2 Individual brainstorm
4.2.1 Idea 1. Escape room 19
4.2.2 Idea 2. Pokemon Go as inspiration
4.2.3 Idea 3. Board game19
4.2.4 Idea 4. Weight Watchers as inspiration
4.2.5 Idea 5. "FoodPrint"
4.2.6 Idea 6. SimCity as inspiration
4.3 Brainstorm with Alex
4.3.1 Family game
4.3.2 Social platform game
4.4 Client meeting
5. Specification
5.1 Concept of choice

5.2 Requirements	24
5.2.1 Must have	24
5.2.2 Should have	25
5.2.3 Could have	25
5.2.4 Won't have	
5.2.4 Summary	
5.3 Interface	
5.3.1 Children's interface	
5.3.2 Parent's interface	
6. Realisation	29
6.1 Usability testing	29
6.1.1 Results children's interface	
6.1.2 Results parent's interface	
6.2 Approach	
6.3 Creation	
6.3.1 Outline	
6.3.2 Quizzes	
7. Evaluation	
7.1 Test outline	
7.1.1 Participants	
7.1.2 Test design	
7.2 Test results	
8. Conclusion and recommendations	40
8.1 Conclusion	40
8.2 Discussion	40
8.2.1. Discussion of application	40
8.2.2. Discussion of methodology	
8.3 Recommendations	
9. References	
10. Appendices	
10.1 Appendix A - Mind map	46
10.2 Appendix B – Paper prototype Children interface	47
10.3 Appendix C – Paper prototype Parents interface	51
10.4 Appendix D – Walk-through of app – Children interface	55

10.5 Appendix E – Walk-through of app – Parents interface	. 61
10.6 Appendix F – Outline Pretest and Posttest	. 68
10.7 Appendix G – Questions questionnaire Pretest and Posttest	. 69
10.8 Appendix H – Outline intervention test	. 71
10.9 Appendix I – Quizzes in app, including answers	. 72

Table of figures

Figure 1 Smart Scale for restaurants ¹	12
Figure 2 Samsung smart refrigerator ²	13
Figure 3 Food label that becomes bumpy when meat is no longer safe to eat ³	13
Figure 4 Euphoria - smartphone app that tracks fridge content	13
Figure 5 Example of a BinCam bin	14
Figure 6 BinCam interface with images of the bin responsibilities and bin spies to the left, and an	
enlarged and tagged bin picture in the middle	14
Figure 7 Paper prototype family game.	22
Figure 8 Paper prototype of social game	23
Figure 9 Preview of paper prototype	29
Figure 10 Outline of app frames	31
Figure 11 Interaction links Parent's interface	32
Figure 12 Bloom's taxonomy (Bloom et al., 1956)	34
Figure 13 Connections quiz-questions different quizzes	35

Table of tables

Table 1 Definitions of interventions and examples (Michie et al., 2011)	10
Table 2 Overview of components and BCIs (Michie et al., 2011)	11
Table 3 Summary of MoSCoW method	26

1. Introduction

We, as consumers, are the biggest sources of food waste in The Netherlands. Of all of the food wastage, half of it is done at the homes of the Dutch people. Not only in terms of money this is a waste, it is also a waste of valuable resources that were needed to transport and produce the food (Dossier Food Waste, 2014). In a time of global warming and large environmental changes, it is of essence that resources are wasted as little as possible. The clients of this research project, Anke Janssen and Rene de Wijk, are two researchers from the Wageningen University. They are both part of the department of "Fresh Food & Chains," in which they focus on healthy and tasty food and a sustainable food chain. The question they posed us was whether a game could be helpful to reduce consumer food waste. The target group that was decided on is households with at least one child living at home.

To contribute to the reduction of food waste, an intervention needs to be created. This research project looked into the possibilities of using a technology to reduce food waste by enhancing knowledge of households with at least one child. Before this application could be designed, it was important to know what type of intervention would work well. To find this out, the application of different technologies was looked into to see how and if they can contribute to change in food waste behaviour. First, a state-of-the-art review was created to express what technologies are currently being used for similar goals and if they work. This was done by examining three sub questions, namely "Why do people waste food?", "Which behavioural change techniques (BCTs) work best when changing this behaviour?" and "How can different technologies change food waste behaviour?"

Next, the Creative Technology Design Process (Mader & Eggink, 2014) was put in motion. Several iterations took place in which was reflected on the current product and changes were made, based on usability tests. The end result was a gamified food waste reduction app, called Feed The Movement, which was aimed at food waste reduction at households with at least one child. This intervention was created in collaboration with Alexandra Țițiu. She focused on the gamification elements of the product and on making sure that the user is engaged with our application.

2. State-of-the-art on food waste reduction technologies

2.1 Why do people waste food?

The behaviour of wasting food has several different determinants and can happen in six different stages. First off, it is important to look into what food waste is exactly. This paper looks into the part of food waste that is created by consumers. "Consumer food waste is the edible food and drink fractions from products or meals that are acquired with the intention to be consumed by humans, but remain unconsumed and are discarded," as is defined by van Geffen, van Herpen and van Trijp (2016).

As mentioned, food is wasted at different stages. These stages are planning, provisioning, storing, preparing, consuming (Schmidt & Matthies, 2018) and van Geffen et al. also suggest 'serving' as an additional stage (2016). Each stage comprises different actions that increase food waste. These actions are explained by van Geffen et al. (2016). Behaviours in the planning stage can indirectly result in food waste, for instance due to incorrect or lack of planning. Bad planning can lead to purchasing too many products. This way, the likelihood that not all products can be eaten before becoming spoiled increases Provisioning refers to all ways in which food can enter the household. When purchasing food products in a store, several behaviours increase the likelihood of food waste. Examples are impulse buying, buying a package size that is too large or buying discounted food when it is not necessary. With regards to storing, in many cases, correct storage can prolong the shelf life of the products greatly. There are many different ways people can store their foods in a bad way, but the most common examples are not cleaning the storage spaces, fridges and freezers well, having an unorganized way of storing the foods and just general lack of knowledge on what to store where. The next stage of preparing the food comprises every way the food is handled to enhance edibility. An example of how food can be wasted in this stage is that the products are only used partly, that the portion size is incorrectly estimated or that the food that is prepared simply tastes bad. The fifth stage of consuming refers to the moments when the food products or meals are being consumed and leftovers are being handled. People can waste food here by throwing away the left-overs, or forgetting they stored-left overs and end up not eating them.

During these stages, actions can be taken to prevent the eventual outcome of food waste. As is pointed out by Quested, Marsh, Stunell and Parry (as cited in van Geffen et al., 2016), the opportunity to prevent food from becoming waste has already passed by the time food is thrown away. Within each stage, the underlying cause of the behaviour seems to mainly lie at the psychographics of the users (Aschemann-Witzel, de Hooge, Amani, Bech-Larsen, & Gustavvson, 2015). More detailed, it seems to be the lack of motivation, ability and opportunity of consumers to prevent food waste (Aschemann-Witzel et al., 2015; van Geffen et al., 2016). It is argued that these three components, when interacting with each other, comprise the behaviour of a human being in every sense of behaviour, not just food waste behaviour (Michie, van Stralen, & West, 2011). Concluding, it appears that food waste behaviour can be split up in the three components of motivation, ability and opportunity and it happens in different stages, each bringing along their own challenges.

2.2 How can this behaviour be changed?

Looking at the fact that lack of opportunity, capability and motivation are the main underlying causes of the problem of food waste, different behavioural change techniques (BCTs) can be used to alter this behaviour. For each individual component of the underlying cause of food waste, Michie et al. gave a list of specific BCTs that they found that worked well (2011), looking at this "COM-B Model" (Capability, Opportunity and Motivation). These interventions and their definitions are given in Table 1.

Behaviour Change	Definition	Examples
Interventions		
Education	Increasing knowledge or understanding	Providing information to promote healthy eating
Persuasion	Using communication to induce positive or negative feelings or stimulate action	Using imagery to motivate increases in physical activity
Incentivisation	Creating expectation of reward	Using prize draws to induce attempts
		to stop smoking
Coercion	Creating expectation of punishment or cost	Raising the financial cost to reduce excessive alcohol
		Consumption
Training	Imparting skills	Advanced driver training to increase safe driving
Restriction	Using rules to reduce the opportunity to engage in	Prohibiting sales of solvents to people under 18 to reduce
	the target behaviour (or to increase the target	use for intoxication
	behaviour by reducing the opportunity to engage	
	in competing behaviours)	
Environmental	Changing the physical or social context	Providing on-screen prompts for GPs to ask about smoking
Restructuring		behaviour
Modelling	Providing an example for people to aspire to or	Using TV drama scenes involving safe-sex practices to
	imitate	increase condom use
Enablement	Increasing means/reducing barriers to increase	Behavioural support for smoking cessation, medication for
	capability or opportunity	cognitive deficits, surgery to reduce obesity, prostheses to
		promote physical activity

Table 1 Definitions of interventions and examples (Michie et al., 2011)

For the lack of Capability, one could create interventions that focus on the Behaviour Change Interventions Education, Training and Enablement. For the lack of Motivation, interventions should be created that focus on Education, Persuasion, Incentivisation, Coercion, Environmental restructuring, Modelling and Enablement. Lastly, lack of Opportunity can be solved by interventions focused on Restriction, Environmental restructuring and Enablement. A clear overview of the components of food waste behaviour and their corresponding Behaviour Change Interventions can be found below in Table 2.

	Education	Persuasion	Incentivisation	Coercion	Training	Restriction	Environmental	Modelling	Enablement
							restructuring		
Capability	\checkmark				~				\checkmark
Opportunity						\checkmark	\checkmark		\checkmark
Motivation	~	~	~	~			~		~

Table 2 Overview of components and BCIs (Michie et al., 2011)

This composition of the three components of behaviour is also argued by Vogels, van der Haar, Zeinstra and Bos-Brouwers when looking at apps specifically (2018). They state that apps make it possible to focus on the three key determinants of the Consumer Food Waste Model, which are Opportunity, Ability and Motivation. This Consumer Food Waste Model show the same determinants as the general behaviour model explained in the paper on the COM-B model (Michie et al., 2011).

The paper of Vogels et al. argues several effects that apps can have on food waste behaviour (2018). For instance, apps can provide a new technology that helps consumers at the moment of shopping not to buy foods they already have in stock, helping the user in their lack of opportunity to reduce their food waste. This implementation of technology corresponds to the Behaviour Change Technique enablement, mentioned by Michie et al. (2011). Apps can also increase consumers' knowledge about expiry times or help consumers with food planning, creating a better Ability to change food waste behaviour for the user. This Behaviour Change Intervention corresponds to the BCTs Education and Enablement. Lastly, apps can motivate consumers by presenting feedback or compliments when desirable behaviour occurs, creating a higher Motivation of the user. This Behavioural Change Intervention corresponds to the Behavioural Change Intervention corresponds to the Behavioural Change Technique Incentivisation, as mentioned by Vogels et al. (2018). Concluding, different BCTs appear to work well for different aspects of behaviour.

2.3 Use of technology

Different technologies have been used to try and change the behaviour of food waste. Altarriba, Lanzani, Torralba and Funk present, in their state-of-the-art on this subject, several different concepts were deployed to reduce food waste (2017). The state-of-the-art review first examined the usage of a smart scale for restaurants¹, a smart refrigerator² and a sticker that reacts to the state of a product (Woollaston, 2014). What these three products have in common, in the eyes of the authors of the stateof-the-art review, is that the solutions are rather informative and lack intention. Effective social means to behaviour change are not strongly involved.



Figure 1 Smart Scale for restaurants¹



¹ https://www.winnowsolutions.com/

² https://www.samsung.com/us/explore/family-hub-refrigerator/overview/

Figure 2 Samsung smart refrigerator²



Figure 3 Food label that becomes bumpy when meat is no longer safe to eat³

The article looked into several different academic projects that took further steps. This resulted in two more products related to food waste. They looked into a smartphone app, called Euphoria, that tracks fridge content resulting in recipe suggestions (Yalvaç, Lim, Hu, Funk & Rauterberg, 2014) and an augmented bin, called the BinCam used to track household food waste and using social influences as a trigger to reduce food waste (Thieme et al., 2012). According to them, the use of social influence is a good way to change food way to reduce food waste.



Figure 4 Euphoria - smartphone app that tracks fridge content



Figure 5 Example of a BinCam bin



Figure 6 BinCam interface with images of the bin responsibilities and bin spies to the left, and an enlarged and tagged bin picture in the middle

A different article looked into different smartphone applications and why and how they work well in reducing food waste (Vogels et al., 2018). Several types of apps were investigated. It is stated that apps and ICT-tools can be effective in raising consumer awareness (Farr-Wharton, Choi, & Foth; Lim, Funk, Marcenaro, Regazzoni, & Rauterberg; Nguyen, V. N., Nguyen, T. H., Huynh, Nguyen, V. H, & Stigberg as cited in Vogels et al., 2018). It appeared that users of an app with the aim to encourage sustainability behaviour stated that the app impacted their awareness on their food supply positively. The studies they investigated also showed that users like to get feedback on their behaviour. An example of this could be in the form of social comparison. The consumers perceived this social comparison component as being effective in them reducing their food waste and thought of it as a motivating factor, which complies with the conclusion of the state-of-the-art review of The

Floor Kuipers

Grumpy Bin (Altarriba et al., 2017). Furthermore it appears that an element of goal-setting contributes to compliance, as stated by Aleahmad, Balakrishnan, Wong, Fussell, & Kiesler (as cited in Vogels et al., 2017).

Several aspects appear to be of importance for an app in order to be successful. Examples of these that are mentioned in the paper from Vogels et al. are time and effort (2018). The app should be user-friendly, requiring minimal cognitive effort and usage time, as Home and Lim et al. state (as cited in Vogels et al., 2018). A review of Zhao et al. (as cited in Vogels et al., 2018) investigated explored which aspects would most enhance the effectiveness of an app. This review concluded that user-friendly design, individualized elements, health professional involvement, less time consumption, real-time feedback, may improve effectiveness of behaviour apps. Overall, it appears that the use of an app shows potential for a food waste reduction intervention.

2.4 Conclusion of State-of-the-art

The question that was posed as the main research question was *"How can food waste behaviour be changed?"*. This paper aimed to answer this question through answering three sub questions, namely "Why do people waste food?", "Which behavioural change techniques (BCTs) work best when changing this behaviour?" and "How can different technologies change food waste behaviour?"

Different aspects of food waste behaviour appear to be of influence, namely Capability, Opportunity and Motivation. From this research it became clear that these three aspects of behaviour are of great importance in the reason why people waste food. Each of the aspects requires a different type of Behavioural Change Technique (BCT) and corresponding Behaviour Change Intervention (BCI) for the aspect to change. These different BCTs and BCIs were looked into and appeared in different applications that were investigated to see to what extent they are effective. Several interventions came forward that worked well in reducing food waste. For instance, different apps were compared to see to what degree they are effective. This proved that some aspects of an app are of importance to get right, in order to have a successful food waste behaviour change app. These aspects were user-friendliness, minimal required cognitive effort, low usage time, individualized elements, health professional involvement, less time consumption and real-time feedback.

The information that resulted from answering the three sub questions can now be used to answer the main research question. It can be concluded that food waste behaviour can be changed in a number of ways. This paper looked into which ways have been proven to work. When keeping in mind the aspects that are of importance for a good food waste app, an intervention in the form of an app shows potential to be a good solution to the problem of food waste. Different behavioural change techniques were implemented in these apps and proven to be effective. Examples given were receiving feedback on their behaviour and an aspect of social comparison. The implementation of BCTs showed an increase in consumer awareness and motivation. Recommendations for further research would comprise expanding the search for possible technologies to change food waste behaviour. Besides the articles discussed in this paper, there are still a lot of solutions and BCTs that are left unreviewed. The focus slowly started leaning towards the use of apps as interventions in this paper, because the papers deemed most relevant to answer the questions that were posed mostly discussed the use of apps rather than other technologies. For this reason, this paper cannot firmly conclude one technology is the best technology to use when trying to change food waste behaviour, but the use of an app certainly shows potential. The third sub question posed, dealing with how different technologies can change food waste behaviour thus mainly needs further research. The question of how food waste behaviour can be changed requires a more elaborate answer than was possible to give in this literature research. The possibilities are far more endless than only the mentioned options in this paper, this review merely summarized well-working possibilities.

During the course of performing this bachelor thesis, a food waste game will be developed.. User testing on the game prototype will be performed to gain insight into how well the concept works in reducing household food waste by education.

3. Methods and techniques

3.1 Creative Technology Design Process

The design method of Creative Technology is used in this research. This method was developed by Mader and Eggink (2014). Four different phases are distinguished, namely ideation, specification, realization and evaluation. Within each of the phases there is the possibility to iterate and diverge ideas, where at the end of the phase the idea should converge again.

3.1.1 Ideation

During this first phase of ideation the main goal is to generate ideas. This thinking of ideas can be initiated by brainstorms, making sure the thinking process explores different directions rather than focusing on a single idea from the beginning. After these brainstorms, requirements and research into possibilities will narrow down the ideas to potential solutions. These ideas will then be narrowed down to the final idea.

3.1.2 Specification

The next phase of specification focuses on specifying what is chosen to be created. The description of the product should be clear enough to be able to create it immediately after this phase. Low-Fi prototypes are created to see whether or not the concept has potential.

3.1.3 Realisation

The information and parts of the previous phases are combined to start the creation of a final prototype that can be evaluated to see if the hypothesis of the research is correct.

3.1.4 Evaluation

The final phase of the Design Process cycle is the evaluation phase. The prototype is evaluated and user tests are performed. The results of the tests can give valuable insights into whether or not the requirements are met and into answering the research question. Besides this, possible feedback can be used to improve the prototype or to continue working on the product.

3.2 Requirement Elicitation and Categorisation

The elicitation and categorisation of the requirements is done as a first part of the specification process. The requirements for the product are gathered by interviewing the client (Anke Janssen and Rene de Wijk from the Wageningen University of Research) and brainstorming with the co-developer of the product, Alexandra Țițiu, to see what features are feasible and which are not. Next, the features and components of the application are evaluated based on the MoSCoW analysis. It is a technique in which four priority groups are formed, which are Must have, Should have, Could have and Won't have (Khan, J. A., Rehman, Khan, Y. H., Khan, I. J., & Rashid, 2015). Each of the requirements that is

thought of to be of use for the system is placed in one of the four categories to determine how important it is to integrate this requirement in the system.

The Must have category comprises the requirements that must be implemented in the application before it is released. The Should have category comprises the requirements that if they are implemented, it will be beneficial for the product. The Could have group consists of requirements that are less beneficial for the end product, but that would still attribute to the quality of the application. The Won't have category mainly contains requirements that, in the current iteration, cannot be implemented for any reason.

3.3 Usability testing

Usability testing is used to research the interface and how to improve it. It can be used to learn more about how the representative users doing a representative task will interact with the specific interface, even when the goal is not fixing the interface, but learning about the users and interactions (Lazar, Feng, Hochheiser, 2017). As Lewis (2006) states, "Usability testing, in general, involves representative users attempting representative tasks in representative environments, on early prototypes or working versions of computer interfaces".

This concept of testing is applied by having representative users use a paper prototype mockup of the eventual app.

4. Ideation

In this phase, a list of ideas and concepts is presented, of which only one is selected in the end.

4.1 Mind map

To start off the ideation phase, first a mind map was created to better understand the correlation of the different aspects of food waste and how they can be integrated into the created concept of this research. This mind map can be found in Appendix A. Different sources were integrated to make the differences and similarities clear on their views.

4.2.2 Idea 2. Pokemon Go³ as inspiration

This concept involves the user going out into the world with a quest to visit relevant places for food waste, like a store or your own kitchen. You could then, for instance, scan a certain object that is needed for recognition of the location and a little quizlet would pop up. If you were to answer the question corresponding to the location correctly, you can earn rewards in the game. These rewards could be either virtual or something you can exchange for real-world experiences (like discount in a supermarket).

4.2 Individual brainstorm

With the concepts of the mind map in mind, an individual brainstorm was conducted. This led to several different concept ideas of how to create a food waste game through the use of technology. Not all ideas were deemed as relevant, so a summary of the most relevant ideas is given below.

4.2.1 Idea 1. Escape room

An *escape room* could be an interesting setting for the provision of knowledge on food waste reduction. The game element would be that you have to solve different puzzles and problems that are related to reducing food waste in order to leave the room that you are in. You could, for instance, as a user come into contact with situations that are suboptimal in the food waste reduction process, that you have to change or deal with. An example of this could be that you would have to store products that are recently bought in the correct place and way. Another example could be that you have to estimate whether or not food is still edible without having a 'best-before date' to look at.

4.2.3 Idea 3. Board game

An idea in the sense of a boardgame that fits well with the concept of educating the users could be a game similar to "a game of goose". The players have a pawn that they move across the board by rolling a dice. The square you end up on will correspond to a specific topic on which you will get a question. You then get a card from the stack of cards that contains a multiple choice question. If you

³https://www.pokemongo.com/

answer correctly, you can roll the dice again. The questions will be about the several stages in which you waste food.

This concept can also be digitalised, by integrating an app that keeps updating the information given to the user, so the game can be played more often. This way you prevent the users from getting the same questions over and over again. The whole game could also be transferred to an application format, where the board is shown on the screen and you don't physically roll a dice but click on a dice in the app.

4.2.4 Idea 4. Weight Watchers⁴ as inspiration

In the app of Weight Watchers, the user tracks their progress by manually inputting what they have eaten. The app will then show the user their statistics and suggestions. A similar idea could work for the concept of food waste. The user would have to enter what they bought in the store, what they have in stock and what they throw away for example. A record of how much food is wasted of the food they buy is kept in the app, so the effects of the wastage are made more visual. The user can then see the direct influences on their amount of money and the more indirect influences on the environment. Again, if the user starts doing better and changing their behaviour, awards can be earned.

4.2.5 Idea 5. "FoodPrint"

The concept of FoodPrint revolved mainly around showing your ecological footprint based on the amount of food you waste. Next it was thought of how this can be done exactly. One of the ideas that was worked out was to create a game in which the user controls a character that lives in the world that the user creates by their amount of food waste. At certain points of time the user has to input data on different aspects of food waste (how often/well they store left-overs, how often they plan ahead before going to the supermarket et cetera). This data will then be analysed and translated into an individual 'FoodPrint' of the user. The world in which the character has to live in the period of time before the user can enter their food waste data again will show an exaggerated version of the consequences of their choices. Consequences of food waste that can be physicalised would have to be looked into further, but examples could be a planet with lots of floods and a high temperature, due to all of the greenhouse gasses that are emitted because of the user's food waste. Another example could be that the user sees the results of their food waste in their wallet, since they are wasting a lot of money by wasting food.

The other way around, if the user is doing well and changing their food waste behaviour, they will see their virtual world change into one that shows regrowth of trees and a recovery of the overall ecosystem. Furthermore they would become more wealthy for example.

⁴ <u>https://www.weightwatchers.com/</u>

4.2.6 Idea 6. SimCity⁵ as inspiration

This idea comprises a virtual world in which the user can walk around with their character. Different locations can be visited, which are all physicalisations of the different stages in which food is wasted. An example of this is that you can visit a supermarket where you learn about the stage of "Provisioning", or a setting of different spots to store your food (refrigerator, cupboards et cetera) is shown to represent the "Storing" space. The idea is that the user is taught what he or she is currently doing suboptimally and how they can improve this behaviour in every separate stage. The reason for this is that this way the information provided to the user can this way be made more specific for each of the settings in which food is wasted, instead of the more general information.

It is probably a bit too farfetched to integrate all of the mentioned stages, since, for example, the "Preparing" stage comprises a great amount of ways in which you can incorrectly cook your meal. It is estimated that this stage would take too much time to work out in a game, because the process of cooking food in a good way is a whole subject on his own. The focus will thus mainly lay at the other four stages of food waste, *Planning, Provisioning, Storing* and *Consuming*.

In each of the stages you will be tested on your knowledge. If you, for example, were to answer a question correctly, you receive rewards. This could be in the form of virtual points, or points that you can exchange in the 'real world'. Furthermore, an overview can be found of how the user is doing with regards to the environment and their financials.

4.3 Brainstorm with Alex

After discussing the ideas that were created, together other ideas were generated. Two of which stood out.

4.3.1 Family game

One of the ideas that was thought of was to look at the problem from a different angle. Earlier, the focus lied at the parents as a target group, but the parents could also be targeted through the influence of their kids. A well-known example of this is the distribution of collectable items, like cards with soccer players on them, by supermarkets when the parents buy their groceries there⁶. When the parents buy more items, they will be given more cards, which will make the children that collect them more happy. The kids will thus incentivize their parents to buy more groceries.

This concept can also be applied to the reduction of food waste. The idea is that a platform is created in which the child sees their personal character, which they can alter by adding accessories and add-ons that they can earn when their parents show the right food waste reduction behaviour. When the parents finish different assignments, the kid will earn points with which they can enhance their character.

⁵ <u>https://www.ea.com/nl-nl/games/simcity</u>

⁶ https://www.ah.nl/voetbalplaatjes

Examples of these assignments could be that the parent would have to answer questions in a quiz, testing if they understand how to, for example, store different products in the correct way. If they answer correctly, the child will receive a point for that question. If they answer incorrectly, the parent will be provided with feedback and information on how to do better next time. Another example could be that the parent would have to use an already existing, working, food waste reduction solution, like "Too good to go⁷". This concepts gives the option to buy a 'mystery-package' for a low price, from stores that would otherwise throw away the food that is in the box, because of health inspection rules. This food is often however still perfectly good to eat. If the parent of the child were to buy one of those packages and scan the receipt for example (as proof), the child would, again, earn points for this. This can be applied to lots of different already existing food waste reduction applications.

A possible look of this concept can be found below in Figure 7, in one of the paper prototypes that was created.



Figure 7 Paper prototype family game.

4.3.2 Social platform game

A second idea that was worked out was the concept of a social platform. The user could have a personalized character that they would have to, for example, look after, or enhance. The user could improve their character by gaining likes or shares on their posts on the platform. The posts that they

⁷ https://toogoodtogo.nl/

post should be related to food waste reduction and pose interesting solutions to, together, tackle the problem. If your idea is good, it will get likes and shares. Together everyone will attribute to the solution, so a feeling of community will be created.

In a separate menu the user can view their progress and see the impact they have had on other users (whether it was shared, whether people are using their idea et cetera). The use of social comparison and social feedback is an effective behaviour change technique. Again, a paper prototype was created to concretize the concept, which can be found below in Figure 8.

movement the teed LEVEL (4) 60% 100 FOOD PRINT Patts elizabet undinon 2000 likes 400 840103 feedwaste feed the movements share returnet discover ideas Stole 4 lips

Figure 8 Paper prototype of social game.

4.4 Client meeting

A discussion of the possible ideas with the client put forward the specifications needed for the application and a decision was made on what concept to continue working on. The Family Game showed potential in their eyes. Through the use of quizzes and assignments it can be easily tracked to what extent the user is bettering their behaviour and learning about food waste. Furthermore, this data is useful in the collection of food waste behaviour information.

5. Specification

In this chapter the final idea will be elaborated, based on the requirements of the project, which will result in a concrete description of the interface. Different options will be considered and therefore design choices will be made.

5.1 Concept of choice

The concept that will be worked from now on is the "Family game" concept.

5.2 Requirements

When starting to specify the chosen idea, it turned out to be difficult to prioritize which implementations were most important to the system. This is why a prioritization technique was implemented. This technique is called the MoSCoW method. Based on this framework, the requirements that were mentioned by the clients of the university of Wageningen were categorized in the following manner.

5.2.1 Must have

The clients stated they strongly preferred the platform of an app over other possibilities, like a desktop game. The reason for this was that they felt like a wider audience could be reached, since nowadays almost everyone, almost always, has access to a smartphone. The threshold, in their opinion, is higher to keep playing a desktop game than a game you can casually play on a device that is already on you. Furthermore, the application must contain gaming elements, meaning it should be a gamified experience. The definition this research upholds is one that is drafted by Deterding, Sicart, Nacke, O'Hara, & Dixon (2011), which is that "Gamification is an informal umbrella term for the use of video game elements in non-gaming systems to improve user experience (UX) and user engagement." The goal is thus to make a not-so-fun experience, like reducing your food waste, more fun.

Furthermore, the goal of the application was further specified. On the one hand the users should be educated on what behaviour they are exhibiting that is suboptimal in the food waste reduction process and how they can change this for the better. Next to that, the client wants to gather data on food waste behaviour of the users. The way that was thought of to work well in achieving both is through the use of daily quizzes and assignments in the app.

Other "must haves" with regards to the gamification elements that were thought of were rewards for the children, to make sure they are motivated to use the app. Also, the application must contain a personal character for the children. The reason for this is that the use of an avatar has shown positive outcomes in the majority of studies investigated by Johnson et al. (2016). One of the researches that was investigated found that the implementation of avatars, in combination with rewards, levels and narrative, led to increased fruit and vegetable consumption of children. It was decided that the character should be a likeable, cartoon character that the children want to look after.

When looking at the state of the final product, the client made clear that what they envision is an application that can be built upon and that can be extended in the future. They hope that other students or researchers can continue working on this application or use it as a starting point for a new idea. What this means for the specifications of the app is that the focus will lie more on the delivering of a well-worked-out, yet unfinished product rather than a product that is finished but not looking or working optimally.

5.2.2 Should have

The application should include some sense of community, if possible. This will create ease of interaction and inspiration from the behaviour of other users. Furthermore, it would be useful to have the possibility as a user to see the statistics of their progress and provide them with feedback on this.

5.2.3 Could have

Some elements of the application were deemed less relevant, yet still showed potential to attribute to the quality of the product. These elements were having a 'leader board' menu-item, where the user can see their progress compared to the progress of others, by showing a ranking of who is performing best. If there is the possibility to integrate this element, it should be taken into account that not only an overall leader board is shown, but also on a smaller scale (of the neighbourhood for example, or of the day). This way the user will feel like it is achievable to reach the top of the leader board.

Furthermore, different ways of finishing an assignment for the parents can be integrated, besides the participating in quizzes. Examples of these could be that the parent would have to scan their grocery list and receipt of the supermarket, if feasible with already existing software, to show that they bought what they set out to buy and not more than that. Another example could be that the user would be asked to provide proof that they are using an already existing working application to reduce food waste, like Too Good To Go⁸, by inputting their proof of payment.

Another possibility that might be interesting to add is the aspect of rewards for the parents, as well as for the kids. This way the incentive will be even higher for the parent, since both their child will motivate them to do well in reducing food waste as well as the rewards.

A last interesting addition to the application could be to have a small minigame menu-item for the children, in which they can use their personalized character. The reason this requirement was put into the Could have category is that it is estimated that the integration of this element will take up too much time and research on its own, so in the timeframe that is provided it will probably be impossible to accomplish this as well.

⁸ https://toogoodtogo.nl/nl

5.2.4 Won't have

To make sure that the system has the necessary limitations, the requirements were critically investigated to see if they could be placed in the "Won't have" section. For instance, it was decided that the final application is not a completely finalized product, due to the lack of time for the development. The focus is on the front-end development of the product, so back-end aspects like a server keeping track of the user data "won't" be in the final product.

5.2. i Summary			
Must have	Should have	Could have	Won't have
Mobile application	Sense of community	Leader board menu item	Finalized product
Gamified experience	Possibility to see statistics	Other assignments than	Back-end aspects (like
Goal should be to educate	on progress	just quizzes	server keeping track of
the user		Minigame	data)
Rewards for children		Rewards for parents	
Personal avatar			
Assignments and quizzes			
Application that can be			
built upon (can be			
extended in the future)			
Table 3 Summary of MosCol	Wmethod	•	•

5 2 4 Summary

Table 3 Summary of MoSCoW method

5.3 Interface

The interface of the app will be different for the parent and the child. Both interfaces will contain different menu-items that are deemed more relevant for both the users.

5.3.1 Children's interface

As can be seen in the paper prototype in Figure 8 in chapter 4.1.3, several different menu-items were thought of. The home screen of the user will contain the personalized character of the child.

In the top of the screen the characters of the family members are shown. To the left, a menubar is displayed, showing emoticons that represent different menu-items. Furthermore, the current balance of the user's amount of points in the game is shown.

5.3.1.1 Store

The first menu-item that the user will encounter is a symbol that represents a virtual store. In this virtual store, different items can be purchased that can be given to the character of the user. These items will consist of different accessories (like hats, scarfs, t-shirts, et cetera) and foods and beverages. Each item will show a different price. These items will represent the goals the children can set for themselves.

5.3.1.2 Assignments

The second menu-item will comprise the assignments that the parents of the child are able to finish and the corresponding amount of point they will earn for this. This way, the child can see what the parent has to do in order to earn the amount of points they need for the new item they want to purchase. In a sense, both the parent and the child is being rewarded in this way. The use of rewards and goal setting has been shown to be an effective behaviour change technique for children (Steward, Chapple, Hughes, Poustie & Reilly, 2008). The children were reported by the parents to be more motivated.

5.3.1.3 Social screen

There is also the possibility for the children to look at the characters and the progress of other users. Social comparison has been proven to be an effective behaviour change technique (Nguyen et al., as cited in Vogels et al, 2018), as it is thought of to be a motivating factor. This paper, however, discusses the effect of the BCT of social comparison on adults. The research of Johnson et al. (2016) looked into gamification elements and their effectiveness in the health and wellbeing domain, of both children and adults. Their research showed that in a lot of studies the use of a leader board to have an element of social comparison showed a behaviour change in the user. An example of this is that an increase in physical activity, thus a behaviour change, was observed when a combination of points and leader boards were integrated in the system (Thorsteinsen et al., as cited in Johnson et al., 2016).

5.3.2 Parent's interface

5.3.2.1 Assignments

The parents' interface will also contain the screen with the assignments and the corresponding rewards in coins. The same assignments will be shown that the children can see in their menu, but the parents are able to click on them and actually do them. The behaviour change techniques of goal setting in earning rewards are also applicable to the parents.

5.3.2.2 Quizzes

The second menu-item will contain different quizzes the parents can do and again the number of points they can earn for this. Each correctly answered question will earn the user one coin. The use of quizzes is a good way to gather data on the knowledge of the user, while also teaching the user about their behaviour and how they can improve it. The quizzes will be updated daily, so each day the parent has something to do in the app, to keep them engaged with the app.

5.3.2.3 Statistics

There is also a menu-item in which the parents can see how well they are doing in their food waste reduction. Different graphs will be shown that display the improvement in correct answers in the quizzes and how many coins they have already earned.

5.3.2.4 Social screen

Similar to the interface of the child, the interface of the parent will also contain a social screen in which they see a leader board type of situation of other users. To make sure that the achievement of a high ranking is feasible for the user, not only a leader board will be shown of the entire user population, but also of users in the area, and of the day (instead of over the entire course of the usage of the app). As also mentioned in chapter 2.3. Use of technology, users like to get feedback on their behaviour through the form of social comparison, because it appears that this BCT is thought of as a motivating factor.

6. Realisation

After the product specification was worked out, the methods of decomposition of the start specification, realisation of the components, integration of the components and evaluation can be followed (Mader & Eggink, 2014). At the end of the realisation phase, a finished prototype is delivered.

6.1 Usability testing through paper prototype

After the specification phase, the first step was to make a more complete paper prototype. Paper prototypes are stated to be useful, because they do not cost much to make and multiple designs can be quickly presented and evaluated by participants. Furthermore, designers are less likely to become committed to a specific design early on, because the prototype involved little development time, which corresponds to the iterative approach to design this paper uses. Iterative design is thought of as essential for game design (Schell, 2014). Besides this, users might feel more comfortable giving feedback on the interface when they know that not much work has been done yet on the interface (Lazar, Feng, Hochheiser, 2017).

The complete paper prototype can be found in Appendix B. A preview of the paper prototype can be seen in Figure 9.



Figure 9 Preview of paper prototype

The paper prototype was tested on two subjects. One of the two participants was asked to look at the prototype from the eyes of a child, using only the children's interface. The other participant was asked to be the parent in the situation. She was only shown the parent's interface.

6.1.1 Results children's interface

One of the first things that became clear was that the user was missing a menu-item in the menu-bar representing the home screen. In Figure 9 it can be seen that this item was immediately added to the prototype after this comment.

With regards to the content of the application, the participant noted that the user possibly might not feel enough motivation to use the app simply to sustain an avatar they cannot use in another context (like a game). The participant suggested a collaboration with an already existing, popular game, like Fortnite⁹, to ensure stronger connection between the application and the child. This, however, is something that would be put in the "won't have" category of the MoSCoW method because this is simply not feasible with the available time and resources.

6.1.2 Results parent interface

The results from the usability test with the second participant gave some similar insights as the one from the children's interface. Again, it appeared that the incentive to use the app and complete the assignments and quizzes might not be high enough. She compared the concept to the Menzis Samengezond App¹⁰, where the adult gains the points instead of the kids. He or she then has the possibility to spend those points themselves, in several different stores that Menzis has a collaboration with. This issue was discussed and the possibility of a combination of rewards for both the parent as well as the child was put forward.

6.2 Approach

Since no previous experience in app development was expressed by both authors of this research, the second step undertaken was to research which development approach is best suited for the development of the app at hand. Due to the time constraint of the project, it was decided that the focus lies on the front-end development of the app, rather than the combination of both front-end and back-end. This way, the end product will be more detailed, rather than rushed. Because of the fact that the client specified that the end-product that is delivered should be a product that can be worked on further by someone else, like a developer, this decision was made. The program of choice to design this front-end interface is called Figma¹¹, an interface design application that runs in the browser. This program allows for smooth collaboration between the two developers, because it is an online tool. Also, the working of the software was easy to learn, which was necessary for the product to be finished in time. The software works in a similar way to for instance AdobeXD¹², Sketch¹³ and InVision¹⁴.

⁹ https://www.epicgames.com/fortnite

¹⁰ https://samengezond.menzis.nl/

¹¹ https://www.figma.com/

¹² https://www.adobe.com/nl/products/xd.html

¹³ https://www.sketch.com/

¹⁴ https://www.invisionapp.com/

6.3 Creation

6.3.1 Outline

Before starting the creation of the app, a clear division was made between the two developers. The focus of the co-developer of the app, Alexandra Țițiu, would be on the design of the UI-elements, whereas the author of this research focuses more on the actual working of the app prototype, meaning the linking of the UI elements, deciding which UI elements should be put where and what the outline of the app should look like.

The first step was to create an outline of the different frames that the app should contain. To each of the frames, a textual description of what elements it should contain was added, so Alexandra could start the design process immediately. The structure was made up from a separate page for the children and a separate page for the parents. Next, the frames were added to the pages. These frames consisted of the main menu-items (Log-in, Home, Store, Assignments, Social screen, Statistics) and the screens linking from those menu-pages. These screens consisted of different overlays, pop-up screens and redirecting screens. An intermediate setup of the app frames can be found below in Figure 10. Most of the UI elements are already present here as well.



Figure 10 Outline of app frames

After the UI elements were added, the interaction of the app was created. This was done by creating different demands for different actions (like 'if clicked upon', 'link to 'Menu' page'). A visualisation of these links can be found in Figure 11. The Figma software allowed for easy allocation of functions

Floor Kuipers

to different UI elements (like buttons). It however also limited the possibilities of the app. For the front-end developed product, it was not possible to keep track of the users actions. For instance, the figma software did not offer the possibility to update the amount of coins that were earned and spent by the user. If the product were to be further developed, the transmission to the back-end developer should include a clear description of the features that were not possible to be integrated in the front-end prototype.



Figure 11 Interaction links Parent's interface

6.3.2 Quizzes

One of the elements of the parent's menu is the quizzes. This will enable the user to gain knowledge by doing something fun. The creation of well-formulated multiple choice questions is a challenge on its own. First it needs to be determined what knowledge needs to be transferred through the app. In the design, the decision was made to split the assignments and statistics of the user up into different themes within which they can make progress. These themes are the six stages of food waste, discussed in the literature review in Chapter two, namely planning, consuming, storing, provisioning, preparing and disposing.

Furthermore, it was made clear in the state-of-the-art review that food waste behaviour comprises three different aspects that are of influence: Capability, Opportunity and Motivation (van Geffen et al., 2016). Each of these aspects bring about their own challenges and reasons why food is

wasted. For the Capability of the user to prevent food waste, the perceived difficulty of planning, cooking, food safety estimation and shelf-life longing should be lowered. This can be done by educating the users on ways to make these aspects of food handling easier, lowering their perceived difficulty.

The component of Opportunity can be increased by making products, stores and storage equipment more available to the user. This can be done through education by showing different options of food waste friendly concepts, like Too Good To Go, or good shopping planning tools.

The final component of Motivation of the user can be enhanced by three ways. The first way is by educating the user on the consequences of food waste, in the environmental, social and financial sense. The next way is to create a more negative attitude towards food waste. Thirdly, the injunctive and descriptive social norm can be looked at: if the user feels like their food waste behaviour is disapproved by their social group, they tend to feel more motivated to change this behaviour. Furthermore, if the user feels like their social group wastes food themselves, the user is less motivated to decrease their own waste. Thus, by educating the users on the social view on food waste, the motivation will also increase.

Before the quiz-questions can be drafted, the learning objectives op the app should be made explicit. This is done by following the guidelines of the SLO curriculum design. These guidelines state that each learning goal should be created by the SMART method, meaning the goal should be Specific, Measurable, Acceptable, Realistic and Time-bound. Furthermore, the Bloom's Taxonomy – Teacher Planning Kit was used as a guide to formulate the goals in the correct way (Bloom, Engelhart, Furst, Hill, & Krathwohl, 1956). The time-constraint for each goal is formulated by "After finishing the available quizzes in the app," because the time a user takes for this varies and is not that relevant.

Bloom's theory states that there are different levels of understanding. These different levels can be viewed in Figure 12. As stated by Bloom et al., the way of providing knowledge by quizzes relates to the level of remembrance. The other levels of understanding are out of the scope of this research, but they definitely offer interesting opportunities for further research and development of the application. The implementation of knowledge by 'applying' it is already more meaningful for the food waste problem than 'remembering' it.

It can be stated that, even though the use of quizzes corresponds mainly to the bottom two levels of understanding, it is still fairly possible that the user still reaches levels of higher understanding. It is a possibility that the user is inspired by the information and feels an intrinsic motivation to start applying the knowledge as well as just recalling it. The quizzes could also function as a kick-start in the process of reducing food waste, thus resulting indirectly in higher levels of understanding.

Bloom's Taxonomy



Figure 12 Bloom's taxonomy (Bloom et al., 1956)

6.3.2.1 Learning objectives Capability

- 1. After finishing the available quizzes in the app, the user will be able to name different ways to plan for a supermarket trip.
- 2. After finishing the available quizzes in the app, the user will be able to explain the best way to cook certain specific foods.
- 3. After finishing the available quizzes in the app, the user will be able to identify which foods can still be eaten and which foods cannot.
- 4. After finishing the available quizzes in the app, the user will be able to locate specific foods in their corresponding correct storage space.

6.3.2.2 Learning objectives Opportunity

- 1. After finishing the available quizzes in the app, the user will be able to list different food waste reduction initiatives.
- 2. After finishing the available quizzes in the app, the user will be able to list useful products for storing food properly.

6.3.2.3 Learning objectives Motivation

- 1. After finishing the available quizzes in the app, the user will be able to explain the environmental, financial and social impact food waste brings about.
- 2. After finishing the available quizzes in the app, the user will be able to recognise that it is on average not socially accepted to waste food.

After these learning goals were drafted, the quiz-questions were created. They were formulated in such a way that they provide the user with the knowledge they need to fulfil the learning objectives. These quiz-questions were then added to the app, in the structure that can be found in Figure 12. Each question corresponding to one of the six stages of food waste corresponds with an explanatory text explaining why the answer of the user is right or wrong, including additional information on the topic.



Figure 13 Connections quiz-questions different quizzes

6.3.2.4. Example quiz on consuming

The complete quizzes can be found in Appendix I, but one example quiz about consuming can be found below.

Q1. What does TGT stand for? Waar staat TGT voor?

- A. Te gebruiken tot
- B. Ten minste goed tot
- C. Ten minste gebruiken tot
- D. Te genieten tot

The TGT-date is the last day on which you can safely eat or drink the product. The TGT-date is put on products you can only store shortly, like meat, fish, pre-cut vegetables, cooled meals and fresh juices. De TGT-datum is de laatste dag waarop je het product veilig kunt eten of drinken. De TGT-datum staat op producten die je maar kort kunt bewaren, zoals vlees, vis, voorgesneden groenten, koelverse maaltijden en verse vruchtensappen.
Q2. What does THT stand for? Waar staat THT voor?

A. Te houden tot

B. Ten minste houdbaar tot

- C. Ten minste happen tot
- D. Houdbaar tot en met

The THT-date is on products that do not expire fast. After this date the quality might decrease a little, but you can still safely eat is.

De THT-datum staat op voedingsmiddelen die niet snel bederven. Na deze datum kan de kwaliteit iets achteruit gaan. Je kunt het dan vaak nog wel veilig eten. De fabrikant garandeert tot en met de THT-datum een smaakvol en kwalitatief goed product.

Q3. What product is better not eaten after the date on the package? Welk product kun je na het verstrijken van de datum beter niet meer eten?

- A. Bread/Brood
- B. Olive oil/Olijfolie
- C. Yoghurt
- D. Chicken/Kip

Chicken, meat and fish are perishable products that you cannot eat after the date on the package. After this date, bacteria might have started growing. You might get sick if you eat it. You should thus freeze it in time!

Kip, vlees en vis zijn bederfelijke producten die je na de datum beter niet meer kunt opeten. Na de datum kunnen er bacteriën zijn uitgegroeid. Je kunt ziek worden als je ervan eet. Op tijd opeten of invriezen dus!

Q4. What product can you still eat after the date on the package? Welk product kun je na de datum vaak nog veilig eten?

- A. Codfish/Kabeljauw
- B. Turky/Kalkoen
- C. Steak/Kogelbiefstuk
- D. Quark/Kwark

Dairy can still safely be eaten several days after the passing of the date on the package. Use your senses to judge the quality of the product.

Zuivel kun je tot enkele dagen na het verstrijken van de datum nog veilig eten. Zet je zintuigen in om de kwaliteit van het product te beoordelen.

Q5. What product sometimes does have a THT-date, but is often best not eaten after this date passes? Welke product heeft soms wel een THT-datum, maar kun je toch beter niet meer eten na de datum?

- A. Smoked salmon/Gerookte zalm
- B. Brie
- C. Steak tartare/Filet americain

D. All three answers are correct/Alle 3 de antwoorden zijn juist

Products with a THT-date can often still be eaten after the date passes, but smoked fish, soft cheeses, cold cuts and steak tartare are exceptions. These are perishable products that can make you sick. It is rather confusing that the producers of the products put a THT-date on the packaging, instead of a TGT-date.

Producten met een THT-datum kun je na de datum vaak nog eten, maar gerookte vis, zachte kazen, vleeswaren en filet americain zijn uitzonderingen. Dit zijn bederfelijke producten en je kunt ziek worden als je er na de datum van eet. Verwarrend dat sommige fabrikanten een THT-datum op verpakkingen van dit soort producten zetten.

7. Evaluation

Before the testing of the app concept can take place, another round of usability testing was performed. The reason for this is that it is undesirable that the results of the evaluation are influenced by hick-ups caused by the app, like a malfunctioning UI-element.

This usability test was performed with one participant, to see what the overall feeling of using the app was. The participant was asked to simply use the app, no specific goal was given (like 'I want you to complete one of the quizzes). This way the auto-intuitiveness of the app was tested as well. Furthermore she was asked to speak out loud when she ran into something and tried to solve this issue.

This resulted in the fixing of several menu-items that were linked incorrectly or unclear. The participant also noted that the content of the store was a bit scarce and that she would like to see more options to buy for the character, instead of just the capes and masks. Furthermore it became clear that the overall purpose of the app needed some more clarification before starting to use the app. This was taken into account when creating the outline of the conversation about the intervention test. The overall response of the participant were positive, she liked the look of the app and the navigation through the app seemed natural.

7.1 Test outline

7.1.1 Participants

The target group of the app is households with at least one child. However, the knowledge-transfer is only taking place at the parents' interface, so only the adults of the family need to be interviewed for answering the research question this paper posed, which was "Can an app be successful in reducing food waste by educating households of families with at least one child?".

The recruitment of the participants of the test was based mostly on family members and suggestions from them of other possible families that would want to participate. This resulted in a number of 8 participants.

7.1.2 Test design

The chosen test design was a pretest-posttest design. The basic premise of this design involves obtaining a pretest measure of the outcome of interest prior to administering some treatment, followed by a posttest on the same measure after treatment occurs (Bell, 2012). The simplest form of a pretest-posttest design was chosen, which is the One-Group Pretest-Posttest Design. This design is typically represented as follows: O1 X O2, where O1 represents the pretest, X represents the intervention, and O2 represents the posttest.

The pre- and posttest consist of survey-questions, all open-ended. These questions are kept the same in the pretest and the posttest, to be able to see a clear difference between the pre-intervention situation and the post-intervention situation. Furthermore, the conditions in which the test took place were kept the same, to prevent circumstantial factors to influence the results. The outline of the pre-

and posttest (O1 and O2) can be found in Appendix F and the questions of the questionnaire can be found in Appendix G. Furthermore, the intervention outline (X) can be found in Appendix H. As mentioned in the introduction about the final usability test, a clearer description of what the app entails and the goal of the user are given.

7.2 Test results

A total number of 8 participants made the pre- and posttest and used the intervention. The conditions of each of the tests were kept the same to the extent at which this was possible. Furthermore, the posttest took place one day after the intervention was used to ensure the knowledge that was gained by the participants was not only based on short term memory.

The results of the pre- and posttest were first compared to see if the intervention brought about any changes to the answers. What stood out immediately was that the knowledge of the participants when they took the pretest was already higher than anticipated. For instance, almost every participant stated in the pretest that they already use both the best-before-date as well as their senses to judge whether food can still be eaten or not, which corresponds to the learning objective of Capability stating that the user should know which foods can still be eaten and which cannot. Also, the participants all seemed to know quite well which products belong in the freezer, fridge and cupboard so not much ground was left to cover in this area. Finally, the participants often mentioned that they use a list or make a weekly menu when they prepare their shopping trip and their answers almost did not change when looking at the pretest situation compared to the posttest situation. Thus, to summarize, the learning objectives of Capability were often already achieved before using the intervention.

Furthermore, all participants were already able to state why food waste is a bad thing, all mentioning the impact on the environment, and some mentioning the fact that it is unfair that food gets thrown away while some people do not even have food to eat. This corresponds with the learning objective of Motivation in which the user should be able to explain the environmental, financial and social impact food waste brings about. It turns out that after using the intervention, some of the users also mention the aspect of money loss as a reason why food waste is bad, so even though the user was already more aware of the impact of food waste than expected, still some new insights were gained.

Some of the users remembered the app Too Good To Go as an example of a food waste reduction initiative after using the intervention, so knowledge on the existence of different food waste initiatives was also slightly enhanced, corresponding to one of the learning objectives of Opportunity. However, the knowledge on what products are useful for storing food properly appeared to already be high, so in this learning objective there again was not a lot of ground left to cover.

8. Conclusion and recommendations

In this final chapter, the research is concluded by answering the main research question, evaluating if the aim of the application has been achieved and providing some points of discussion and recommendations.

The main research question focused on the enhancement of knowledge among households with at least one child by an intervention in the form of a technology. First, a state-of-the-art review was conducted to research different technologies and their effectiveness in changing food waste behaviour. What came forward from this review, in combination with a discussion with the client, was that the use of an app can provide a good solution in reducing food waste.

With this in mind, the design process began. Several iterations took place in which was reflected on the current product and changes were made, based on usability tests. The end result was a gamified food waste reduction app, called Feed The Movement. This application was next evaluated to see if it fulfils its aim of enhancing the knowledge of households with at least one child, by performing pretests and posttests.

8.1 Conclusion

The evaluation put forward that indeed participants gained knowledge on the learning objectives that were stated in the realisation chapter on the quizzes. A lot of the learning objectives appeared to already be achieved before the intervention was even used. Mainly the learning objectives of Opportunity (listing the different food waste reduction initiatives) and of Motivation (explaining why food waste is a bad thing) seemed to be obtained through usage of the intervention. It can thus be concluded that the concept of the Feed The Movement app can, to a certain extent, contribute to the enhancement of knowledge about food waste and the reduction of it. It should be noted, however, that there are some points of discussion.

8.2 Discussion

8.2.1. Discussion of application

Several points of discussion are relevant to mention. First of all it should be noted that the change of behaviour is not proved by proving that knowledge on the topic is gained. Enhancement of knowledge is merely an aspect of behaviour change. It would be a recommendation for further research to look into the impact of enhanced knowledge on food waste behaviour change more.

Next, the app contains some suboptimal elements. For instance, the providing of knowledge through feedback on the quiz-questions might not work on all users in transferring the knowledge. It is really easy to simply click through the questions without reading the informational text given in the feedback pop-up. This way you do earn points but you do not necessarily gain knowledge in the process.

Floor Kuipers

Furthermore, it is assumed that the parent users feel motivated enough to keep using the app when their child asks them to finish assignments for them. However, it is fairly possible that this is in fact not enough incentive for the parents to keep doing the assignments. Also, the maintenance of the avatar of the child might not be enough incentive for the child to want to motivate the parent.

8.2.2. Discussion of methodology

8.2.2.1 Reliability

The number of participants of the test could have definitely been higher. The reliability of the outcome is influenced by the background of the participants, since it is possible the sample of participants consists of people who already know much about food waste. A more reliable outcome could be established by recruiting more participants, so the background knowledge does not influence the results because there would be people with little background knowledge as well as a lot of background knowledge. In the case of this paper it appeared that the participants of the test already knew a lot about food waste and how to reduce is. Furthermore, the participants were recruited from the immediate vicinity from the author of this research. This could have biased their answers to the test, since they were aware of the aim of the app. They might have thought that it would be beneficial for the research if the outcome would be that they learned about food waste through the app, making them fill-out the pretest worse than the posttest on purpose.

8.2.2.2 Validity

The pre- and posttest questions might not necessarily test the whole knowledge of a user on food waste. A more extensive questionnaire including control questions could lead to more accurate testing of the knowledge. Furthermore, the posed learning objectives are often goals that can always be improved. For instance, there are infinite ways to plan a supermarket trip, cook food, list food waste initiatives et cetera. It is thus really easy to fulfil these goals while still not really learning anything from the app. The reason these learning objectives were not made more Specific (following the SMART method) was that it was unclear what the background knowledge of the users comprised and what amount of information was feasible to transfer.

8.3 Recommendations

As mentioned in the chapter on the realisation of the quizzes, the level of understanding that the current quizzes is aimed at is the lowest one possible. There is still ground to cover on getting the user to reach a higher level of understanding in the context of food waste, since this way the users will actually 'create' using the knowledge, instead of just recalling it. This would, in the end, contribute way more to the food waste problem, because this way new creative solutions might be created. A recommendation for further research and development would thus be to look into how to reach these higher levels of understanding and how to implement this in the app. Next, this could be implemented

in the app to gradually increase the difficulty and thus integrate the higher levels of understanding during longer usage of the app.

A point of discussion related to the one mentioned above is that not everyone's background knowledge is the same: someone might already know much about food waste reduction and get bored really easily with the lower-level-understanding questions. A recommendation to solve this issue could be to either have the user state their starting level on the knowledge about the subject or to test it before giving the user access to the quizzes in the app, when the user signs up for the app.

As mentioned in the discussion, the user does not necessarily have to read all of the information provided by the quizzes. A recommendation for further research and development would thus be to think of a new way of passing on the knowledge, rather than just showing it in a pop-up. This also correlates to the statement made above, because simply showing information to a user corresponds to the lowest level of understanding, where a higher level of understanding would be more beneficial.

Furthermore it is stated that the motivation through the children might not be enough incentive for the parent to keep using the app. A possible recommendation could thus be to find companies that want to collaborate with the app. This way the parent can earn coins for both the child as for him- or herself, which they can then spend on items in 'real-life' stores, like for instance supermarkets, restaurants, food waste reduction initiatives and so on. The way the child could be more motivated to use the app if the items and coins they earn could be spent in a more advanced, popular game, like *Fortnite* or *The Sims*. A recommendation for further development could thus be to start collaborations with larger, already available games which are already widely used. This, however, was out of the scope of this research.

9. References

- Aleahmad, T., Balakrishnan, A. D., Wong, J., Fussell, S. R., & Kiesler, S. (2008). Fishing for sustainability: The effects of indirect and direct persuasion. *Extended Abstracts on Human Factors in Computing Systems*, 3021-3026. https://doi.org/10.1145/1358628.1358801
- Altarriba, F., Lanzani, S. E., Torralba, A., & Funk, M. (2017, June). The grumpy bin: reducing food waste through playful social interactions. *In Proceedings of the 2017 ACM Conference Companion Publication on Designing Interactive Systems*, 90-94. https://doi.org/10.1145/3064857.3079125
- Aschemann-Witzel, J., de Hooge, I., Amani, P., Bech-Larsen, T., & Gustavsson, J. (2015). Consumers and food waste-a review of research approaches and findings on point of purchase and inhousehold consumer behaviour. *European Association of Agricultural Economists (EAAE)*, 143. Retrieved from: http://purl.umn.edu/202716
- Bell, B. (2012). Pretest–Posttest Design. In B. Bell, *Encyclopedia of Research Design* (pp. 1087-1091). SAGE Publications, Inc. https://dx.doi.org/10.4135/9781412961288
- Bloom, B.S. (Ed.), Engelhart, M.D., Furst, E.J., Hill, W.H., & Krathwohl, D.R. (1956). Taxonomy of educational objectives: The classification of educational goals. Handbook 1: Cognitive domain. New York: David McKay
- Deloitte Global Mobile Consumer Survey, N. e. (2018).
- Deterding, S., Sicart, M., Nacke, L., O'Hara, K., & Dixon, D. (2011, May). Gamification. using gamedesign elements in non-gaming contexts. *In CHI'11 extended abstracts on human factors in computing systems*, 2425-2428. https://doi.org/10.1145/1979482.1979575.
- Dossier Food Waste. (2014). Retrieved from Wur.nl: https://www.wur.nl/en/Dossiers/file/Dossier-Food-waste.htm
- Farr-Wharton, G., Choi, J. H. J., & Foth, M. (2014, December). Food talks back: exploring the role of mobile applications in reducing domestic food wastage. In *Proceedings of the Australian Computer-Human Interaction Conference on Designing Futures: the Future of Design* (pp. 352-361). University of Technology, Sydney, Australia. https://doi.org/10.1145/2686612.2686665
- Hoem, H. (2017). The potential of a smart phone app to support consumers in preventing household food waste (Master's thesis, Norwegian University of Life Sciences, Ås). Retrieved from: http://hdl.handle.net/11250/2456970

- Johnson, D., Deterding, S., Kuhn, K. A., Staneva, A., Stoyanov, S., & Hides, L. (2016). Gamification for health and wellbeing: a systematic review of the literature. *Internet Interv.* 6: 89–106. https://doi.org/10.1016/j.invent.2016.10.002
- K. Thorsteinsen, J. V. (n.d.). Increasing physical activity efficiently: an experimental pilot study of a website and mobile phone intervention. *Int. J. Telemed. Appl.*, 2014 (2014), p. 746232, https://doi.org/10.1155/2014/746232.
- Khan, J. A., Rehman, I. U., Khan, Y. H., Khan, I. J., & Rashid, S. (2015). Comparison of requirement prioritization techniques to find best prioritization technique. *International Journal of Modern Education and Computer Science*, 7(11), 53. https://doi.org/ 10.5815/ijmecs.2015.11.06
- Lazar, J. F. (2017). *Research Methods in Human-Computer Interaction 2nd edition*. Morgan Kaufmann.
- Lewis, J. R. (2006). Sample sizes for usability tests: mostly math, not magic, interactions, v. 13 n.6. November+ December.
- Lim, V., Funk, M., Marcenaro, L., Regazzoni, C., & Rauterberg, M. (2017). Designing for action: An evaluation of Social Recipes in reducing food waste. *International Journal of Human-Computer Studies*, 100, 18-32. https://doi.org/10.1016/j.ijhcs.2016.12.005
- Mader, A., and Eggink, W. (2014) A design process for creative technology. International conference on engineering and product design education, The Netherlands.
- Michie, S., Van Stralen, M. M., & West, R. (2011). The behaviour change wheel: a new method for characterising and designing behaviour change interventions. *Implementation science*, 6(1), 42. https://doi.org/10.1186/1748-5908-6-42
- Nguyen, V. N., Nguyen, T. H., Huynh, T. T., Nguyen, V. H., & Stigberg, S. K. (2015, June). Interactive fridge: A solution for preventing domestic food waste. In *International Conference* on Smart Homes and Health Telematics (pp. 361-366). Springer, Cham. https://doi.org/10.1007/978-3-319-19312-0_36
- Quested, T. E., Marsh, E., Stunell, D., & Parry, A. D. (2013). Spaghetti soup: The complex world of food waste behaviours. *Resources, Conservation and Recycling*, 79, 43-51. https://doi.org/10.1016/j.resconrec.2013.04.011
- Reilly, L. S. (2008). The use of behavioural change techniques in the treatment of paediatric obesity: qualitative evaluation of parental perspectives on treatment. https://doi.org/10.1111/j.1365-277X.2008.00888.x.

Schell, J. (2014). The Art of Game Design: A book of lenses. AK Peters/CRC Press.

- Schmidt, K., & Matthies, E. (2018). Where to start fighting the food waste problem? Identifying most promising entry points for intervention programs to reduce household food waste and overconsumption of food. *Resources, Conservation and Recycling, 139*, 1-14. https://doi.org/10.1016/j.resconrec.2018.07.023
- SLO. (n.d.). *Leerdoelen Formuleren*. Retrieved from Cursus curriculum ontwerp: www.cursuscurriculumontwerp.slo.nl/toolkit/Leerdoelen_formuleren.docx/
- Stewart, L., Chapple, J., Hughes, A. R., Poustie, V., & Reilly, J. J. (2008). The use of behavioural change techniques in the treatment of paediatric obesity: qualitative evaluation of parental perspectives on treatment. *Journal of human nutrition and dietetics*, 21(5), 464-473. https://doi.org/10.1111/j.1365-
- Thieme, A., Comber, R., Miebach, J., Weeden, J., Kraemer, N., Lawson, S., & Olivier, P. (2012, May). We've bin watching you: designing for reflection and social persuasion to promote sustainable lifestyles. In *Proceedings of the SIGCHI Conference on Human Factors in Computing Systems* (pp. 2337-2346). ACM.
- Van Geffen, L. E. J., Van Herpen, E., & van Trijp, J. C. M. (2016). Causes & Determinants of Consumers Food Waste. Project Report, *EU Horizon, 2020 REFRESH*. Wageningen, The Netherlands. Retrieved from: https://eu-refresh.org/causes-determinants-consumers-foodwaste
- Vogels, J. W. P. M., van der Haar, S., Zeinstra, G. G., & Bos-Brouwers, H. E. J. (2018). ICT tools for food management and waste prevention at the consumer level. *REFRESH*. Retrieved from: https://www.wur.nl/nl/Publicatie-details.htm?publicationId=publication-way-353434373839
- Woollaston, V. (2014, July 30). End of the best before date? Food label made from gelatine becomes bumpy when meat is no longer safe to eat. *Daily Mail*. Retrieved from Daily Mail: https://www.dailymail.co.uk/sciencetech/article-2710689/End-best-date-Food-label-gelatinebumpy-meat-no-longer-safe-eat.html
- Yalvaç, F., Lim, V., Hu, J., Funk, M., & Rauterberg, M. (2014, April). Social recipe recommendation to reduce food waste. In *CHI'14 Extended Abstracts on Human Factors in Computing Systems* (pp. 2431-2436). ACM.
- Zhao, J., Freeman, B., & Li, M. (2016). Can mobile phone apps influence people's health behavior change? An evidence review. *Journal of medical Internet research*, 18(11), 71-82. https://doi.org/10.2196/jmir.5692

10. Appendices



Floor Kuipers

10.2 Appendix B – Paper prototype Children interface



1. Main Screen

2. Main Screen including menu bar



A ss	ignments	
Planning Do weekly quiz lopt	Prebore grocers list lept	Chech what is in
Provisioning	tell your porent to	
Do weekly qui ? 10pt	Scan super- morter receipt	
Storing		
Do weekly guit work		

3. Assignments menu

4. Assignments menu including motivational text balloon



5. Store menu

6. Store menu including information on item



7. Family social screen

8. Friends social screen

10.3 Appendix C - Paper prototype Parents interface



1. Main Screen

2. Main Screen including menu bar



3. Quizzes menu

4. Quiz example question



5. Screen correctly answered questioin

6. Statistics screen

≡ A	ssignments
Planning	
Do weekly quiz jopt	Prebore grocery list bept what is in shee
Provi qui Do u qui	other week another 2! you can earn one per correctly swered question!
Storing	
Do weekly quit work	

7. Assignments screen including motivation text balloon to do the quiz

10.4 Appendix D – Walk-through of app – Children interface



1. Feed The Movement – infopage

2. Feed The Movement – pop up screen



3. Home screen

4. Home screen including menu bar



5. Shop

6. Shop including popup

ant 🗎 11.50	ant 🗎 11.50
Feed the movement.	Feed the movement.
	Here you can find the assignments your parents can do
Guiz your Knowledge	Ouiz your Knowledge
Planning Consuming Storing	Planning Consuming Storing
Do weekly quiz Do weekly quiz 2.* Do weekly quiz 2.*	Have your parent complete this assignment!
Prepare grocery list	OK!
	\sim \sim \sim
Do weekly quiz zx [®] . Zx [®] zx [®]	Do weekly quiz Do weekly quiz Zx [®] Zx [®]
Scan a receipt	Scan a receipt
7. Assignments	8. Assignments including pop up

	ant 🗈 11.50
Feed the movemen	t. 12x
Notifications F	riends
Jenna Hampton wants to become your friend	
Marc W. wants to become your friend	
Marianne Toms wants to become your friend	
Jenna Hampton wants to become your friend	Frends :
Marc W. wants to become your friend	Frends :
Marianne Toms wants to become your friend	Friends
Jenna Hampton wants to become your friend	Friends
Marc W. wants to become your friend	Friends
() ()	
Invite more people to joi	in our movement



9. Social screen – Friends page

10. Social Screen - Notifications

11. Family social screen

10.5 Appendix E – Walk-through of app – Parents interface



- 1. Feed The Movement sign up screen
- 2. Feed The Movement pop up



3. Assignments

4. Home screen including menu bar



5. Assignments

	Feed the movement.
	Storing Weekly quiz This assignment is worth:
	Which place is best to store your bread?
_	Cupboard
Ĺ	Freezer
	How long can rice dishes be kept?
	How long can rice dishes be kept?
	How long can rice dishes be kept? 2-3 days 1 day
	How long can rice dishes be kept? 2-3 days 1 day
	How long can rice dishes be kept? 2 2-3 days 1 day What does "use by" date mean? 3
	How long can rice dishes be kept? 2-3 days 1 day What does "use by" date mean? use before the expiration date

6. Quiz example





7. Shop

8. Shop including pop up



- 9. Social screen Notifications section
- 10. Social screen Friends section

Feed the movement. 12x	=
Global Personal	Se
Where are we now	
888 million water of their water of	
Sustainable development goals Fixed the Mexement this to contribute to the sustainable development goals. Read below why the sustainable development goals are so important!	
1 mer 2 mer 3 minterine 4 minter 5 minter 6 minterine 3 minterine 4 minterine 5 minterine 6 minterine 6	
	•
🐺 📶 🚓 💠 🚛 💿	
13 and Minawa Shi tanawa Shi tan	
Feed the movement. Actions taken by family	ł
M T W T F S S	Α
Gather more information on Food Waste and take action! Recommended	
TOPFoodWastele	

11. Statistics page – Global page

	■ Ihe	11.50
	Feed the movement.	
Settir	ngs	
	Personal information Update your name, phone numbers and email addresses.	
۹	Notifications Turn on or off your notifications	
0	Location Turn on or off your location	
	Email Turn on or off emails	
Hel	lρ	
Abo	out	

12. Settings

a 🗎 🗎 11.50
Son Me Dad Daughter
Feed the movement.
Me Dad
Son
Your son completed an assignment! Today at 1250
Your son completed an assignment! Teesty it tax
Your son completed an assignment! Toxidy at 1209

13. Family social screen

10.6 Appendix F – Outline Pretest and Posttest

Welcome

Introduce the interviewer/Introduceer de interviewer

Introduction of topic

Through the questionnaire, I would like to discuss the topic of food waste.

Middels de vragenlijst zou ik het graag willen hebben over het onderwerp voedselverspilling.

The results will be used for research on how to decrease food waste among households with at least one child.

De resultaten zullen worden gebruikt voor onderzoek over hoe voedselverspilling kan worden verminderd in huishoudens met ten minste één kind.

Guidelines

There are no right or wrong answers /

Er zijn geen goede of foute antwoorden

If a question is unclear you can ask me for guidance/

Als een vraag onduidelijk is kun je mij om raad vragen.

You will fill in the same questionnaire twice: once now, before using the app that was designed throughout this research, and once after using this app./

Je zult tweemaal dezelfde vragenlijst invullen: een keer voor het gebruik van de app die is ontworpen middels dit onderzoek en een keer erna.

Questions

You can now start the online questionnaire/

Je kunt nu beginnen met de online vragenlijst.

Closing up

Thank you!/*Bedankt*!

10.7 Appendix G – Questions questionnaire Pretest and Posttest

Below, each of the learning objectives composed in the quizzes can be found. For each of the learning objectives, questions were framed to pre- and posttest the knowledge of the user.

6.3.2.1 Learning objectives Capability

After finishing the available quizzes in the app, the user will be able to name different ways to plan for a supermarket trip.

Q1. How do you plan your shopping trip?/

Q1. Hoe bereid jij je supermarkt bezoek voor?

After finishing the available quizzes in the app, the user will be able to explain the best way to cook certain specific foods.

Q2. Do you think that you are aware of the right portion sizes of different foods? (Like pasta, rice etc.) Do you take this into account when you cook?/

Q2. Denk je dat je je bewust bent van de juiste portiegroottes van verschillende etenswaren? (Denk aan rijst, pasta, etc.). Houd je hier rekening mee als je kookt?

After finishing the available quizzes in the app, the user will be able to identify which foods can still be eaten and which foods cannot.

Q3, On what do you base whether or not your food is still good to eat?/

Q3. Waar baseer je op of je eten nog goed is om op te eten?

Q4. What kind of packaging contains information on the shelf life of the product and what kind of information is this?/

Q4. Wat voor verpakkingen bevatten informatie over de houdbaarheid van het product en wat voor informatie is dit?

After finishing the available quizzes in the app, the user will be able to locate specific foods in their corresponding correct storage space.

Q5. What foods do you store in the freezer and for how long do you think they can still be eaten?/

Q5. Wat voor eten bewaar je in de vriezer en hoe lang denk je dat je dit hier kan bewaren?

Q6. What foods do you store in the fridge and for how long do you think they can still be eaten?/

- *Q6. Wat voor eten bewaar je in de koelkast en hoe lang denk je dat je dit hier kan bewaren?*
- Q7. What foods do you store in the cupboards and for how long do you think they can still be eaten?/
- *Q7.* Wat voor eten bewaar je in een kast en hoe lang denk je dat je dit hier kan bewaren?

6.3.2.2 Learning objectives Opportunity

After finishing the available quizzes in the app, the user will be able to list different food waste reduction initiatives.

Q8. Are you familiar with any initiatives you can use to reduce your food waste? Can you name them?/

Q8. Ben je bekend met initiatieven die proberen voedselverspilling tegen te gaan? Kun je er een paar noemen?

After finishing the available quizzes in the app, the user will be able to list useful products for storing food properly.

Q9 Are you familiar with useful products you can use to store your food properly? Can you name any?/

Q9. Ben je bekend met producten die handig zijn om je voedsel op de juiste manier te bewaren? Kun je er een paar noemen?

6.3.2.3 Learning objectives Motivation

After finishing the available quizzes in the app, the user will be able to explain the environmental, financial and social impact food waste brings about.

Q10 What percentage of the edible food do you estimate is thrown away annually?/

Q10. Welk percentage van eetbaar voedsel schat jij dat er jaarlijks weggegooid wordt?

Q11 Do you think this is a bad thing? Why or why not?/

Q11. Denk je dat dit slecht is? Waarom wel of niet?

After finishing the available quizzes in the app, the user will be able to recognise that it is on average not socially accepted to waste food.

[Q11]

Floor Kuipers

10.8 Appendix H – Outline intervention test

Welcome

Introduce the interviewer/Introduceer de interviewer

Introduction of topic

During the research at hand, an intervention was created aimed at reduction of food waste among households with at least one child./

Gedurende dit onderzoek is een app ontwikkeld met het doel voedselverspilling onder huishoudens met ten minste één kind te verminderen.

Today, you will use this application./

Vandaag zul jij deze app gebruiken.

The app consists of several menu-items, which you can look through if you want to./

De app bevat verschillende menu-onderdelen, waardoor je even mag kijken als je dat wil.

Guidelines

Your goal is to complete the 6 available quizzes in the app/

Je doel is de aanwezige quizen in de app te voltooien.

Questions

You can now start using the app/

Je kunt nu beginnen met het gebruik van de app.

Closing up

Thank you!/Bedankt!
10.9 Appendix I – Quizzes in app, including answers



There are many different ways in which you can better prepare your grocery shopping trip! First off, always go with a list and stick to that list. Next, you can plan out a weekly menu. This is the best way to ensure that your list is complete, and that you have enough to serve your family dinner for the week. Furthermore, don't go when you're hungry! When you're hungry, you want to buy all kinds of junk. You'll end up spending a lot more. Another good tip is to keep a list on your fridge, and write things down immediately. When you run out of something, don't leave it to your memory, but jot it down immediately. Lastly, buy in bulk only when it makes sense. If you can save money, over the course of a month or two, by buying in bulk, plan to do so. A good application to keep track of the items you need is Wunderlist



1. Planning Q1

i 11.50 ■ Feed the movement.	Whoops! The correct answer was 125
Preparing Weekly quiz This assignment is worth ap	grams. For a side dish (like a pasta salad), cook approximately 100g per person. For a main dish you should cook 125g pasta per person.
What is the optimum amount of grams of pasta to cook for one person's main dish? 80 grams 100 grams 125 grams 150 grams	That is correct! For a side dish (like a pasta salad), cook approximately 100g per person. For a main dish you should cook 125g pasta per person.
	Next

2. Preparing Q1

Whoops! The correct answer was 5 minutes.
You should cook your brocolli for 4-6 minutes.
Next
That is correct! You should cook your brocolli for 4-6 minutes. Next

3. Preparing Q2

ant 📋 11.50	Whoops! The correct answer was 1 month.
Feed the movement.	Bread stays fresh for approximately 1 month in the freezer. After that, the quality and taste decreases and the bread becomes
Storing Weekly quiz This assignment is worth ap	dry. If bread tastes stale or has mold on it you should not eat it.
	Next
How long can you store bread in the freezer?	That is correct! Bread stays fresh for approximately 1 month in the freezer. After that, the quality and taste decreases and the bread becomes dry. If bread tastes stale
1 month	or has mold on it you should not eat it.
1 quartile	
1 year	Next

4. Storing Q1

✓ I 11.50 Feed the movement. ✓ Storing ✓ Weekly quiz This assignment is worth 3P	Whoops! The correct answer was 1 year. Cook the vegetables briefly before freezing, or store it in a closed-off bag of container. Write down the date of freezing.
How long can you store vegetables in the freezer? 1 week 1 month 1 quartile 1 year	That is correct! Cook the vegetables briefly before freezing, or store it in a closed-off bag of container. Write down the date of freezing. Next

5. Storing Q2

ant 🗎 11.50	Whoops! The correct answer was 2 days.
■ Feed the movement. Storing ↓ Weekly quiz This assignment is worth 3p	Cut pieces of fruit can only be kept for a few days in the fridge. Because you cut up the fruit, bacteria can grow faster. Also the pre-cut fruits from the supermarket are only good for two days in the fridge. Eat them in time, or store them in the freezer! Next
How long can you store cut pieces of fruit in the fridge? 1 day 2 days 1 week 2 weeks	That is correct! Cut pieces of fruit can only be kept for a few days in the fridge. Because you cut up the fruit, bacteria can grow faster. Also the pre-cut fruits from the supermarket are only good for two days in the fridge. Eat them in time, or store them in the freezer!

6. Storing Q3

■ 11.50 ■ Feed the movement. Storing Weekly quiz This assignment is worth 3p	Whoops! The correct answer was 2 days. Cut pieces of fruit can only be kept for a few days in the fridge. Because you cut up the fruit, bacteria can grow faster. Also the pre-cut fruits from the supermarket are only good for two days in the fridge. Eat them in time, or store them in the freezer! Next
What is the ideal temperature for your fridge -1°C 1°C 4°C 7°C	That is correct! Cut pieces of fruit can only be kept for a few days in the fridge. Because you cut up the fruit, bacteria can grow faster. Also the pre-cut fruits from the supermarket are only good for two days in the fridge. Eat them in time, or store them in the freezer!

7. Storing Q4



8. Consuming Q1

Image: Wheekly quize The assignment is worth go What does THT stand for? Ten minste houdbaar tot Te houden tot Te minste happen tot Houdbaar tot en met
Consuming Tris assignment is worth go What does THT stand for? Ten minste houdbaar tot Ten minste houdbaar tot Ten minste happen tot Houdbaar tot en met Next
What does THT stand for? Ten minste houdbaar tot Te houden tot Ten minste happen tot Houdbaar tot en met

9. Consuming Q2

 ✓ I 11.50 Feed the movement. Consuming Weekly quiz This assignment is worth 3p 	Whoops! The correct answer was chicken. Chicken, meat and fish are perishable products that you cannot eat after the date on the package. After this date, bacteria might have started growing. You might get sick if you eat it. You should thus freeze it in time!
What product is better not eaten after the date on the package? Bread Olive oil Yoghurt Chicken	That is correct! Chicken, meat and fish are perishable products that you cannot eat after the date on the package. After this date, bacteria might have started growing. Une might get sick if you eat it. You should be the freeze it in time.

10. Consuming Q3

ad 🗎 11.50	Whoops! The correct answer was quark.
Feed the movement.	after the passing of the date on the package. Use your senses to judge the quality of the product.
Consuming Weekly quiz This assignment is worth 3P	Next
What product can you still eat after the date on the package?	That is correct! Dairy can still safely be eaten several days after the passing of the date on the package. Use your senses to judge the quality of the product.
Codhsh	
Turkey	Next
Steak	
Quark	

11. Consuming Q4

✓ Feed the movement. Consuming Weekly quiz This assignment is worth 3P	That is correct! Products with a THT-date can often still be eaten after the date passes, but smoked fish, soft cheeses, cold cuts and steak tartare are exceptions. These are perishable products that can make you sick. It is rather confusing that the producers of the products put a THT-date on the packaging, instead of a TGT-date.
What product sometimes does have a THT-date, but is often best not eaten after this date passes? Smoked salmon Brie cheese Steak tartare All of the above	Whoops! The correct answer was all of the above. Products with a THT-date can often still be eaten after the date passes, but smoked fish, soft cheeses, cold cuts and steak tartare are exceptions. These are perishable products that can make you sick. It is rather confusing that the producers of the products put a THT-date on the packaging, instead of a TGT-date.

12. Consuming Q5

📶 🛢 11.50	That is correct! According to the Food and
■ Feed the movement. ■ Disposing Weekly quiz ■ This assignment is worth 3p	Agriculture Organization (FAO) of the United Nations, "one-third of food produced for human consumption worldwide is annually lost or wasted along the chain that stretches from farms to processing plants, marketplaces, retailers, food-service operations, and our collective kitchens." This wastage totals 2.8 trillion pounds, enough to feed three billion people
How much of the world's food is wasted each year?	Next
10% 20% 30% 40%	Whoops! The correct answer was '30%'. According to the Food and Agriculture Organization (FAO) of the United Nations, "one-third of food produced for human consumption worldwide is annually lost or wasted along the chain that stretches from farms to processing plants, marketplaces, retailers, food-service operations, and our collective kitchens." This wastage totals 2.8 trillion pounds, enough to feed three billion people

13. Disposing Q1



14. Disposing Q2

Next

📶 🗐 11.50	That is correct! According to National
Feed the movement.	geographic Magazine, "Producing the food we throw away generates more greenhouse gases than most entire countries do If food waste were a country, it would be the
	world's third largest emitter of greenhouse gases, behind the U.S. and China."
nns assignment is worm 🥪	Next
Greenhouse gas emissions – which are carbon dioxide, methane, and	
warming. Food waste is responsible for a large amount of greenhouse gas emissions. How? Food that is thrown out rots in landfills and dumps, where it releases a lot of methane.	Whoops! The correct answer was all of the above. According to National Geographic Magazine, "Producing the food we throw
Growing food requires a lot of energy. Tractors on farms use fuel. Water has to be pumped from ponds, lakes and water storage areas. Trucks that drive food from farms to markets use gasoline. All of these uses of energy releases greenhouse gas emissions.	away generates more greenhouse gases than most entire countries do If food waste were a country, it would be the world's third largest emitter of greenhouse
When food is wasted, that energy goes to waste.	gases, behind the U.S. and China."
	Next

			llts	11.50
	Feed th	e movement.		
	\leftarrow	Weekly quiz	This assignment is we	orth 3p
Н	ow often do	you buy products th	at are on sale	
Neve	ecause they	are close to expiring	15	
Som	etimes			
Ofter	n			
Alwa	iys			

Another way you can buy foods close to expiring, but still good to eat, for a low price is for instance Too Good To Go, where you can buy a mystery package from stores that would have otherwise had to throw the ingredients away for only a few euros.



16. Provisioning Q1