

Design Probes: A Good Method for Designing with Children

A Qualitative Study Investigating the Appli-
ance of Design Probes with Children as Participants

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Abstract

Design probes are a User-centered Design method with focus on close involvement of users in design. This is done by creating a package of artefacts that participants can complete wherever and whenever the individual sees fit. Further, children are a user group that differentiate from other user groups having other needs and attributes within design. This study investigated how design probes motivate children in the design process. A focus of the study is also to compare the applicability of thematic and non-thematic design probes with children.

The study was conducted with a qualitative approach where the empirical data was in the shape of four different design probes that were created and tested by students from Linköping University from the program of Design and Product Development. The tests they carried out were performed on children at the age of 10 to 13. Data analysis were made through coding and thematic analysis.

The study concludes that design probes is an adequate method for designing with children. Although, there are additional challenges in terms of playfulness, motivation, language, rewards, time-sense, creativity, influences and reflection. If design probes with children are managed correctly, they will yield results of great value to design. Also, having a theme in the design probe might help to motivate children. Although, themes are no guarantee for success since it will not solve challenges that are independent of themes.

Keywords: Design probe, children, designing with children, User-centered Design, motivation

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1. Introduction

In this chapter the reader will be introduced to the design area and more specific about design probes and children. The problems that are the foundation for this study will be presented followed by the purpose and the research questions that the study aims to answer. Lastly, the reader will go through the delimitations that has been taken into consideration for the study.

1.1 Background

In the field of design, many researchers have mentioned that quality and usability are two effects of having a close relation to users when conducting a design process (Vredenburg, Mao, Smith, Carey, 2002; Lai, Honda & Yang, 2010). Out of these facts there have over the years emerged multiple disciplines and approaches to the involvement of users, where common methods are Participatory Design (PD) (Törpel, 2004), User-centered Design (UCD) (Mao, Vredenburg, Smith & Carey, 2005; Saffer, 2010) and Collaborative Design (co-design) (Vaajakallio & Lee, 2006). Early views on user involvement is related to the UCD approach and is highly focused on specifying the users' requirements and needs at the beginning of the design process (Lai, Honda & Yang, 2010). This view is limited, given that involvement of users through the whole process is a success factor in specifying needs that reflect the actual needs of the user. The strength of UCD comes from making designers and users equal in the eyes of the design process and by that enabling collaboration that yields these needs (Park, 2012). PD is more about active participation and letting users have direct influence on decisions or sometimes even rights to make decisions themselves (Törpel, 2004). At the same time, co-design is a branch of PD that has its main focus on how to empower users to collaborate and generate new ideas (Vaajakallio & Lee, 2006). In the end, what all these approaches have in common is that they unanimously share the view that it is the users who best know their needs.

Within these approaches, there are specific methods that have been created to enable close relation to users. Design probes are a design method that involve users in the design process in a way that enables collaboration between users and designers (Wallace, McCarthy, Wright & Olivier, 2013). One definition of design probes are that they are packages of artefacts that has been designed with the purpose of enabling the users' creativity (Gaver, Dunne &

Pacenti, 1999). By this, creating artefacts that give the users inspiration for innovation is essential (Sleeswijk Visser, 2009). With the artefacts, the users have to carry through self-documentation of experiences, thoughts and ideas which make them active participants of the design process (Mattelmäki, 2007). The users play an important role in the conduction of the method when they perform the tasks of the artefacts in the design probe. The users have therefore a high influence on the result of the method. This gives importance to developing design probes that focus on the target users' contexts and properties (Mattelmäki, 2007). Design probes can be both thematic and non-thematic, where thematic design probes are those that follow a certain theme whereas the non-thematic design probes do not. The themes from the thematic design probes have no relation to the aim and purpose of a certain probe, rather it relates to layout, description and tasks.

One type of user group that differentiates from other user groups, is children. Designing with children adds additional challenges but will, when performed effectively, yield great results due to their creativity and imagination (Jones, McIver, Gibson & Gregor, 2003). Challenges include that they generally want to say what adults want to hear, has little understanding of the concept of projects being long-term and that each child and project where children participate will be unique (Jones *et al.*, 2003; Vaajakallio & Lee, 2006; Wyeth & Diercke, 2006; Vaajakallio, Lee & Mattelmäki, 2009; Guha, Druin & Fails, 2010). Due to these challenges, selection of participants need to be conducted carefully (Wyeth & Diercke, 2006). Children that are good listeners, want to participate and have some knowledge about technology, are considered ideal. A designer must bear in mind these challenges and factors when working with children. Also, when selecting methods, the choice needs to enable their creativity.

1.2 Problem formulation

As mentioned in the background, it is of great importance for design processes to be planned and conducted with the users in the center. Attempts to create methodology that encourage this behavior are also present (Törpel, 2004; Mao *et al.*, 2005; Vaajakallio & Lee, 2006; Saffer, 2010), and design probes are a common approach to conduct a User-centered Design (Graham, Rouncefield, Gibbs, Vetere & Checerst, 2007). It is also clear that when working with children, it puts up additional challenges for the designer that have to be tackled (Jones *et al.*, 2003; Vaajakallio & Lee, 2006; Wyeth & Diercke, 2006; Vaajakallio, Lee &

Mattelmäki, 2009; Guha, Druin & Fails, 2010). It is notable that there has been research that focused on the appliance of design probes with children. An example of that is the study conducted by Wyeth and Diercke (2006). Theirs and others' research had focus on the attributes of children, rather than on the appliance of design probes as a method with children, which indicates that there is a gap in current research.

Given these challenges of designing with children, the way design probes enable participation in users and the gap in current research, there is great interest in studying if design probes are an effective method when designing with children.

1.3 Purpose and research questions

The purpose of this study is to investigate and compare the use of thematic and non-thematic design probes with children. The study aims to contribute to the field of design with knowledge about how these types of design probes can be used to motivate children in the design process.

Based on the purpose of the study, the following research questions are proposed:

- 1) How does using design probes motivate children participating in the design process?
- 2) How do thematic and non-thematic design probes compare when being used with children?

1.4 Delimitations

One delimitation that has been taken into consideration for this study is to examine only one type of design probe. The design probes that will be examined are of diary book type with different tasks of either thematic or non-thematic character. The thematic and non-thematic perspectives hope to give the study a deeper understanding of the appliance of design probes for children. Additionally, a delimitation is to use already existing design probes and thereby leave out the process of creating design probes within the study. Another delimitation is testing the design probes on children as participants, since the focus is the methods' applicability on children. Comparison with other types of participants could give meaningful insights but does not have room within this study.

2. Method

This chapter contains the method of the study which takes a qualitative approach. Through the chapter the procedure for the study is described in detail as well as the selection of design probes and participants. Moreover, the chosen data analyses method is presented which were coding and thematic analysis. Lastly, the ethical principles are presented and applied on the study.

2.1 Research Strategy

For this study, a qualitative approach has been applied to go into depth with a specific phenomenon, namely the usage of design probes with children as participants. An inductive approach has been conducted, since it is the empirical data of the tests with children that is to be examined. Bryman (2011) describes that induction is related to which role theory has for a study. Specifically, for induction, theory is what the study is supposed to generate, and empirical data and observations is the starting point. This is aligned with the aim of this study and was therefore a natural choice. The opposite view of theory is deduction and sets theory as a starting point with empirics to test the hypotheses that the theory generated. Bryman (2011) criticize these distinct views when they are seen as exclusive to each other. What he means is that research is almost always influenced by both views, but normally more influenced by one of them. This is clearly the case for this study, since literature was used to get an initial understanding of the area and to build argumentation around my empirical findings. In other words, the study is mainly inductive but has deductive elements throughout the process.

While conducting a qualitative study, Bryman (2011) also explains that the researcher normally applies an interpretive approach. This approach supports a view that the researcher will interpret the interpretations of the participants in the study and that these given participants have their own free unique will that will affect the study.

2.2 Procedure

The procedure started with me getting inspiration from a professor at the university, Stefan Holmlid, who conducts research in service design. It was during a meeting with him that the idea, of studying design probes with children, first was introduced. The design probes were

made by engineering students from the program of Design and Product Development. In the course User Driven Product Development (TDDE33), students made design probes in groups. They had two weeks to create the design probes before being tested. For this study, the design probes selected was from different years. There were four groups selected in this study that all made design probes for children where three designed thematic design probes and one designed a non-thematic probe. These groups then performed tests with 46 children from schools in Linköping. All schools were contacted for approval to conduct the test by the principal. Thereafter teachers, children and their guardians were informed about the studies and afterwards requested to sign an informed consent for the child's participation.

The children were given the design probes to complete throughout the week. For the thematic design probes, the children were informed to complete the tasks in their free time, wherever and whenever they preferred. The non-thematic probe was slightly more bound to the school since it contained a few activities with the student group. Some design probes had motivational rewards like sweets or cinema tickets for the children if they completed the probe, in hopes of increasing the number of participants and the frequency of answers. The completed design probes, in other words the result of the groups' tests, is the empirical data for this study.

After this, the data was analyzed with the analytic methods, coding and thematic analysis. These are described in-depth in the following section. The findings from the thematic analysis were then related to literature to achieve a scientific level of the argumentation, which then led to the final conclusions of the study.

2.2.1 Selection of design probes

All the design probes were made by the student groups mentioned in the procedure. The design probes were all meant to be used on children, a prerequisite in the selection. Further selection was made to incorporate both thematic and non-thematic design probes to hopefully gain valuable insights in their applicability. The aim for this study was to select design probes with different purposes, where examples are waste and the child's everyday life. Lastly, design probes were selected randomly from a sample of design probes that was handed to me from Stefan Holmlid's archives.

2.2.2 Selection of participants

The participants for this study were children aged 10 to 13 years from Linköping. They all attended different schools in the municipality. For this study participants were gathered through a stratified sample. A stratified sample means that a group is selected where containing members are asked to participate, normally in a randomized manner. For this study, the group was schools and the participants were the schools' pupils. Which pupils that got to participate was up to the conductors of the tests, in other words the students from Linköping University that made the design probes. A between-group-design was used with a portion of the participants in respective condition. In total there were 46 participants attending with different numbers of children for each design probe.

2.3 *Data analysis method*

The data analysis method that was chosen for this study was the coding and thematic analysis that Bryman (2011) describes. The first focuses on sorting and fragmentation, while the latter focuses on creating themes out of the coding. Below, detail about the data analysis process is expressed.

2.3.1 Coding

According to Bryman (2011) coding is the starting-point of most qualitative approaches of data analysis. The study has followed Bryman's (2011) process with the following steps. Initially the design probes were read through to get acquainted with the material without taking notes or trying to interpret the material. Some particularly interesting things were noted after this read-through, to have in mind in the next read-through. Secondly, the design probes were gone through once again, while also making notes of important observations and thoughts. Here, focus was to take as much notes as possible and trying to identify some recurring keywords within these notes. Lastly, these notes and keywords were examined with a critical mindset to make sure there were not multiple keywords stating the same thing.

2.3.2 Thematic analysis

Bryman (2011) explains that thematic analysis is one of the more common approaches to analyze data in qualitative research and is a natural part of qualitative research that is incorporated implicitly in most analysis methods. The method itself is based on the

identification of themes in the empirical data that leads the researcher into the topics of the themes. The coding process, that was explained above, generated keywords (or codes) that made a great foundation for thematic analysis by providing an initial fragmentation and categorization of the empirical data. Further, Ryan and Bernard (2003) describe that themes can be driven both inductively and deductively, but the thematic analysis performed is inductive, meaning that the themes originated from the empirical data. There is no explicit process to thematic analysis, given the wide appliance of the method.

2.4 *Ethics*

The four ethical principles according to Vetenskapsrådet (2002) have been taken into consideration for this study. The information requirement concerns informing the participants about their role in the project and the terms of participation. The requirement of consent means that the participants need to confirm their consent to the test, otherwise there is no possibility for the test being conducted by that participant. The consent is also dependent on guardians, if the test is performed by children under fifteen years old. Further, the participants have the right to decide for how long and on which terms they will participate. The third requirement is called the confidential requirement and means that the participants have the right to be anonymous. The use of data requirement is the last requirement and regards use of data. This type of data that comes from scientific tests is only allowed to be used for the purpose of the study and not non-scientific studies.

In this study, informed consent was collected from the children and their guardians since the children were underage. All participants were informed about the study and were told that it was optional and up to them if they wanted to finish the test or not. The data was processed confidentially to maintain the anonymity of the participants. This shows that the study follows all the ethical principles that Vetenskapsrådet (2002) refers to.

3. Literature

In this chapter, all the essential literature was gathered to make the reader aware and attended to a profound knowledge on the area. This chapter also relates and strengthens the empirical findings that the study concludes. Down below, topics are presented such as designing for users, design probes, designing with children and the abilities and capabilities of children.

3.1 Designing for users

This section goes through three main design approaches that are of relevance to understand design and more specifically design probes. These are User-centered Design, Participatory Design and Collaborative Design. Design probes is a user-centered design, although the other approaches are mentioned since they give additional perspectives on how design work can be performed.

3.1.1 User-centered Design

According to (Saffer, 2010), UCD comes from the philosophy that the users know best about their own needs and that it is the designer's task to find out and map those needs. Mao *et al.* (2005) defines UCD as a multidisciplinary design approach that focuses on active involvement of users of the product with the purpose of getting a better understanding of the users' needs and requirements through iteration of design and evaluation. Lai, Honda and Yang (2010) mention that a challenge with UCD is recognizing it is not only the process of writing requirements but to actively investigate the underlying motivations of the users. At the same time Park (2012) describe a big challenge to UCD to not make assumptions of the users' needs since it might lead to a gap between specified needs and the actual needs of the users. This could lead to a low acceptance of the design solution by the users, which is crucial to the solution. Making the users recognize their needs in a design solution is the fundamental purpose of UCD. When conducted right, Vredenburg *et al.*, (2002), Mao *et al.*, (2005) and Lai, Honda and Yang, (2010) state that UCD is a great enabler of quality of given design solution. It is also considered that having few but comprehensive collaborations with the users is considered better than having a large amount of users involved in the UCD-process (Lai, Honda & Yang, 2010).

3.1.2 Participatory Design

PD is another design approach with focus on the users. Törpel (2004) defines PD as the direct participation of individuals that will be affected by a product regarding decision-making, process and design. Further, Luck (2003) mentioned that it has been acknowledged that the direct participation of users in the design process has positive influence on the design solution. The researcher also states that a key to PD is to realize that design is not only in the designers' hands but a social process that participating users also shape. Because of that, the boundary between designer and user is less clear compared to other design methods. Iversen, Halskov and Leong (2012) describe the need to focus on value when working with PD, and by that make sure that the participation of users will yield value to the design process.

3.1.3 Collaborative Design

Co-design comes from the tradition of PD since it has focus on empowering users to collaborate and bring new ideas into the design process (Vaajakallio & Lee, 2006).

Vaajakallio, Lee and Mattelmäki (2009) explain that co-design is based on building design artifacts together with users. They also describe that the collaboration that co-design enables, brings a spirit of idea generation at the same time as participants negotiate with one another.

The role of the designer can vary between different appliances of co-design where the role sometimes means being a facilitator of the process and sometimes being an active participant in the process. Nevertheless, Vaajakallio and Lee (2006), Vaajakallio, Lee and Mattelmäki (2009) and Mattelmäki and Sleeswijk Visser (2011) describe that the purpose of co-design comes down to enhancing the creative thinking of the participants and to support them in dialog with one another. Mattelmäki and Sleeswijk Visser (2011) explain that co-design is dependent on the specific environment it is applied to and can therefore vary on factors like organizational culture and in which field of design the method is used. Regarding environment, Vaajakallio and Lee (2006) presents that it is considered effective to perform co-design at the everyday environment of the users, since it gives the users a more relaxed sensation. According to Mattelmäki and Sleeswijk Visser (2011), co-design requires an open mindset of all involved users, which can be a challenge, while it also is a complex process that takes much time and effort.

3.2 Design probes

This section goes through the definition of design probes, its uses and other aspects related to the method.

Design probes are a UCD method (Graham *et al.*, 2007; Mattelmäki, 2007). According to Sleeswijk Visser (2009), design probes enable dialogues with users, focusing on giving the participating users inspiration. Inspiration is considered to be more valuable than information and is the designers responsibility to carry through in the creation of design probes. It is also up to the designer to interpret the users' world in a fashion that does not validate or evaluate it.

Mattelmäki (2007) describes that the users are active in the design process where they make self-documentation of their experiences, thoughts and ideas through a collection of assignments. Gaver, Dunne & Pacenti (1999) define a design probe as a package of artefacts that has been designed with the purpose of provoking the users with creative responses. Ideally, it should lead the users toward generation of unexpected ideas. Wikberg Nilsson, Ericson and Törlind (2015) give examples of design probes and explain that they have different appearances. Some examples they brought up were writing a logbook, photograph a day of your life and showing interaction for future solutions.

Further, Gaver, Boucher, Pennington & Walker, (2004) criticize the stories humans tell, since they are regularly challenged regarding our interpretations, meaning that stories are only provisional. Our minds change all the time, which also reshapes our stories and truths. Besides the provisional human mind, the stories that the design probes generate are rich in information at the same time as being multilayered since they are generated over time.

“...the probes encourage us to tell stories about them, much as we tell stories about the people we know in daily life...They give us a feel for people, mingling observable facts with emotional responses.”

(Gaver *et al.*, 2004, 55)

There are, according to Lucero, Lashina, Diederiks & Mattelmäki, (2007), strengths with design probes that can support the design process. Their findings come from a design project

that applied design probes that generated valuable insights to design. The first strength is that design probes enable the designer to enter the intimate space of users. This opens a door to users' more emotional and private aspects, which makes it possible for a much deeper understanding of their context. The second finding is about discovering unexpected uses. Through design probes, the participants can view their experiences from a different perspective and reflect on these experiences in a new way. These new insights might bring new valuable information to the designer. Thirdly, design probes enable gathering of requirements which is an important process in UCD. The fourth strength is that design probes create natural dialogue between users and designers which is important in understanding the users in depth. Furthermore, design probes allow an early insight in the needs of the users which enables early shifts to the right focus of the design process. Lastly, design probes create an inspirational spirit within the team that carries out design and can generate solutions that none of the team members had foreseen.

3.2.1 Autoethnography

According to Ellis, Adams and Bochner (2011), autoethnography is an approach which explains cultural experience by describing and analyzing personal experiences. This means that what is studied is a cultures' relational practices, shared experiences, common values and the individuals' beliefs. Autoethnography shares the purpose of ethnography out of the fact that they both want to help insiders and outsiders to the culture to better understand the culture. The main difference between the two is that ethnography sees the researcher as participating observer in the culture, and in autoethnography the researcher is being a part of the culture with a cultural identity within it. Cunningham and Jones (2005) describe diary studies, which are common in design probes, to have an autoethnographic stance in the way the participants reflect over personal experience. This also eliminates any issues with privacy and intrusion that ethnography normally has.

3.2.2 Contextmapping

Graves Petersen (2002) describes that a big challenge within the area of design is designing within the users' everyday context, or in other words designing in the users' home environment. Sleeswijk Visser, Stappers, van der Lugt & Sanders, (2005) state that designers increasingly need to know about the context of their users' lives in order to design solutions that fit them properly. Crabtree *et al.* (2003) also support this view, describing how design by

the years has moved out of the users' workplaces into their everyday lives, which has led to new challenges in design.

"...our prime concern is informational – a matter of gaining insights into how people live their lives, their everyday circumstances, their routines and rhythms, their practical concerns, and so on."

(Crabtree *et al.*, 2003, 4)

Contextmapping is, according to Sleeswijk Visser *et al.* (2005) the process of eliciting contextual information about the users that participate in design. It does so by evoking emotional responses from the users, including concerns, feelings, experiences and memories. The designer should aim at receiving rich and broad information, in order to make it valuable to the design process. Further, the researchers define following research steps that contextmapping usually consists of:

- **Preparation** – Initial step that includes planning, goal formulation, participant selection and choosing techniques to work with.
- **Sensitization** – The step that includes to prepare the participants for following sessions by giving them activities to perform before the session. These activities should encourage and trigger the participants to reflect and think of their own context.
- **Sessions** – A meeting where participants create artefacts that express their thoughts, feelings and ideas.
- **Analysis** – Analysis and processing of the material gathered at the sessions.
- **Communication** – The final step where the results are incorporated to the design process. Ideally, these results will generate further ideas and inspire the design team.

Sleeswijk Visser *et al.* (2005) describe that this process is supposed to make the participants dig deeper within their knowledge to make them express emotions that they were not aware of beforehand. Further, Lucero *et al.* (2007) argue that design probes are particularly good at expressing users' contextual information by making the users perform the tasks of the design probes at their home environments. This calls for the design probe to be created with tasks that elicit emotions from the users.

3.3 Designing with children

This section contains literature about challenges and opportunities with designing with children both in general and with design probes.

In the field of design, it is clear that designing with children adds additional challenges to the design process (Jones *et al.*, 2003; Vaajakallio & Lee, 2006; Wyeth & Diercke, 2006; Vaajakallio, Lee & Mattelmäki, 2009; Guha, Druin & Fails, 2010). The first challenge that Vaajakallio and Lee (2006), Wyeth and Diercke (2006) and Vaajakallio, Lee and Mattelmäki (2009) point out is the environment in which design with children is conducted. Vaajakallio and Lee (2006) describe that it is considered good practice to perform design in the users' everyday environment, for adults that would be their workplace, but for children it is different. Children get affected by the rules in the classroom in a way that it inhibits their ability to be creative and collaborate with one another.

Another challenge with working with children is the fact that PD is time-consuming, according to Wyeth and Diercke (2006). While time being needed, children generally have a lack of patience and also an inability of performing tasks long term (Jones *et al.*, 2003). Even conducting design over more than a day is too much for children. This leads to the need to plan involvement of children with tasks that are easy to understand and at the same within a short time frame (Wyeth & Diercke, 2006).

Furthermore, children require more attention and support than adults when participating in design (Vaajakallio & Lee, 2006). The designer will need to take on an even bigger role of a facilitator, giving the children help with tools, fix social problems while also making them understand how the task should be performed. At the same time the designer has to act as a researcher to make the involvement of children valuable. Vaajakallio, Lee and Mattelmäki (2009) state that having other adults in the process, with a supportive facilitator role, could ease the burden of the designer being a facilitator and a researcher at the same time. Finally, children in the design process can yield great results if the challenges that comes with the user group are handled properly (Jones *et al.*, 2003). The children's ability to achieve these results comes from their natural ability of being creative and innovative.

3.3.1 Design probes with children

Jones *et al.* (2003) conducted a test of design probes with children and stated that design probes can be valuable when applied with children, giving contextual insights of their lives. A key factor of the probe is that it must be playful, yet with a supportive framework for clear and easy instructions. This makes for creative responses from the children. Besides that, the researchers point out similar issues as for designing with children in general. Topics have to be of direct interest to the child, while being easy to understand and differentiate from other activities, in a short time frame. Riekhoff and Markopoulos (2008) explain that the design probes for children must differ in tasks compared to appliance with adults. Artefacts that are commonly known to be fitting for design probes with adults had no or little interest from children.

3.4 *Children's abilities and capabilities*

This section is about the children's fundamental abilities and capabilities which are of relevance to design work.

3.4.1 Creativity and motivation

Sali (2015) points out that creativity is present in all humans and that it is an essential part of the development of society and humanity. Galenson (2009) shows one view of creativity where creativity is considered to come from within.

" ...It is people, not activities, that determine the nature of creativity."

(Galenson, 2009, 8)

Moran, Sawyers and Moore (1988) describe further that the grade of creativity is depending on the use of structured materials. The creative thoughts and the production of variety ideas tend to be limited for preschool children with structured materials. Instead, unstructured materials have a higher effect on producing ideas, which the researchers express with less being better. Moreover, they explained that there is a difference in creativity whether talking about the structure in materials or instructions. The implication from the researchers became that the structure in materials alters a more influential creativity.

Furthermore, cognitive- and affective processing in pretend play is effective but also predictive of divergent thinking. Divergent thinking can be seen as a cognitive process which

is important in creativity (Russ, Robins & Christiano, 1999). Additionally, Lillemyr (2002) puts emphasis on that play creates experiences and brings motivation. The motivation is an essential part, but rather hard to explain why. In play, the children dare to fail which is an element that encourage learning. At the same time, play makes the children have the feeling of control.

3.4.2 Effects of reward

Warneken and Tomasello (2008) investigated 20-month old infants helping behavior when receiving different types of rewards. They found that infants receiving material reward on the first test helped less in the subsequent test. Whilst infants that had received social praise or no reward at all performed at the same high level. On the other hand, Sarafino and Stinger (1981) found that rewards increase the children's performance. The motivation was different between ages, where kindergartners valued money more and fourth-graders preferred praise.

3.4.3 Reading

Cox and Guthrie (2001) discuss reading for pleasure and that it is associated with intrinsic motivation. Colombo and Landoni (2014, see Aamri, Greuter & Walz, 2016, 55) describe further that there are three aspects of intrinsic motivation that should be taken into consideration when designing a playful reading experience. The first aspect is curiosity which could be implemented by adding element that causes exploratory behavior, playfulness and interactivity. Secondly, desire for challenge is an aspect that can be achieved by giving children the choice to select opportunities by themselves. They can then select opportunities that are suitable for their specific abilities. Involvement is the last aspect regards how deeply focused the children are at the given text. On the other hand, Cox and Guthrie (2001) explain that it is important to distinguish reading for enjoyment and reading for school. Both of them are driven by motivation, although reading for school was predicted most highly by cognitive strategy use, like re-reading and self-monitoring.

3.4.4 Sense of time

McCormack and Hanley (2011) describe that reasoning about event order is limited for children in age four, when it comes to difference between the past and the future. In age five, the children do not have the same difficulty in reasoning about events. Instead the 5-year-olds make judgments that is reliably about future event order. Further Busby Grant and

Suddendorf (2009) explained that childrens' ability to assess past events from the present was insignificant to their ability to assess future events when age was controlled. McCormack and Hanley (2011) strengthens this finding, saying that additional cognitive abilities are needed when reasoning about future events contrary to reasoning about past events.

4. Empirics

This chapter contains presentations of all the analyzed design probes for the study.

Thereafter, the result from the thematic analysis of the design probes are arranged through given themes.

4.1 Selected design probes

The design probes that have been studied and analyzed were in total four design probes. Three design probes were of thematic character and one was non-thematic. These design probes vary in layout where some were made as one-week diary books and some as work books.

4.1.1 Panda bear probe

The first design probe “Panda bear probe” was a thematic diary book with a streak of assignments. The purpose was to get a deeper understanding of the participants and their relation to waste and in the end learn about which kind of waste-related problems children need solutions for in their everyday life. This design probe was given to a school class of children in grade six (12 years old) and in total there were 12 participants attending. The design probe had a theme that permeated through the whole diary book, where a panda bear leads the children through the assignments. In the diary book there were both writing and drawing assignments.



Image 1 – Front page of the panda bear probe.

Tidsdagbok - Dag 1

Nu är det dags för tidsdagbok! Har du slösat på någon tid idag? Vad, varför, och hur länge?

Image 2 - Recurring task about waste where the participants will describe what, why and for how long they have wasted time.

The first day, the participants were presented to the recurring task that was the same each day of the probe. It consisted of writing down how much time they had wasted over the day and with what activity.

Secondly, the first regular task was presented being a drawing task. The participants were asked to draw what their room look like while also pointing out something in their room that is wasteful that could be changed to the better.

Uppgift 1 - Undersökning hemma

Dagens uppdrag är att rita av ett rum hemma hos dig! Börja med att gå runt hemma och försök hitta något slösigt som ni skulle kunna förändra till det bättre. Rita sedan av rummet som du valt och markera med ett kryss var det finns något som kan förbättras. Beskriv sedan problemet du funnit och vad man skulle kunna göra för att förbättra det!

Image 3 – The first regular task of the probe about the participants room and its potential waste-problems.



Image 4 - Extra assignment asking what the panda bear says.

Thirdly, a small extra assignment was shown where the participants were asked to fill in what they think the panda bear says.

The second day, the regular task was about finding things over the day that was about waste. The participants were then asked to rank how wasteful the thing was and how important it was to change it.

Uppgift 2 - Slös i vardagen

Idag är uppgiften att tänka lite extra på slöseri. Allt du hittar under dagen som du tycker har med slöseri att göra ska du skriva ner så att du kommer ihåg det. När du sen kommer hem ska du sätta ut alla olika saker du hittat på två skalor. Den ena beskriver hur slösigt du tycker saken är och den andra hur viktigt du tycker det skulle vara att förändra på saken.

Fyll i listan här och sätt sedan ut bokstäverna på linjen.
(Man behöver inte fylla i saker på varje bokstav!)

- A.
- B.
- C.
- D.
- E.

Slösighets-skala

LITE MYCKET

Hur viktigt är det att förändra saken?

LITE MYCKET

Image 5 - The second day's regular task about wasteful things over the day.

This day also had an extra assignment where the participants were asked if they had any “cool” environmental tips.

Har du något fett miljötips?



Image 6 - Extra assignment about cool environmental tips.

Uppgift 3 - Uppfinningar

Finns det något problem du skulle vilja bli av med i din vardag? Eller något problem du saknar en uppfinning till? Rita en uppfinning du har på lager och beskriv vad den löser och hur den löser det. Eller rita & förklara ett problem du tycker är jobbigt i din vardag du önskar det fanns en uppfinning till.

Image 7 - Third day's regular task about inventions that could change the everyday life.

The third day, the regular task was about inventions. The participants were asked if an issue existed of the participant's everyday life that needed to be removed or if there was a need that an invention could fill. They were then asked to write or draw their invention.

The fourth and last day, the regular task was to write a letter to the grandchild's child of the panda bear. The letter was instructed to be about an issue the participant think will exist in the future.

Uppgift 4 - Brevet

Idag ska ni få skriva ett brev till en av Panda Pants barnbarns-barn. Tänk till en stund och fundera ut ett problem du tror kommer finnas i framtiden. Det kan vara en påföljd av något som finns idag eller något du kommit på själv. Beskriv sedan problemet och berätta i brevet hur du tror man skulle kunna förhindra att problemet blir värre/skapas genom att göra någonting åt det redan idag!

Image 8 - The last day's regular task about writing a letter about the issues of the future.

4.1.2 Movement probe

The second design probe “Movement probe” was a work book with 6 tasks and subtasks. The purpose was to make the participants reflect about their everyday exercise and how it could be improved. The goal was to understand how the participants think and reason about exercise and movement. The design probe followed a theme, which was the feeling of being on a tropical island. This design probe was given to children in seventh grade (13 years old) and in total there were three work books that were analyzed for this study. In the work book there were writing assignments and more creative assignments but also questions of reflection and feedback.

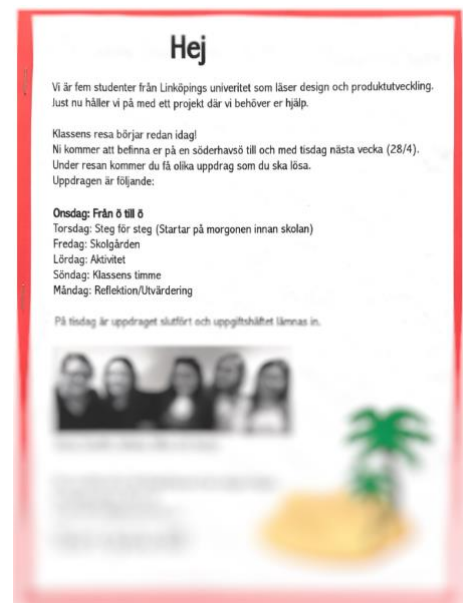


Image 9 - Front page of the movement probe.

The first day consisted of a task where the participant were asked to write down which places had been visited over the day and how the participant traveled between these places.

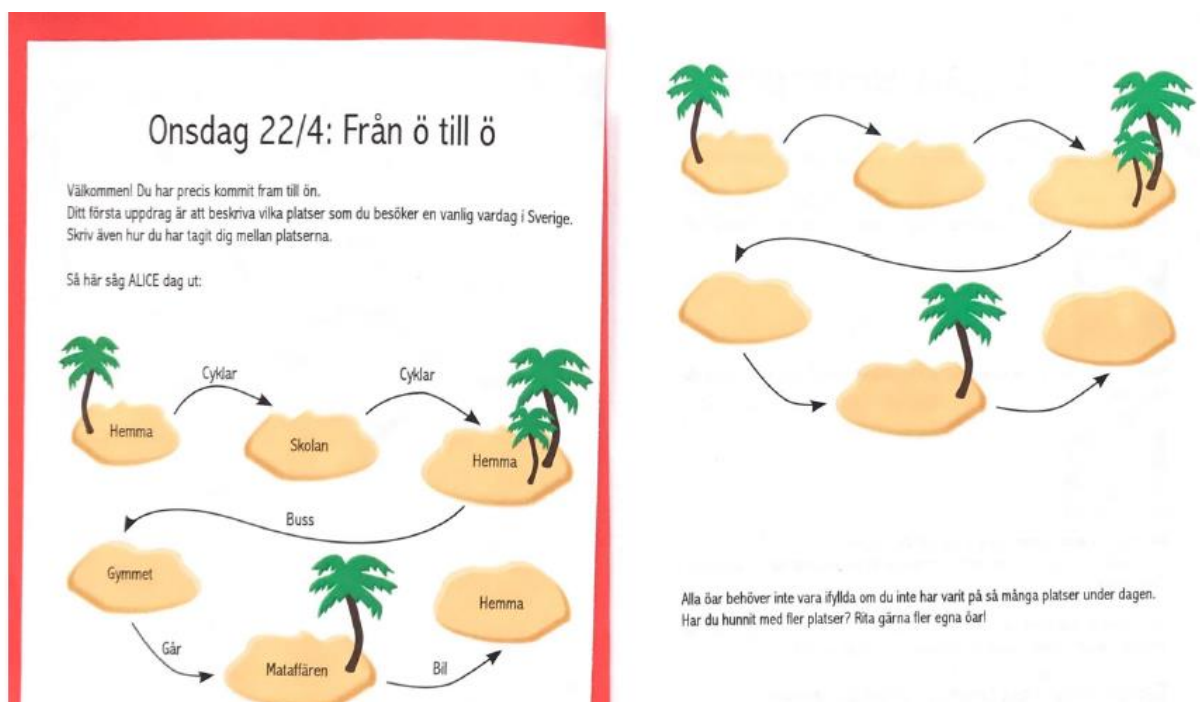



Image 10 - The first day's task about movement over the day.

The second day involved a task about counting steps for a day by using a smartphone application. The participants were asked to answer questions both before and after the day about the experience.


Torsdag 23/4: Steg för steg

Resan är nu inne på sin andra dag. Några i klassen ser resan som en semester där man kan ta det lugnt och bara göra ingenting. Andra ser resan som ett tillfälle att hitta på roliga saker.

Vi vill att du laddar ner en app med stegräknare om du inte redan har en på mobilen. Om du har iPhone söker du i appstore på "Stegi", appen är röd med ett vitt fotavtryck på.



Har du android söker du i googleplay på "walklogger stegräknare", appen är blå med vita fotavtryck på.



Båda apparna är gratis men kräver tillgång till din platsinfo. (Skulle det vara så att du har en telefon som saknar tillgång till appar kan du hoppa över denna uppgift.)

Du aktiverar stegräknaren när du kommer till skolan på morgonen och stänger av den när skoldagen är slut. Därefter antecknar du hur många steg du har tagit.

Den här frågan ska besvaras innan skoldagen:
Hur många steg tror du att du går under skoldagen?

Efter skoldagen:

Hur många steg gick du under dagen?

Stämmer antalet steg du gått överrens med hur många du trodde?

Varför tror du att resultatet blev som det blev?

Image 11 - The second day's task about counting steps with a smartphone.

The third day's task was about imagining how the school yard could look like. The participant was given examples of things that could be on the yard and asked to order them by liking, writing what activity is done with these things and come up with new ideas for the yard.

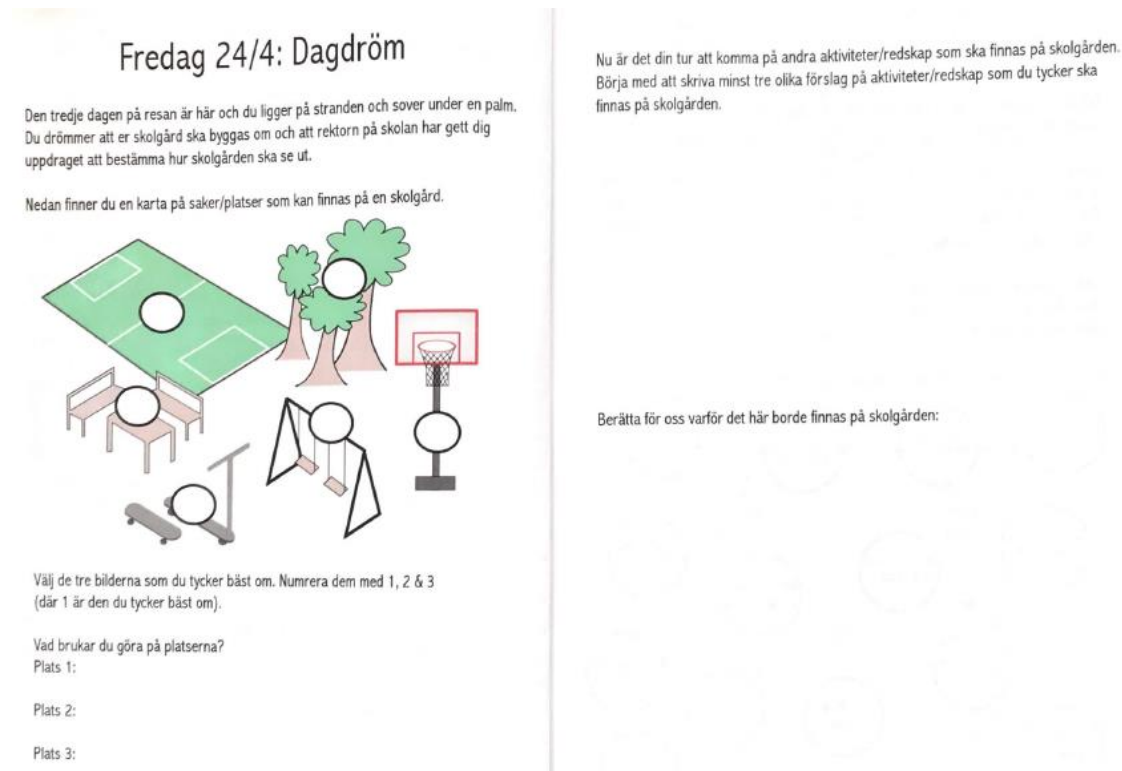


Image 12 - The third day's task that involves imagining a new school yard.

The fourth day consisted of two tasks. The first task was to color circles containing activities to classify the participant's enjoyment of these activities. Available colors were green, yellow and red where green was high enjoyment, red was low enjoyment and yellow meant that the participant had not tested the activity. There were also empty circles available to express additional activities.



Image 13 - The first task of the fourth day consisting classification of activities.

The second task was to pair five activities with five tools. An example was given where running and a hula-hoop was combined to create a new activity. The left list were the activities and the right list were the tools. The participant was supposed to draw lines between activities and tools.

I nästa uppgift ska du para ihop olika aktiviteter med olika redskap. Para ihop fem aktiviteter med varsin redskap genom att dra ett streck mellan dem. Exempel: Josefina sitter och tänker och kommer på en superrolig idé, tänk om man skulle kunna springa medan man rockar rockring. Därför parade hon ihop löpning med rockring.

Handboll	Boll
Innebandy	Klubba
Dans	Rockring
Gymnastik	Badboll
Simning	Lacrosseklubba
Teater	Häst
Musik	Bandymål
Löpning	Lådbil
Orientering	Studsboll
Ishockey	Studsmatta
Skidor/Snowboard	Ögonbindel
Ridning	Simbassäng
Klättring	Ballong
Skateboard	Bowlingklot
Volleyboll	Gitarr

Image 14 - The second task of the fourth day that consists of pairing activities with tools.

The fifth day consisted of a task where the participant was supposed to create an activity on the island with the material that was available on the island or in the boat. An example was given where a volleyball net was created by a fish net and set up between palm-trees. They were then asked what their activity would look like and to fill in which tools were used.

Söndag 26/4: Klassens timme

Nu har du och dina klasskamrater varit på ön i fyra dagar. Dagens uppdrag är att komma på en rolig aktivitet till klassen.

Det har flutit i land en båt med saker som du kan använda till er aktivitet.

I båten finns:

- Två stycken fiskerät
- Många rep
- 3 saker som du själv får komma på.

På ön finns:

- Kokosnötter
- Pinnar
- Snäckor
- Palmblad
- Stenar
- Vatten

Om Jenny hade fått bestämma en aktivitet hade hon gjort ett volleybollarät av fiskerät och två palmer. Sedan hade hon använt kokosnöt som boll.



Hur skulle din aktivitet se ut? Kryssa i de redskap som du vill använda och beskriv hur aktiviteten ska gå till. Rita gärna en bild på din aktivitet.



Image 15 - The fifth task consisting of creating an activity by material present on the island.

The sixth and last task of the design probe was to reflect on the tasks performed throughout the week and write which tasks were most fun, least fun and hardest. Also, more general opinions were asked.

Måndag 27/4: Återblick

Resan har nu kommit till sitt slut och klassen är på väg hem. Du börjar då fundera på hur du har haft det under resan och de uppgifter som du har fått.

Vilken uppgift var roligast?
Varför?

Vilken uppgift var minst rolig?
Varför?

Vilken uppgift var svårast?
Varför?

Tycker du att det har varit roligt att göra dessa uppgifter?
Om inte varför?

Övriga funderingar eller åsikter om dessa uppgifter:

Image 16 - The last task containing questions to reflect of the week and the tasks that has been performed.

4.1.3 Space probe

The third thematic design probe “Space probe” had the purpose to investigate how and with what children occupy themselves during breaks at school. The theme that was found throughout the design probe was the story about the space alien called Pim. This gender-neutral character arrives to Earth and needs help from the children, through various tasks in the design probe, to understand humans. The design probe was given to children in fourth grade (10 years old) and in total there were 20 participants attending. The design probe was a work book with three tasks that comprised writing and cut ‘n’ paste assignments.



Image 17 - Front page of the space probe.

The first task of the design probe was about helping the alien Pim understand humans by writing down what makes the participant happy, sad, angry and scared.

Det verkar som **Pim**s tefat har gått **sönder** så mycket att det inte kan lyfta igen.
Pim ringer sina föräldrar med sin rymdmobil men det kommer ta en stund för dem att ta sig till jorden, så fram tills dess är **Pim** fast på vår planet.
Pim känner sig ensam och lite vilsen, **Pim** vet ju ingenting om **människor** .
Du kanske kan hjälpa **Pim**?

UPPGIFT 1

Hjälp **Pim** förstå människor genom att berätta lite om **dig** själv:

rita eller skriv vad som gör dig glad	rita eller skriv vad som gör dig ledsen
rita eller skriv vad som gör dig arg	rita eller skriv vad som gör dig fädd

Image 18 - The first task to fill the boxes with emotions after an introduction that Pim needs to know how humans work.

The second task was to imagine the dream school yard and to illustrate it by cutting and pasting in objects from two sheets called Jupiter and Mars. The instructions were to pick five objects from Jupiter, three objects from Mars and three additional objects of choice from either sheet. The participant was also asked to write down the three most important objects.

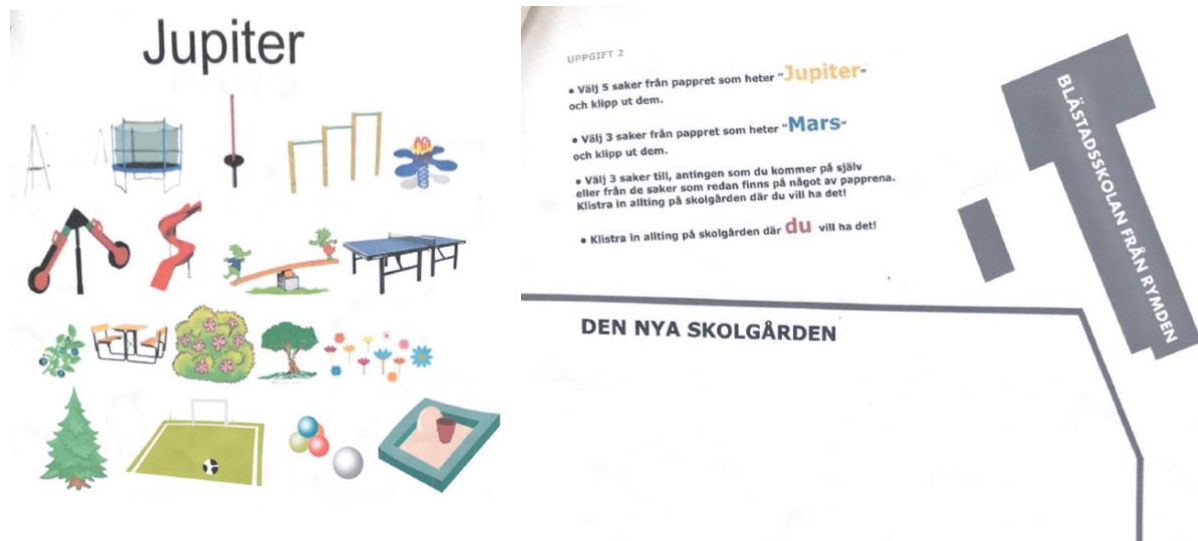


Image 19 - The second task to cut and paste objects into the school yard.

The third and last assignment of the design probe was about writing down what a typical evening would be like by the hour if Pim was to sleep over. Two hours are already set, where 2 o'clock was when the participant and Pim went home and 9 o'clock was bedtime for Pim.

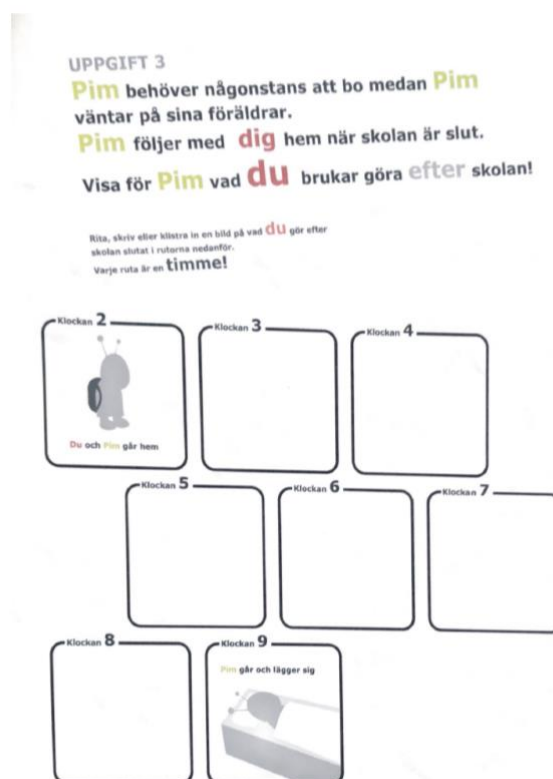


Image 20 - Task about leisure where the participants write activities they perform over time.

4.1.4 Collaboration probe

The non-thematic design probe called “Collaboration probe” had the purpose of gathering information about how the participants experience the interaction with each other and how they work in groups. The design probe was handed out to children in fifth grade (11 years old) with 12 of these workbooks analyzed in this study. The design probe was a diary book with eight questions for each of the five days the design probe was performed. In the beginning the children presented themselves through writing and painting. Thereafter, the children became introduced to an activity daily that they tried out. After each day they used the book to answer questions about the activity that they



Image 21 - Front page of the collaboration probe were the children writing their own names.

had tried. There were also recurring questions about the children’s wellbeing of the specific day. Lastly, there were some questions about friendship that were presented in the end of the book. Over the week, the participants were also handed a “secret friend” of which to be extra kind to.

The presentation of the participant was the initial task to be performed and consisted of writing a presentation containing name, location, family and interests, and draw a picture of something the participant like.

Det här är jag

Skriv en presentation av dig själv (t.ex. vad du heter, var du kommer ifrån, familj, fritidsintressen mm.)



Rita en bild av dig själv när du gör något som du tycker om.



Image 22 - The initial task to let the participants present themselves.

The first activity that was performed was a game where newspapers were placed on the floor which all participants were supposed to stand on. By time, papers were removed which reduced the area to stand on. The goal was to remove as many papers as possible without anyone falling out. As standard with these activities, the participant was supposed to answer questions in the book afterwards. The same questions were expressed for all activities, with room for slight differentiation.

Uppdrag 1 – En tidning ska bort

Måndag

Var du med och lekte? Om inte, varför?

Tog någon ledningen i uppgiften?

Var uppgiften rolig? Varför/ varför inte?

Varför skulle göra det roligare?

Vad var roligast i skolan idag? Varför då?

Vad gjorde du efter skolan idag?

Hur kände du dig idag? (fyll i den/de som passar bäst)

glad ledsen arg ensam lycklig nervös rädd

Varför då?

Image 23 - The questions asked in the book after the first activity.

The second day's activity was a game where the participants were split up in groups of three or four. Together they were asked to draw their dream school yard on a paper. Once again reflection is made in the book in the same way as for the first activity.

The third day's activity was a game where the participants sat in a circle and were told to say one word at a time to create a story. Same reflection in the book as previous activities.

The fourth day's activity was in groups of three or four and consisted of drawing and explaining a game they like. Once again, they reflected in the book after the activity.

The last day's activity is the game where the participants stand in a circle, close their eyes and reach for a random hand to create a knot. This knot should then be solved without releasing the grip of any hand. The secret friend was also revealed, which made the reflective questions focus on friendship and the secret friend.

4.2 Results of design probes

All the design probes were analyzed through thematic analysis where different themes were produced. The result consists of 5 themes. These are the following themes that have been identified and are presented down below (see table 1):

Themes
Response and completion
Language
Creative elements
Use of rewards
Participants' reflections and feedback

Table 1 - Table of themes identified through thematic analysis.

4.2.1 Response and completion

This first theme from the thematic analysis consists of data generated by the answers from the participants of the design probes. This includes expressing the response rate of the design probes. The tasks mentioned in this section refers to the tasks expressed in section 4.1.

For the panda bear probe, the overall response rate is high. The recurring tasks (see Image 2, pp. 16) were completed on all occasions by all participants, except for the first occasion being skipped by one participant. Both the second extra task (see Image 6, pp. 18) and the third day's regular task (see Image 7, pp. 18) were only answered by nine out of the 12 participants, being the least frequently answered tasks. All other tasks were answered by all or all except one participant. The answers themselves are mostly detailed. From the answers of the recurring task the participants show various types of waste where smartphone, YouTube and the shower are common reasons. There are also answers that shows that no time was wasted during the day:

"Jag har slösat tid framför mobilen (4 tim) för att jag ville/hade tråkigt"

"Jag har inte tänkt på någon tid jag har slösat. Men tror faktiskt att jag inte slösat någon tid alls."

"Jag titta på youtube istället för att göra läxor. Hela kvällen."

"Duschade i 20 minuter istället för 10. Målade en teckning i en halvtimme som jag sedan råkade spilla vatten över. Snozade i 15 minuter."

The last task of the panda bear probe also shows a great level of detail in the answers.

Following is a sample from a participant that believed plastic in the ocean is an issue:

“Hej! Jag vet ett stort problem som finns redan idag som jag tror är katastrof för er. Problemet är att det är så mycket plast i haven och fabrikerna tillverkar bara mer och mer plast. Jag tror att om vi inte stoppar detta problem kommer jorden snart vara täckt av plast. Men jag har en idé på hur problemet kanske kan lösas ...”

Within the recurring task mentioned earlier this section, the participants would commonly talk about the same time-waste issue at multiple occasions:

“Idag tycker jag att jag har slösat på vatten.”

”Idag tycker jag att jag slösat på vatten igen.”

There are also less detailed answers from the participants, where examples are talking about losing the sense of time or not to litter:

“Jag skulle plugga men tappade tiden.”

”Inte kasta skräp i naturen.”

For the movement probe, all three participants completed all tasks except the step-count task (see Image 11, pp.20) and the reflection task (see Image 16, pp. 23). These two tasks were never completed by any participant. The tasks that were completed had generally a high level of detail, where an example is the activity-classification task (see Image 13, pp.21). All three participants colored all circles. Also, all three participants valued a football court highest at the school yard task (see Image 12, pp. 21), but only one of the participants described the reason for it being important. The other two left the reasons blank.

Regarding the space probe, the first (see Image 18, pp. 24) and the third task (see Image 20, pp. 25) were completed by 19 of the 20 participants. The second task (see Image 19, pp. 25), that consisted of selecting objects for the school yard, was completed by 15 participants. Only ten out of these 15 performed the second part of the task, to write down which objects were considered most important. More participants preferred to write rather than drawing. At the first task about the participant, four of the 19 participants who completed the task included drawings while the rest did not. The level of detail also varied between participants, where both thorough answers and short answers occurred when talking about fear in the first task:

“Sura gubben två hus bort, bollar, när någon hotar eller slåss och när mamma och pappa bråkar.”

”Inget”

For the collaboration probe, the response rate varies between tasks. The task with the best response rate was the questions about the first activity (see Image 23, pp. 27) where ten out of the 12 participants answered the questions. The questions about the last two activities (see pp. 27) had only been completed by four and five participants out of the 12. The rest of the tasks were completed by six to eight participants. Regarding answers, all questions about activities were shortly answered. Answers like “Ja”, “Nej”, “Vet inte” and “Bra” were common among all participants. Some exceptions were also present with more detailed answers, like the performance of a group activity:

“Aa, men vi kom inte så långt med uppgiften.”

The first task (see Image 22, pp. 26) were detailed by most of the participants who completed the task, including information about name, location, family and interests that was asked for by the task:

“Jag heter ... och jag kommer ifrån Trosa men när jag var ungefär fem år flyttade vi till Norrköping. Jag bor med mina två föräldrar och min lillebror. Jag har oxå två kaniner och en Hund. Jag älskar att spela fotboll.”

4.2.2 Language

This theme consists of the aspects of the tasks that is related to the use of language.

The panda bear probe is using a language that is easy to understand and is using some words that is relatable for children. Example of this is the following text in the second extra assignment (see Image 6, pp. 18) where the panda bear asks for a “cool” tip:

“Har du något fett miljötips?”

The movement probe did not adapt the language for children. Words are used that are advanced, like in the following task’s text from the step-count task (see Image 11, pp. 20):

“Varför tror du att resultatet blev som det blev?”

The space probe has highlighted some words with color and increased size. No use of advanced words is present. Initially, the story consists of much text. See Image 18 (pp. 24) for an example containing highlighted words, use of simple words and long text.

The collaboration probe has no issues with advanced words. The first question of the first activity's reflection (see Image 23, pp. 27) illustrate this simple language use with a clear question about attending the game:

“Var du med och lekte? Om inte, varför?”

4.2.3 Creative elements

This theme consists of elements from the design probes that has a creative character. The creative character could be tasks or aspects that requires a creative and innovative mindset.

The panda bear probe involves creativity in its third (see Image 7, pp. 18) and fourth task (see Image 8, pp. 18). The third task is about coming up with an invention that could solve a problem of the participant's life while the fourth task is about writing a letter about an environmental problem in the future. Both these tasks require creativity to perform.

For the movement probe, some assignments have a creative character. As an example, the task that is about creating an activity with the islands material (see Image 15, pp. 22) requires the participant to be creative to create an activity out of the available materials. The same creativity applies with the school yard task (see Image 12, pp. 21) where the participant needs to come up with new activities and tools that should be available at the school yard.

The space probe's second task (see Image 19, pp.25) is highly creative in the way that the participant needs to setup the school yard by cutting and pasting from sheets of available activities.

The collaboration probe involves creativity through the playful activities that occurred each day. An example is the second day's activity (pp. 27) where small groups drew their dream school.

4.2.4 Use of rewards

This theme consists of data regarding the use of rewards for the design probes.

The panda bear probe rewarded the participants who completed the probe with sweets. Following quote is from the introduction of the design probe:

“Det kan också vara så att det utlovas fika till de som är med”

The movement probe did not involve rewards.

The space probe had a lottery at the end of the probe where cinema tickets were handed out to participants who completed at least two of the three assignments:

”I det här häftet finns tre uppgifter som du kan göra. Om du gör minst två så har du chansen att vinna en biobiljett när du lämnar tillbaka häftet på torsdag.”

The collaboration probe did not involve rewards.

4.2.5 Participants’ reflections and feedback

This theme consists of data regarding users’ opportunity to make self-reflection of their participation and give feedback of the design probe.

The panda bear probe has an element of self-reflection with its recurring task that reflects about the participants daily waste (see Image 2, pp. 16).

The movement probe’s last task is reflective (see Image 16, pp. 23). The questions within the task focus on asking the participants their opinions on the other tasks of the probe:

“Vilken uppgift var roligast? Varför?”

”Vilken uppgift var minst rolig? Varför?”

”Vilken uppgift var svårast? Varför?”

The space probe has no specific elements of reflection or feedback.

The collaboration probe has reflective questions in the book, which can be seen in Image 23 (pp. 27) where questions are asked about what is considered fun:

“Vad var roligast i skolan idag? Varför då?”

“Vad skulle göra den roligare?”

5. Analysis and discussion

In this chapter the body of argumentation is presented where literature and results are analyzed and discussed. At the end there is also room for a method-related discussion where criticism towards the method of choice is discussed.

5.1 Analysis and discussion of design probes

This section lifts topics that has been identified as of interest for the study either from the literature or the results. Topics are Motivational aspects, Creativity, Internal and external influences, Creation of value and Participants' reflection and feedback.

5.1.1 Motivational aspects

Creating probes that inspire and motivate the children to perform the given tasks is important. Jones *et al.* (2003) explain that design probes, when applied with children, requires a sense of playfulness within a topic that is of direct interest to them. At the same time, Gaver, Dunne and Pacenti (1999) express in their definition of design probes that the purpose of the method is to provoke creative responses and generation of unexpected ideas. Russ, Robins and Christiano (1999) describe how play can be an enabler of creativity and divergent thinking, which Lillemyr (2002) strengthen by the statement that play let children dare to fail and thereby become more open to creativity and divergence. It is hard to determine what is considered playful within the design probes. Above, the literature clearly stated that it is needed with children. At the same time there were no further definitions stated regarding what playfulness is. The result from the Response and completion theme showed that the collaboration probe had issues regarding response rate and therefore motivation by participants to complete the tasks. This probe could therefore be considered not being playful since only a few participants managed to stay motivated and complete the tasks through the whole week. At the same time, remaining design probes had a relatively high response rate which could indicate that they overall had a greater sense of playfulness. When viewing and comparing the creative elements of each probe, the main difference between the collaboration probe and the rest is that the collaboration probe had its creative element within the activities rather than in the work book. The other design probes had creative elements incorporated in the books. This could mean that playfulness and creativity have a tight relation to each other. Another key difference between the collaboration probe and the rest is that the collaboration

probe is not thematic. Being thematic could play a role in either achieving playfulness itself or creating motivation directly but is unconfirmed at this state. Lillemyr (2002) also mentioned that play is highly motivational for children. I believe it is hard to express a general statement of good practice in the sense of playfulness. Each design probe must be created with playfulness in mind. In a way, this should be natural when creating a design probe that is meant for children due to the nature of what motivates children. After all, motivation seems to be highly tied to playfulness. Jones *et al.* (2003) did also state that the tasks should be within a topic of interest for the children. This could be related to the aspect of being thematic but depends on what is defined as a topic. For example, the space probe has the obvious theme of space with an alien figure. By experience, it is not unusual that children find space interesting, which means that the probe could be successful from that point of view. What I believe is a challenge with this aspect is that it is hard to find a topic that is of interest to all children. Children are unique individuals just like any human and finding a topic that fits all might be hard if not impossible. Maybe it is not just about having an interest of a topic, rather to be able to relate to the given theme or subject.

Further, an aspect nearly related to motivation that has been shown as a challenge in literature is the childrens' ability to focus on tasks. Firstly, Vaajakallio and Lee (2006), Wyeth and Diercke (2006) and Vaajakallio, Lee and Mattelmäki (2009) explain that a children-related challenge is in which environment to perform design. Normally it is considered ideal to be in an everyday environment, which for adults would be the workplace. The natural instinct is to conduct design with children in a school environment but that adds the complexity of the classroom rules and norms which might affect the childrens' creativity. This should not be an issue for design probes given that they according to Lucero *et al.* (2007) commonly are performed in the participants home environment, which is also considered a strength given the challenges designwork normally face in terms of contextmapping (Graves Petersen, 2002). Getting to know the context of the participants' lives is considered to be important for finding a solution fit for the users (Crabtree *et al.*, 2003; Sleeswijk Visser *et al.*, 2005). For the design probes, none of them have indicated any challenges in terms of surroundings. Rather, all design probes except the collaboration probe have shown the strength of bringing the design probes to the home environment. This was expected from the literature. Both the panda bear probe and the space probe managed to give detailed answers about the participants' everyday lives. What I find interesting with this is that it is natural for a design probe like the panda bear probe to be conducted in a home environment given that the

purpose is to reflect on the participants own habits of waste. At the same time, some of the design probes, like the movement probe, consisted of tasks that had no relation to the home environment while yet being performed in the home environment. What is interesting is whether these tasks should be conducted in the form of a design probe or not. As an example, a task about how to design the school yard might give more meaningful insights when performed at the school yard.

Another factor that plays in when planning on involving children in design is their inability of performing long term tasks (Jones *et al.*, 2003). According to Wyeth and Diercke (2006) it is also not uncommon that UCD is time-consuming which present yet another challenge. Busby Grant and Suddendorf (2009) and McCormack and Hanley (2011) present specifically that young children at the age of four are lacking the ability to distinct past from future and that the ability start to evolve at the age of five. In terms of the design probes, this is something that has been performed well among all tasks. From the descriptions of the tasks, not one task stretches over more than one day. Tasks that do stretch over a whole day did get quite low attention from the participants. A clear example is the movement probe's task about step counting. Not a single participant completed that task. The question is whether it is because of the time or other factors. I believe children should be able to perform a task that stretches over the day. I think it is more of a motivational question that might go hand in hand with the need for playfulness as mentioned above. After all, installing an app that passively counts your steps does not sound like a motivator, while it also feels complicated. As a whole, the design probes lasted a week which could indicate the time frame being too long. I find this aspect interesting since Busby Grant and Suddendorf (2009) and McCormack and Hanley (2011) do state the need to involve children short term. Nevertheless, they are talking about children at the age of four and five, which is lower than the children of the design probes in this study. The children in this study have probably developed a greater sense of time compared to a five year old, so having a design probe project over a week is not something I see as a problem, especially due to the fact that the tasks do not stretch over more than a day. I believe all design probes analyzed in this study have done this in a good manner.

Further, the topic of language and reading has shown to have an impact on the design probes. Firstly, Jones *et al.* (2003) have explained that children need tasks that are easy to understand, indicating importance of appropriate language for children. Secondly, Cox and Guthrie (2001) and Colombo and Landoni (2014, see Aamri, Greuter & Walz, 2016) describe curiosity, challenge and involvement as important factors in creating a playful reading

experience. According to the Language theme, there are both good and bad examples of language for children. One example of a good appliance is the panda bear probe that has adapted towards the easy language children need. The movement probe is written with advanced words containing some expressions and questions that can be seen as hard even for an adult. The collaboration probe does not have any advanced words, but according to me the questions are not friendly for children anyhow since they are rather dull and informative. From my point of view, language could play an important role in motivating the children in doing the tasks since the panda bear probe got a clearly higher response rate than the collaboration probe. Then again the movement probe did also achieve a high response rate while using advanced language, which could indicate that the language does not play an important role in terms of motivation. Although, the main source of the advanced language used did come from the two tasks that no participants completed, which could indicate importance after all. By this, there seem to be a fit between the literature and the empirics in the way that an adapted language seem to have paid off for the design probes. Cox and Guthrie (2001) also stated that reading motivation differs between reading for enjoyment and for school. To me, the design probes can be seen as either, since it is a task but with playful parts that make it enjoyable. Maybe the language plays an important role in the distinction of being enjoyable and feeling like a school chore.

Another factor that has been lifted through the theme Use of rewards, is how rewards affect children's motivation. Warneken and Tomasello (2008) mentioned that material reward for infants lose efficiency after the first occasion, while praise kept the motivation. Also, Sarafino and Stinger (1981) expressed that rewards increase children's performance. When looking at the design probes, both the panda bear probe and the space probe had a material reward for the participants who completed or partly completed the probe. The difference of ages between the study conducted by Warneken and Tomasello (2008) and the children participating in the design probes might lead to different results. Also, another difference is the type of tasks since Warneken and Tomasello (2008) is based on helping-tasks which has no presence in the probes of the study. Because of that I believe the statement of material rewards having a negative effect on children might not be relevant. When looking at the response rate of the design probes that had material rewards, both the space probe and the panda bear probe showed a high frequency of answers, indicating that the participants were motivated enough to perform the tasks within the design probes. This is aligned with the findings of Sarafino and Stinger (1981). What is interesting is if there would have been any

difference in motivation if the rewards would have been praises instead of material rewards. What we can not see directly in the design probes is whether praises actually have been absent. It is highly likely that some kind of praise could have been expressed without any explicit information about it in the introductions of the design probes as it was for the material rewards.

5.1.2 Creativity

The purpose of design probes is according to Gaver, Dunne and Pacenti (1999) to enable creative responses of the users and thereby generate unexpected ideas. Also, Jones *et al.* (2003) point out that children have a natural ability of being creative and innovative through their imaginative mind. All four probes do have some element of creativity in them according to Creative elements theme, although in many different ways. All tasks in the movement probe that were completed by the participants did have some kind of creative element in them. Example of its creative elements was to either create an activity on the island or combine activities with tools in a new way. The tasks that did not have any creativity involved, like the reflection in the last task, was not completed by any user which shows a correlation between having creativity involved and completing the tasks. Although, Galenson (2009) explains that creativity is not within activities, rather within people. This view adds another dimension to creativity. If not tasks can create creativity, then what makes the participants creative? I believe this relation is more about that a task that enables creativity will not get a creative response if not the person performing it has a creative mind. At the same time I believe that a task that does not enable creativity will not get a creative response even if the participant is creative. A similar view is presented by Moran, Sawyers and Moore (1988), who state that structured material might limit creativity, especially when used with children. This means that a task with structured material might restrict the participants from generating creative responses. An interesting endpoint regarding this is that the panda bear probe did achieve an extra level of detail among the answers of its last task about writing a letter to the future. This task was not creative in a cut and paste kind of way, rather it was creative by thought. By the statement made by Moran, Sawyers and Moore (1988) above about structured material, this task seem to leave an open interpretation for the participants, which could be the reason for the high level of detail in the answers.

5.1.3 Internal and external influences

Regarding influences, Vaajakallio and Lee (2006) describe that design with children require extra attention and support from adults to not let aspects like social problems affect the activities. Therefore, the designer needs to take the role as facilitator seriously. According to Vaajakallio, Lee and Mattelmäki (2009) it is also not unusual to bring in other adults to support the facilitation. At the same time, it is also known that the classroom can influence the children with its rules (Vaajakallio & Lee, 2006). Also, the children's creativity can be inhibited by tasks being too structured since they lead the children towards an answer or type of answer (Moran, Sawyers & Moore, 1988). All the design probes do in one way or another risk having influential problems. An example is the movement probe's task to create an activity on the island. The participants are given an example of an activity that could be created, which could influence the participants by leading them into only focusing on sport activities. Another example is the collaboration probe which has activities at school, that could make the participants influence each other. To me, these are aspects that could be avoided if the common issues are known when creating a design probe. I believe these influential aspects could impact the relevance of design probes, since it might yield answers that do not reflect the actual needs and is therefore important to bear in mind especially when designing with children.

5.1.4 Creation of value

That design probes aim to generate value to the design process is given. This is something that UCD, PD and co-design also has in common with design probes. The purpose of these different methods is to get an understanding of the users' needs and requirements and are based on the fact that the users best know these needs (Mao *et al.*, 2005; Saffer, 2010). More specifically, design probes are according to Graham *et al.* (2007) and Mattelmäki (2007) a UCD method. At the same time, UCD can be an enabler of quality when applied in a way fit to the design situation (Vredenburg *et al.*, 2002; Mao *et al.*, 2005; Lai, Honda & Yang, 2010). Jones *et al.* (2003) also mention that children as participants can yield great results due to their natural creativity and innovation. When comparing the design probes' answers from the Response and completion theme with their purposes, their creation of value can be rather clearly examined. The panda bear probe wants to understand their participants relation to waste, while getting answers that express the participants' views of what is wasteful. Also, the space probe wants to investigate what children occupy themselves with on their free time,

while getting answers about their leisure activities. Both these design probes have a clear alignment between purpose and what has been generated. At the same time the remaining design probes shows a different level of alignment. The movement probe is interesting in the way that the purpose is to make participants reflect about their exercise and understand how they think about that. The Response and completion theme state that the response rate is high, and answers are detailed, but the tasks themselves rarely focus on either giving the participants an understanding of their exercise or generating anything of interest other than what they would build if they were on an island. This view is not fully transparent, some alignment is present where the design probe as an example show if the participants prefer football over relaxing or vice versa. In other words, alignment is there but not as much as for the panda bear probe and the space probe. The last probe, collaboration probe, has the purpose of gathering information about the participants experiences with each other and working in a group. The activities are clearly aligned with the purpose. The problem is rather the diary not getting enough attention from the participants. From my point of view, where I have only seen the diaries, there is rather vague expressions of experiences of the activities while also having a low response rate, meaning that the diaries themselves did not generate much value to the purpose.

What I find interesting in these findings is that examples are shown both that design probes can successfully be applied with children, but that it also requires extra thought and planning to the design probe so that the tasks are fit for children to complete. In other words, by the looks of it a success factor is related to the motivation and playfulness that has been discussed earlier in this chapter. Therefore, many of the aspects that Jones *et al.* (2003) explain seem to have a high impact on the success of design probes with children. Being thematic could also be an enabler for value, given that both the panda bear probe and the space probe, that is considered successful, are thematic. But what also needs to bear in mind is that one of the less successful probes, the movement probe, are thematic, which means that being thematic does not guarantee that value is created.

What is also interesting is the view Gaver *et al.* (2004) present, that the human mind is provisional and constantly changed over time. They emphasis that design probes become multilayered by the fact that they are generated over time. I believe this to be true and that a strength of design probes with children are that the designer gets to see contributions in the design probe from many days in the week and by that also with high probability from

different moods and feelings. It can be seen in the various answers in the tasks from both the space probe and the panda bear probe.

A challenge that I see regarding the value of design probes in general that I also believe applies for children, is the view Lai, Honda and Yang (2010) and Park (2012) describe. Firstly, they see UCD as the process of not only writing requirements but to understand the underlying needs of the users. A challenge is to them also that assumptions might create gaps in specified and actual needs of users. In other UCD methods or the methods of a more PD-approach, the designer works in a closer relation to the participants giving a high chance of avoiding the creation of a gap in term of needs. For design probes on the other hand, the participants perform the tasks by themselves and the designer interpret the answers of the design probes. I believe there is a certain risk with the distance between participant and designer to enter the trap of having a gap between needs. I think it is therefore extra important that design probes are conducted in a good way so that the answers cannot be misinterpreted.

5.1.5 Participants' reflection and feedback

Reflection is to design probes something that comes naturally. Mattelmäki (2007) describe design probes as a process where participants self-document experiences, thoughts and ideas. Also, Lucero *et al.* (2007) explain that the participants will see their experiences from a different perspective through design probes and also reflect on them in a new way. The design probes have all been lacking in the planning or creation of reflection-tasks. Either there are tasks that were not completed enough or there is an absence of reflective tasks. An example is the movement probe's final task with reflections and feedback that was not completed by any of the three participants. What is obvious, is that all design probes have tried in involving reflection into the probe. From my point of view, they were all too focused on creating a task with the sole purpose of letting the participant reflect. As both Lucero *et al.* (2007) and Mattelmäki (2007) expressed, reflection is something that comes with the tasks themselves. I do not think there is a need for a pure reflective task since it is not fit for children. Children will not get motivated to answer a pure question about reflection since it is too complex and lacks playfulness. By this I am not saying I believe the design probes were bad at reflection and feedback, rather that they failed to realize the reflective nature every task within the design probes have themselves. From an autoethnographic view, which design probes follow, the cultural experience of the participants are expressed by them analyzing and describing their personal experience (Cunningham & Jones, 2005; Ellis, Adams & Bochner,

2011). In other words, naturally when conducting tasks about oneself the person must analyze its own experiences in a reflective manner giving little need of a pure reflective task. What I think is more important is that all tasks within a design probe are challenging enough that they need to be analyzed and not too quickly answered. An example that could be criticized about this aspect is the collaboration probe that rarely yielded detailed answers. It makes it possible for participants to answer without thoroughly thinking it through, which also might have affected the value of these answers in the design probe.

5.2 *Method discussion*

This section analyzes and discuss the method choice, implementation and the delimitations from a critical view.

In the research strategy the studys' relation to theory is considered inductive. The relation might by this view oversimplify the actual relation to theory, given that it is rare that a study is fully inductive or deductive. In most of the cases, including for this study, the process both has parts with an inductive approach and parts with a deductive approach. In this study induction is clearly dominant but at some points, as reading literature to gain insight in the research area, a deductive spirit is present. This does not implicate the study in a negative manner, rather it is necessary to give room for the scientific literature.

The main motive for the delimitations of the study was to be able to conduct the study within the given scope and time frame. To consider more types of design probes would be interesting to see their applicability on children, yet it would greatly increase the workload. At the same time, creating design probes myself would make it possible to adapt them further towards the purpose of the study but is also a time-consuming task. To me, the given delimitations can be seen as interesting endpoints of further research, but in this study, I prioritized the appliance of thematic and non-thematic design probes with children which does not require tailor-made design probes or other types of probes.

As mentioned before, it is students that creates the design probes and tests them. Due to this, complications could arise regarding the creation of the design probes and the finished result since the students have varying experience of design and overall ambition. However, I do not see this as something that limits my study, rather it shows that there's a diversity in the design probes that are studied. From my point of view, there would be much more crucial if all design probes were created by the same persons, given that they all probably would be rather

alike and therefore hard to draw conclusions from. Further, the limited number of participants and design probes may affect the generalization of the result. With a larger group of participants or a larger sample of design probes, the result would become generalized to a greater extent. On the other hand, quantity is not the only metric of success for a study and with the scope of this study, lifting in more participants or design probes would make the study hard to complete within the given time frame. I believe that the assortment of participants and design probes for this study can both yield plausible conclusions at the same time as being achievable in terms of scope.

Regarding the data analysis method, there is also some critique worth to bear in mind when conducting a study with coding and thematic analysis. Bryman (2011) has stated that during coding the researcher must preserve the context of codes, generate as much codes as possible, and take distance to the coding process and by that leave remain an objective stance to not influence data. All these aspects I have had in mind when conducting the coding of my empirical data were to me great guidance in how to think when coding empirical data. I believe these aspects helped me achieve a great foundation for the thematic analysis. Further, Bryman (2011) criticize thematic analysis on the basis that it has no formal procedure expressed. It is because of this I have combined thematic analysis with coding, to express an explicit process that creates a foundation for the thematic analysis' generation of themes. At the same time, I see the concept of thematic analysis as rather easy to understand, given that it focuses on the identification on themes. I do not see this critique as something negative, rather as an opportunity since it gives me room to analyze the empirical data in a way fit for the study. I believe that this freedom to adapt the method is a necessity for my study, given that its primary source of empirical data is design probes and thereby not only written data.

6. Conclusions

This chapter compiles the analysis and discussion to answer the two research questions that were stated in the beginning of this study.

6.1 *Children as participants with design probes*

There is in fact a good fit with using children as participants when it comes to how design probes motivating children participating in the design process. The reason behind that is that two of the four probes within this study did show results of great value. When conducted in a way that is fit for children, it will highly likely yield great results of value to the given design process, which has been seen in the design probes within this study. It does add additional challenges to the method with more children-specific aspects that the designer needs to bear in mind. Firstly, playfulness evidently plays an important role in motivating the children to perform the tasks within a design probe. Yet playfulness is not easy to achieve or determine within a design probe. Other aspects that could affect the children's appliance with the method is children's inability to perform tasks long-term, language, performing the task in a home environment and the use of rewards. Secondly, children are good at being creative which is an opportunity for designers. Making the tasks creativity-focused might result in both a greater motivation and more detailed answers. Thirdly, children are subject to be influenced by both internal and external factors that could possibly affect the result of the design probes. Lastly, children do not perform well on tasks with a reflective focus. Reflection is still evident in any task by the autoethnographic stance design probes have on the participants. Participants need to reflect on their everyday to perform most tasks within a design probe, generating reflective answers nonetheless.

6.2 *Thematic and non-thematic design probes with children*

Regarding the comparison of thematic and non-thematic design probes with children, this study suggests that there is a relation between having a theme and success. The two design probes that were successful, in terms of alignment between purpose and the answers from the participants, were thematic. The reason is not yet confirmed but this study indicates that having a theme motivates the children. What is evident is that applying a theme leaves no guarantee of success. One design probe, which did not achieve the alignment between

purpose and answers, is still thematic. This indicates that there are more factors involved than being thematic in terms of value creation. Aspects like influences, environment, time and reflection seem to be independent to the themes, giving both thematic and non-thematic design probes equal challenges within these topics.

7. Reflections

This chapter introduce insights and thoughts from the study. At first, the reflection of the study is presented where critique is lifted while also mentioning things that could have been made differently. Thereafter, reflections are made regarding possible paths for future research.

7.1 Reflections of the study

Overall, I am pleased with the study and the conclusions drawn out of it. Also, this has been an educational journey which has taught me much about both research and design work. Nonetheless, there is also some critique that is worth lifting. Firstly, the more general kind of criticism regarding the selection of empirical data also applies for this study. Due to the scope and time I had to perform this study, it was not possible to incorporate more than four design probes. Although, more design probes could have contributed to even deeper findings and generalizability. Besides, I believe that the result and conclusions of this study are findings that can be of value for the gap in current research. Secondly, students created and tested the design probes themselves which could have had an impact on the outcome of each design probe. After all, students with high likelihood does not have experience working with design and thereby might have entered some pitfalls of design. Yet, I believe that the design probes still could generate great value to the study since even the design probes, that from this study was considered to have unsuccessful elements, sometimes could make a good example of what not to do.

What is also important to remember is that this is a qualitative study that has been interpreted by me as a researcher and other studies alike this one might generate completely different conclusions. Generalizability is therefore hard for me to state, because of its complex nature. Yet, some of the conclusions of this study is highly likely to be applicable for other settings. This applicability remains to be tested within the other settings to claim the study to be generalizable.

7.2 Research for the future

When conducting this study, multiple new perspectives and approaches have become evident for further research. This study has been limited to only one type of design probe, to the

thematic and non-thematic comparison and towards children. On each area there are interesting new endpoints for further research. Firstly, to study other types of design probes and their applicability with children could yield even further insights to the area of research. At the same time, it would be interesting to make a comparison between different types of design probes to see if any type is superior to the other. Other than comparing thematic design probes with non-thematic design probes, there are probably plenty of attributes that are of interest to analyze with children. Themes ended up being mostly about motivation and playfulness, but what I would like to see if other attributes could have a major impact on other success factors of the method with children. Further, another interesting endpoint would be to assess different target groups. Being a child could range from infants to adolescents, meaning that the result from design probes with high probability will vary between different ages of participants. This study focused on children ages 10 to 13, leaving out both younger and older children as possible target groups for future research. Another endpoint would be to go into depth with which tasks would be adequate for design probes meant for children. This seemed to be a recurring issue for the design probes within this study where every design probe had at least one task that was not fit for children. What could also be an interesting endpoint is to replicate this study with other design probes to see if there is any variance between results.

Following are some examples on research question for future research:

- How do design probes enable adolescents participating in the design process?
- How do different type of design probes compare when applied with children?
- Which type of tasks is adequate when applying design probes with children?

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