Getting healthier : creating interactive cooking tools for kids

Please check the document version of this publication:

• A submitted manuscript is the version of the article upon submission and before peer-review. There can be
important differences between the submitted version and the official published version of record. People
interested in the research are advised to contact the author for the final version of the publication, or visit the
DOI to the publisher's website.
• The final author version and the galley proof are versions of the publication after peer review.
• The final published version features the final layout of the paper including the volume, issue and page
numbers.

Link to publication

Getting Healthier: Creating interactive cooking tools for kids

Manon Spermon (manonspermon@gmail.com), Miguel Bruns Alonso

Department of Industrial Design, TU Eindhoven

Den Dolech 2, 5612 AZ Eindhoven, The Netherlands

Abstract

Cooking lessons are believed to be the basis for a healthy lifestyle for both children and adults. However, while children learn their eating habits during childhood, most people only learn to cook from the age of sixteen onwards. Therefore, it is suggested that people should learn to cook during childhood.
Current cooking classes aim mainly at the cognitive skills, with children learning about food in a traditional setting, i.e. in class and from books. Children are taught that water boils at a hundred degrees Celsius by using numbers and visualizations of thermometers, instead of what boiling water looks like. This way of teaching contrasts very much with the rich sensorial experience that cooking actually is. Therefore, we argue that learning about cooking should be aimed more at exploiting the perceptual-emotional skills.

In the current paper we present the design and development of an interactive learning environment that teaches children how to prepare healthy meals. The project was developed by means of a process referred to as research through design, i.e. by iteratively ideating concepts, making prototypes and evaluating them in context. A key element of this project is the facilitation of learning by doing in the interactive learning environment. It is argued that performing an action is a more effective way of learning than learning on a cognitive level. In addition, principles from tangible interaction have been integrated in the design. Tangible interfaces are believed to engage multiple senses, support natural learning and create playfulness.

The Supersous Game supports an interactive feedback loop with five different cooking tools; a knife, a peeler, a masher, a scale and a rasp. The game guides the children through the process of cooking by auditory guides and visual explanations.

Various prototype iterations have been evaluated on interaction and experience at an after school day care centre with children in the age group of 7 to 11 years. The experiential results, which were obtained by means of semi-structured interviews, suggest that after playing the game the children have a more positive attitude towards cooking. In addition, children have greater confidence in their ability to cook and have a better understanding of how they can eat healthier. Furthermore, all children indicated that they wanted to play the game more often, and some even mentioned that they would like to involve their parents in the process of cooking as well. Moreover, parents were surprised by the cooking skills of their children, as well as of their willingness to try out new self-prepared dishes. Finally, the evaluation of the interaction suggests possible improvements to the environment such as applying inherent feedback and personalization of guidance.

The presented project suggests that interactive games may support a healthier lifestyle for children and that interactive learning environments could offer new opportunities for health promotion programs

Keywords

Designing for food, Interaction Design, Food Education, Children

Introduction

The kitchen is a mess; there is flower and icing everywhere, and the floor has become slippery. A pile of different shaped cookies with coloured decorations shows the result of an afternoon cooking with the kids. This is a common situation for most people. When we cook with children we use simple and easy to follow recipes, often with lots of sugar or fat. However, recently more cookbooks for adults and also children are focussing more on a healthier lifestyle. This shift to a healthier lifestyle is necessary due to the growing amount of adults and children that are overweight. In the Netherlands for example obesity is a growing health problem addressing 10% of the population (Hirasing, 2009; Hurk, 2006). Authorities are taking steps to get people to lose weight and exercise more. However, far less attention is given at preventing children and adolescents from getting obese by learning them about a healthy lifestyle and nutrition (read in Bemelmans, 2004).

The Netherlands Nutrition Centre developed two interventions that focus on teaching children about a healthy lifestyle and nutrition; Supershopper and Superchefs. The first intervention is aimed at teaching children how to purchase healthy products from the supermarket; they are taught to read labels, to interpret commercials and make the healthiest choice for food (Scheffers, Linden & Zadelaar, 2009). In the Superchefs intervention children are taught several recipes for a healthy breakfast, lunch, dinner and snack via twelve cooking lessons (Linssen, 2010). Both interventions are aimed at children between 10 and 12 years old. Also, Jamie Oliver is trying to raise attention for the same problem by organising a challenge together with open IDEO to "raise kids' awareness of the benefits of fresh food so they can make better choices" (Oliver, 2010). Seventeen winning concepts have been chosen, and are currently researched for further development.

Nevertheless, these interventions and concepts are mostly aimed at adolescent children or need extensive guidance from teachers or supervisors. However, the researchers believe that children should be stimulated to be able to create their own healthy dishes from a young age on, since their eating habits are developed during childhood (Shepherd, Harden, Rees, Brunton & Garcia, 2006).

Therefore the challenge for the project was to develop a game that stimulates children of 8-10 years to prepare a healthy breakfast, lunch or snack independently. This paper presents the development of such a game and the first results of an exploratory evaluation of this game.

First, the theoretical background of the project will be described. Consequently, the design process and a short explanation of the first iterations of the project will be explained. Finally, the actual creation of the final concept and prototype will be described and the experimental evaluation done with this prototype will be discussed.

Theoretical Background

Different elements in this project are coming together; food (preference, taste), learning and interaction. In the following paragraphs we will explain the theoretical framework underlying the project, leading to the different steps in the design process.

Food; taste, preference and behaviour

Food is a necessity for human beings. However, nowadays, food is treated differently than thousands of years ago; we eat quickly and fast, and nutritious value is less of importance compared to the taste and comfort. We adapt eating behaviour from our parents (Savage, Fisher, and Birch, 2007) and are spoiled with food we like; we don't have to eat foods we do not find tasty.

As Kelder, Perry, Klepp and Lytle (1994) state "children learn their eating habits during childhood and pursue their consumption pattern into young adulthood". However, these eating habits and preferences of children are less stable and better susceptible than habits and preferences of adults (Savage, Fisher & Birch, 2007). Therefore, children of different ages can still be taught to choose a healthier lifestyle, but the younger a healthy eating habit is learned the larger the chance is that the child will pursue this in his later life.

Also, during childhood the children become more autonomous and want to make their own choices, such as choosing their own food (World Health Organisation, 2008). Nevertheless, they are also still open for change in food choice (Birch, Gunder, Grimm-Thomas & Laing, 1998; Wardle & Huon, 2000). This suggests that, as a response, children could be taught healthy recipes, so they can choose their own food, but still can be appointed in the healthiest direction. Also, during this age they are becoming more aware of their own dietary pattern, which could be an ideal moment for education.

One of the key elements for children to actually eat healthier is the consumption of fruit and vegetables. And although children might have a positive attitude towards eating healthy and know the importance of a healthy diet, their choice of food is still dominated by taste (Shepherd, Harden, Rees, Brunton &Garcia, 2006). Moreover, a study of Cullen, Baranowsk, Rittenberry & Olvera (2000) describes that if children are allowed to choose what they like, they are not likely to choose any fruit or vegetables. Therefore, it will be important to show and teach children recipes that contain a lot of vegetables and/or fruit but tastes good.

Next to persuading children to eat more fruits and vegetables, it will be a challenge to let children eat food that they do not know. As Cooke and Wardle (2005) state children like what they know and therefore eat what they like.

An important role in the consumption of food and the development of certain food preferences and eating behaviour is that of the parents. Children learn about food, which shapes their food choice, diet quality and weight status later in life from their parents (Savage, Fisher & Birch, 2007). Therefore it will be important to involve parents in this process as well.

A key element in getting children to live healthier is actual change of behaviour. A few determinants influence the unwanted behaviour; unhealthy eating. Contento (2007) describes these determinants in her work; she divides the determinants into three categories: food- related factors, person- related factors and environmental factors.

Within the food- related factors two categories again are made, the first describes the biological determined factors, such as taste preferences and the psychological reaction on eating. The second category describes the experience with food, e.g. learned behaviour. Here we find the determinants 'food preference', 'psychological consequences' and 'social affective context' (Contento, 2007). The second category describes the inter- and intrapersonal factors, e.g. interactions in the social environment (Contento, 2007). Several determinants are listed under the intrapersonal factors; attitude, self-efficacy, knowledge and social & cultural norms. Several studies have been conducted on the different determinants within this group. Shepherd, Harden, Rees, Brunton and Garcia (2006) showed that children have a different attitude towards healthy food as compared to unhealthy food, e.g. children associate healthy food with parents, adults and their homes, and unhealthy food with social environments, friendship, pleasure and relaxation. Moreover, children that have a positive attitude towards fast food and junk food, prefer these kinds of food over fruit and vegetables (Cooke &

Wardle, 2005). Therefore it will be important to focus on influencing the intrapersonal factors during the development of the interactive learning environment.

Learning

The learning in this project is twofold; learning new tastes and food, and learning about food and preparation methods.

Learning new tastes and food

For long term adaption of food choice and taste several factors are important. Contento (2010) distinguishes four factors that influence food choices and dietary behaviour: biological, perceptual, cognitive and societal factors. Children's thoughts, perceptions, arguments for decision making and abstraction capacities should be taken into account in the development of interventions that stimulate fruit and vegetable intake among children (Zeinstra, Koelen, Kok & De Graaf, 2007). Therefore, focus of this project should be on affecting the sensory-affective preferences (i.e. perceptual factors) to teach children new beliefs attitudes and norms (i.e. cognitive factors) as children learn more by experiencing (Piaget, 1964). In particular while learning about food, focus on the senses will stimulate children to try unfamiliar foods (Mustonen & Tuorila, 2010).

Learning about food and preparation methods

Learning is a phenomenon that occurs when knowledge or skills are gained; this can be done via schooling or study. Different views exist about teaching children. A variety of methods have been developed, but the most common way of teaching is textbook based (e.g. training cognitive skills). However, the researchers believe that learning about food cannot be done solely from textbooks; it is a much richer experience and therefore perceptual emotional skills should also be addressed.

A relevant theory on the inclusion of perceptual emotional skills is that of off-line cognition (Wilson, 2002). Off-line cognition means that even when decoupled from the environment, the activity of the mind is grounded in mechanisms, such as sensorimotor processing, that evolved for interaction with the environment (Dijk, van der Lugt & Overbeeke, 2007). This suggests that learning via the mind, the body and the environment, e.g. by using physical attributes, and provides a richer input for the cognitive processes. Concluding, physical attributes can provide a richer learning experience.

Interaction

Learning about food is a rich experience and is therefore not only done via textbooks, but involves physical interaction with food as well. As also suggested by the off-line cognition theory, this project may well benefit from the physicality of learning tools, and specifically of the principles of tangible interaction.

Opposed to interaction by means of graphical user interfaces as, the principles of tangible interaction are based on physical interaction and manipulation of computational empowered environments. Tangible interaction emerged from the field of Human-Computer Interaction (HCI). Fitzmaurice (1995) introduced the notion of graspable handles used to manipulate digital objects. Ishii and Ullmer (1997) presented a vision on turning the physical world into an interface for manipulating digital data. Due to the physicality of tangible interfaces, tangible interaction soon attracted the attention of designers who are educated to build and develop physical objects.

Djajadiningrat, Wensveen, Frens and Overbeeke (2004) presented a vision on tangible interaction from a design perspective, stating that physical artefacts can provide the user with a grip of the systems functionality and can guide user's actions. These physical artefacts offer the user rich action possibilities with immediate embedded feedback and therefore utilize every detail of a human's motor skills (Djajadiningrat, Wensveen, Frens & Overbeeke, 2004).

A large number of Tangible User Interfaces (TUIs) can be classified as computer-supported learning tools (Shaer & Hornecker, 2010). Several learning systems relate to the categories of problem solving, planning, and simulation systems, such as Illuminating light (Underkoffler & Ishii, 1998), which is an optical prototyping tool simulating the optical elements selected by the user. Other systems are referred to as Digital Manipulatives (Resnick, Martin, Berg, Borovoy & Collela, 1998) these are computationally enhanced versions of physical objects that allow children to explore concepts, which involve temporal processes and computation (Zuckerman, Arida & Resnick, 2005). Also, Hengeveld, Hummels & Overbeeke (2009) state that tangible interaction appears to be useful for learning because of several reasons. And Marshall (2007) addresses the emphasis on using the

mind, the body and the environment in learning in his analytic framework on learning with tangible interfaces. He suggests it is possible that since tangible interfaces often make use of concrete physical manipulation, they might support a more effective or natural way of learning. In addition, Zuckerman, Arida and Resnick (2005) describe the advantages of tangible interaction as a teaching tool for abstract problem domains ; sensory engagement, accessibility and group learning. Moreover, tangible interaction brings playfulness, which is an important contribution since fun is an important factor for learning (Xie, Antle & Motamedia, 2008; Marshall, 2007).

Using tangible interaction for designing a tool for children to cook with and learn about food, seems a natural way for learning and can be used to address perceptual-emotional skills as well as cognitive skills. Moreover, by balancing these skills with reflection on action will stimulate a richer learning experience in contrast to traditional focus on cognitive skills. We propose to achieve this balance by stimulating learning by doing and reflection in action (Schön, 1984).

3 Design Process

In the presented project we developed an interactive system that enables learning by doing. The system has been developed by means of a process referred to as research through design (Archer, 1995). We define research through design as an iterative process of ideating, building and validating concepts in context. The central activity of the process was ideating, integrating and realizing interaction solutions between the children and the interactive learning environment at an after school day care. In this continuing process the designer researcher gained insight into the design opportunities. During the process these insights are physicalized and result into a final solution. The first steps in the process (e.g. the first iterations) are presented here.

Cooking workshop

A cooking workshop was executed at the after school day care, *Korein Kinderplein Eindhoven.*The goal of this workshop was observing the cooking skills of the children, getting inside in their knowledge and understanding of the process of cooking and gaining experience with cooking with the children.

Set up workshop and evaluation

The recipe that was chosen came from the SuperChefs (Linssen, 2010) cooking book. The recipe was altered with small logo's to indicate specific tasks, and some assignments were formulated differently for better understanding, as logo's have been suggested as a good method for communication with children(Markopoulos, Read, MacFarlane and Höysniemi, 2008).

The children would cook in pairs, and would have all ingredients and tools needed per pair. However, the children were free to pick one of the three vegetables available: champignons, paprika and courgette. Also, the researcher and leader of the group would help with cutting the onion.

The observations were done via direct observation (Markopoulos, Read, MacFarlane and Höysniemi, 2008). The participants of the cooking workshop were the children from the after school day care in the age of 8 till 12 years old, both girls and boys.

Results & Guidelines

In total 12 children participated in the workshop and they were all enthusiastic about the cooking workshop. The children were able to name all the ingredients that were brought. Using specific tools was a problem for the children, both the usage of the tools as well as how to combine the tools with the food. Many children had difficulties following the recipe; they did not know where they were in the recipe, and what to do with the ingredients that were already prepared. Moreover, they took all the tasks literally, e.g. if the image showed that they had to add the sliced vegetable to the bowl with a knife, they did so. Also the children found it difficult to understand the quantities of ingredients; it was hard to define half a paprika, and a teaspoon of spices for example.

The findings from this workshop suggest that the tools used for cooking should be altered for usage by children. Also the recipes should be very explicit, and visual as well as auditory feedback should be added for clearer understanding of the recipes. Furthermore, different ways for explaining the amount of ingredients are needed, as well as showing which step of the recipe they are currently performing need to be explored.

Creating an educational cooking game

During the cooking workshop a lot of guidance from the researchers was needed, and the game element was missing. Therefore, an educational cooking game was created by using the results from the cooking workshop. The children from the after school day care participated in the evaluation of the game.

Set up game and evaluation
The children were divided in pairs; each pair formed a specific team. Each team received a different set of adapted tools, a set of assignment cards and a recipe. The adapted tools were a knife with a squeezable handle, cartoon recipe, a comic book with only visuals of the steps of the recipes and a stuffed toy with an mp3 player explaining the steps of the recipe. On the assignment cards all the steps that needed to be undertaken were explained, as well as the usage of the tools. The children were not allowed to ask the researchers any questions, unless they really needed to. After finishing their recipe, the children would taste each other's recipes and would rate the dishes on healthiness, look and taste.

Figure 1: The different toolsets each team received during the cooking game. The Blue team received a knife with squeezable handles, the yellow team received a cartoon recipe, the green team received a stuffed animal with spoken facts and the red team received an auditory explanation of the game.

Initial observations were done via direct observation (Markopoulos, Read, MacFarlane and Höysniemi, 2008). The entire game was videotaped, and the material was used for indirect observation (Markopoulos, Read, MacFarlane and Höysniemi, 2008) afterwards. Next to observations, the participating children filled in a short questionnaire after the game for evaluation of the tools and assignment cards. The participants of the cooking workshop were the children from the after school day care in the age of 8 till 12 years old, both girls and boys.

Results & Guidelines
Ten children participated in the game, so five teams were formed. The researchers observed that most children benefitted from visual or auditory explanation of the recipe, although the preference for either visual or auditory feedback differed per child. Also the stuffed animal was very popular; everything the stuffed animal 'said' was adopted immediately by almost all children.

Moreover, it was noticed that the regular cooking tools, developed for adults, were hard to handle for the children; they did not know how to handle them, or their hands were too small.

From the evaluation it was concluded that the adapted tools used during cooking should be improved and embedded in the final game, and should be intelligent to actually give the children feedback about the action they are performing. Specifically, the cutting and the measuring of the amounts needs to embedded. Moreover, for following the recipe a visual and verbal explanation needs to be included, as it was noticed that both teams used these tools, and it was noted by the teacher that each child has different learning preferences, e.g. verbal or visual. For teaching the children about healthy living, a buddy can be included in the game, since the stuffed animal was incredibly popular and the children actually listened to what it said.

The recipe disks are placed in the drawer and via a hole in the desktop the images can be viewed while the characters explain the steps verbally

Two characters explaining the recipes to the children, and giving them feedback how to use the tools

Five interactive tools with sensors and Jeenodes integrated, sending their data over radio to the receiver

Cabinet holds a computer with an RFID reader and two boxes attached

the drawer can be used for storing the recipes disks and extra cups and other cooking tools

4 Designing an interactive learning environment

By using the guidelines developed in the previous iterations of this project, an interactive learning environment was developed. This environment consists of two agents, five interactive tools, four recipe disks and a desktop to work on. This interactive learning environment, called the Supersous game, was evaluated by ten children from the after school day care *Korein Kinderplein.*

Design of the interactive learning environment

During the cooking workshop and the cooking game it was apparent that the children needed extra guidance during the preparation of the recipes. To include this extra guidance in the game, two characters were added to the interactive learning environment. Different characters have been developed and presented to the children at the after school day care. Via voting amongst twelve children, two characters were chosen for further development. These agents were Peter Pear and Mindy Mandarin, whom function is to guide children through the recipes. The two characters are physicalized and included in the learning environment, and they guide the children through speech.

Next to the inclusion of extra guidance, it was observed that most regular cooking tools are too big or hard to handle for most children. Therefore a set of cooking tools was redesigned for better use by the children. These tools were a knife, peeler, masher, rasp and a scale. Each responding to the use of the children, i.e. a child pushes to hard when cutting with the knife, the sensor in the knife reports this and either Peter Pear of Miny Mandarin provided the child with useful tips and feedback on how to use the knife correctly.

As was concluded after the evaluations of the cooking workshop and game, both auditory and visual guidance is needed. The auditory guidance is included in the two agents, as described previously. The visual guidance is done via images. These images are placed together on a disk and each disk represents a recipe. The different elements are placed on a cabinet with extra expandable desktop space.

Figure 2: The prototype with which the evaluations are performed.

7

All recipes that are used within the Supersous game are following the health guidelines as set up by the Netherlands Nutrition Centre. Moreover, all facts that are presented to the children while playing the Supersous game have been adopted from the Netherlands Nutrition Centre. Examples of concepts that are cited in the 'Wheel of Five' and 'two pieces of fruit and 200 grams of vegetables a day'.

Playing with the interactive learning environment

When the children want to prepare a recipe, they choose one of the recipe disks, loaded in the drawer of the cabinet. To start cooking, the children have to place the disk in the drawer beneath the surface and turn the disk until they see the first step. Then the cooking process starts and the two agents start explaining what the children need to do. Also the image shows this step in the recipe. Once done with a step, the child spins the recipe disk one step further and the agents start explaining the subsequent step. The two agents guide the children through the recipe from gathering the ingredients until the plating of the dish. Next to this guidance, the agents also explain important facts about food and healthy lifestyles.

During the steps in which the children have to use the cooking tools, their usage is monitored. When a child uses the tool inappropriately, i.e. a child is mashing potatoes by pushing really hard; the two agents guide the child to using the tool properly via auditory feedback.

Technical specifications

To build the network of interactive tools within the learning environment, Jeenodes (Wippler, 2009) were used. The JeeNode is a small wireless board with an 8-bit microprocessor and compatible with the Arduino platform and programmable in Windows. The main Jeenode was built in the cabinet and functioned as communicator between the interactive tools and two agents. Each interactive tool had a Jeenode inside, as well as a battery pack and a specific sensor, depending on the function of the tool and the sort of feedback. Via radio frequencies the signals from the Jeenode inside a tool was send to the main Jeenode inside the cabinet. This main Jeenode was programmed to receive the signal and act accordingly by using the Processing platform on top of the Arduino platform to be able to include audio for the two agents.

Next to the network of agents, the main Jeenode also functioned as a reader of the recipe disk. Each recipe disk consists out of two sides; one side with images representing the steps of a recipe, and another side holding RFID tags representing the same steps of a recipe by holding a specific tag number. These RFID numbers were read by an RFID reader, attached to the main Jeenode, after which the according audio record was played, simulating the auditory explanation of the recipe by the two agents.

Evaluation of the interactive learning environment

After the development of the interactive learning environment it was tested with a group of children on fun, knowledge, interaction and attitude, confidence and self-efficacy.

Methodology

Each session in which children participated in cooking a dish within the interactive learning environment, called the Supersous game, was recorded. This recording was mainly done for creating a promotional video afterwards, but could also function as an extra tool for observation. During the sessions the researcher was observed the children directly.

Moreover, for retrieving specific answers about the fun factor, knowledge, interaction and attitude a semi-structured interview technique (Lindlof & Taylor, 2002) was used. To develop the questions and structure of the semi-structured interview, the questionnaires developed and validated for Supershopper (Scheffers, Linden & Zadelaar, 2009) and Superchefs (Linssen, 2010) were used. These questions mainly focus on different parameters within behavioural changes, e.g. knowledge, attitude, self-efficacy and confidence. The questions were adopted, and sometimes adapted for retrieving deeper insight. Moreover, questions about the interaction were added.

Ten children from the after school day care centre in the age group of 7 to 11 years participated in the evaluation. The children were allowed to play on their own (single play), in a pair of even with three children at a time. One pair of boys and two pairs of girls, one group of three girls and one boy alone played the Supersous game. The children were allowed to pick one of four recipes that were available.

Figure 3: Two boys participating in the evaluation of the Supersous game; preparing cruesli.

Results

The results will be discussed per category, e.g. fun, knowledge, interaction and attitude, confidence and self-efficacy.

Fun

All of the children indicate that they would like to play the game again, and that they thought it was fun to do. However, three girls (11 years old) did indicate that it was quite an easy game for them. A boy said that he especially liked the jokes the male agent made, and that he liked the fact that he could prepare the recipe all by himself and show his mother. This was also indicated by three other participants. All girls indicated that they liked cooking, and they thought it was fun to do together. The more experienced chefs, also indicate that is was more fun for them to prepare recipes that they have never made before. Moreover, a boy said "Maybe we can prepare the salmon wraps or another recipe next time and give these out to the others?".

Knowledge

Six of the ten children indicated that they learned from the game, the other four claimed that the interactive learning environment had taught them nothing new.

Eight out of ten children had noticed that the agents told them facts about food and healthy living. All children knew the concept of the 'Wheel of Five', and knew roughly which parts are included in this wheel. After having prepared a dish, four children indicated that they knew the compartments of the 'Wheel of Five' better, but still not precisely. Moreover, some noted that they did not know all facts that were explained during the preparation of the recipe.

Also, when answering the questions, the children indicated that they actually have learned, but point out that they have learned a recipe, or a specific preparation technique, instead of facts about food.

All of the children were enthusiastic about the game, and two of them also reported this to their parents. The children indicated that they would like to make a recipe another time. Two children proudly presented their parents what they had made.

Interaction

All children indicated that they liked the link between spinning the recipe disk and the storytelling by the guides. However, some indicated that turning the wheel was a bit difficult, and that it was unclear which way.

Also, four children thought that the auditory feedback from the agents while using the tools was useful. However, they also mentioned that the first time it is hard to grasp 'what is happening' and how to adjust the technique. Moreover, four girls did not get any feedback from the agents on using the tools, since they used them properly. Also, three children indicated that 'it felt weird' to get auditory feedback from the agents while cutting or peeling something, since 'I was cutting over here, and the pear started talking over there'.

Moreover, some children indicated that for example the knife was too big to be used properly, and that sometimes the agents responded quite quickly, e.g. the sensor was too sensitive.

Attitude, Confidence and Self-efficacy

All of the boys indicated that they never cook, but that they would be able to make more recipes by using the interactive learning environment Supersous. One of the girls says that she does cook sometimes, but only fairly simple recipes, and often more snacks and not healthy recipes. All children think they would be able to make healthier recipes if they would play the game more often. Also some girls indicated that if they knew more healthy recipes, they would more easily make healthy recipes.

All of the children also think that the actual preparation would go better if they would cook more often. After having played with the interactive learning environment Supersous all children were confident they were able to prepare more recipes in the future. Eight of the ten children also indicated that their technique (cutting, peeling etc.) would improve as they would cook more.

All children showed an open and positive attitude towards cooking, and some even asked when they could prepare another recipe. Also, especially the boys admitted that they did not think that would like cooking so much.

Discussion

The aim of this project was to create an interactive learning environment that teaches children how to prepare a recipe and facts about healthy food. Via three iterations a game was developed. The results of an explorative evaluation shows promising results on the parameter 'attitude', 'confidence' and 'fun'. However, the game was now evaluated with only ten children and by using qualitative research methods; this means that results can only be accounted for as promising indications and not facts.

As Contento (2007) describes in her work 'person related factors such as perceptions, beliefs and attitudes play a role in influencing eating patterns and food related behaviour' (pg 43). Therefore, the change in attitude towards cooking and healthy living occurring in the children that have played the game once, suggest that this will only continue in the long term. However, this does not immediately mean change of eating behaviour in adolescence and adulthood. Though, playing the Supersous game would create a healthy starting point, as Kelder, Perry, Klepp and Lytle (1994) state "children learn their eating habits during childhood and pursue their consumption pattern into young adulthood".

Furthermore, parents play an important role in children's perceptions, beliefs and attitudes (Savage, Fisher, and Birch, 2007). As indicated at the results multiple children would like to involve their parents in the cooking process, and want to show his or her prepared recipe to the parents. Also, the parents indicated that they liked that the children prepared healthy dishes, instead of cookies or other snacks. This notion could be beneficial for the attitude, since it was also apparent that the children wanted their parents to be proud of them, e.g. the parents could enforce the positive attitude towards healthy food.

Next to attitude, confidence plays a role in changing children's eating behaviour. Confidence plays an important role in a child's self-efficacy, since children are more motivated as they are more confident they can reach a certain goal. The children thought that practicing the skills of cooking would help them in developing towards a healthy lifestyle.

Closely related to confidence, is knowledge. Knowing about a healthy life style is the basis for change (Contento, 2007). As the children indicated themselves, they feel that they learn mostly in preparing recipes and cooking techniques. Nevertheless, it seems that the children also learn actual facts about healthy living, but not concisely. As a boy indicated that he hadn't learned from the game, but he did brag to his mother that he knew he should eat 200 grams of vegetables.

This unconscious learn possibly has to do with the set-up of the learning element in the game. The different facts are presented via a dialogue between the two agent and are spread over the recipes. Therefore not all the facts can be learned after preparing one dish. Nevertheless, it was apparent that the children do listen to the characters and remember what has been said about healthy food.

Fun is also determined as an important factor for learning (Marshall, 2007; Xie, Antle & Motamedi, 2008). The children all mentioned they enjoyed playing the game. Also interesting is the fact that the children did not even notice that facts about healthy food were integrated in the game; it appears that the learning element is hidden in the game. Also some children said things like "Oh, this I can do more often" or "Now I can show my mom that I can also make recipes", indicating that they would like to play the game more often.

As the results indicate, this project shows a promising direction for future research. For this specific project, however, minor changes in the interaction should be implemented. As some children indicated the interaction with the tools in combination with the verbal feedback, seems to be decoupled. Therefore, the interaction with the tools could benefit from the implementation of inherent feedback, as proposed by Djajadiningrat, Wensveen, Frens and Overbeeke (2004). Moreover, it might be beneficial for the interactive learning environment, as well as for the children to personalize the feedback by tracking results, for a faster learning curve. Changes, which can be included in future work on this specific project.

Conclusion

In this paper we have presented the development and experiential evaluation of the interactive learning environment; the Supersous game. The aim of this game is to change children's eating behavior towards living a healthier life, by addressing their knowledge about healthy living, altering their attitude towards cooking and helping them to feel confident about living healthier. Via different iterations this game has been developed by means of ideating, creating and evaluating. The eventual learning environment has been evaluated with ten children from an after school day care. The results show an alternation of confidence and attitude towards healthy living. Moreover, the evaluation shows that children are having fun in playing the Supersous game, and would like to cook more often. The results indicate a promising direction for future research within this area.

Acknowledgements

References

Archer, B. (1995)The Nature of Research. *Co-design*, 6-13.

Bemelmans, W.J.E., **Wendel-Vos G.C.W., Bos, G., Schuit A.J., Tijhuis M.A.R.** (2004) *Interventies ter preventie van overgewicht in de wijk, op school, op het werk en in de zorg: Een verkennende studie naar de effecten*. RIVM, Editor, Bilthoven.

Birch, L.L., Gunder, L., Grimm-Thomas, K., & Laing, D.G. (1998). Infant's consumption of a new food enhances acceptance of similar foods. *Appetite*, 30, 283-295.

Contento, I.R. (2007). *Nutrition education. Linking research, theory, and practice*. Boston: Jones and Bartlett Publishers.

Cooke, L.J., & Wardle, J. (2005). Age and gender differences in children's food preferences. *The Britisch Journal of Nutrition*, 93(5), 741-746.

Cullen, K.W., Baranowski, T., Rittenberry, L., & Olvera, N. (2000). Social-environmental influences on children's diets: results from focus groups with African-, Euro- and Mexican- American children and their parents. *Health Education Research*, 15(5), 581-590

Dijk, J.v., R. van der Lugt, and K. Overbeeke(2009) Let's Take This Conversation Outside: Supporting Embodied Embedded Memory, in *Designing Pleasurable Products and Interfaces*. Compiegne, France. p. 1-8.

Djajadiningrat, T., Wensveen, S., Frens. J., Overbeeke, C. (2004) Tangible products: redressing the balance between appearance and action. *Personal and Ubiquitous Computing*, 8: p. 294-309.

Fitzmaurice, G.W. (1995) Graspable User Interfaces, in *Computer Science*, University of Toronto: Toronto. p. 181.

Hengeveld, B., Hummels C., Overbeeke, K. (2009) Tangibles for toddlers learning language,

in Tangible and Embodied Interaction, ACM Cambridge, UK. p. 161-168.

HiraSing, R.A., (2009) Kinderen en overgewicht, *in Jaarboek Huisartsgeneeskunde, J.N. Keeman, J.A. Mazel, and F.G. Zitman*, Editors, Bohn Stafleu van Loghum: Houten.

Hurk, K.v.d., Dommelen, v, P., Wilde, d., J.A., Verkerk, P.H., Buuren, v., S., HiraSing, R.A.(2006) *Prevalentie van overgewicht en obesitas bij jeugdigen 4-15 jaar in de periode 2002-2004*. TNO, Editor.: Leiden. p. 44.

Ishii, H., Ullmer, B. (1997) Tangible bits: towards seamless interfaces between people, bits and atoms, in *Computer Human Interaction*. Atlanta, GA, USA. p. 234-241.

Kelder, S. H., Perry, C. L., Klepp, K. I., Lytle, L. L. (1994). Longitudinal tracking of adolescent smoking, physical activity, and food choice behaviors. *American Journal of Public Health*, 84(7), 1121-1126.

Lindlof, T. and B. Taylor, (2002) *Qualitative Communication Research Methods* . Thousand Oaks: Sage Publications.

Linssen, S. (2010) Superchefs: *An effect evaluation of a program aimed at changing behaviour and behavioural determinants related to preparing a healthy meal among Dutch 10-12 year olds*. Voedingscentrum: Den Haag. p. 65.

Markopoulos, Read, MacFarlane, Höysniemi. (2008) *Evaluating Children's Interactive Products*. Massachusetts: Morgan Kaufmann.

Marshall, P., (2007) Do tangible interfaces enhance learning?, in *Tangible and Embedded Interaction*, ACM: Baton Rouge, LA, USA. p. 163-170.

Mustonen, S., Tuorila, H. (2010). Sensory Education Decreases Food Neophobia Score and Encourages Trying Unfamiliar Foods in 8-12-year-old Children. *Food Quality and Preference* ,21 (4), 353-360.

Oliver, J., (2010, July 27*). How can we raise kids' awareness of the benefits of fresh food so they make better choices?* Available from http://www.openideo.com/open/how-might-we-give-children-the-knowledge-to-eat-better/winner-announced/

Piaget, J. (1964). Development and Learning. In *Ripple, R.E., & Rockcastle*, V.N. (Eds.), Piaget Rediscovered (pp. 7-20).

Resnick, Martin, Berg, Borovoy & Collela (1998) Digital Manipulatives: New Toys to Think With, in *Computer Human Interaction*. 1998: Los Angeles, CA, USA. p. 281-287.

Savage, J. S., Fisher, J. O., & Birch, L. L. (2007). Parental influence on eating behaviour: conception to adolescence. T*he Journal of Law, Medicine & Ethics*, 35(1), 22-34.

Scheffers, F.R., v.d. Linden, LF, and A. Zadelaar, Evaluatierapport Supershopper pilot 1. 2009, Voedingscentrum: Den Haag. p. 75.

Shaer, O. and E. Hornecker, Tangible User Interfaces: Past, Present, and Future Directions. *Foundations and Trends in Human–Computer Interaction*, 2010. 3(1-2): p. 1-137.

Shepherd, J., Harden, A., Rees, R., Brunton, G., Garcia, J., Oliver, S., et al. (2006). Young people and healthy eating: a systematic review of research on barriers and facilitators. *Health Education Research*, 21(2), 239-257.

Schön, D. A. (1984). *The Reflective Practitioner*. New York: Basic Books.

Underkoffler, J. and H. Ishii (1998). Illuminating Light: An Optical Design Tool with a Luminous-Tangible Interface, in *Computer Human Interaction*, Los Angeles, CA, USA. p. 542- 549.

Wardle, J., & Huon, G. (2000). An experimental investigation of the influence of health information on children's taste preferences. *Health Education Research*, 15(1), 39-44.

Wilson, M. (2002) Six views of embodied cognition. *Psychonomic Society*, 9(4): p.625-636.

Wippler, J.C. (2009, June). *Jeenode*. Available from: http://jeelabs.com/

WHO (2008). *Inequalities in young people's health: Health behavior in school-aged children. International report from the 2005/2006 survey.* Scotland: HBSC International Coordinating Centre.

Xie, L., A.N. Antle, and N. Motamedi (2008). Are Tangibles More Fun? Comparing Children's Enjoyment and Engagement Using Physical, Graphical and Tangible User Interfaces. in *Tangible and Embedded Interaction,* Bonn, Germany: ACM.

Zeinstra, G.G., Koelen, M.A., Kok, F.J., & De Graaf, C. (2007) Cognitive Development and Children's Perceptions of Fruit and Vegetables; a Qualitative Study. *International Journal of Behavioral Nutrition and Physical Activity*, 4(30), 5868-4-30.

Zuckerman, O., S. Arida, and M. Resnick. (2005). Extending Tangible Interfaces for Education: Digital Montessori-inspired Manipulatives, in *Computer Human Interaction*. 2005, ACM: Portland, Oregon, USA. p. 859-868.