Experiencing the impact of food choices through a playful, interactive supermarket environment

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September 3, 2021

Abstract

Obesity is becoming more and more prevalent. A big part of this problem starts during childhood. Therefore, by educating children on healthy food options this problem might be remedied. The biggest food decisions are made in the supermarket and children who go shopping with their parent(s)/caretaker(s) have a lot of influence on the grocery shopping of their parent(s)/caretaker(s). That is why, this research aims to develop a high-fi prototype that makes children aware of healthy food choices within a supermarket using interactive technology and marketing strategies.

For this research the Creative Technology design process will be used to develop and evaluate the prototype. First, theoretical research was performed to gain knowledge about related work and a literature research was done to gain a bigger insight in decision making and learning pattern of children, marketing techniques of supermarkets, and children's influence on parents during grocery shopping. Second, during the ideation phase various techniques were used to come up with an idea.

After the ideation phase, the idea is specified during the specification phase and the game was developed into more details, using a low-fi prototype and evaluating it. When everything is specified in order to realise the prototype, the high-fi prototype was realised during the realisation phase. The high-fi prototype was then evaluated to test the effectiveness in the supermarket with the target group.

From this evaluation, it can be concluded that interactive technology, such as RFID tags and a touchscreen, can be used in a supermarket environment. The already existing marketing techniques used for unhealthy food promotions could be used for healthy food promotions. And by using the interactive shopping cart together with the marketing techniques, in a long term, children can be made aware of what healthy food is.

Acknowledgment

Firstly, I would like to thank supervisors dr.ir, R.W. van Delden and dr. R.A.J. de Vries for helping me and guiding me through the whole process. Secondly, I would like to thank Joris Jager for the nice collaboration. Next, I would like to thank the stakeholders of this project being University of Twente, UW-s, Jumbo Leussuink and Achieve for providing foreknowledge, a testing environment, work environment and for financing the project. Lastly, I would like to thank everyone who helped realising the prototype, especially Adrian Hopfenspirger and Kevin Smid for helping with programming.

Contents

Chapter 1

Introduction

1.1 Situation

Over the past few years the number of children with obesity increased a lot. In the US alone, this number tripled between 1980 and 2000 [1]. According to Pi-Sunyer [2] and to a literature review "Do obese children become obese adults?" A review of the literature [3], children who are obese have a higher chance of being obese as an adult as well. This might contribute to the fact that the number of people with obesity worldwide has almost tripled since 1975 [4]. Obesity can lead to several physical diseases such as diabetes, cardiovascular disease (CVD), obstructive sleep apnea, hypertension, dyslipidemia, the metabolic syndrome and even cancer [1, 5]. Rankin et al. [6] suggests that children with a normal weight have more social interaction with their peers than children with overweight, which could lead to isolation and mental diseases such as depression and suicidal thoughts and attempts [6].

As stated by Fisk et al. [7] children do not consider health value when choosing food. There are several factors, such as the quality of their mother's diet, educational attainment, BMI and the child's time spend watching television that play a role for children when choosing food. Fisk also states that there is a strong correlation between the diet of the mom and the diet of the child. Next to this, factors such as in which order the siblings are born and time spend watching TV have a lot of influence on the diet of a child [7]. In contrast, [8] indicates that children rather prefer food with more immediately rewarding results, such as good taste. This is very much influenced by TV-commercials [8]. However, children are also influenced a lot in the supermarket itself as suggested by [9]. In 2009 millions of dollars were spent on marketing and packaging of food such as snacks, cereals, beverages etc. solely aimed at children [9].

Next to that, technology is becoming widespread in supermarkets. Think of scanning devices, tablets on shopping charts, touchscreen monitors on a wall and so on. There are several researches done regarding bringing in new technology within a supermarket [10, 11, 12, 13]. Lopez et al., for example, uses RFID tags

to guide visually impaired people along the aisles of the supermarket to reach their destination [13]. And the company UW-S uses touchscreens on shopping carts to give information about the supermarket to adults. They even made special touchscreens for shopping carts for children to play games as they are doing groceries [12].

1.2 Goal

Therefore, by preventing children from becoming overweight and/or obese the risks of several physical and mental disorders might be lowered as well. One of the main aspects, that causes the problem, is marketing and branding in the supermarket. By educating children on what healthy food is and making them conscious about what to choose, the problem might be addressed. Using technology, such as RFID tags [13], and/or developing them further can help reaching the goal of this project, namely to create an interactive learning environment for children about healthy food in the supermarket.

1.3 Research questions

From the goal mentioned above, one main question and two sub questions can be derived. These questions will be answered by doing research on the state-of-the-art, by user testing, interviewing stake holders and after that prototype realizations.

Main question

How can interactive technology be used to make children in the supermarket aware of healthy food choices, with technology relating to marketing?

Sub questions

- How can food choices, made by children in the supermarket, be made conscious, so that healthy options are preferred?
- To what extent does an interactive experience realised with technology, e.g. e-beacons, RFID tags and touchscreens, help in educating children on healthy food?

In order to answer these questions, this paper will first look at related work, after which it will give a literature review in state-of-the-art. After that, it will discuss the method of the research. The third part will show the ideation and specification process. This will mainly be about the design. Subsequently, the realization and evaluation will be discussed. Lastly, the final part will talk about the conclusion and any future work.

Chapter 2

State-of-the-art

In this chapter, state-of-the-art will be researched. First, some related work will be stated. Then, a literature review will be done on educating children on healthy food choices in the supermarket. Within this literature review, a part of the sub questions will be answered. A full answer will be given later on in Chapter 9 Conclusion.

2.1 Related work

2.1.1 UW-s Kidsclub

UW-s[12][1] is, amongst others, a stakeholder of this project. The KidsClub department of the company makes interactive games that children can play within a supermarket. These games are played on a tablet either attached to a shopping cart or to a wall. The children can first enter their age, which will determine the difficulty of the games. After that, the children can move around the supermarket with a shopping cart for instance. As they go through the supermarket the games change depending on the location of the cart. This localization is done with e-beacons which are deployed around the aisles of the supermarket. The reason for using e-beacons is that other types of connections such as WiFi can cause problems regarding connection loss. The tablets on the carts contain Bluetooth low energy beacons to receive information from the other beacons [12]. In figure 2.1 a picture of such carts is shown.

[1] https://www.uw-s.nl/product/kidsclub

Figure 2.1: UW-s KidsClub shopping carts with tablet[12]

2.1.2 RFID tags

Over the past decade Lopez et al. and Black et al. did research regarding integrating RFID tags within a supermarket [11, 13]. On one hand Black et al. uses shopping lists in their system. These are registered in the screen on their shopping cart. RFID tags are only used to register product collection so that the items on the shopping list can be identified[11]. In figure 2.2 the shopping cart with shopping list can be seen on the left. The other two pictures show how a customer would interact with the system.

Figure 2.2: RFID tag system in a supermarket with shopping list[11]

Lopez et al. on the other hand, is using RFID tags on the floor across the

supermarket to guide visually impaired people along the aisles of the supermarket. The user can walk around the aisles with their cane. On their cane is a receiver attached in order to be able to guide the user through the supermarket. When the user comes across a product they want to buy, they can scan a QR-code with their phone in order to identify the product they are planning to buy [13]. In figure 2.3 the RFID tags can be seen on the left, and on the right the scanning of the QR code can be seen.

Figure 2.3: RFID tag system in a supermarket [13]

One possible method to integrate Lopez et al's system into the project would be to use the RFID tags on the floor to create an interactive system with the tablet. That way the child will not only be engaged with what is going on on the tablet, but also with the rest of the environment.

2.1.3 Jumbo foodmarkt Tilburg

Jumbo foodmarkt Tilburg is the biggest supermarket in the Netherlands. Not only do they have a wide product range, but they also have a lot of interaction points for the customers. One of those interaction points is in the candy and cookies aisle. In figure 2.4 a picture of this interaction point can be seen. This interaction provides an opportunity to chose the desired flavour for an Oreo cookie by turning the big Oreo cookie. The installation has different sounds and lights with every option of cookie flavour in their product range. As the user/customer turns the Oreo cookie the light changes to the desired option. With every option the sound changes into the corresponding advertisement of the flavour.

Figure 2.4: Oreo installation Jumbo foodmarkt Tilburg

2.2 Educating children on healthy food choices in the supermarket: A Literature review

[2]

Introduction

Over the past few years the number of children with obesity increased by a large margin. In the US alone, this number tripled between 1980 and 2000 [2]. Studies have shown that children who are obese have a higher chance of being obese as an adult as well [2] resulting in a number of people with obesity worldwide that has almost tripled since 1975 [4]. Obesity can lead to several physical

[2] Academic writing chapter

diseases such as diabetes, cardiovascular disease (CVD), obstructive sleep apnea, hypertension, dyslipidemia, and the metabolic syndrome and even cancer [5, 14]. Hence, it is important to prevent children from becoming overweight and obese.

Bruce et al. suggests that children do not consider health value when choosing food. They instead look more into direct rewarding results, such as good taste. This is very much influenced by tv-commercials [8]. Next to this, Fisk et al. mentions that there can be a strong correlation between the diet of the mom and the diet of the child [7]. According to [6] children with a normal weight have more social interaction than children with overweight, which can lead to depression and mental illnesses in children with overweight. By preventing children of becoming overweight and/or obese the risks to several physical and mental diseases might be lowered. Therefore, this literature review will focus on how children can be educated on making healthy food choices in supermarkets. The first section of this literature review will talk about how children make decisions and their learning behaviour. Then it will look at influences of children's food choices from environmental factors within a supermarket. In addition it will look at to what extend children have influence on grocery shopping behaviour of their parents. Lastly, this literature review will provide a further insight on how to solve the problem and will answer the research question:"How can children be educated on making healthy food choices in supermarkets?".

Decision making and learning

Decision making is a skill often learned at a young age. Demirtaş and Sucuoğlu imply in their study that, just like any other skill learned in life, the decision making skill is learned by life experiences over time [15]. However, the process can also evolve spontaneously during children's communication with others. There are several approaches that [15] mentions when it comes to decision making by a child. One of them being consulting an authority, e.g. their parent(s). On the other hand, Betsch suggests that decision making in general is based on two models, probability and experience based decision making [16]. Children are highly influenced by the information they get about their choices. As Betsch stated , at the age of 6 children often do not consider probability in their decision making. They rather rely on invalid information which causes them to make poor decisions. While at the age of 9 children rely on probability as well [16].

Additional to that, learning behaviour of children is also essential to look at. The results of [15] illustrates that active learning is important in early childhood education. This is a way of teaching with interactivity as basis. By doing this, the child is enabled to use their intellectual skills. That way the child is allowed to make decisions about their learning. In parallel, [17] supports this by saying "knowledge is better gained when children are deeply and actively involved in building their own meaningful constructions.". This makes it possible that a child is not a passive receiver. Instead, it ensures that children discover their own knowledge. On the whole, the decision making of a child is a skill that

needs to be learned and can be influenced by an authority. It also changes over time from non probability based decision making to partly probability based decision making. Moreover, the learning behavior of a child is positively influenced when teaching is done in an active manner.

Supermarket factors; taste over health, brand characters, and shelf visibility & placement.

Children are heavily influenced from environmental factors when it comes to food intake. On a daily basis this means that they are mostly influenced by their parents or e.g. their neighbourhood [18, 19]. Nevertheless, children are also highly influenced by two main environmental factors in the supermarket. When choosing a product a child is more likely to choose something that is tasty rather than healthy. The first and one of the biggest factors that influences the choice of children, remarked by McGale et al., is brand equity characters on food. That is due to the fact that children are highly influenced by advertising done with imagery and symbolism. Unfortunately this is not used to influence children in choosing healthy food, but more to influence children in choosing food with high sugar, fat and salt [20].

Likewise, Mehta et al. points out another factor [21]. The second factor is the way that shelves in the supermarket are placed, along with price promotions and special displays. This is done by, first of all, placing the food targeted towards children on the eye level of children. Therefore, children are more exposed to those products and thus more likely to want to buy the products. Second of all, it is also done by placing products that are colourful or in promotion at a level where children can grab it easily. Third of all, special displays mainly display unhealthy food and drinks with low nutrition. Think of big bins with candy or chocolate at the counter [21].

The third factor that Mehta et al. mentions is the packaging of food. A large number of products are marketed towards children. Which is done in different ways such as lettering, use of icons, themes that are interesting to children and cross-promotions. Cross-promotion is done when two or more companies cooperate to promote one and other [22]. For example a cookie brand with your favourite cartoon character on it. The study of Mehta et al. states that 75.2% of these products marketed towards children are high in fat or sugar, making it non-core food. There are numerous marketing techniques that can be applied to products. It has been found that on average 6.43 of more than 16 techniques are used on non-core food. When this research was conducted(2012), more than half of the cases the packaging even stated false information about the food, such as stating that the food is healthy or nutritious, while it was not [21]. All in all, it has become apparent that there are, amongst others, three factors in the supermarket that influence children in their shopping behaviour. These three factors, being taste over health, brand characters, and shelf visibility & placement, can be used to promote unhealthy and non-nutritious food as it is used now. Nonetheless, it can also be used to promote healthy food. this could help addressing the problem of having obesity at a young age.

Children's influence on parents during grocery shopping

Even though a big part of the marketing in supermarkets is directed towards children, the grocery itself is done by their parents. That is why it is important to look at how much children effect their parents grocery behaviour. As reported by the NRF (National Retail Federation) of the US, about 44% of the purchases in food and drinks, done by parents, are influenced by their children [23]. This influence on the shopping behaviour of their parents, is also known as "pester power" and has a big role in marketing [24].

Another perspective to take into account is in what terms children influence their parents in shopping behaviour. From a field study done in a supermarket in Nepal with 60 participants shows that only less than 2% of the parents never take their children to grocery shopping [25]. When shopping, 90% of the time children demanded food from their parent. The most favorable items of children were chocolate, ice-cream, biscuits and noodles. The least favourite items were soups and juice. Furthermore, over 60% of the demands of the children were fulfilled first before buying something else [25]. Overall, even though children are not the ones actually buying the groceries, they still have a big impact on the shopping behaviour of their parents.

Conclusion

In conclusion, children learn in a better way when teaching is done in an interactive manner. Apart from that, children learn how to make decisions from an early age on. This decision making is at around the age of 6 mainly based on non probabilistic choices, meaning not based on probability but more on information they receive from their surrounding. It is also influenced by an authority like their parents. It can be concluded from section 3 that children can also be influenced from environmental factors in the supermarket. Brands are well aware of this and market their products in the supermarket. This is done by smart shelf placement, imagery, symbolism, displaying known characters etc. The marketing is mainly targeted towards children. The downside of this is that at the moment those products often are unhealthy and low-nutrient food. On the contrary, children influence their parents shopping behaviour a lot as well. Most of the demands of children lies within unhealthy food such as chocolate and ice-cream.

Considering all of this, the problem could be addressed by educating the parents of the children, since the decision making of a young child is partly influenced by their parent(s). However, the fact that decision making is learned in an early stage in life makes it important to educate the children as well. If this is done in an interactive way, children could be educated to make healthy food choices over unhealthy food choices from an early age. Lastly, the marketing strategies (brand characters, and shelf visibility & placement) of brands and supermarkets could be used to promote healthy food instead of unhealthy food, which would help solving the problem further.

2.3 Conclusion

In conclusion, there are several interactive technologies already in use in supermarkets, like tablets on shopping carts, RFID tags to scan products for a shopping list or to guide visually impaired people in the supermarket and food stations with sound and light to promote a certain product. Following, the decision making of a child is a skill that needs to be learned and can be influenced by an authority. It also changes overtime from non probability based decision making to partly probability based decision making. Moreover, the learning behavior of a child is positively influenced when teaching is done in an active manner. Furthermore, there are, amongst others, three factors in the supermarket that influence children in their shopping behaviour. These three factors, being taste over health, brand characters, and shelf visibility & placement. So, the sub question "How can food choices made by children in the supermarket, be made conscious, so that healthy options are preferred?" can be answered as follows. Children learn better when it is done in an interactive manner. Therefore, by using interactive technology, such as tablets and RFID tags, teaching children about healthy food could be made easier. Next to that, marketing techniques can be used to promote healthy food options instead of unhealthy food options. Brand characters, for example, can be used within the interactive installation to promote healthy food options. However, further research needs to be done to be made sure.

Chapter 3

Methods and Techniques

In this chapter the method and techniques used during the research will be explained. Throughout the research the Creative Technology design process is used in order to develop an interactive installation within the supermarket [26].

3.1 Creative Technology Design Process

The Creative Technology Design Process (CTDP) is widely used within the study Creative Technology. The CTDP contains four phase including Ideation, Specification, Realisation and Evaluation[26]. In figure 3.1 a schematic overview of this can be seen.

During the ideation phase, the goal is to come up with new ideas. The ideation has two phases in it's self. First there is the divergent phase followed by the convergent phase. During the divergent phase a lot of ideas are produced[26]. This can be done in many ways, such as mind mapping, 100 ideas technique, reversal method etc. Through the convergent phase these ideas are narrowed down to just a few ideas.

In the specification phase some prototypes are made in order to evaluate the ideas. Based on these prototypes improvements can be made. These prototypes are usually low-fi prototypes so that they can be modified easily. These prototypes can be tested with stakeholders or by the designer itself[26].

When the specification phase is finished, the realisation phase can be started. The generated idea from the previous two phases can be realised by making a more high-fi prototype[26].

After this, the product can be user tested on functionality. Then, the functional testing is evaluated during the evaluation phase. And lastly, the whole process is reflected on in order to see what could have been done better[26].

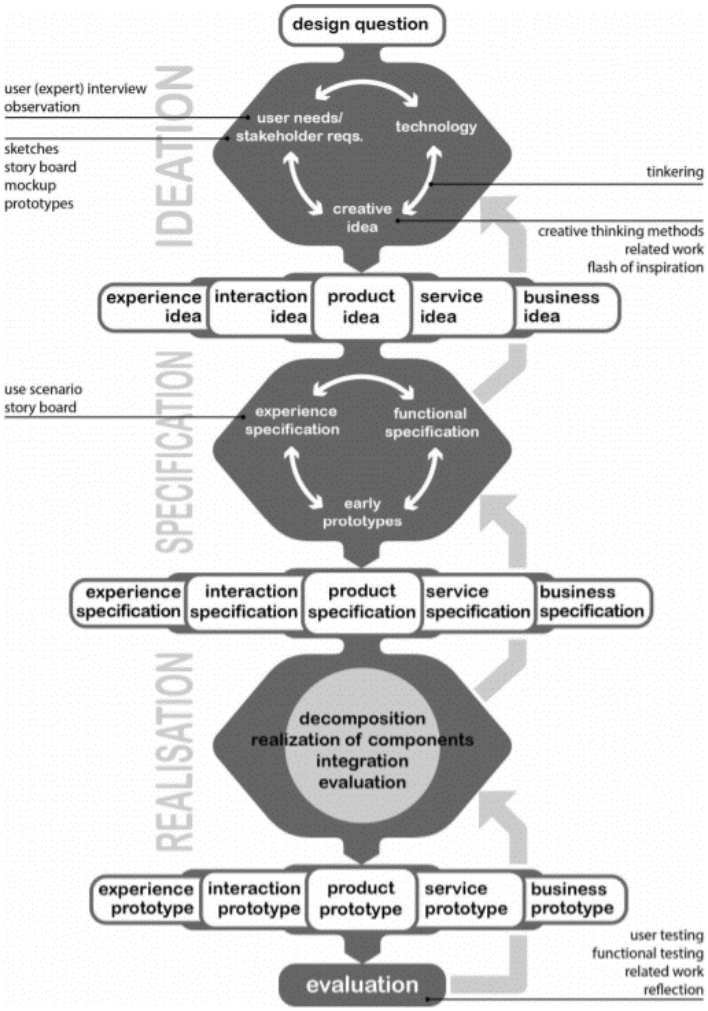


Figure 3.1: Schematic overview of CTDP [26]

3.2 Methods in Ideation phase

The main idea is developed during the ideation phase. To be able to come to one main idea, several techniques are needed. The first technique is the Hundred idea technique in which as many ideas as possible are generated. These ideas do not have to be good. The goal of this technique is rather to have a lot of ideas to start the creative thinking. After creating as many ideas as possible, 3 ideas are chosen to be evaluated further. Following, a mind map is made to come up with more ideas, but also to broaden the already existing ideas. Next, a mood board is created to get a better feeling of how the end product will look

and what kind of vibe it will have. Lastly, storyboards are made to visualize the three chosen ideas. These storyboards are then evaluated by showing it to children from the ages 7 to 10 and asking some questions. From this evaluation, one idea is chosen to be the main idea.

3.3 Methods in Specification phase

After choosing one idea, the whole idea is specified. The specification is divided into three main sections. The first one is the game specification explaining in a bit more detail what the game is about and how it will look like. The second one is the software, in which the design of the software is tested and evaluated. And the third section is the hardware. The hardware section explains more in detail what is needed to realise the product.

3.4 Methods in Realisation phase

The realisation phase combines all of the previous chapters to realise the product. The design of the product is realised by combining the hardware with the software. The hardware being, the tablet, Bluetooth module, RFID tags -and reader. The software being, the Arduino and the application.

3.5 Method in Evaluation phase

lastly, all of this is evaluated and put into test by doing user tests in the supermarket. To be able to answer the main research question: "How can interactive technology be used to make children in the supermarket aware of healthy food choices, with technology relating to marketing?" the sub question:"To what extent does an interactive experience realised with technology, e.g. e-beacons, RFID tags and touchscreens, help in educating children on healthy food?" is being answered here. The user test is done with children doing groceries with their parent(s)/caretaker(s) in the supermarket. After that, the tests and the results are evaluated and a conclusion is made.

3.6 Conclusion

So, after completing the theoretical research, the overall research is continued by using the Creative Technology Design Process (CTDP) and it's four faces; Ideation, Specification, Realisation and Evaluation. In the next chapter the Ideation phase will be further explained and implemented.

Chapter 4

Ideation

During the ideation phase ideas are generated. These ideas are generated in order to come up with more specific concepts and eventually prototypes. For this several methods are used. First, the hundred idea technique is used. Then, a mind map is used. After the mind map, a mood board is made. Lastly, storyboards are used in order to test and chose one of the three ideas.

4.1 Hundred idea technique

The hundred idea technique is a technique in which as many ideas as possible are written down, preferably hundred. For this technique it is important to not filter the ideas before writing them down. In figure 4.1 a list of written ideas can be found for this project. The first few ideas are quite detailed, however as the ideas start to flow the ideas became less detailed. The list contains only 46 ideas, since after some point it was not necessary to generate more. Next, from these ideas three were chosen to be worked out more in detail.

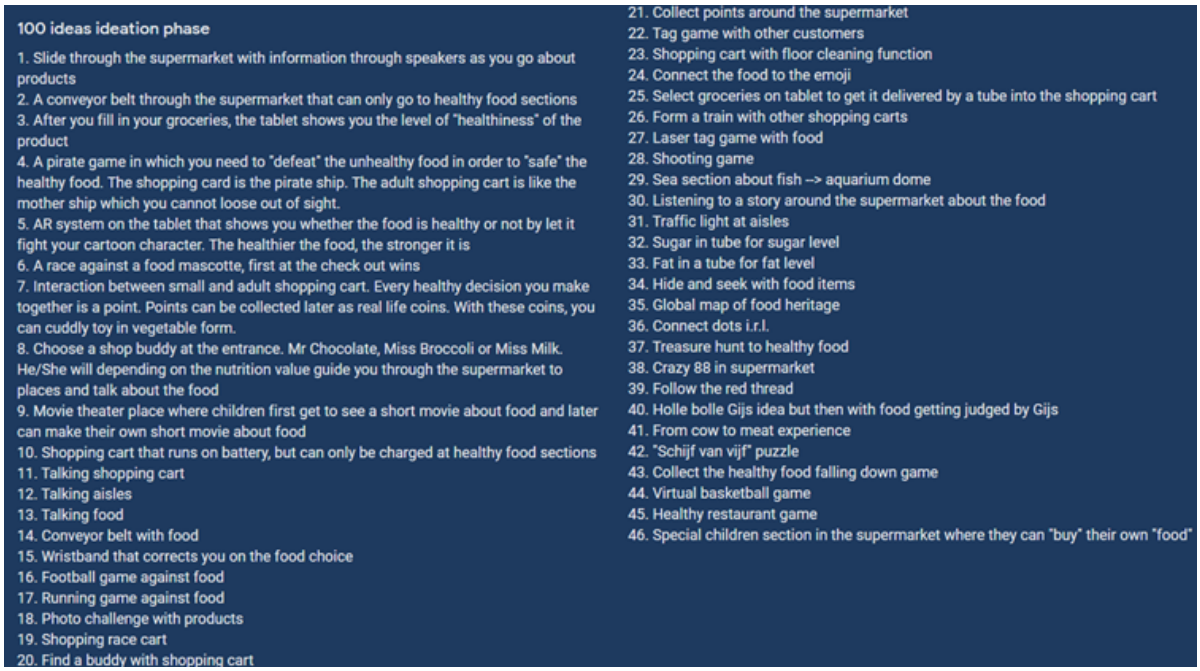


Figure 4.1: List of ideas

Three main ideas

1. Collect the healthy food falling down game with your shopping cart.
2. Photo challenge with products
3. Scavenger hunt with pirate theme The shopping cart is your ship. You need to complete tasks in the time you are in the supermarket.

With all of the games, try to get the food with the most vitamins/sugar/protein/healthy oil etc.

4.2 Mind mapping

The second method used during the ideation is mind mapping. This method is used to come up with more ideas, but also broaden the already chosen ideas. In figure 4.2 the mind map can be seen. In this mind map there are two sections, one in which there is some thinking done about road mapping, so how the user will be guided through the supermarket. This part is written with some of the chosen ideas in mind. The second section is about the visualisation. Here, both new ideas are generated and broadening of chosen ideas is done.

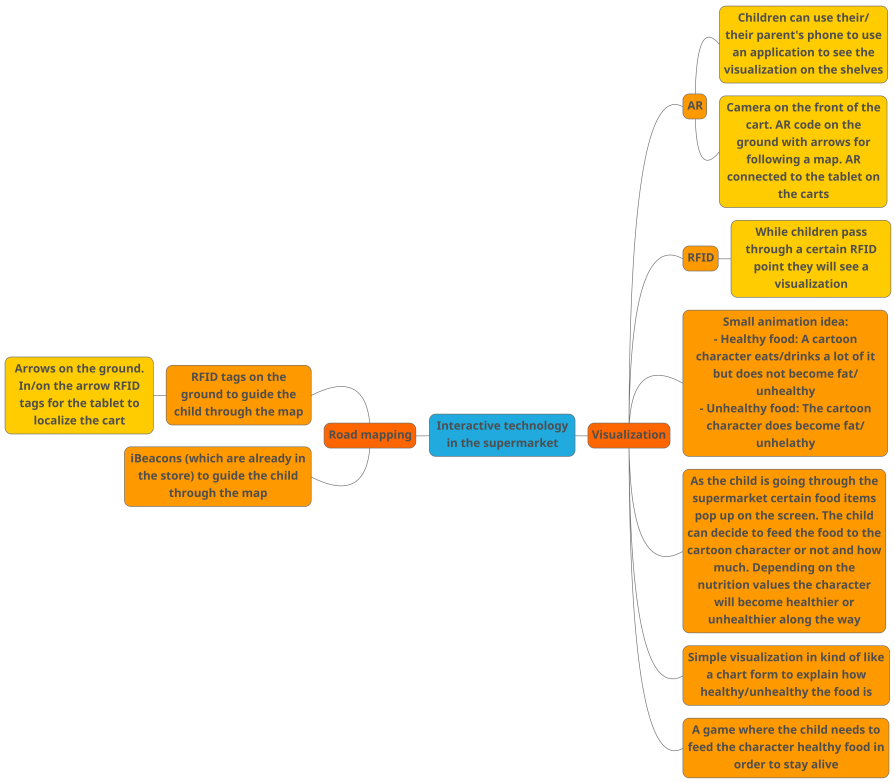


Figure 4.2: Mind Map

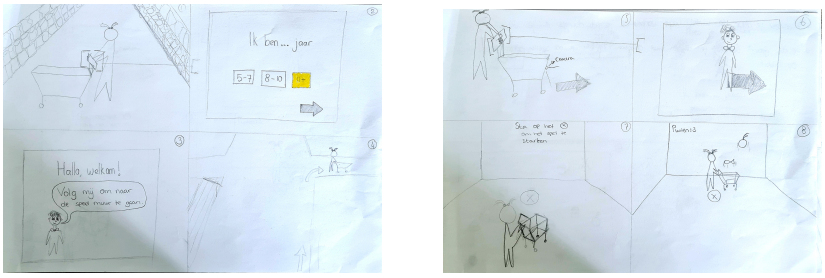
4.3 Mood board

The third method used is a mood board. The purpose of the mood board is mainly to play around with the vibe and feeling of the product. Therefore, the mood board is made based on the mind map. The mood board can be seen in figure 4.3.

Figure 4.3: Mood board based on the mind map

4.4 Storyboard

Lastly, in order to chose one of the three idea a storyboard is made per idea. The storyboards are then one by one showed and explained to children from the age group 7-11 year old. In figure A.1, A.2 and 4.6 the three storyboards corresponding to the three main ideas can be seen. Also see Appendix A.



(a) Page 1 (b) Page 2

Figure 4.4: Storyboard 1

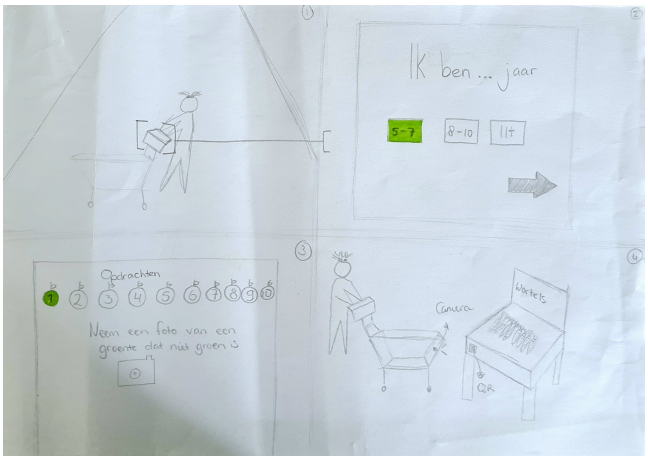
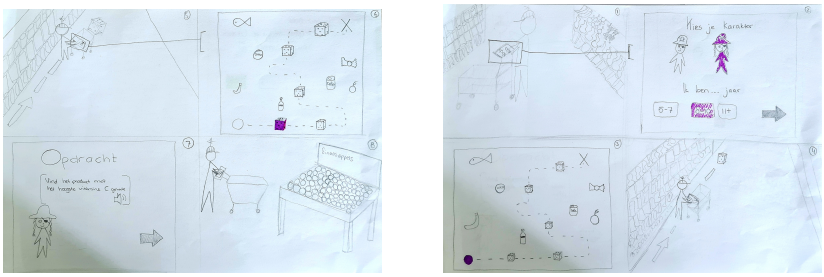


Figure 4.5: Storyboard 2



(a) Page 1

(b) Page 2

Figure 4.6: Storyboard 3

4.4.1 Evaluation

After showing the storyboard a small evaluation is done by asking several questions. Based on these answers one idea is chosen. The questions were as followed:

- Which of the three ideas did you liked the most and why?
- If the supermarket would display this game, would you come again to play it?
- Per chosen storyboard, what did you like the most?

The answers given to the questions can be summarised as follows. Two out of three participants like the pirate themed scavenger hunt game the most (storyboard 3). What those two like the most from the game was mainly looking for the interaction points, since it feels like a challenge for them. The other child liked the game with collecting the food the most (storyboard 1). What they

liked the most was trying to catch things. All three of the children would come back for the chosen idea. Lastly, all three of the children liked the main aspect of the chosen game the most. Further results of the questions per participant can be found in Appendix A. From those results it has been concluded that the idea from storyboard 3 is the best option. Therefore, that idea has been chosen.

4.5 Main idea

The final chosen idea is a scavenger hunt game in a pirate theme. In this game, the user can chose their character to play the game with. Within the supermarket there are interaction points. At those points the child can answer questions or complete certain tasks. After a correct answer is given the child will receive some coins. Within the game there is also a villain which the child needs to defeat by answering correctly. At the last point a screen will pop up indicating that the child did a good job.

4.6 Conclusion

To conclude, the ideation phase started with the 100 idea technique in which the goal was to come up with as many ideas as possible. With the hundered idea technique, 46 ideas were generated. After generating 46 ideas, 3 main ideas were chosen to conceptualize further. To conceptualize the three ideas and to generate a few more a mind map was made. This mind map consists of two sections. One about the road map within the supermarket and one about the visualisation. Next, a mood board was made to give a better feeling of how everything could look like and to get a better idea of the vibe of the product. After that, three storyboards were made to visualize the ideas even better. These storyboards were then evaluated by showing them to children from the ages 7 to 10 and asking them some questions. From this evaluation one final idea came forward. The main concept of the final idea is a scavenger hunt with a pirate theme. This final idea will be specified more in the next chapter, Chapter 5 Specification.

Chapter 5

Specification

This chapter will talk about the initial design of the product, further detail into the game specification, the paper prototype made in order to evaluate the chosen idea and what components are needed to realise the product.

5.1 Initial design

The already existing part of the product is the tablet on the shopping cart[12][1]. This tablet contains several games that pop up when passing by a certain point. These points are triggered by iBeacons. iBeacons are small devices that use Bluetooth Low Energy (BLE) to transmit and receive data from other devices[27]. So when a child with a shopping cart passes by, for example, the vegetable and fruit aisles, a game about vegetables and fruit will pop up.

5.2 Game specification

The game consists of two types of interaction. Interaction with the tablet and interaction with the supermarket.

When the user, in this case a child, takes the shopping cart they can chose a character of their choice, a boy pirate or a girl pirate, as seen on figure 5.1.

Figure 5.1: Initial screen to chose character

[1] Not a paper

After they chose a character two pop ups will show up. First pop up will explain a bit about the game itself and the second one explains about the interaction within the supermarket, as shown in figure 5.2.

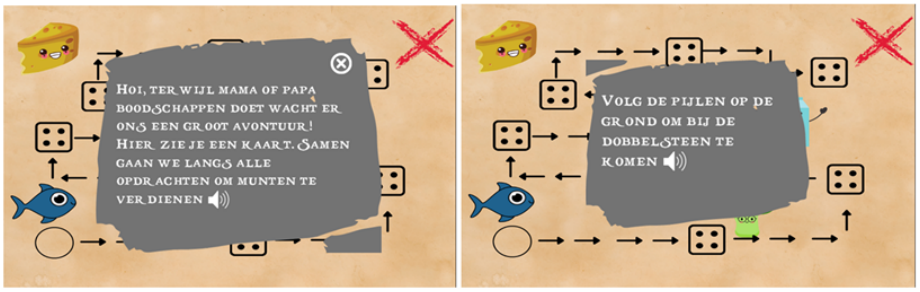


Figure 5.2: Pop ups with explanation

Next, the child can start following the arrows on the ground which leads them to the first interaction point. At this first interaction point the child needs to scan the RFID tag, which is attached to the interaction point, at the reader next to the tablet. Then, the first question pops up. This first question is an interactive question in which the child needs to answer the question by showing something to the camera. In figure 5.3 an example of such a question can be seen.

Figure 5.3: An example of question 1

After this is done, child can go to the next point by again following the arrows on the ground. At the second point there is first a brief explanation about what a portion is. Then a small intro to the second question is given, see figure 5.4.

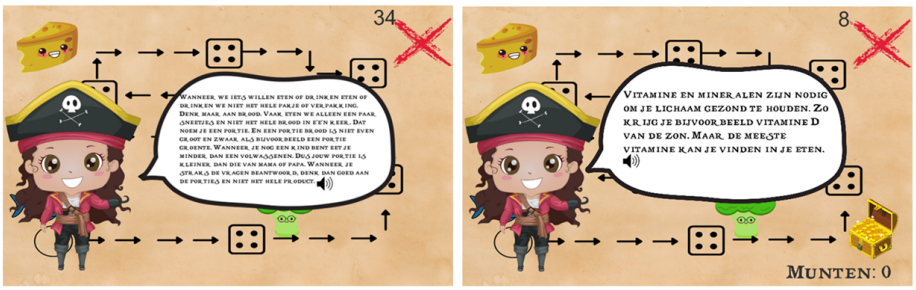


Figure 5.4: Portion explanation on the left — Introduction to question 2 on the right

Following, the second question will pop up. The second question is a multiple choice question, meaning the child only need to click on the correct answer. In figure 5.5 an example of question 2 is given.

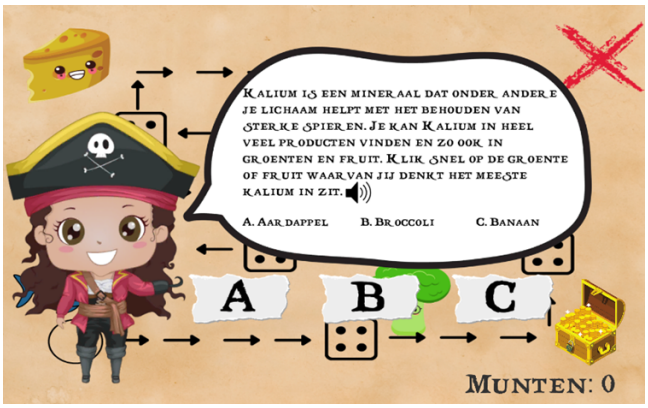


Figure 5.5: An example of question 2

Then, the child can go to the next point. This goes on till the end point. There are in total 8 question of which 3 are interactive and 5 are multiple choice. Throughout the questions there is also a bit of a story line where the child needs to defeat the villain by answering the questions correctly. At the end screen the child can see how many coins they have gathered. All of the text within the game has a voice over so that even children who can not read can still play the game.

In order to make the game re-playable there are some variations made to each question. So, for example, question 1 has five different varieties to the question. Every time the game is played, the program chooses randomly one of those five variations. This way the same child can play the game several times instead of just once or twice. See Appendix B for all the explanations and questions displayed within the game and some additional screenshots of the game. Within the game there are also several timers. All of the explanations

also have a timer so it goes automatically to the next screen. And the interactive questions 1, 7 and 8 also have a timer. The purpose of these timers is that the game goes to the next screen even if the child could not answer the question. When this happens, the child will not receive any points for that question.

5.3 Software

The software part of the game is made using Unity[28][2] and Canva[29][3]. Unity is a program to make games for different platforms. The motive to use Unity is because it is fairly easy to use and very suitable for this game, since the game has multiple scenes and uses sound. Within Unity the ArduinoBluetoothAPI library is used[30][4]. Canva is an online tool in which all sorts of graphic designs can be made. The pro version of Canva is free for students for 1 year and provides a large variety of options.

The game consists of several screens. Every screen is a different scene in Unity. To be able to see whether the application is clear or not a paper prototype has been made, see figure 5.6. This paper prototype is then being tested with a couple children from the ages 7 to 11.

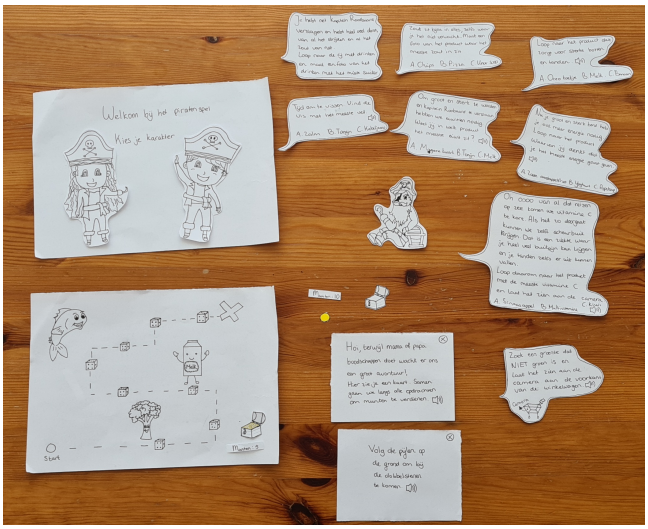


Figure 5.6: Paper prototype

5.3.1 Test setup

For the paper prototype user test there were some modifications made to the interaction, since the testing was done in a backyard of a house. Originally

[2]Not a paper
[3]Not a paper
[4]Not a paper

the user needs to go to an interaction point in order to see the next question, however this has been modified to a stable point where the questions can be viewed. Instead, the different questions could be answered by going to one of the three points, named A, B and C. After answering the question a new question was shown by the tester self. A schematic overview of the setup up can be seen in figure 5.7.

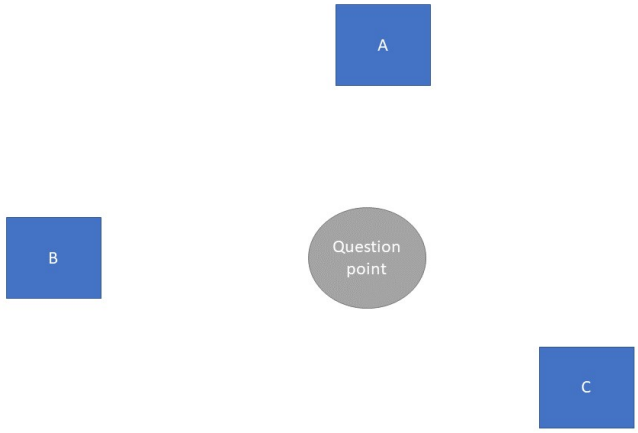


Figure 5.7: Paper prototype setup

After completing the paper prototype test each participant was asked some questions. These questions can be found in Appendix C. The questions are mainly to test whether the idea is still a good idea to execute or not and whether the game is doable for children.

5.3.2 Evaluation

The answers to these questions is summarised here, the full version of the questions and answers can be found in Appendix C. The evaluation is done with three children from the ages 7 to 11. The participants were the same three children from the evaluation of the ideation phase. This made it easier to explain what to do, since they were already familiar with the concept. There were in total 6 questions. The questions used in the paper prototype were overall fairly easy to understand. Some design questions were asked about how to questions should be viewed on the application. All of the participants said that they would like to see the questions with a white background, since it would be easier for them to read. The storyline was also liked by all three of them. They mentioned that the story is easy to understand and that the questions were fun to answer. All of the participants had learned something new about healthy food options while answering the questions. And none of them disliked it when a given answer was wrong. At last, when asked whether something could have been done in a better way, there were no additional remarks.

5.4 Hardware

The hardware consists of two parts, sensors and the interaction.

5.4.1 Sensors

The game has two sensors. The first sensor is next to the shopping cart, which is the RFID reader. In order to go to the next screen the child needs to scan the RFID tag at the RFID reader. This reader only receives data from the RFID tags. The second sensor is the RFID tag, which can be found at the interaction points. When the tag is scanned it will send a message through Bluetooth to the tablet that the tag is scanned. The tablet will then, after receiving the message, tell Unity to open the next screen. The same tag can not used twice in a row to avoid unintended jumping from one screen to the other.

5.4.2 Interaction

Tablet

The main game is played on the tablet. On the tablet the user can chose a character, see the questions and information about the game or educational information.

Interaction point

There are 9 interaction points throughout the supermarket. All of those interaction points have an RFID tag, a picture of a die and some of them have a cartoon character.

5.5 Components

The components needed for this project are

- A tablet
  To play the game with
- An RFID reader
  To scan the RFID tags
- 9 RFID tags
  To trigger the app to go to a new screen
- An Arduino UNO
  To combine the hardware with the software
- A bluetooth module
  To communicate between Unity and Arduino

- 9 interaction points with a picture of a die
  To make it intuitive for the user where to go to
- 5 cartoon characters
  To test a hypothesis (see chapter 7 Evaluation).

5.6 Conclusion

In conclusion, the initial design of the product is a shopping cart with a tablet and games on it. These games use iBeacons to localize where the user is. The new product will have a similar concept by using a shopping cart with a tablet and an application in the form of a game as well. However, there will be no localization used to localize the user, as it is not needed to reach the goal of the interactive shopping cart. The game will have a pirate theme with questions and tasks regarding healthy food options. The user either needs to answer the question by clicking on the touchscreen or complete the task, depending on the question. The overall theme and some of the questions are tested with children from the ages 7 to 10. From these tests it came out that the theme is very much adored by the children and that the questions are in general not too hard nor too easy. Some certain design choices are made, such as, how the questions should look to make it easier to read. All of the participants of the test learned something new because of the questions. And none of them disliked it when they had a question wrong. Lastly, there were no additional remarks made by the participants. Overall, the end product is highly feasible as non of the hardware or the software is hard to retrieve or develop. The next chapter will talk about how the prototype can be realised and how the different components are put together in order to be able to evaluate the prototype.

Chapter 6

Realisation

The realisation phase is done by combining the previous chapters. During the realisation phase the high-fi prototype is made. The chapter is divided into three parts. First, it will talk about the design choices of the product. Then about the hardware of the product. And lastly, the software of the product.

6.1 Design

There are several design choices made throughout the process of developing the product. The first design choice is the theme. The pirate theme is chosen, since it was appealing to the children with whom the storyboard testing was done.

The second design choice was the ratio aspect between interactive vs multiple choice questions. This ratio is 3:5, because too much interaction could distract the children too much and too little could be too boring after some time.

The third design choice made is about how to lead the children to the interaction points. This is done by using arrows on the ground, see figure 7.2. The arrow also indicates that there is a scavenger hunt in the supermarket that they can play.

The next design choice was what to display at the interaction point. At the interaction point there is a die, as seen on figure 7.2. The die is an intuitive symbol for children to let them know that there is a game to play there.

Lastly, all of the symbols and characters in the supermarket, but also in the application, were made in a cartoon style so that it is appealing towards children.

6.2 Hardware

6.2.1 RFID

The hardware consists of several items. The RFID reader used for the product is the Joy-IT RFID module MFRC-522[31][1]. There are in total 9 tags needed for the game. The RFID reader which is attached next to the tablet has a die on it just like the dice at the interaction points to make it recognisable for the children, as shown in figure 6.1. This gives a more intuitive feeling to the game.

Figure 6.1: RFID reader with die

6.2.2 Bluetooth module

In order to let Unity and Arduino communicate with each other the HC-05 Bluetooth module is used. This Bluetooth module sends and receives data from the RFID reader to Unity through the Arduino. The Bluetooth module is coded using the ArduinoBluetoothAPI library. This library provides tutorials to be able to modify the code easily[30]. In figure 6.2 a circuit diagram of the Arduino with RFID reader and Bluetooth module can be seen.

[1] Not a paper

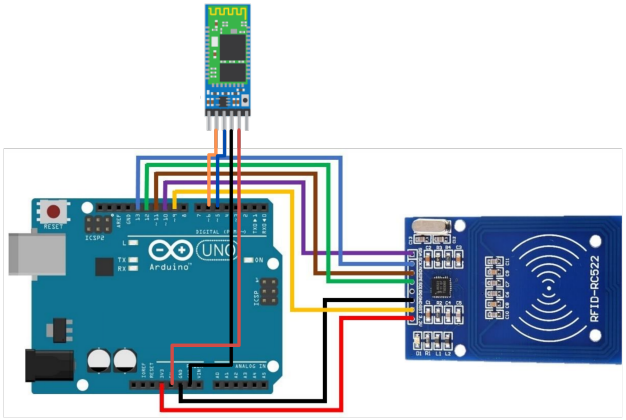


Figure 6.2: Arduino circuit diagram with RFID reader and Bluetooth module

6.3 Software

6.3.1 Arduino

The RFID tags were coded using an Arduino UNO. For this, the SPI.h and MFRC522.h libraries are used. These libraries already provide an example code, so adjusting to the needs of the game was not a big problem. The code used can be seen in Appendix D.

6.3.2 Application

The main game is played on the tablet it self. On the tablet the application is displayed. The application receives and sends data from and to the Bluetooth module. After receiving data from the Bluetooth module that an RFID tag is scanned, the application will open up the next screen.

6.4 Conclusion

In summary, five design choices were made. The first one being the pirate theme scavenger hunt, the second one being the 3:5 ratio aspect between interactive vs multiple choice questions. The third design choice is the arrows that lead the children to the interaction points. The forth design choice is how the interaction points are going to look like, which is shown in figure 7.2. And the fifth design choice is the general cartoon style throughout the whole product, including the application and the interaction points.

Next to those design choices, the prototype can be realised by combing both the hardware and the software as defined earlier in Chapter 5. The high-fi prototype consists of 9 RFID tags, 1 RFID reader, a bluetooth module and a tablet for the hardware. The software consists of an Arduino and it's code, and the application itself.

Chapter 7

Evaluation

After completing the high-fi prototype, it is being user tested during the evaluation phase. The user testing will be done to test the functionality of the prototype, to see whether a child learns better when it is done in an interactive way or not, and whether marketing techniques can be used to promote healthy food options. The user testing will be done in a supermarket environment. Finally, the results will be evaluated.

7.1 Method

Before the test is being conducted each parent/care taker of the participant will be informed about who the conductors of the user test are, why the test is being conducted and how it will be conducted. Following, the parent(s)/caretaker(s) will read the information brochure, see Appendix E. Then, the child will be asked whether they want to participate or not. If the child wants to participate, the parent(s)/caretaker(s) can sign and return a consent form, see Appendix E. After that, the testing can start. When the test is finished a small set of questions are asked. These questions can be found in Appendix G. Lastly, after the test a small debriefing is given. Since not all of the products can be taken into account in the game, a bias towards certain products can be caused. In the debriefing this is made sure to be clear towards the participant. This test was approved by the ethical committee with reference number RP 2021-115, see Appendix F.

7.1.1 Research questions

- What type of playful interactions do children show?
- To what extent do children learn about healthy food choices by using the interactive shopping cart?

- To what extent could cartoon help characters with promoting healthy food options?
- To what extent does the interactive shopping cart make children aware of healthy food choices?

7.1.2 Hypothesis

H1: What type of playful interactions do children show?
Since it is hard to predict what the participant will do, only several actions are listed down below. These actions are based on visible actions that could be tracked during the user test.

- Follows the arrows on the ground to the interaction points.
- Is able to scan the RFID tags well.
- Is able to interact with the touchscreen to answer the multiple choice questions.

H2: To what extent do children learn about healthy food choices by using the interactive shopping cart?
With learning it is meant that the child can recall some of or the full given information later when it is asked. Healthy food choices can differ per situation. The intention is that children will learn about why a certain food option is healthy in one situation and not healthy in the other. This is mainly done by using the same type of options in different situations. So in one case tuna can be healthy while in the other case it is not. The expectation is that children will learn a bit of new information about healthy food options by answering the questions or completing the tasks.

H3: To what extent could cartoon help characters with promoting healthy food options?
Cartoon character within the supermarket currently can be seen on most likely unhealthy food options. With this user test it is tested whether it can be used for healthy food options by placing cartoon characters at some of the interaction points. The expectation is that children will notice the cartoon character and that they will be positively influenced by them.

H4: To what extent does the interactive shopping cart make children aware of healthy food choices?
By learning new information about what healthy food options are and why they are healthy. And by using marketing strategies like the one mentioned in H3, awareness of healthy food choices can be made. Therefor, the expectation is that children will be more aware of what healthy food choices are after using the interactive shopping cart.

7.1.3 Participants

The user testing is done with children from the ages 5 to 8 who are doing grocery shopping with their parent(s) or caretaker(s). The grocery shopping of their parent(s)/caretaker(s) is not being disturb as the participants are retrieved by asking only to children who were already going to take a small shopping cart. Next to that, the system does not require extra energy to be able to use it apart from their usual groceries.

7.1.4 Material

The test will be done using the high-fi prototype. The high-fi prototype consists of

- the shopping cart with the tablet on it,
- the RFID reader next to the tablet with a picture of a die,
- a box where all the electronics go into in the shopping cart,
- 9 interaction points with each of them an RFID tag and a picture of a die,
- 5 cartoon characters at some of the interaction points,
- 20 printed arrows on the ground to lead the interaction points,
- clear tape to tape the arrows on the ground,
- 9 poles to attach the dice, cartoon characters and RFID tags,
- a wireless computer mouse.
- a notepad and a pen to take notes.

7.1.5 Evaluation design

The evaluation is done in two steps. First, the child is being observed from a safe distance while conducting the test. These observations are written down on an observation form. This form can be found in Appendix G. The observations mainly focus on

- enthusiasm of the child,
- listening skills towards the given portion explanation,
- ability to operate the touchscreen,
- ability to use the RFID tags,
- whether or not the child notices the cartoon figures and
- other.

The observation form is based on the Playful Experience (PLEX) framework [32]. The PLEX framework contains 22 categories. From these 22 categories 5 are used for this observation form. Those categories are Finishing a major task (Completion), Finding something new or unknown (Discovery), Investigating an object or situation (Exploration) and Excitement by stimulating senses (Sensation).

Finishing a major task is about the child being able to answer the questions or complete the tasks, but also about being able to use the RFID tag to go to the next question.

Finding something new or unknown in this case is the new shopping cart that the child will use. The shopping cart is a complete new environment for the child and they still need to discover how they should use it. Especially the RFID tag -and reader.

Investigating an object or situation have to do with engaging with the supermarket while trying to answer the question or complete the task. As the child looks around they try to look for the correct answer within the supermarket. The cartoon characters also help a lot with this as they often give away a tip for that question.

Excitement by stimulating senses is done by the different sound effects in the game. For example, when the child answers the question correctly a *pling* sound will occur indicating that the given answer is correct.

Second, after conducting the user test some substantive questions are asked to the child. Next to that, some questions about the high-fi prototype are also asked. The goal of these questions is to evaluate the user test, but also to see whether the child has learned something new or not. Alongside, some of the hypotheses will be tested here. The given answers, together with the observations will used to answer the evaluation research questions.

7.1.6 Test setup

The prototype will stand next to the other shopping carts, so that the prototype does not look too different from the other shopping carts. This way it is anticipated that children find it less of a big step to try out the prototype.

From the the supermarket gate entrance till each interaction point there are arrows printed and taped to the ground to lead the children towards the correct interaction point.

9 poles are distributed within the supermarket at the correct places. Each questions corresponds to a certain area or aisle within the supermarket. These nine interaction points are predefined by using a map of the supermarket. On this map, the route is being drawn of where all the interaction points need to be and how the children should walk towards each point. At 5 out of 9 interaction points there are cartoon characters corresponding to the questions. These cartoon characters can be seen in figure 7.1

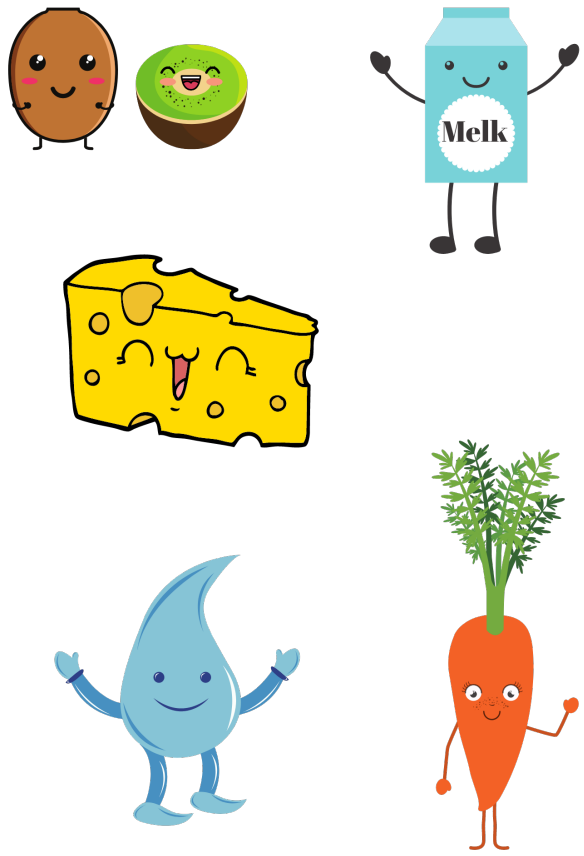


Figure 7.1: Cartoon characters used during high-fi prototype user testing

The child first has to chose a character in order to start the game. After the game is started some information will be given. Next, the child can follow the arrows distributed on the ground to the interaction points to answer the questions and complete the tasks and to the end point of the game. Questions 1, 7 and 8 are interactive questions. For these questions the child needs complete a task. The system will then let the child know whether it is correct or not. For question 1, for example, the child needs to show something to the camera. For this test, Wizard-of-Oz is used to decide whether the child answered correct or not [33]. The observer has a wireless mouse in their hand, when right clicked, the answer is correct, when done nothing, the answer is wrong. For the sake of testing the child's reaction and the game itself, the questions 1, 7 and 8 were all correct for all children. When the child reaches the end point they can follow their parent(s)/caretaker(s) with the groceries. Finally, at the exit of the supermarket the evaluation questions will be asked.

An overview of the setup can be seen in figure 7.2.

Figure 7.2: An overview of the high-fi prototype test setup

7.2 Results

The results of each user test is being discussed here. A small overview of the taken notes can be found in Appendix G. Every user test will first be evaluated independently and summarised later on.

7.2.1 User test 1

Observations

The first user test was done immediately after setting up the test setup. Therefore, it was not pretested yet and the prototype still contained some small errors, which were only discovered during the testing. The participants of this test were two children of 7 and 8 and their mom. Both of the children were asked to participate and both of the children agreed. The children were both very excited to play the game. The first question is a question in which they have to complete a certain task. In this case, show something to the camera. This was a bit confusing for them since the camera of the tablet was not a very obvious option for them, so a little help was provided for this question.

The game contains several explanations about the game and about food. Both of the children seemed to listened very well to the information given. However, the introduction to question 2 seemed a bit too long for them. The children were very familiar with the touchscreen and therefore, answering the multiple choice questions was not that difficult. But they did need some help

with scanning the RFID tags at first. After showing how the tag works the children were able to use it themselves for the next interaction points. Both the older child and the younger child were very dependent on their mom when it came to answering the questions. Even though they could understand the question they still asked almost every question to their mom. The mom tried to lead them to the correct answer without giving away too much information.

Questions

There were in total 6 questions asked. Questions 1, 2, 4 and 6 were answered by both of the children and questions 3 and 5 were answered only by the older child. Both of the children find the game fun to play, since they could look for the interaction points. The 7 year old indicated that they found the questions hard to answer, as they did not know the answers. The 8 year old found some of the questions hard to answer. When asked about whether they could explain what a portion is after they heard an explanation only the 8 year old could tell a little bit about what a portion is. This indicates that all though both of them seemed to listen very well, only one of them could recall a small bit of the given information.

They both noticed the cartoon characters at the interaction points. The route of the game is in such a way planned that the question theme corresponds to the aisle or area of the supermarket. The 8 year old indicated that they liked this part of the game, since otherwise they would have to walk from aisle to aisle with every question. Instead, now the questions are asked at the corresponding aisles. Lastly, both of the children indicated that they liked the ABC questions more. Meaning, the questions in which they have to answer by clicking on the A, B or C button.

7.2.2 User test 2

Observations

The second user test is done with a 5.5 year old child and their mom. The second test was a bit better prepared, since small bugs from the previous test were taken out and fixed, and a round of pretesting was done between the first -and second user test. This test was very interesting since the child was noticeably more active than the children from the previous test. Just like the other two children, this child was also very excited to play the game. However, the child did not listen very well to the given information at the beginning neither to the information about food itself. They had a lot of energy and did not like to stand still to listen to the story or any other information.

Comparable to the previous user test, they also knew right away how to answer the ABC questions (touchscreen questions). In contrary to the previous test, they did know how to use the RFID tags without any help. But, following the arrows on the ground seemed a bit too difficult for them, since they did not notice them at first. After the mom gave some instructions they were able to

follow the arrows. They did not seem to notice any of the cartoon characters when passing them by. To make the game a bit more interesting, one of the questions was directed towards unhealthy food options. When that questions appeared the child went to the chips aisle, since one of the answers was chips. They then grabbed a bag of chips and insisted to their mom to buy the chips and put it in their shopping cart. After a little discussing with their mom, the child put the chips back in the aisle.

Questions

As the child was very active and did not like to stand still, answering questions did not seem like his favourite thing to do. Therefore, it was quite hard to still get some useful information. They did find the game fun to play, especially the part where they have to find the next interaction point. They did not find it hard to play. As it was expected from the observations, the child could not recall any of the information given during the portion explanation. The child did also not notice any of the cartoon figures. The fact that the questions were asked at the corresponding aisles or areas was a positive factor for the child. They mentioned that it made the game fun to play. Finally, the child indicated that the interactive questions were more fun than the ABC questions.

7.2.3 User test 3

Observations

User test 3 was done with two children of the ages 6 and 7 and their mom. Yet again, the children were noticeably enthusiastic about the game. This was the first time that one of the children noticed the arrows on the map on the background of the application. This caused a bit of confusion in the beginning as the arrows on the application did not match the route that they had to follow in the supermarket. Starting the game, the children were both very patience with the first two explanations about the game itself. However, the explanation about what a portion is was too long for them and after some time they could not follow it anymore. Just like the previous participant these children were also good in using the touchscreen and the RFID tags. They did not seem to notice the cartoon characters as they did not show any reaction when passing by a cartoon character. Next to that, they did not see two of the arrows, which almost led to overseeing an interaction point.

Questions

Remarkably, like the previous participants, both of the children liked the game, because they could look for the interaction points. Neither of them had difficulties understanding the game. Nonetheless, it seemed like the children were paying a bit of attention to the portion explanation, neither of them could recall anything about the information given. Even though it did not seem like the

children noticed any of the cartoon characters, when asked they could sum up almost all of them. They even mentioned that the cartoon characters helped them with answering some of the questions. Recalling some of the questions and answers was then also not that hard for them.

Another thing that helped them with answering the questions was the fact that the questions were at the corresponding aisles or areas. The children mentioned that it helped them with guessing the correct answer by looking around. At last, both of the children hesitated about which type of questions they like the most, but went with the more interactive one as their favourite.

7.2.4 User test 4

Observations

The last user test was done with a 7 year old child and their mom. Just like the others the child seemed to be very enthusiastic about the game. From the start of the game up to and including the last explanation the child seemed to listen very well to the explanations. They even went closer to the sound output to be able to hear it better, while it was clearly hearable even as an observer from a distance. The child was able to use the touchscreen to answer the ABC questions and they were also able to use the tags in the correct way. The child could follow the arrows very well and had no problems with this.

While standing at the interaction points, the child seemed to notice the cartoon characters. They were even so sure of their answer being correct, because they mentioned that the milk carton cartoon character would not be there without a reason. And as answer to the corresponding question they clicked on Milk.

Questions

During the last user test some additional questions popped up in mind. These questions were asked after the standard six questions. Those additional questions are supporting questions for the questions asked during the low-fi prototype testing. This child, in contrary to all the other children, liked the scanning of the tags the most of the game. They sometimes find the questions a bit hard to answer. Although the child seemed to listen very carefully to the portion explanation, they could not recall any of the information given.

When asked about the cartoon characters the child could recall the characters and the corresponding questions and answers. The child also mentioned that it was easier to answer the questions because they could look around for some inspiration, since the questions were asked at the corresponding aisles or areas. Finally, the child like the more interactive questions where they had to complete a task more than the ABC questions. The additional two questions were questions about whether they liked the theme or not and whether it was annoying to give incorrect answers. The child liked the theme a lot and did not find it annoying to give incorrect answers.

Overall observations

Some of the observations were done with (almost) every user test. For example, the X on the map, which was meant to be there as just a background seemed very confusing for the children. The children though it was something to click on, while it was not. This may be because it was on the upper right corner of the screen. Secondly, there was initially right answer given when a question is answered incorrectly. This was not helpful in terms of learning new stuff. Therefor, after the second user test, the correct answers were mentioned by the observer if the child had answered the question wrong. The final overall observation is that it was not clear enough for the children what to do after they had given an answer. The observer needed to tell them to go to the next point for about 2 or 3 questions long with every user test.

7.3 Discussion Evaluation

In order to conclude the user testing, the following research questions will be answered in the discussion. And the related hypotheses will be looked at.

- What type of playful interactions do children show?
- To what extent do children learn about healthy food choices by using the interactive shopping cart?
- To what extent could cartoon characters help with promoting healthy food options?
- To what extent does the interactive shopping cart make children aware of healthy food choices?

H1: What type of playful interactions do children show?

All of the children showed some type of playful interaction. Nevertheless, what they all showed was Investigating an object or situation (Exploration). All of the children discovered how to use the shopping cart and the RFID tags. Even though some of them figured out how to use the RFID tag right away, and some of them needed a bit of extra help, all of them tried and explored on their own. Next to that, all of the children looked for the interaction points, which corresponds to Finding something new or unknown (Discovery). Sometimes by following the arrows and sometimes on their own, when the next point was nearby.

Some of the children got really excited when they had answered a question correctly. This is a playful interaction that belongs to Excitement by stimulating senses (Sensation) as the feedback provided by sound stimulated this feeling. And some of the children did not want to walk around with the shopping cart anymore after completing the game, this corresponds to Finishing a major task (Completion), as they did not want to proceed after completing the game.

The hypothesis was that the children would show three visible playful interactions. Namely, follows the arrows on the ground to the interaction points, is able to scan the RFID tags well and is able to interact with the touchscreen to answer the multiple choice questions. From the answer given above it can be concluded that the hypothesis is met and therefore the hypothesis will not be rejected.

H2: To what extent do children learn about healthy food choices by using the interactive shopping cart?

For this research question the main focus was on active versus passive learning. As mentioned by [15] and [17] children learn better when it is done in an interactive manner. The goal of this research question is to test whether this applies to the participants of this high-fi user test. Within the test there were several learning points. Some of those points were passive, such as the information given about what a portion is. And some of them were active, such as the questions at the interaction points, whether it be ABC type of questions or interactive questions with the supermarket.

As seen in the results, almost non of the children could recall anything from the passive learning points. However, some of the children could recall quite some information about the questions. Therefor, the interactive shopping cart could be a helpful tool to teach children about healthy food options when the whole experience is done in an interactive manner. With that reason, the hypothesis is met, since the hypothesis mentions that the children will learn a bit of new information about healthy food options. So, the hypothesis will not be rejected.

H3: To what extent could cartoon characters help with promoting healthy food options?

During the user tests there were 5 cartoon characters at the interaction points. This was done to check whether questions with a cartoon character leave a bigger impact on the children than without or not. During the testing itself it did most of the time not seem like the children noticed the cartoon characters. Almost none of them gave a reaction or responded to the cartoon characters after seeing them.

However, during the evaluation with questions after the prototype testing, some of the children mentioned that they did see some characters. They were even able to describe the characters. Not only could they describe the characters, they could also mention what the questions were about. While the other questions without a cartoon character did not seem to stick with them as much. For that reason, using cartoon characters to promote healthy food options could be helpful, even though it may not seem like it at first glance. Meaning, the hypothesis will not be rejected, as almost all of the children noticed the cartoon characters and were positively influenced by them.

H4: To what extent does the interactive shopping cart make children aware of healthy food choices?

Making children aware of healthy food choices would mean that they would get an inside to what healthy food can be and what options there are out there. Something could be healthy in one situation but less healthy in the other. The interactive shopping cart provides a game with questions and explanations showing why certain food can be healthy at one point and less healthy at an other point. It also teaches children a lot about food that they might have not known before using the shopping cart.

The interactive shopping cart is an experience that should be carried out as a whole. Meaning, it should include the applications, the interaction points, the scavenger hunt theme, the cartoon characters spread out at the interaction points and the questions should partly be interactive with the supermarket and partly on the tablet. When all of this is combined, the interactive shopping cart could make children aware of healthy food choices. Although, the more the child would use this shopping cart the more information the child would gain after using it, the more aware the child could get.

Therefor, using it once, just like the user test, might not be enough to create enough awareness to the child to bring the child into action. So, for example, advising their parent(s)/caretaker(s) to buy or not to buy a certain product. That is also why it is important to keep the application replayable for the children. In that way, they would like to use the interactive shopping cart more than just once or twice. In conclusion, the interactive shopping cart could make children aware of what healthy food is, however, maybe not after one time use. With that, the hypothesis that children will be more aware of what healthy food choices are after using the interactive shopping cart will be rejected. Since it does not meet the expectations after using the shopping cart once. This could change after using the interactive shopping cart more than once or twice per user.

7.4 Remarks

There were also elements that were not taken into account when answering the research questions, but are still relevant to mention. First of all, the first question of the game was in general quite hard for the children to understand what to do. The children most of the time did not understand in one go where the camera is and how the system then would know whether it is correct or not. This could be helped by making the camera and the question more obvious.

Second of all, the X on the map was placed in the wrong place. Currently it is on the upper right corner, where typically an exit button can be found. This caused confusion at almost all of the participants. Changing the position of the X could help preventing this confusion.

Third of all, just like the X on the map, the arrows were also misplaced. At the moment, the arrows have a clear path towards the X. This also cause con-

fusion for some of the participants. They thought that the arrows corresponded to the direction that they need to go into. But, in real life those arrows were there as just a background. Changing the arrows into stripes, or making them go more random could solve the problem.

What was also not taken into account when designing the user test were two other PLEX frameworks, namely Forgetting one's surroundings (Captivation) and Sharing emotional feelings (Sympathy) . Some of the children really seemed like they forgot that they were grocery shopping and only focused on answering the questions or interacting with the supermarket itself, which belongs to Captivation. And some of the children involved their parent by asking for help with answering the questions or scanning the RFID tags, which belongs to Sympathy.

7.5 Conclusion

To conclude, the high-fi prototype is user tested within the supermarket. With this test, there were four research questions to be answered and next to that, four hypotheses were made. The hypotheses 1, 2 and 3 were met and therefore, not rejected. However, hypothesis 4 was not met and consequently, rejected. The participants in the user test were children from the ages 5 to 8 doing grocery shopping with their parent(s)/caretaker(s). The parent(s)/caretaker(s) were ask to read and sign the consent form. After the form was signed, the children could use the interactive shopping cart. The observations were made using an observation form. Then, the children were asked several questions to evaluate the interactive shopping cart after using it. And lastly, some final remarks are made which were not taken into account in earlier stages. In the next chapter an overall conclusion of the evaluation and an answer to the main research question and the sub questions will be given.

Chapter 8

Discussion

In this chapter some additional findings will be discussed. After that the limitations of the research will be mentioned. Lastly, some recommendations will be given of what could be kept in the research if conducted an other time.

8.1 Findings

The first finding is that children show way more playful interactions when using the interactive shopping cart than expected. When forming the hypotheses, the emotional interaction and captivation were not taken into account. Children seem to forget their surroundings more easily than expected and share their emotions, feelings and experiences with their parent(s)/caretaker(s) more than expected. Other than that, as expected, children are very enthusiastic when using the shopping cart. But, interestingly enough, none of them went crazy with the shopping cart going from there to there. All of them followed the arrows very well and did not take another path than drawn for them. This shows that children are able to focus on what they are doing while being very enthusiastic and walk a certain route even though they could choose not to.

The second finding is that children take in a lot of information without them noticing it. When for example asked about the cartoon characters they first think that they did not see any cartoon character, but when asked further they can even tell about the question itself and the answer they gave. Apart from that, children also seem easily influenceable. Almost all of the questions were about healthy food options, apart from one. At first, it seemed like the children do not care much about the type of questions (healthy vs unhealthy). But when one of the children insisted on buying the unhealthy option, it became clear that children are most definitely influenced by the questions.

The third finding is that children can recall information better when the information is given in an active manner. Meaning, when children simply have to listen or read a bit of text, the information does not stick with them that long, and maybe not at all. Rather, when the information is given in a form of

a quiz or assignment the children could recall the information a lot better. This finding supports the findings of Papavlasopoulou et al. as well, as they mention that "knowledge is better gained when children are deeply and actively involved in building their own meaningful constructions." [17]. Next to that, the answers given by the children during the evaluation confirms that they like the more interactive questions more than the multiple choice questions. As almost all of them mentioned that they find the more interactive questions more fun.

The last finding is that the marketing technique of brand characters can help with making children conscious about what healthy food options are. Almost all of the children were later be able to recall which characters there were and where they were standing. Not only that, but some of the children could even tell what that specific question corresponding to that cartoon character was about. And some of them could even tell something about their answers they had given or something that they learned during that question.

8.2 Limitations

When choosing the correct program to build the application with, initially Processing was chosen. However, after using this program for about three weeks and not a lot of progress, Unity was chosen as second option. After starting to build the whole application with Unity, it only took 1.5 weeks to finish. Meaning, a lot of time could have been saved if the correct knowledge about the different programs was there. Due to those time constraints, a part of the high-fi prototype needed to be Wizard-of-Ozed. This made the testing sometimes less smooth then expected. The wireless mouse used for the Wizard-of-Oz did not always work that well, which caused longer waiting time for sending any feedback to the user. An other consequence of time constraint is that the whole study is conducted as a short-term study. This lead to some question marks still not being answered within the study. Some of these question marks will be discussed in Chapter 10 Future work.

The tests were conducted with children, therefor not only the child needed to agree to conduct the test, but also their parent(s)/caretaker(s). This led to situations in which the child seemed to want it, but the parent not or the other way around. Which made it more difficult sometimes to persuade both parties. Next to that, the tests were conducted in the supermarket during the week from 10.30 till 16.30. Since it was not a lab or other testing environment, people were most of the time busy with their daily lives. This also made it harder to reach to people to ask whether they would like to participate in the test or not.

Setting up the test set up took longer than expected. The expected time to set up the user test was one hour, but in reality it took almost 2 hours. This caused to start the user testing later than expected as well. Which was unfortunate as most children and their parent(s)/caretaker(s) come early in the morning to the supermarket rather than later in the morning. Because of that, only four rounds of tests could be conducted. Other than that, there were also children coming in with their parent(s)/caretaker(s) while one test was going

on. What could have helped was if there was a second or third shopping cart with the application on it and more observers so that several tests at the same time could be held.

8.3 Recommendations

Some recommendations could be made based on the user testing as they were very effective or preferred by the children during user testing.

8.3.1 Theme

The theme was very much liked by the participants of the low-fi and- high-fi prototype testing. Therefor, keeping the theme is highly recommended. The theme also matches some of the questions very well which makes it a more coherent experience.

8.3.2 Interaction points

The interaction points were definitely one of the most favourable parts of the experience. Almost all of the children indicated that the interaction part was the most fun. Apart from that, the interaction points are the main interaction that the shopping cart has. These interactions stimulate the learning process of children and should be therefor kept within the game.

8.3.3 ABC buttons

The multiple choice questions in which the children only need to press a button on the screen make it possible to keep the attention of the children. When the user clicks on an answer and the answer is incorrect, the user does not have an other opportunity to try again. It is recommended to keep it that way so that the user can not spam till they get the correct answer, but rather learn from their mistakes and move on to the next question.

8.4 Improvements

8.4.1 RFID reader -and tags

The first improvement that can be made is the RFID reader -and tags. At the moment, both the reader and the tags are visible. The reader is even made sure to be matching with the interaction points. But it would be better if both of them would be less to invisible. The child now has to take a few steps in order to be able to go to the next question. First, the child needs to go to the interaction point, then grab the RFID tag, bring it to the reader next to the tablet, hold it against the reader and let go.

This can be improved by implementing a suggestion made by Niek Leussink, one of the CEOs of Jumbo Leussink and at the same time stakeholder of the research. Instead of using a pole with all the interactions attached to it a small portal can be made where the child simply has to go through in order to see the next question. The technicalities will remain the same. So the shopping cart will still have an RFID reader and the portal will have one or more RFID tags, but it will be less visible and the child would only have to proceed one step instead of five as it is now.

8.4.2 Design of the application

The second improvement would be within the design of the application itself. Right now there are some design choices made that are a bit confusing towards the user. These design choices include the map on the background with the arrows and the X. The placement of these could be different to avoid those confusions. Besides, the application allows the user to choose between a boy pirate and a girl pirate. This does give some options for the user to play the game with, nevertheless it would be nicer if the user would be able to chose from a set of characters. This would give the game a more inclusive feeling.

8.4.3 Explanation storyline

The third improvement that could be made is within the different types of explanation and the storyline. Those bits of text were placed in the application to test one of the hypotheses with the expectation that it would be too long for children to listen to. These expectations were met, the bits of text were indeed too long for the children to keep their attention at the game. That is why, for the next time both the explanations and the storyline could be displayed as an animation or at least with some graphics so that children will find it less boring to listen to. But also, so that it sticks more with them even after completing the groceries. This way, the explanation part would also be part of the interactive learning part which could help with making children more aware of what healthy food choices are.

8.4.4 Ratio interactive versus multiple choice

The forth improvement lies within the ratio of the interactive questions versus the multiple choice questions. At this moment, the ratio of interactive versus multiple choice is 3:5. This is done so that children have something interactive within the game, but not too many. Yet, during the evaluation it came to light that children prefer the interactive questions more than the multiple choice questions where they only need to click on the correct answer. Thence, the ratio could be increased to a ratio of 1:1. Since the attention spam of children is not too big, not all of the question can be interactive. Thus, with a ratio of 1:1 children would keep their attention throughout the whole game and the game would not be too monotonous.

8.4.5 Feedback answers

The fifth improvement is about the feedback that the user receives after answering a question. As for now, the application makes either a *pling* sound when the answer is correct or a *buz* sound when the answer is incorrect. What could be added toe that is a green screen with a bit of text indicating that the answer is correct when it is correct or a red screen whit a bit of text indicating that it is incorrect when it is incorrect. When the given answer is incorrect the system stays like that till the user goes to the next interaction point. Because of this, most of the children did not know what to do next.

So, another improvement to the feedback could be a screen with text and voice over indicating that the user needs to go to the next interaction point. Lastly, when the user gives a wrong answer the correct answer is not given. This is a major mistake that is overseen when making the prototype. As the feedback for giving the correct answer would help teaching children about healthy food choices more than just indicating that the given answer is wrong.

8.4.6 Only healthy food choices

The last improvement is regarding the type of questions. To keep the game interesting some of the questions were about unhealthy food options. But, during the user testing it appeared that children really get affected by those questions as after seeing the unhealthy food option questions one of the children tried to convince their parent to buy one of the options. So by keeping all the questions about healthy food options, this could be prevented.

8.4.7 Timer

The timer could be implemented throughout the whole game. As for now, the game only has a timer for the interactive questions. But adding a timer to the whole game would give a new game element. The child could, for example, try to beat their own time record, or penalty points could be given when it takes the child too long to answer. Just like these examples, a couple more implementations could be realised to make the game a bit more exciting.

Chapter 9

Conclusion

The aim of this research was to answer the main research question:

How can interactive technology be used to make children in the supermarket aware of healthy food choices, with technology relating to marketing?

And the sub questions:

- How can food choices, made by children in the supermarket, be made conscious, so that healthy options are preferred?
- To what extent does an interactive experience realised with technology, e.g. e-beacons, RFID tags and touchscreens, help in educating children on healthy food?

These two sub questions will help answering the main question. The first sub question "How can food choices made by children in the supermarket, be made conscious, so that healthy options are preferred?" is partly answered in Chapter 2.3 Conclusion. The overall answer to the question is that by using interactive technology, such as tablets and RFID tags, children can be taught in an interactive manner which leads to a higher chance of information recall ability. The second part of the answer lies within the marketing strategy used in the user test. By placing cartoon characters related to healthy food at certain points, children were able to recall those questions better than other questions without cartoon characters. So, the food choices made by children in the supermarket can be made conscious so that healthy options are preferred, by combining the interactive technologies and the marketing technique used in the high-fi prototype. However, only in the long run, as using the interactive shopping cart once or twice will not be enough to create a conscious decision making.

The second sub question "To what extent does an interactive experience realised with technology,e.g. e-beacons, RFID tags and touchscreens, help in educating children on healthy food?" is answered during the evaluation of the user testing. It can be concluded that an interactive experience realised with

technology, in this case RFID tags, a tablet and a game application, can help children with recalling new information. But, not with every single detail, at least not after one time use.

To be able to answer the main question, a prototype is made based on literature research and lo-fi prototyping. This prototype needed to be interactive with and within the supermarket. The prototype is then being user tested in a supermarket environment and was based around playful interactions that children show, to what extend children learn about healthy food choices, whether cartoon characters can be used in promoting healthy food options and testing whether the interactive shopping cart make children aware of healthy food choices.

The interactive technology used for this prototype consists of three elements. A shopping cart with a tablet, containing the application with the questions and tasks in a pirate theme. An RFID reader with a die to correspond to the interaction points. And interaction points with dice and RFID tags. From the evaluation it can be concluded that, the interactive technology used for this prototype did make children excited to use the shopping cart. It can also be concluded that the game can be played more than once without it becoming too repetitive. Therefore, the interactive technology used for this interactive shopping cart could be implemented to make children aware of healthy food choices.

The marketing technique used in this prototype consists of 5 cartoon characters distributed within the supermarket. These cartoon characters corresponded to the questions so that specific questions could be asked during the evaluation after testing. From the evaluation it can be concluded that, the cartoon characters did leave some impact at the children, even though it did not seem like they even noticed it during user testing.

The children who mentioned that they did notice the characters were also be able to recall what the question was about. During the testing itself some of the children mentioned that the answer should be corresponding to the cartoon character, which also indicates that the cartoon character has some impact on them. However, it can not be concluded that the children could recall the information purely because of the cartoon characters. That is why, more testing needs to be done to be able to be sure.

The last aspect is about passive versus active learning. During the testing some of the information was given in passive form and some of the information was given in active form. During the evaluation it came clearly to light that children do not pick much information from the passive learning part, while they did pick some information from the active learning part. This could indicate that children do learn better when it is done actively rather than passively.

In conclusion, interactive technology, such as RFID tags and a game application, can be used in a supermarket environment. The already existing marketing techniques used for unhealthy food promotions could be used for healthy food promotions. And children could be made aware of what healthy food options are in a long term, when using an interactive shopping cart, combined with the brand character marketing technique, within the supermarket.

Chapter 10

Future work

This chapter will talk about some things that could be done or considered for future works.

10.1 Long-term study

Due to time constraints the study was conducted in a short-term. The user testing is done in only one day. But, if the user testing was done throughout multiple days, then it could be looked at other factors such as, whether gender, age, wealth and other demographics would make a difference in how they use the cart, but also how much they learn etc. Next to this question mark, some other question marks arose. One of those question marks is, whether using the interactive shopping cart more than twice will really create some awareness among children or not. An other question mark is, whether those children who used the shopping cart will be any different in lifestyle, when they grow up, than children who did not use the shopping cart. These question marks could be answered with a long-term study in which the interactive shopping carts would be used and monitored daily. The data from the usage, but also the users could give an answer to those questions.

10.2 Technology

During this study, only a few sets of different technology is used. For future works, it could be interesting to look at whether different type of technology would lead to different results. The RFID tags, for example, could be substituted by an AR (Artificial Reality) system. Children can then use a device and it's camera to try to find the interaction points. Or maybe even make the interaction points a whole AR system. So in real life only a QR code can be seen, but on the device a whole interaction point can be seen. Just like this, a lot more can be discovered to see other technologies are a possibility or not.

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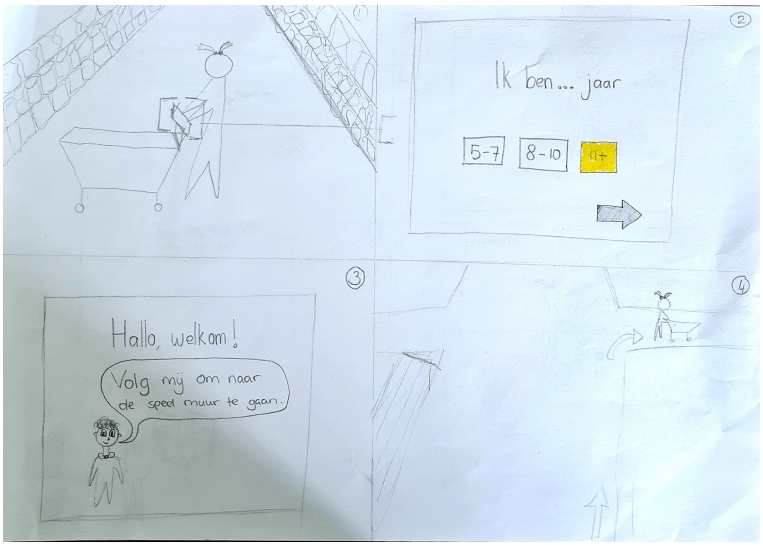
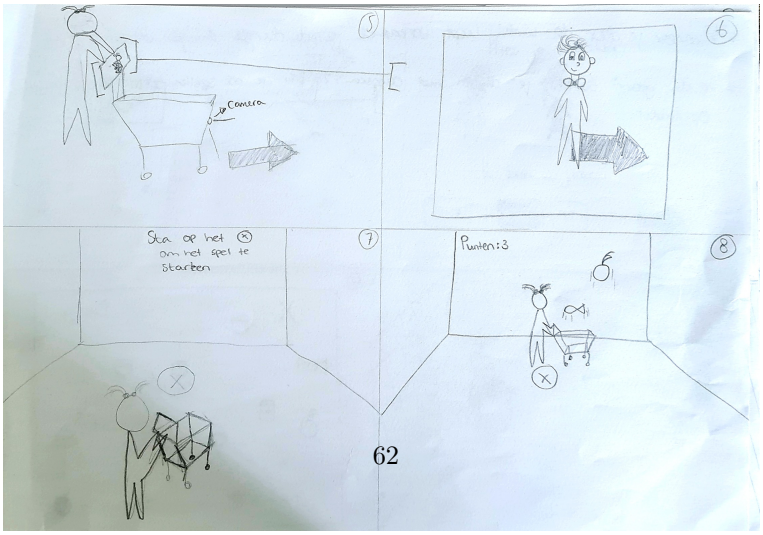
Appendix A

Appendix A: Storyboards



(a) Page 1



(b) Page 2

Figure A.1: Storyboard 1

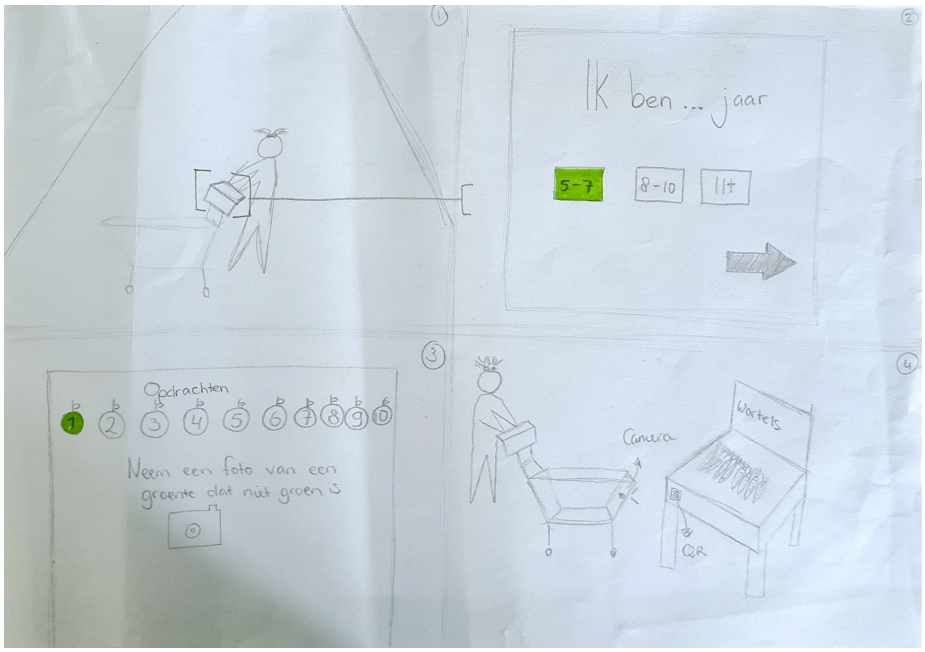


Figure A.2: Storyboard 2

Questions:

1) Which of the three storyboards did you like the most and why?
2) If the supermarket would display this game, would you come again to play it?
3) Per chosen storyboard, what did you like the most?

Participant 1:

1) The pirate game, because you have to find something. It feels like a challenge. Looking for stuff is fun.
2) Yes, I would play this again.
3) That you have to do different exercises.

Participant 2:

1) The catch game, because it seems fun to catch things.
2) Yes, I would play this again.
3) That you can catch things.

Participant 3:

1) The pirate game, because you have assignments that you can complete. I like the map and the pirates and stuff.
2) Yes, it would be fun.
3) The assignments.

Appendix B

Appendix B: Game specification

Opdracht 1

1) Zoek een groente die niet groen is en laat het zien aan de camera aan de voorkant van het karretje.
2) Aan welke groente of fruit moet je denken als je denkt aan een aap? Laat het zien aan de camera aan de voorkant van het karretje.
3) Wist je dat komkommers bijna alleen uit water bestaan? Welke groente of fruit is nog meer zo sappig? Laat het zien aan de camera aan de voorkant van het karretje.
4) Welke groente of fruit heeft zaadjes er in? Laat het zien aan de camera aan de voorkant van het karretje.
5) Met welke groente kan je soep maken? Laat het zien aan de camera aan de voorkant van het karretje.

Portie uitleg:

Wanneer we iets willen eten of drinken eten of drinken we niet het hele pakje of verpakking. Denk maar aan brood. Vaak eten we alleen een paar sneetjes en niet het hele brood in één keer. Dat noem je een portie. En een portie brood is niet even groot en zwaar als bijvoorbeeld een portie groente. Wanneer je nog een kind bent eet je minder dan een volwassenen. Dus jouw portie is kleiner dan die van mama of papa. Wanneer je straks de vragen beantwoord, denk dan goed aan de porties en niet het hele product.

Opdracht 2

Vitaminen en mineralen zijn nodig om je lichaam gezond te houden. Zo krijg je bijvoorbeeld vitamine D van de zon, maar de meeste vitamine kan je vinden in je eten.

1) Oh oooo van al dat reizen op zee komen we vitamine C te kort. Als het zo door gaat kunnen we zelfs scheurbuik krijgen. Dat is een ziekte waar je heel veel buikpijn van krijgt en je tanden zelfs er uit kunnen vallen.
   Klik snel het product aan met de meeste vitamine C
   a. Sinaasappel
   b. Multivitamine
   c. Kiwi
   Uitleg goed antwoord:
   Sinaasappel heeft 60mg/100mL
   Multivitamine heeft 12.0mg/mL
   Kiwi heeft 79mg/mL
2) Om ook in het donker goed te kunnen zien heeft je lichaam vitamine A nodig. Dit kan je lichaam maken met de hulp van een stofje dat bètacaroteen heet. Dat zit meestal in oranje producten. Loop naar het product dat zorgt voor de meeste vitamine A en laat het zien aan de camera.
   a. **Wortels**
   b. Boerenkool
   c. Spinazie

   Uitlet antwoord:
   Wortels: 8332 µg betacaroteen = 694.3 µg vit. A
   Boerenkool: 8172 µg = 681 µg vit. A
   Spinazie: 6288 µg = 524 µg vit. A

3) Kalium is een mineraal dat onder andere je lichaam helpt met het behouden van sterke spieren. Je kan Kalium in heel veel producten vinden en zo ook in groenten en fruit. Laat aan de camera zien welke groente of fruit jij denkt het meeste kalium heeft.
    a. Broccoli
    b. **Banaan**
    c. Aardappel

    Uitleg antwoord:
    1 opscheplepel gekookte broccoli (50 gram)= 200 mg Kalium
    1 kleine banaan (100 gram)= 374 mg Kalium
    1 middelgrote aardappel (70 gram)= 240 mg Kalium

Opdracht 3
Vetten en oliën kunnen heel goed voor je zijn.

1) Zoals die van een vis. Dus tijd om te vissen. Vind de vis met het meeste vet. Laat het zien aan de camera
    a. Zalm
    a. Tonijn
    b. Kabeljauw
        i. Uitleg goed antwoord:
        Zalm heeft meer dan 5% vet en tonijn en Kabeljauw minder. Vis vet helpt je beschermen tegen hart- en vaatziekten
2) Zoals die van een vis of een avocado. Maar niet alle vetten zijn goed voor je bijvoorbeel die van kaas. In welke plakje kaas zit het meeste vet? Laat het zien aan de camera.
    a. Jong belegen 48+
    b. Oude kaas 48+
    c. Feta kaas
3) Er zijn ook vetten die minder goed voor je zijn. Hier onder zie je drie opties. Twee daarvan bevatten goede vetten en eentje niet. Weet jij welk product dat is? Loop naar het product en laat het zien aan de camera.
    a. Kaas
    b. Vis
    c. Avocado

    Kapitein roodbaard komt in beeld “Haha ik ben kapitein roodbaard en ik daag je uit tot een duel. Wie wint mag alle munten(punten die gescoord zijn tijdens de opdrachten) behouden.”

Opdracht 4
Om Kapitein Roodbaard te verslaan heb je ook meer energie nodig. Loop naar het product waarvan jij denkt dat je het meeste energie gaat geven.

a. Liga Milkbreak
b. Fruitreep
c. Havermoutreep

a. Ontbijtkoek

b. M&M's Pinda chocolade
c. Liga Milkbreak

a. Havermoutreep
b. Ontbijtkoek
c. Liga Milkbreak

Opdracht 5

Nu je meer energie hebt kan je ook groot en sterk worden. Hiervoor hebben we eiwitten nodig. Weet jij in welk product het meeste eiwit zit? Klik het juiste antwoord aan.

1)
a. Magere kwark
b. Tonijn
c. Melk

2) .
a. Gekookt ei
b. Kipfilet
c. Amandelen

3) .
a. Kaas
b. Tonijn
c. Gekookt ei

Opdracht 6

Loop naar het product dat zorgt voor sterke botten en tanden.

a. Vla
b. Melk
c. Chocolademelk

a. Drinkyoghurt
b. Vla
c. Chocolademelk

Opdracht 7

Zout zit bijna in alles, zelfs waar je het niet verwacht. Loop naar het product waar het meeste zout in zit.

1) .
a. Chips
b. **Pizza**
c. Unox soep

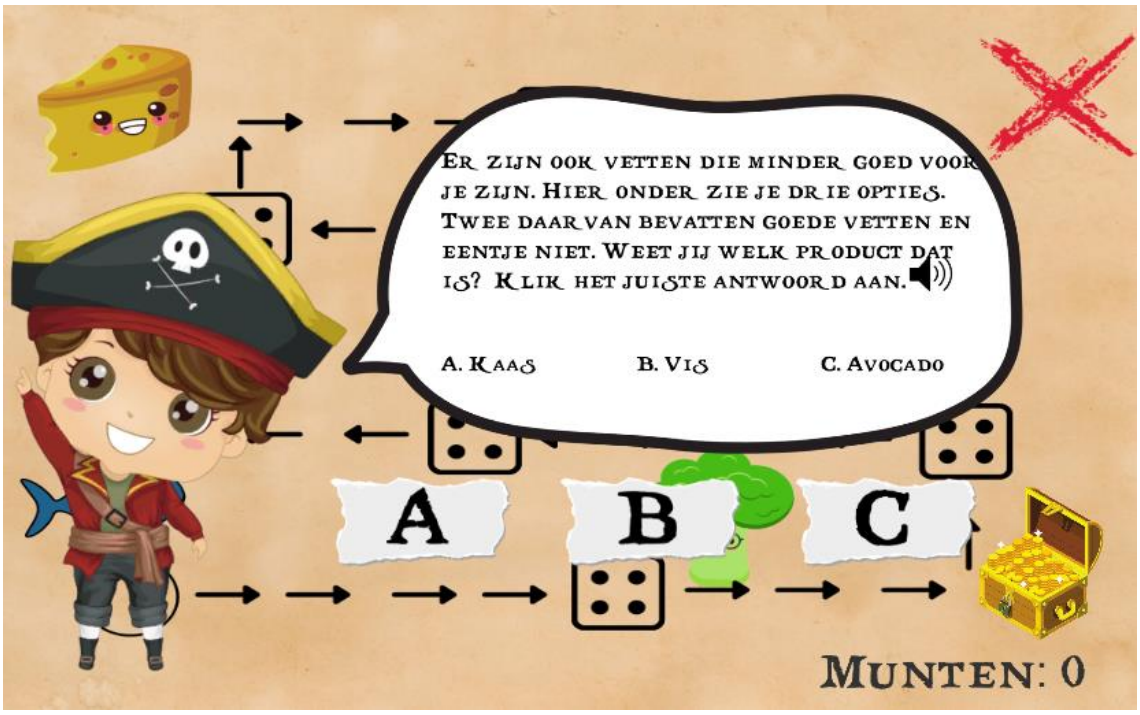
a. Yum yum noedels
b. Kroepoek

c. Unox soep

a. Chips
b. Yum Yum noedels
c. Kaassaus

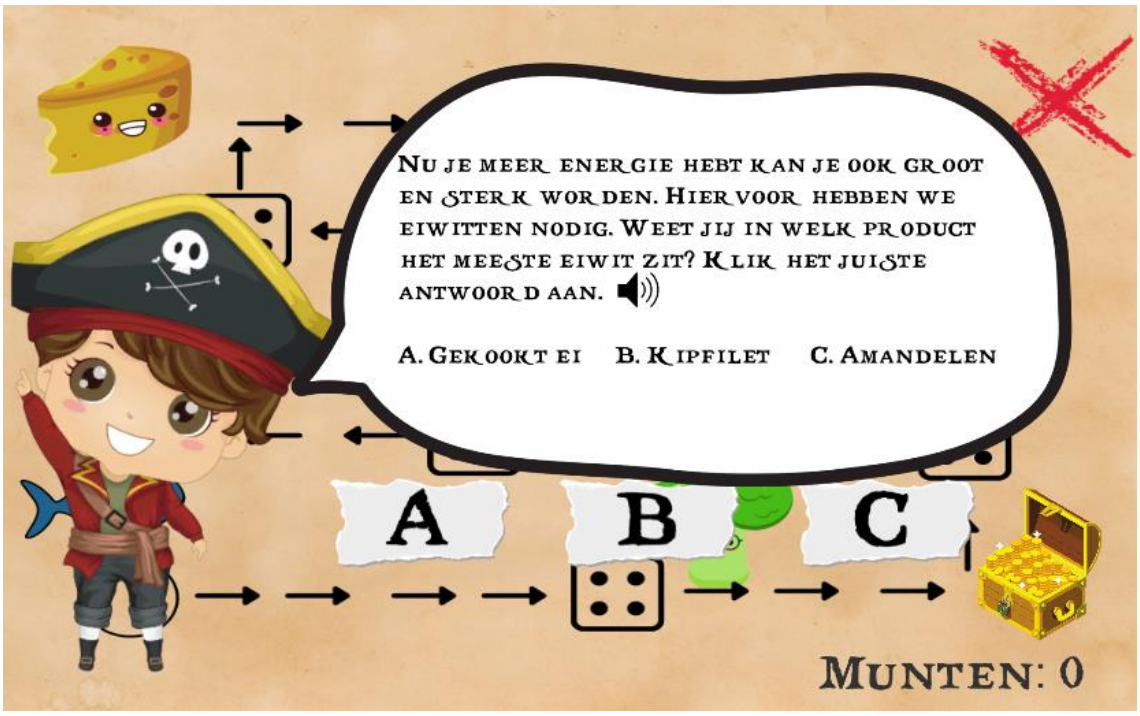
Opdracht 8

Je hebt net kapitein roodbaard verslagen en hebt heel veel dorst van al het strijden en al het zout van net. Loop naar de rij met drinken en maak een foto van het drinken met het minste suiker.




89
HAHA IK BEN KAPITEIN ROODBAARD EN IK DAAG JE UIT TOT EEN DUEL. WIE WINT MAG ALLE MUNTEN BEHOUDEN
MUNTEN: 0


OM KAPITEIN ROODBAARD TE VERSLAAN HEB JE OOK MEER ENERGIE NODIG. KLIK OP HET PRODUCT WAARVAN JIJ DENKT DAT JE HET MEESTE ENERGIE GAAT GEVEN.
A. ONTBIJTKOEK B. M&M'S PINDACHOCOLADE C. LIGA
A
B
C
MUNTEN: 0


Nu je meer energie hebt kan je ook groot en sterk worden. Hiervoor hebben we eiwitten nodig. Weet jij in welk product het meeste eiwit zit? Klik het juiste antwoord aan.
A. Gekookt ei B. Kipfilet C. Amandelen
A
B
C
Munten: 0


Kies het product dat zorgt voor sterke botten en tanden
A. Melk B. Vla C. Chocolademelk
A
B
C
Munten: 0


89
Zout zit bijna in alles, zelfs waar je het niet verwacht. Loop naar het product waar het meeste zout in zit.
A. Chips B. Pizza C. Unox soep
Munten: 0


88
Je hebt net kapitein Roodbaard verslagen en hebt heel veel dorst van al het strijden en al het zout van net. Loop naar de rij met drinken waarvan jij denkt waar het minste suiker in zit.
Munten: 0


GOED GEDAAN!
DANKZIJ JOU HEBBEN WE
KAPITEIN ROODBAARD
VERSLAGEN!
MUNTEN: 0

Appendix C

Appendix C: Paper prototype

Questions:

1) Was there a question you did not understand? Which one?
2) What was easier to read, the question with a white background or without?
3) What do you think of the storyline?
4) Did you learn something new? What did you learn?
5) Did you dislike it when you gave a wrong answer?
6) What could be improved?

Participant 1:

1) No, everything was clear.
2) Without the white background.
3) Fun, that you can choose stuff and learn new things.
4) Yes, that orange juice contains a lot of sugar.
5) No.
6) Nothing.

Participant 2:

1) I did not know what Unox soup is from question 7.
2) When the background of the game is less visible, so with white background.
3) Fun, I liked the questions.
4) Yes, that kiwi contains more vitamin C than Oranges.
5) No.
6) Nothing.

Participant 3:

1) No.
2) With the white background.
3) Nice, fun! Easy to understand.
4) Yes, that milk doesn’t always contain the most protein.
5) No.
6) Everything was good.

Appendix D

Appendix D: Arduino code

```
#include <SoftwareSerial.h>

#define RX  5
#define TX  6


#include <SPI.h>
#include <MFRC522.h>

#define RST_PIN         9          // Configurable, see typical pin layout above
#define SS_PIN          10         // Configurable, see typical pin layout above

SoftwareSerial mySerial(RX, TX);
String PreviousID = "";
int CurrentQ;

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

void setup() {
        Serial.begin(9600);             // Initialize serial communications with the PC
        while (!Serial);            // Do nothing if no serial port is opened (added for Arduinos based
on ATMEGA32U4)
        SPI.begin();                    // Init SPI bus
        mfrc522.PCD_Init();             // Init MFRC522
        delay(4);                               // Optional delay. Some board do need more time
after init to be ready, see Readme
        mfrc522.PCD_DumpVersionToSerial();      // Show details of PCD - MFRC522 Card
Reader details
        Serial.println(F("Scan PICC to see UID, SAK, type, and data blocks..."));

  mySerial.begin(9600);
}

void loop() {
        // Reset the loop if no new card present on the sensor/reader. This saves the entire
process when idle.
        if ( ! mfrc522.PICC_IsNewCardPresent()) {
                return;
        }

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

```
  //Show UID on serial monitor
  Serial.print("UID tag :");
  String content= "";
  byte letter;
  for (byte i = 0; i < mfrc522.uid.size; i++)
  {
     Serial.print(mfrc522.uid.uidByte[i] < 0x10 ? " 0" : " ");
     Serial.print(mfrc522.uid.uidByte[i], HEX);
     content.concat(String(mfrc522.uid.uidByte[i] < 0x10 ? " 0" : " "));
     content.concat(String(mfrc522.uid.uidByte[i], HEX));
  }
  Serial.println();
  Serial.print("Message : ");
  content.toUpperCase();


  if (content.substring(1) != PreviousID) //change here the UID of the card/cards that you want to
give access
  {
    CurrentQ += 1;
     mySerial.println(CurrentQ);
    PreviousID = content.substring(1);
   Serial.println("Authorized access");

  }
}
```

Appendix E

Appendix E: Consent forms

Toestemmingsformulier

Hierbij verklaar ik dat ik op een voor mij duidelijke manier ben geïnformeerd over de aard en werkwijze van het onderzoek zoals uitgelegd tijdens het introductiegesprek. Mijn vragen zijn naar tevredenheid beantwoord. Ik verklaar dat ik bevoegd ben te tekenen voor deelname van het kind aan het betreffende onderzoek. Ik ga vrijwillig akkoord met de deelname van het kind aan mijn zorg aan dit onderzoek. Ik behoud het recht voor het trekken toestemming zonder de noodzaak om een reden op te geven en ik ben me ervan bewust dat het kind zich kan terugtrekken uit het experiment op elk moment. Als de onderzoeksresultaten van het kind onder mijn hoede worden gebruikt in wetenschappelijke publicaties of openbaar worden gemaakt in op een andere manier, dan worden ze volledig anoniem gemaakt. De persoonlijke gegevens van het kind zullen niet openbaar gemaakt worden aan derden zonder mijn uitdrukkelijke toestemming.

Gesigneerd op …- …- 2021:
Melike Oğuz Naam subject

…….. Naam ouder/verzorger Handtekening

Introductiepraatje

Ouders

Wij zijn studenten van de universiteit Twente. Voor onze afstudeeropdracht heeft de jumbo gevraagd of wij kinderen meer bewust willen maken van de impact van hun eten keuzes op hun gezondheid en hoe je duurzamere eten keuzes kan maken. Hiervoor hebben we het prototype wat u hier ziet staan, ontwikkeld. We zitten momenteel in de testfase en we willen u vragen of uw kind ons prototype wilt testen. Het kind wordt gevraagd om het winkelwagen door de winkel te lopen en gebruik te maken van de interacties die de winkelwagen biedt. Wij zullen uw kind observeren en kijken naar hoe hij de winkelwagen gebruikt en welke eten keuzes hij maakt op basis van de interactie met de winkelwagen. Deze data zullen wij alleen gebruiken om ons prototype te verbeteren. Om onze observaties te controleren zouden we ook nog graag enkele vragen willen stellen aan het kind na het afrekenen. De data zal volledig geanonimiseerd worden. Als u het niet eens bent met het onderzoek, mag u het altijd tussentijds afbreken. Alles is op vrijwillige basis. Heeft u nog vragen over het onderzoek?

Kinderen

Zou je ons willen helpen met ons onderzoek voor onze school. Je mag dan met ons winkelwagentje door de winkel lopen. Hierdoor kan je van alles te weten komen over het eten dat je koopt in de supermarkt en allemaal leuke spelletjes spelen op verschillende plaatsen in de supermarkt. Wij zullen tijdens het winkelen meekijken om te kijken hoe het gaat. Na het betalen zouden wij dan nog graag een paar vragen willen stellen over hoe je onze winkelwagen vond. Als je het niet meer leuk vind en niet meer mee wilt doen, mag je altijd stoppen als je wilt. Zou je hier aan willen meehelpen?

Appendix F

Appendix F: Ethical approval

Research Proposal

Creating an interactive and playful supermarket environment to make children aware of the impact of their food choices.

April 2021

RESEARCHERS

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ORGANIZATION

University of Twente

EEMCS

1. General

Context

This research will be part of the graduation project of Melike Oğuz and Joris Jager. The research will be used to gain information about the context of their graduation project.

Location

This research will be performed in the supermarket environment. The supermarket where the research will take place is the Jumbo in Goor. The address of this Jumbo is Van Kollaan 7 in Goor.

Description of research

The testing will be done in two phases, one of them being ideation and the other one prototype testing. The ideation phase will consist of a questionnaire with questions and a semi-structured interview about different ideas regarding the project. This will then be evaluated and used for the prototype phase.

During the prototype phase two interactive shopping carts will be made for the graduation project. The shopping carts will be made interactive through adding a touch screen, buttons and sensors to the supermarket environment. Children will be able to interact with the shopping cart. Information about the impact of the food to their health and sustainability will be shown on the screen based on the interaction. The information of the first shopping cart will focus on the impact of the food choices of children to their health and the second one will focus on the impact on sustainability. This information will be displayed in minigames and on passive screens. During this research the interaction between children and the shopping cart will be tested by anonymous observation and afterwards, a semi structured interview. This will be done through observing children interacting with the shopping carts. Some additional questions will be asked afterwards to support the observations. These questions will be short and simple to maintain low effort for the children. These interviews could be recorded when consent is given to do so.

Duration

The graduation project will be due at week 26. This research will be used during this project. Therefore this research will end at week 26 and will start as soon as the research is approved.

Participants

During the two phases of testing, three types of participants will participate. The first type are during the ideation phase children with their parents in the supermarket doing their usual business. The second type are acquaintances/family members, of the age between 5 and 12, of the researchers.

The participants of prototype testing are the last type of participants and will contain children that are going to the supermarket. The participants will be recruited through asking people to participate before they are shopping. The amount of participants depends on the amount of children that go to the supermarket. The aim is to recruit at least five participants to test each installation. We aim to recruit these participants as fast as possible. The aim is to spend a minimum of one day and a maximum of three days testing at the supermarket. One session will approximately take 5 hours.

Consent form

The consent form will be in Dutch referred to as “Toestemmingsformulier”(appendix A). This will be in Dutch in order to avoid miscommunication, because the stakeholders mainly speak Dutch. Next to that, the consent form will be signed by the parent(s) or care taker(s) of the child participating in the research. Before signing the consent the researchers will introduce the parent(s) or care taker(s) to the research. They will be introduced to the method used for this research. The researcher will tell that their child has to interact with the interactive shopping cart and that the researchers will observe the interaction of the child with the shopping cart. They will also be told that additional questions can be asked after the interaction of the child with the shopping cart. The researchers will also tell what the rights of the participants are. They will tell the parent(s) or care taker(s) that they can leave the research whenever they want, are participating voluntarily and are not forced to do certain actions.

2. Questions about the research

1. Has this research or similar research by the department been previously submitted to the EC?

☐ Yes,
☐ No
If yes, what was the number allocated to it by the EC?
Explanatory notes:

2. Is the research proposal to be considered as medical research (Also see Appendix 4)

☐ Yes
☐ No
☐ Uncertain
Explanatory notes:

3. Are adult, competent participants selected? (§3.2)

☐ Yes, indicate in which of the ways named in the general requirements and conditions this is so
☐ No, explain
☐ Uncertain, explain why
Explanatory notes:
We will be testing the design of an interactive installation that is made for children. Their parent(s) or caretaker(s) will be asked to sign consent for their child.

4. Name all characteristics participants must possess in order to be included in the research, such as gender, age, membership of a specific organization, etc:

The participants have to be children that do go to the supermarket.(age 5-12). The second type of participants are the parent(s) or caretaker(s) from these children and are asked to sign consent.

5. Are the participants completely free to participate in the research, and to withdraw from participation whenever they wish and for whatever reason? (§3.2)
   ☐ Yes
   ☐ No, explain why not
   ☐ Uncertain, explain why
   Explanatory notes:

6. Is there a risk for adverse effects of the research for certain participants?
   ☐ Yes, there will be a screening of the participants, explain how
   ☐ Yes, but there will not be a screening of the participants, explain why not
   ☒ No, explain why not
   ☐ Uncertain, explain why

Explanatory notes:

The installation will not be able to harm children and the research will only be focused around testing the installation.

7. Does the method used allow for the possibility of making an accidental diagnostic finding which the experimental participant should be informed about? (§3.6 and Appendix 4)
   ☒ No, the method does not allow for this possibility
   ☐ Yes, and the participant has given signed assent for the method to be used
   ☐ Yes, but the participant has not given signed assent for the method to be used
   ☐ Uncertain, explain why
   Explanatory notes:

8. Are participants briefed before participation and do they sign an informed consent beforehand in accordance with the general conditions? (§3.2, §3.3, §3.7, §3.8)
   ☐ Yes, attach the information brochure and the form to be signed
   ☒ No, explain why not
   ☐ Uncertain, explain why
   Explanatory notes: Since the research is conducted on children, consent needs to be signed by their parent(s) or caretaker(s). Children also have to give permission to participate. This will be done through asking them the questions if they would like to use our installations and if we are allowed to observe them.

9. Are the requirements with regard to anonymity and privacy satisfied as stipulated in (§3.8)?
   NB. Make sure to also comply to the General Data Protection Regulation (GDPR), and register the processing of personal data through: https://www.utwente.nl/privacy/.
   ☒ Yes
   ☐ No, explain why not
   ☐ Uncertain, explain why
   Explanatory notes:

10. If any deception should take place, does the procedure comply with the general terms and conditions (no deception regarding risks, accurate debriefing) (§3.10)?
    ☐ No deception takes place
    ☐ The deception which takes place complies fully with the conditions (explain)
    ☐ The deception which takes place does not comply with the conditions (explain)
    If deception does take place, attach the method of debriefing
    Explanatory notes:
    Our installation will be based around certain products of the supermarket. The time we have during this project does not allow us to include all products. Therefore we are not able to include all the impact of products in the supermarket. Children could be steered towards a product that is not the best (most healthy/sustainable) in a certain situation. This is a form of a deception. We should let the parents and children know about this deception by adding it to the debrief.

11. Is it possible that after the recruitment of experimental participants, a substantial number will withdraw from participating because, for one reason or another, the research is unpleasant? (§3.5)
    ☐ No
    ☐ Yes, that is possible
    If yes, then attach the recruitment text paying close attention to what is stated about this in the protocol.
    Explanatory notes:

12. Give a detailed description of the research (i.e., What precisely are the stimuli? Or: What precisely is the task? OR: What is the nature of the measurement/interview questions?) Ensure all data relevant for an ethics consideration is given or, if necessary, attach the research protocol.

    The research consists of two phases, ideation and prototype testing. The aim of the first phase is to improve and generate the ideas made by the researcher about the solution to the problem of the project. The problem of the project being, experiencing the impact of food choices through a playful, interactive supermarket environment. The evaluation will be done by asking a set of questions that will give an idea of what could be improved and which idea is better than which. These questions will most likely be in the form of formative questions to generate and improve ideas.
    The aim of the prototype testing is to test effectiveness of the prototypes of the interactive shopping carts. These shopping carts will be implemented in the supermarket environment. Therefore the tests will be conducted within the supermarket environment. Children have to walk through the supermarket environment and interact with the shopping carts. They have to do the normal

groceries and make decisions based on the information that is displayed on the shopping carts. An example of this is choosing the type of bread that is most healthy and sustainable, instead of choosing the bread they normally eat. We will test if children are changing their normal food choices, because they will be more aware of the impact of their food choices. We will ask how they change their food choices. We will also look at which products they pick based on the interaction of the child with our installation. The last aspect that we will be looking at is the interaction of the child and the parent(s) or caretaker(s). We will look at whether this interaction will change based on the interaction of the child with the installation. These food choice changes will be made anonymous during the data collection by categorizing them. Categories are about which type of food they changed to. This is for the privacy of the children. An example of this is choosing more healthy or sustainable food.
There will also be some changes made to the supermarket environment. The change that will be made is adding an interaction module at certain shelves. This will enable children to physically interact with the supermarket environment. These interaction modules will be small. This is to avoid interrupting the shopping experience of other supermarket customers.

ADDENDUM
4. Why is your work COVID-19 proof?
Note: choice with * requires explanation

13. Do you add additional face-to-face contact?
☐ No, I only work in distributed fashion over phone, survey, or telco (Skype, Zoom, Teams, etc)
☐ *No, only existing face-to-face contact, explain below who and how many you include as already breaking within 1.5m guidelines,
☐ *Yes, explain
Explanatory notes:
For the ideation phase children from the nearby circle of the researcher(s) will be asked to fill in a survey. This can be done online or physical with the needed distance. Since children might not be experienced enough with online surveys, physical might be a better option.
For the prototype testing, we will test an installation that has to be used in the physical supermarket environment. Therefore the test has to be performed within the supermarket environment. For this research we plan to only ask children that are in the supermarket. They already went to the supermarket and therefore we are not asking more people to go to that place. Therefore we will not ask more people to come which will not break the 1.5m guidelines

14. * Do you add indirect physical contact? For instance, sharing a tangible device, please explain why and what actions will be done with the device.
    - ☐ * No,
    - ☐ * Maybe,
    - ☐ * Yes.

    Explanatory notes:
    Children will be using an installation. Children have to interact with the installation to use it. They have to use the tablet and interact with the buttons on the installation. However, the standard cleaning protocol of the RIVM will be followed. The carts and tablets will be cleaned with >70% alcohol. A different tissue will be used after each participant.

15. * Do you put additional burden on people from the care sector that are under pressure?
    - ☐ * No, I work people from another field, explain
    - ☐ * Maybe,
    - ☐ * Yes

    Explanatory notes:
    This research will be performed with children at home or in the supermarket.

16. * Give a thorough explanation, why you consider your research can be considered COVID-19 proof include any considerations you discussed with your supervisor to address the contingency of any additional risks you identified. Explanatory notes:

    We will ask children to disinfect their hands before using the installation. After using we will be disinfecting the installation after the children have used the installation with disinfection wipes and spray. We also only have to observe how children interact with the installation and therefore we can keep 1.5 meter distance at all times. The supermarket environment will also allow us to keep 1.5 meter distance. We are also forced to wear face masks within the supermarket environment. This all is in line with the guidelines of the RIVM.

Appendix

Appendix A

Toestemmingsformulier

Hierbij verklaar ik dat ik op een voor mij duidelijke manier ben geïnformeerd over de aard en werkwijze van het onderzoek zoals uitgelegd tijdens het introductiegesprek. Mijn vragen zijn naar tevredenheid beantwoord. Ik verklaar dat ik bevoegd ben te tekenen voor deelname van het kind aan het betreffende onderzoek. Ik ga vrijwillig akkoord met de deelname van het kind aan mijn zorg aan dit onderzoek. Ik behoud het recht voor het intrekken toestemming zonder de noodzaak om een reden op te geven en ik ben me ervan bewust dat het kind zich kan terugtrekken uit het experiment op elk moment. Als de onderzoeksresultaten van het kind onder mijn hoede worden gebruikt in wetenschappelijke publicaties of openbaar worden gemaakt in op een andere manier, dan worden ze volledig anoniem gemaakt. De persoonlijke gegevens van het kind zullen niet openbaar gemaakt worden aan derden zonder mijn uitdrukkelijke toestemming.

Gesigneerd op ……..2021:

…… Naam subject Handtekening

…… Naam ouder/verzorger Handtekening

Appendix G

Appendix G: Evaluation

Questions after testing

1. Wat vond je van het spel?
2. Was het spel moeilijk om te begrijpen?
3. Kan je me uitleggen wat een portie is?
4. Zijn er bepaalde tekenfiguren je opgevallen in de winkel?
5. Wat vind je ervan dat de vragen niet op een plek gevraagd worden, maar dat je door de winkel heen moet?
6. Er waren vragen waarin je A B C had en vragen met een opdracht. Welke van de twee soorten vragen vond je leuker om te spelen?

Interview:

Participant 1(7 and 8 Y):

1) Liked the game, especially trying to find the dices.
2) 7: Found the game slightly hard. 8: Found some of the questions a bit hard.
    a) Because they did not know the answers.
3) 7: Could not explain what a portion is. 8: Could slightly explain what a portion is.
4) Did recognise some cartoon figures of the game in the supermarket.
5) 8: It was nice that the questions were asked at the corresponding places, because otherwise you would have to go all over the place.
6) Both liked the ABC questions more.

Participant 2 (5.5 Y):

1) Liked the game, especially trying to find the dices.
2) Did not find the game hard.
3) Could not explain what a portion is
4) Did not recognise some cartoon figures of the game in the supermarket.
5) Liked the fact that the questions were at the correct aigles.
6) Liked the more interactive questions

Participant 3 (6 and 7 Y):

1) Liked the game, especially trying to find the dices.
2) Did not find the game hard
3) Could not explain what a portion is
4) Did recognise some cartoon figures of the game in the supermarket.
5) Liked the fact that the questions were at the correct aigles, you can then look around and guess from what is around you
6) Liked the more interactive questions, but was indecisive for some time

Participant 4 (7 Y):

1) Liked the game, especially scanning the tags.
2) Found the questions sometimes hard.
    a) Because he did not know the answers.
3) Could not explain what a portion is
4) Did recognise some cartoon figures of the game in the supermarket.
5) Liked the fact that the questions were at the correct aigles, makes it easier to look around and see what the answer could be.
6) Liked the more interactive questions

Observation:

Participant 1:

1) Gets excited by the game
2) Listens well to the explanations
3) Interacts well with the touchscreen
4) Interacts well with the tags
5) Noticed some of the cartoon characters.
6) Found the first question a bit confusing.
7) The introduction was a bit too long
8) Asks the questions to mom

Participant 2:

1) Gets excited by the game
2) Listens okay to the explanations, not too attentively but still listens.
3) Interacts well with the touchscreen
4) Interacts well with the tags.
5) Doesn't notice the cartoon figures
6) Mom had to help out in the beginning wit finding the arrows
7) Intro was too long
8) Found it a bit hard in the beginning to follow the arrows
9) Having a question about unhealthy food had a bad influence. The child instantly wanted to buy the chips.

Participant 3:

1) Gets excited by the game
2) Listened well to the explanations in the beginning, but it was a bit too long.
3) Interacts well with the touchscreen
4) Interacts well with the tags
5) Did not seem to notice the cartoon figures
6) Map on the background with the arrows was confusing because it did not match the map in real life.

Participant 4:

1) Gets excited by the game
2) Listens well to the explanations
3) Interacts well with the touchscreen
4) Interacts well with the tags
5) Can follow the arrows very well

General:

Feedback about the correct answer was missing
The X on the map is misleading. People think it is a cross you can click on
Q2 point was not visible enough
It was not really clear when you had to move on to the next point