Aalto University
School of Science
Degree Programme in Information Networks

Annika Berg

Co-design with children:
A new mobile financial service concept

Master's Thesis

Espoo, May 21, 2015

Supervisor:	Professor Marko Nieminen
Instructor(s):	Esko Kurvinen D.A., Petri Mannonen M.Sc.(Tech.)

Aalto University
School of Science

Aalto University School of Science Degree Programme in Information Networks	ABSTRACT OF THE MASTER'S THESIS
Author: Annika Berg	
Title: Co-design with children: A new mobile financial service concept	

Number of pages: 82	Date: 21.5.2015	Language: English

Professorship: User Interfaces and Usability	Code: T-121

Supervisor: Marko Nieminen D.Sc.(Tech.)

Instructor(s): Esko Kurvinen D.A., Petri Mannonen M.Sc.(Tech.)

Abstract:

Increasingly younger children own a smartphone with an application store and in-app purchasing possibilities. Consequently, they encounter digital currency even before cash. However, there is no service on the Finnish market that would enhance children's learning and understanding of digital currency. The current practice is that children acquire their weekly allowance as cash.

The aim of this thesis was to plan and execute a user-centered co-design concept design process with children in the context of mobile payment. The methods were suitable co-design methods for children based on literature review implemented in a concept creation project. The target group is children aged 7 to 14 years. The empirical study was conducted in a primary school with a school class of eight sixth graders and fourteen second graders. In addition, moodboard interviews were conducted with four families.

The results of this thesis are threefold: (1) description of children's needs relating to mobile payments, (2) a suggestion and illustrations for a new financial mobile concept, (3) evaluation of the chosen methods and a recommendation for the co-design practice with children. Young children seem to have difficulties in understanding the concept of money; for example, they make accidental in-app purchases. Children desire to make online and mobile purchases, but they mainly have only cash. In addition, saving and games are important to children in the context of payments. However, it was found that second graders and sixth graders have rather different needs for the financial mobile concept, and families differ in their practices related to money. The developed concept reflects the presented results. The chosen co-methods were suitable for the process. This thesis suggests considering the age and role of the child in the process, orienting the children to the activities with their own examples, and interpreting the results with great caution. In addition, flexibility is needed from the researcher. Nonetheless, children are creative and talented designers, especially in the mobile field.

Keywords: co-design, user-centered design, participatory design, service design, children, financial, mobile, payment, money, currency, concept, service

Aalto-yliopisto Perustieteiden korkeakoulu Informaatioverkostojen koulutusohjelma	DIPLOMITYÖN TIIVISTELMÄ		
Tekijä:	Annika Berg		
Työn nimi:	Osallistava suunnittelu lasten kanssa: Uusi mobiili rahapalvelukonsepti		
Sivumäärä: 82	Päiväys: 21.5.2015		Julkaisukieli: Englanti
Professuuri: Käyttöliittymät ja käytettävyys		Professuurikoodi: TU-121	
Työn valvoja:	Marko Nieminen TkT		
Työn ohjaaja:	Esko Kurvinen TaT, Petri Mannonen DI		

Tiivistelmä:

Yhä nuoremmilla lapsilla on älypuhelin, jossa on sovelluskauppa ja mahdollisuus tehdä ostoja sovelluksissa. Näin ollen he tutustuvat digitaaliseen rahaan jopa ennen käteistä. Suomen markkinoilla ei kuitenkaan ole palvelua, jonka avulla lapsille voitaisiin opettaa digitaalisen rahan ymmärrystä ja oppimista. Nykyinen käytäntö on, että lapset saavat viikkorahansa käteisenä.

Tämän diplomityön tarkoituksena oli suunnitella ja toteuttaa käyttäjäkeskeinen osallistava konseptisuunnitteluprosessi lasten kanssa mobiilimaksamisen kontekstissa. Metodina käytettiin sopivia kirjallisuuskatsaukseen pohjautuvia osallistavan suunnittelun työkalun menetelmiä lapsille. Käyttäjäryhmäksi määritettiin 7–14-vuotiaat lapset. Empiirinen tutkimus suoritettiin ala-asteella sellaisen ryhmän kanssa, jossa oli sekä tokaluokkalaisia että kuudesluokkalaisia lapsia. Tämän lisäksi suoritettiin tunnelmatauluhaastatteluita neljän perheen kanssa.

Työn tulokset ovat kolmijakoiset: (1) Kuvaus lasten tarpeista mobiilimaksamiseen liittyen, (2) visuaalinen ehdotus uudesta rahankonseptista, (3) valittujen menetelmien arviointi ja suositus osallistavan suunnittelun menetelmien käytöstä lasten kanssa. Nuorilla lapsilla näyttää olevan vaikeuksia ymmärtää rahan käsitettä. He tekevät esimerkiksi vahinko-ostoja sovelluksissa. Lapsilla on halu tehdä ostoksia tietokoneella ja puhelimissa, mutta heillä on yleensä vain käteistä. Tämän lisäksi säästäminen ja pelit olivat tärkeitä mobiilimaksamisen kontekstissa. Tokaluokkalaisilla ja kuudesluokkalaisilla näytti kuitenkin olevan aika erilaiset tarpeet mobiilimaksamisen konseptille, minkä lisäksi perheillä on erilaisia käytäntöjä rahan suhteen. Konseptiehdotuksessa otetaan huomioon nämä löydökset. Valitut osallistavan suunnittelun menetelmät olivat sopivia tälle tutkimukselle. Tämä diplomityö ehdottaa lapsen iän ja roolin huomioimista prosessissa, lasten orientoimista aktiviteetteihin heidän omilla esimerkeillään ja tulosten tulkitsemista harkiten. Tämän lisäksi tutkijalta vaaditaan erityistä joustavuutta. Lapset ovat kuitenkin luovia ja lahjakkaita suunnittelijoita, erityisesti mobiilialalla.

Asiasanat: osallistava suunnittelu, käyttäjäkeskeinen suunnittelu, palvelumuotoilu, lapset, raha, mobiili, talous, maksaminen, valuutta, konsepti, palvelu

ACKNOWLEDGEMENTS

TABLE OF CONTENTS

1 INTRODUCTION

When designing a service, the designers must ensure whether the service solves everyday problems better than the current practice does. One approach to increase the probability of succeeding in service design is to conduct the design process in user-centered manner: to keep the users involved in the design process to ensure that the service fulfills the end-users' needs. Designing to the children brings other challenges. Even though adult designers may assume that they understand children on the basis that they once were children too, each generation has different motivations, values, culture, understanding, and technologies; as a result, they have different ways of adopting technology (Read, Horton, Fitton et al., 2013). In recent decades, interest in co-designing with children has risen significantly (Read & Bekker, 2011). Children are no longer seen only as research objects or as a passive target group for the development of new technologies; the potential of involving children as active participants in the design process has been increasingly acknowledged (Nousiainen, 2009). In addition, children are commercially interesting target group, since they consume much digital content (e.g., digital games, Mäyrä & Erni, 2014).

This thesis was conducted as a part of an ongoing service development process in Elisa. Elisa is a Finnish telecommunications, ICT, and online service company (Elisa Oy, 2014b). The service under development is likely to be included to an existing service: Elisa Wallet. Elisa Wallet is a service for contactless payment supported by a mobile application. With the service, it is possible to adopt contactless payment, send money to others with the service, and manage eCards for paying in the Internet. The service utilizes funds that the customer has transferred from the user's bank account to the user's account in the service. (Elisa Rahoitus Oy, 2014)

The service being designed could offer a customized solution to families with children. Families encounter every day issues, for example, remembering if the weekly allowance has been paid already, whether the siblings have mixed their money, and whether the cash is still in a safe place. Additionally, weekly allowance might be an excellent way to teach the child about the concept, usage, and saving of money (Numminen & Götenstedt, 2011; Abramovich et al, 1991). Therefore, there is a design opportunity for designing a helpful solution for paying the weekly allowance in a safe manner. Moreover, children will face the challenges of using digital money already at very early ages with their smartphones and games with in-

app purchasing possibilities. Thus, it would be beneficial for the child to learn the concept of digital money early. The target group of the service is children aged 7 to 14 years. 15-year-old and older children are already in charge of their own money in Finland (Young Workers' Act, 998/1993). Additionally, under 7-year-old children were out of the research scope for ethical (Markopoulos et al., 2008) and practical reasons.

This thesis focuses on developing this service for children and their families. The service will be used with a smartphone and in the financial field. The secondary aim is to analyze if a similar process could be applicable to other service design processes of Elisa and function as an example of a service design case that involved users actively in its very early stages. The research questions of this thesis are as follows:

RQ1. **How children consume and understand money in the context of mobile payment?**

RQ2. **What kind of a new service could fulfill the needs children and their families have for a financial mobile application?**

RQ3. **What are suitable co-design process, methods and practices for developing a financial mobile concept for children and families?**

The aim of this thesis is thus to plan and execute a user-centered service design process for the Elisa's Service Design organization. Therefore, the scope of the research questions is the Elisa's Service Design organization in Finland. The results are the developed concept and a suggestion for suitable ways to utilize co-design practice in future projects.

This thesis approaches the subject from the perspective of human-computer interaction and user-centered design. Psychological theories of child development are considered indirectly through the child-computer interaction literature that partly emerges from the child development field. The focus of this thesis is on the development of the concept for children, however, the buyers and secondary users of the service would be parents, and they are considered to a sufficient extend. The methodical focus is on co-design methods due to three reasons. Firstly, it was Elisa's intent to improve ways to apply co-design methodology to their processes. Secondly, co-design is seen as a good methodology for engaging the user more actively in the

user-centered design process (e.g., Nousiainen, 2009). The third reason is the desired emphasis on children's creativity.

The literature that offers the theoretical base of the work is from the databases related to the field of computer machinery and associated fields, for example, the Science Direct and the Association for Computer Machinery (ACM). Additionally, literature was obtained from the Journal of Child-Computer Interaction and conference papers form the field (*the Participatory Design Conference* and *the International Conference on Interaction Design and Children*). The literature was chosen from these databases, journals and conferences due to their approach of human-computer interaction. The methods used are co-design methods suitable for children from the field of user-centered design. The target group of the service being designed is children aged 7 to 14 years, which is a broad group that includes also pre-teenagers. Consequently, the interest is on the relevant studies about school-aged children and teenagers. Additionally, material from Elisa was used; Interviews and observations in the company, all the materials from the existing application already available, as well as the research the company and external partners have already done from the topic.

This thesis is divided into five following chapters: Introduction, Literature review, Methods, Results of Empirical study, and Conclusions. The literature review aims to find a suitable user-centered design process and co-design methods for the development of the mobile financial service concept for children. The third chapter presents the method used for the empirical research based on the literature review and other aspects related to the method. The fourth chapter depicts the results and analysis of the empirical study. The results are threefold. Section 4.1 describes children's usage and understanding of money. Section 4.2 presents the needs for the financial mobile application based on the research, and proposes a concept. Section 4.3 evaluates the chosen methods and recommends best practices for working with children based on the analysis. Consequently, the literature review (Chapter 2) addresses the first research question of this thesis and the empirical part addresses all of the three research questions (see the research questions above). Finally, the fifth chapter concludes the answers to the research questions, proposes further research and steps, and analyses the applicability of a similar co-design process to other service design processes in Elisa.

2 LITERATURE REVIEW

This chapter reviews the literature on current user-design processes and co-design methods that could be used for the development of financial service for children. Section 2.1 presents and compares user-centered service and concept design models. Section 2.2 briefly describes the co-design tradition. Section 2.3 introduces the child-computer interaction tradition. Finally, Section 2.4 depicts the co-design methods previously used with children and families and offers a suggestion for suitable methodology that could be used for the development of the financial service for children. This thesis does not discuss further the differences between terms *product* and *service* (see, e.g., Saffer, 2006). The term *service* is favored in this thesis due to its co-created nature (Saffer, 2006).

2.1 USER-CENTERED SERVICE AND CONCEPT DESIGN

User-centered design (UCD) is a design approach that utilizes end-user involvement to ensure that the designed service meets the end-users goals (e.g., IDEOb; ISO 9241-210, 2010). UCD is also often referred to as *human-centered design* (HCD). However, HCD is not synonymous with UCD, since HCD can emphasize the importance of multiple stakeholders rather than only the users (ISO 9241-210, 2010). In this thesis, these terms are still used as synonymous; the focus is on the end-users of the service, children, though parents are considered to a sufficient extend, since they would be the secondary users and buyers of the service.

The International Organization for Standardization's (ISO) standard 9241-210 for human-centered design process for interactive systems establishes probably the most well-known user-centered process. The process includes the following steps: understand and specify the context of use, specify the user-requirements, produce the design solutions, and evaluate the design (ISO 9241-210, 2010). In addition, the process is iterative; thus the steps are not necessarily done only once. The iterative nature of the process is illustrated in Figure 1. (ISO 9241-210, 2010)
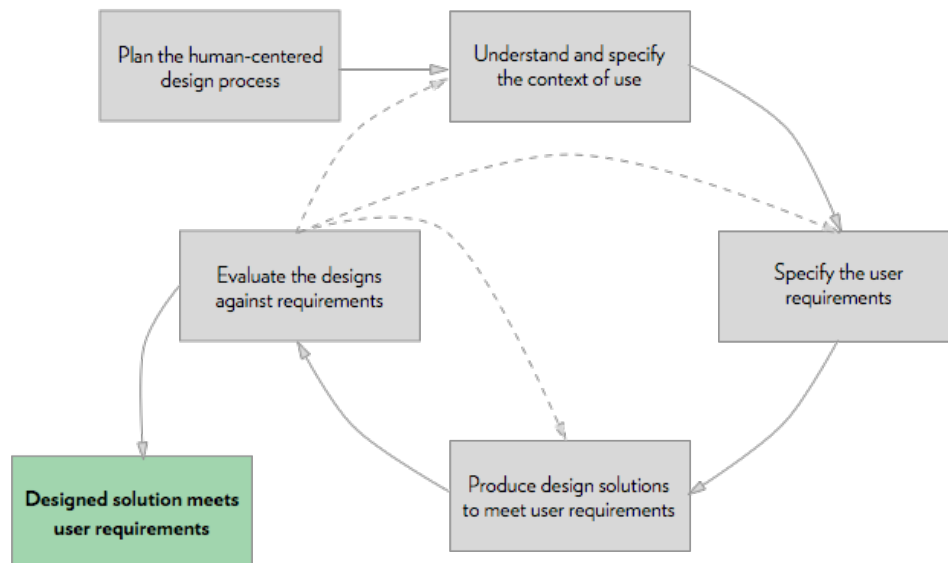
Figure 1 - Human-centered design process (modified from ISO 9241-210, 2010)

The HCD process (ISO 9241:210, 2010) is complemented by the principles of human-centered design. These principles consist of explicit understanding of users, tasks and the environment; user involvement; a design which is driven and refined by user-centered evaluation; an iterative process; a design which addresses the whole user experience; and a design team which includes multidisciplinary skills and perspectives. The second principle, user involvement, is the specific interest of this thesis, since this thesis utilizes primarily co-design methods in the design process to ensure the users are actively involved in the design process. In fact, UCD has been criticized for involving the users insufficiently; as Scaife et al. (1997) point out, the user involvement is often "too little too late" in the process.

Other common design processes in the UCD field include the *Usability engineering life cycle model* (Nielsen, 1994) and the *Contextual design process* (Beyer & Holtzblatt, 1997). However, all of the three design processes follow the same structure; the first phases of the process concentrate on knowing the user and the whole context of use, the following phases innovate and prototype various solutions, and the last phases outline the evaluation and testing of the solutions. Conversely, the Contextual design process embeds the evaluation and testing phases in the phases that innovate solutions. Both of the processes are also iterative and involve the user as well as the earlier discussed HCD process. The Usability life cycle model and the Contextual design process differ from the HCD process in offering specific tools for

the designer. For example, the Usability life cycle model suggests prototyping as phase eight, which is also a design method (IDEOa). Similarly, the Contextual design process offers specific instructions for the design process. For example, the first phase is *Contextual inquiry*, which is also a common design method (IDEOa; Beyer & Holtzblatt, 1997). The differences between the processes are partly related to the difference between the nature of the references. HCD process is an industry standard whereas the authors of the Usability engineering life cycle model and Contextual design process are researchers and usability consultants. Table 1 below summarizes the design processes discussed in this section. All of the processes are iterative though it is not specified in the table.

	HCD process for interactive systems (ISO 9241-210, 2010)	Usability engineering life cycle model (Nielsen, 1994)	Contextual design process (Beyer & Holtzblatt, 1997)
Know the user and the context of use	(Plan the human-centered design process)	Know the user	Contextual Inquiry
		Competitive analysis	Interpretation
		Setting usability goals	Data Consolidation
	Understand and specify context of use	Parallel design	
		Participatory design	Visioning
Creation of the design		Coordinated design of the total interface	Storyboarding
	Specify user-requirements	Apply guidelines and heuristic analysis	User Environment Design
Evaluation and testing	Produce design solutions and evaluate the design	Prototyping	Prototyping
		Empirical testing	
		Iterative design	
		Collect feedback from field use	

Table 1 - Comparison of UCD processes

User-centered concept design

User-centered concept design is an early phase exploratory process in service development (Salovaara & Mannonen, 2005). Although traditional user-centered models have been developed to a detailed level (Kankainen, 2003), there are a few user-centered concept design models as well. Concept development models are

suitable when developing a service or a product to a concept level. As proposed by Nieminen (2006), a user-centered product concept development process includes the following phases: *project commitment*, *user and technology research*, *innovation sprint*, *concept creation* and *validation,* as well as *project assessment*. Table 2 below describes the process in a more detailed way.

Project commitment	User and technology research	Innovation sprint	Concept creation and validation	Project assessment
Define user group and context	Select research methods	Generate ideas	Select and combine	Evaluate concepts against requirements
Select technology framework	Conduct user and technology research	Be creative	Visualize	Collect customer feedback
		Do not criticize	Validate	
Schedule the project	Analyze data			Prioritize concepts and propose future steps
Outcome **Design brief**	**User tasks and needs description**	**Hundreds of ideas**	**Validated concept candidates**	**Final concepts** **Project documentation**
	Technology trends and possibilities			

Table 2 - Summary of the user-centered product concept development process (adapted from Nieminen, 2006)

Kankainen (2003) described a similar user-centered concept design process to the one described by Nieminen (2006). However, it separates motivational level needs and main action level needs as well as low-fidelity and high-fidelity prototypes in the process. Thus, it is more complex than the process described by Nieminen (2006). Likewise, Salovaara and Mannonen (2005) improved a user-centered concept design process with phases that use future oriented information. The process is otherwise similar to the processes described by Kankainen (2003) and Nieminen (2006), but it is improved by adding future oriented information to the process in two-folded manner; in the ideation phase the future trends are considered, and in the idea refinement phase stable context features (i.e., features that are unlikely to change) are acknowledged (Salovaara & Mannonen, 2005).

In general, all of the service and concept design processes follow the same structure: *reveal needs, generate ideas,* and *evaluate concepts* (Bowen et al., 2013). The idea

generation is in bigger role in the concept design models than in the previously discussed service design models, and the process does not define the end-solution to a detailed level, since it ends when the concept, not the final product, is ready. In addition, *reveal need* phase can be understood identical to previously established *know the user and the context of use* phase. This thesis uses *know the user and the context of use* term to emphasize the importance of understanding the user and context. Additionally, the actual concept creation phase is in insignificant role in the general design process described by Bowen at al. (2013): the concept creation is included in the creation of the design phase. Consequently, *creation of the design* phase is divided into *ideation* phase and *creation of the concept* phase to address the creative nature of the concept design process. Moreover, all of the three concept design models mentioned here contain a phase for the design brief, which can be seen as similar to the HCD process phase called *plan the human-centered design process*. However, it can be positioned outside of the actual user-centered design process, as a pre-design phase. Because the aim of this thesis is to develop the service to a concept level, the general process for the user-centered design in this research is based on this suggestion, hence being, *(plan the process) know the user and the context of use, idea generation, creation of concepts*, and *evaluate concepts*. Table 3 below contains all of the mentioned concept design models as well as the refined concept design process. All of the processes are iterative though it is not specified in the table.

Refined concept design process (adapted from, e.g., Bowen et al., 2013)	User-centered product concept development process (Nieminen, 2006)	User-centered product concept design process (Kankainen, 2003)	The user-centered product concept design process (Salovaara & Mannonen, 2005)
(Plan the process)	Project commitment (result: Design brief)	Design brief	Design brief
		User research (motivational level needs)	User research
			Literature research
Know the user and context of use	User and technology research	Generating product concept ideas	Explicating future-oriented information
		Building and evaluating low-fidelity prototypes	Generating product concept ideas
Idea generation	Innovation sprint		Ideation
		Refinement	
			Idea refinement
		Selection	
Creation of concepts		User research (main	
	Concept creation and		

	validation	action level needs)	Building and evaluating prototypes
Evaluate concepts	Project assessment	Building and evaluating high-fidelity prototypes (iterative with next phase)	
			Refinement
		Refinement	Concepts
		Selection	

Table 3 - Comparison of User-centered concept design processes

The above discussed concept design models do not specifically address the other goals for the concept design process than the specification for the following design phases. Keinonen (2006) suggests that the goals for concept design may be, in addition to the contribution to the product development, *innovation, shared vision, competence,* and *expectation management*. Furthermore, an important result of the concept design process may be the decision not to continue with the implementation. Table 4 below summarizes the possible objectives of concept design with example cases (modified from Keinonen, 2006).

Goal of concept design	Examples
Product development	Specification for the following design phases
	Decision to go ahead with implementation
Innovation	Spin-offs for immediate improvements
	Idea bank for future use
	Concept directions for investments
	Alliances with key partners
	Patenting
Shared vision	Specific shared meanings
	Vocabulary for communication
Competence	Improving creative problem solving
	Learning about technology and market opportunities
	Improving team spirit and cross –disciplinary -cooperation
Expectation management	Improving brand image
	Influencing consumers' acceptance level and stakeholders'

interest

Table 4 - The objectives of concept design (Adapted from Keinonen, 2006)

This section presented user-centered processes for service and concept development. The main points are as follows:
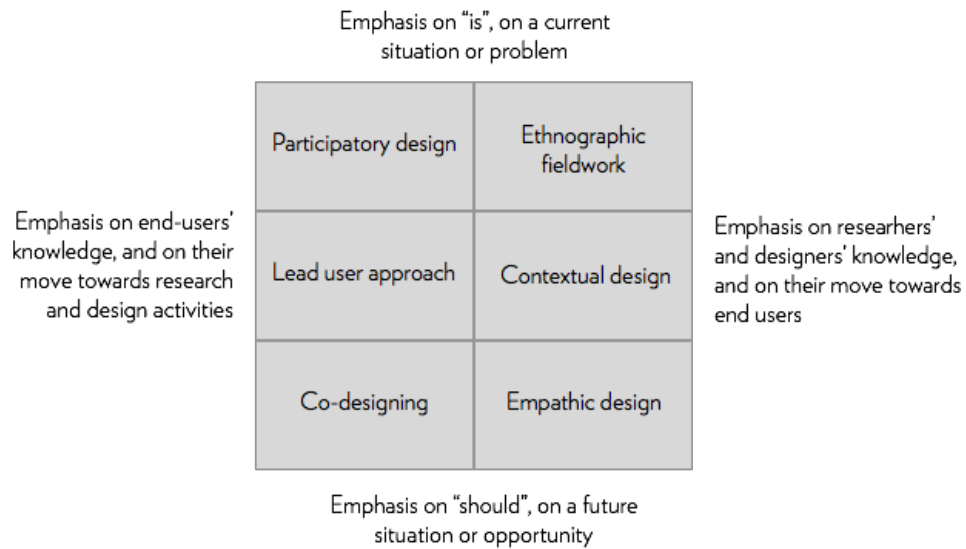
- The standard for user-centered service design model is the HCD process for iterative systems (ISO 92411-219, 2010), which gives a framework and principles for the process. In addition, researchers and consultants have developed models, which gives more specific suggestions for methods to use in each stage (Nielsen, 1994; Beyer & Holtzblatt, 1997).
- The concept design processes are similar to user-centered service design models but they concentrate on the early phase exploratory process, for example, they give more weight on early phase ideation (e.g., Nieminen, 2006; Kankainen, 2003; Salovaara & Mannonen, 2005).
- Even though the presented models have their specialties, they are fundamentally similar. They start from the user and context understanding phase, continue to concept/service specification and creation phase, and end in the testing and evaluating phase. In addition, they are iterative.
- Concept creation models have also other goals than specifications to product development (or decision to not to continue with the implementation). They are innovation, shared vision, competence and expectation management.

2.2 CO-DESIGN

Co-design is collective creativity of designers and people not trained to design applied across the design process; thus, it has an impact on the roles in the design process (Sanders & Strappers, 2008). Co-design process brings the roles of the designer and user closer: the user plays a large role in knowledge development, idea generation and concept development whereas in "traditional" UCD process the user is seen as a passive object of a study (Sanders & Strappers, 2008). Indeed, UCD has been criticized for relying on the users mainly as passive testers or evaluators in the process (Nousiainen, 2009) or involving them in the process too late (Scaife et al., 1997).

The term co-design is often treated as synonyms to various terms, such as co-creation, empathic design and participatory design (Sanders & Strappers, 2008; Steen et al., 2007). As mentioned by Sanders & Strappers (2008), co-creation is broader term referring to any act of collective creativity whereas co-design emphasizes the participation of non-experts. Steen et al. (2007) suggested that the various terms emphasizes different issues. Figure 2 below depicts the differences of the terms and their relation to each other within the field of UCD.

Emphasis on "is", on a current situation or problem

Emphasis on end-users' knowledge, and on their move towards research and design activities

Participatory design	Ethnographic fieldwork
Lead user approach	Contextual design
Co-designing	Empathic design

Emphasis on researhers' and designers' knowledge, and on their move towards end users

Emphasis on "should", on a future situation or opportunity

Figure 2 - The relation of the term co-design to various terms in the field of UCD (Adapted from Steen et al., 2007)

Co-design with children

Co-designing with children is often referred to as participatory design due to historical reasons (e.g., Scaife et al., 1997; Read et al., 2014; Druin, 1999). According to Figure 2, co-design differs from participatory design in the emphasis on future opportunity rather than emphasis on current problem (Steen et al., 2007). However, some researchers in the field of child-computer interaction suggest that the difference is related to the debate on the accurate role of children in the co-design process. The preferred role of a child can vary from very active (Druin, 2009) to only an informant (Scaife et al., 1997). Read et al. (2014) mean by participatory design the latter, they define the term participatory design to be: "involvement of end users as informants in the design of technology". In addition, Read et al. (2014) mention co-design as one meta-method of participatory design in addition to design partners and informant design. Figure 3 below illustrates the different roles a child can have within the design process (Druin, 2009). This thesis, however, uses the term of co-design as a broader term and refers by it both to the involvement of end users of the role of informant and design partner, because the exact role or emphasis is not relevant to the concept design case of this thesis. As Markopoulos et al. (2008) notes, the role of the child might change within one design process: "Even in co-design project, there might be some points in the process in which the assumptions of the design team needs to be tested, so that the children's role change from design partner to tester".
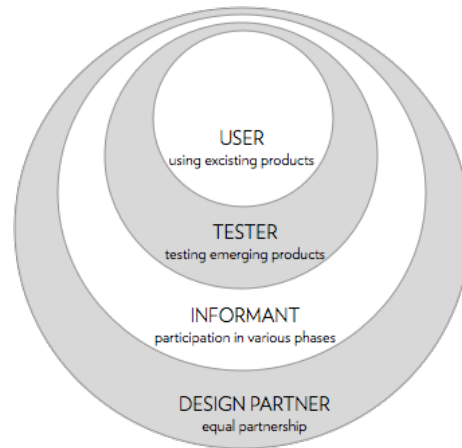
Figure 3 - Children's roles in the co-design process (adapted from Druin, 2002)

Co-design process

Although similar to user-centered view, Sanders & Strappers (2008) note that co-design process has "fuzzier" front-end than "traditional" design processes (see Figure 4); in the beginning of the co-design process, it is not often clear what the end deliverable is going to be. Before pre-design defined a lot of the issues concerning the design, presently this part is included in the design process (Sanders & Strappers, 2008). This phenomenon can be reflected to the UCD and user-centered concept design models discussed in the previous section (see Section 2.1). It is not obvious from the presented models that the beginning of the process would be "fuzzy". On the contrary, many of the mentioned UCD and user-centered concept-design models included a pre-design phase with an outcome of design brief. However, this thesis does not suggest that constructing a design brief would be an obstruction to a successful co-design process. On the contrary, a well-defined goal can be useful in the "fuzzy" front-end of the process.
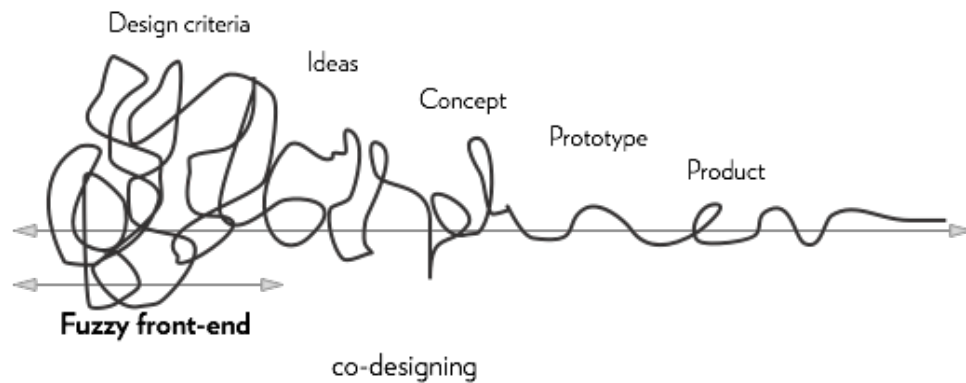
Figure 4 - The front-end of the design process has been growing as designers move closer to the future users of what they design (adapted from Sanders & Strappers, 2008)

2.3 DESIGNING FOR CHILDREN

Before conducting plans for the methodology or process for the design of service for children, the researcher should determine how to design for children. The research field that is interested in designing interactive products for children is called *child-computer interaction*. There are many definitions for child-computer interaction. Read and Bekker (2011) suggested a definition based on the definition of Human Computer Interaction (the definition of the human-computer interaction can be found, e.g., in Hewett et al., 1992):

> *Child computer Interaction is a discipline concerned with the design, evaluation and implementation of interactive computing systems for children's use and with the study of major phenomena surrounding them.* (Read & Bekker, 2011)

Another definition is by Read et al. (2005), but that emphasizes the difference between adults and children; thus, child-computer interaction is not only a subset of human-computer interaction. The three key differences between children and adults are *activities*, *behaviors* and *concerns*: children do different activities with computers than adults do, they behave differently around computers than adults do and the concerns of children are different from adults'. (Read & Bekker, 2011)

Design guidelines for children's services

Literature review

There are guidelines for designing products or services for children, and even more specific guidelines for designing mobile services for children. Druin (2009) suggests the following design guidelines for interactive design for children using mobile, touch-based platforms:

1. Use clear and frequent audio prompts. Clear and frequent audio prompts could explain the needed interaction style, thus prevent the children to hesitate touching the screen.

2. Use specific, concrete instructional language. For example, "Touch and move" is much effective than "Scroll".

3. Program events to occur on touch, not tap. Children prefer "Touch and hold" response to "Touch and lift", which results in the children continuing to press down harder and harder when the device does not respond to their touch.

4. Avoid caching of touches/taps. When the screen is tapped multiple times, for example, iPhone, can store the interactions, and the actions can occur *after* the screen was touched. This delay might be hard to understand for children.

5. Use caution with multitouch. Putting two fingers together or pulling them apart is more difficult for children.

6. Avoid hotspots near the edge of the screen. Children can accidentally press the hotspots on screen if they are too close to the edges.

7. Immediate feedback is necessary, especially in response to touch. If there is a delay in responsiveness, children often think that their response has not registered or has been incorrect and move on to trying something else.

8. Carefully design tilt functionality. Design tilt functionality so that small tilts do not have a big impact on the game play, since children tend to tilt the device unintentionally.

9. Use visual cues to help the user understand when she is in control. On-screen elements should highlight or change visually in some way to indicate when they are hot, or touchable, and when they are not.

10. Rethink placement of icon labels. Computer applications often place labels below pictorial icons. However, such labels will often be obscured by the hand or finger in touch-based mobile applications. Labels should instead be placed above icons whenever possible. (Adapted from Druin, 2009)

These guidelines have been developed in 2009, and in already five years mobile technology has evolved excessively. Presently, young children already have touch-

screen smartphones; according to a recent study in Finland, parents believe that the age of seven is a proper age to acquire a smart phone (DNA Oy, 2014). It can be assumed that children learn to use touch-based interfaces at very early age, and some of the presented ideas may not be an issue anymore, for example, multitouch. More recent studies, however, imply that there is still a difference between the touch-accuracy between children and adults, which affects the smart phone usage (Anthony et al., 2013). Nevertheless, during the last three years the usage of smartphones among children has possibly risen in Finland. According the study conducted in 2011, only 68% of the 7-year-old children had mobile phones at all whereas, in 2014, 91% of the children aged 6 to 12 years had mobile phones, of which 75% were smartphones (the study conducted in 2011 did not separate traditional and smartphones whereas the recent study made in 2014 did not separate different age groups) (DNA Oy, 2011; DNA Oy, 2014). Consequently, the children over 7 years do not usually encounter unconquerable obstacles when using smartphones. Furthermore, children's fine motor skills activities may improve due to the smartphone usage (Elisa Oy, 2014a).

There are also some general guidelines for designing for children which could be applied to the design. The guidelines by Gelderblom & Kotzé (2009) are as follows:

1. If a child can solve a specific kind of a problem in one domain they cannot necessarily transfer that skill to a different domain
2. Young children find it difficult to translate between the formal systems of mathematics and the quantities, operations and concepts it represents
3. Do not separate the instructional part and the fun part of the product
4. Allow children to use different strategies in problem-solving activities
5. Promote reflective thinking and skill development by making children aware of the processes underlying success of failure
6. A skill may be tough or acquired differently by children from different cultural groups
7. Do not rely on children's accurate recall of audio instructions
8. Give children control over the level and frequency of speech feedback
9. Young children perform point-and-click quicker and more accurately than drag-and-drop
10. Reachability, familiarity and substitutivity have special meaning for children's products (Gelderblom & Kotzé, 2009)

Some of the guidelines are not relevant to the design process of this thesis. For example, the children are from the same cultural group and thus there is no need to

consider the guideline six. Furthermore, the point-and-click gesture being more accurate than drag-and-drop (see the guideline 9) might not be valid anymore, as discussed earlier about the children's rapid adoption of new technology. However, some of the guidelines may be relevant to the design process of this thesis, such as guideline 3: "Do not separate the instructional part and the fun part of the product". In addition to the presented guidelines, there are design guidelines that are based on developmental psychology theories (see the work by Gelderblom & Kotzé, 2008).

There are no guidelines for designing financial services for children. Even though there are some sociological and psychological studies of children and payment (e.g., Abramovitch et al., 1991; Ruckenstein, 2010), and some financial services are on the market for children (e.g., *Allowance Manager* in Dunham, 2013), little research has been done in the field of child-computer interaction concerning children and payment. In addition, the roles of parents and siblings as well as the home context have been understudied (Read & Markopoulos, 2013). No financial service for children can be designed without considering the parent, since the parent is the buyer, enabler, and secondary user of the service. Children's technologies have not been studied and developed to a sufficient extent to support and encourage children's social interactions (Bruckman et al., 2001).

This thesis focuses on the co-design methods with children, which is one part of the child-computer interaction field, but does not give throughout overview of the topic. More information on the current status of the child-computer interaction field can be found, for example, in Read & Markopoulos (2013) and Read & Bekker (2011).

Co-design process with children

The co-design process with children usually follows the same process model as the co-design with adults. Markopoulos et al. (2008) describe the overall product design lifecycle model to be, for example, the HCD process (described in more depth in Section 2.1), from which the researcher has to recognize the suitable phases in which children can be involved. Two of the models for user-centered concept development models, described already in Section 2.1, were both used with children (Nieminen & Viitanen, 2008; Kankainen, 2003), although they did not address the specific user group particularly in their research. However, some child-computer case studies mentioned a specific design process. Bowen et al. (2013) described a concept creation process with participants aged 11 to 16 years. The process contained five

following steps: *Understanding and sharing experiences, Exploring blue-sky ideas, Selecting and developing blue-sky concepts, Converging to practical proposals, Prototyping and evaluating*. All of the phases contained one to two co-design workshops with suitable methods, which are introduced in the next section. Another user-centered process for children was depicted from the viewpoint of children as informants. The process contained four following phases: *Define domain and problem, Translation of specification, Design low-tech materials and test, Design and test high-tech materials* (Scaife et al, 1997). The process by Scaife et al. (1997) was a design process – not concept design process – and thus it proceeded to a detailed level. In addition, the model by Scaife et al. (1997) contained many methods in which the children did not take part. The role of children as informant do not involve children as closely in the process as some other roles in the co-design field as discussed earlier in Section 2.2. Frauenberger et al. (2012) used a co-design process with children that contained four following phases: *Foundation - building lasting relationships and initial observations, Inspire - creative design activities facilitating outside-the-box thinking, Listen - capturing and interpreting input and translating it into a design*, and *Evaluate - testing design ideas with the participants*.

The described design processes are all similar, even though they might emphasize different things or their complexity may vary. In general, all of the design processes follow the certain structure introduced earlier: know the user and the context of use, idea generation, creation of the concept, and evaluation of concepts (modified from, for example, ISO 9241-210; Nieminen, 2006 and Bowen et al., 2013). Additionally, there can be a planning stage before the *know the user and the context of use* phase that happens prior the actual design with the users. This stage can be called *plan the process* phase and the outcome can be *a design brief* (see the design brief -phase in Kankainen, 2003; Salovaara & Mannonen, 2006; and Nieminen, 2006). This division is also used later in this thesis when categorizing the possible co-design methods in the next chapter and as a process base for the empirical part. There is no significant difference in design processes with children to the previously introduced design processes (see Section 2.1). However, since the secondary target group of this thesis is the family of the child, it is notable that no process introduced here or in Section 2.1 included the social group of the user in the design process. Though, it can be seen to include in the know the user and context of use phase as a social context of the child to some extent.

2.4 METHODS FOR CO-DESIGNING WITH CHILDREN AND FAMILIES

In recent decades, co-designing with children has become more common (e.g., Read et al., 2014). However, same design methods used with adults are often used with children and teenagers (Read & Markopoulos, 2013). Many researchers note that many of the same methods as designing with adults apply, but many of them have to be adapted (e.g., Druin, 2009). The following list includes only methods that have especially been designed or adapted for co-design with children. There are many ways to categorize these methods. This thesis makes the division by the design stage to facilitate the selection of suitable methods for the empirical study of this thesis. In addition, similar methods are grouped by their nature; for example, *contextual methods* include methods related to observing the environment and the situation.

Know the user and the context of use: The early phase co-design methods with children include various methods such as contextual methods, narrative methods and workshops for categorizing pictures or making personas. Contextual methods include *technology immersion* (Druin, 1999), *contextual inquiry* (Druin, 1999), and *Kidreporter* (Bekker et al., 2003). *Technology immersion* and *contextual inquiry* are phases of the *cooperative inquiry* approach in addition to *participatory design* (Druin, 1999). *Contextual inquiry* (Druin, 1999) encourages children and researchers to observe in a relevant context. *Contextual inquiry* is based on the work by Beyer & Holtzblatt (1997), but it was adapted to the *cooperative inquiry* approach (Druin, 1999). *Technology immersion* phase introduces the children to the particular technology and the capabilities of it (Druin, 1999). *Kidreporter* includes children constructing a magazine in a suitable context by using many methods also common in user-centered design; picture taking, interviewing, article writing, filling in a questionnaire (Bekker et al., 2003). Narrative methods include *Mission from Mars* (Dindler et al., 2005) and *Talking to an alien* (Read, Horton, Fitton et al., 2013). *Mission from Mars* method (Dindler et al., 2005) includes three following stages: establishing the narrative, preparing the encounter with the Martian and encountering the Martian. The children are first introduced a story about a Martian who wants to know more about a certain subject on earth. After that, the children form groups in order to make presentations for the Martian. In the last step, the children present their ideas to the Martian and the presentations are recorded by a video camera. *Talking to an alien* presents the same method adapted to teenagers. Teenagers were

divided into small friend groups, each of which had a top-secret mission to take care of an alien who was about to come to the school; the alien wanted to fit in. They had a sheet of paper with pre-made questions they had to fill in. To add a fun factor in the method, they could leave a recording to the alien as well. (Read, Horton, Fitton et al., 2013) Workshop for categorizing pictures was called *the Cool Wall* method (Bowen et al., 2013) in a diabetes concept design process with teenagers; the method was similar to the activity in TV-series Top Gear. *The Cool Wall* included participants organizing pictures in the wall by their "coolness". Similar method has been used in other co-designing sessions with teenagers, for example, in Fitton et al. (2012). Finally, workshops for *creating personas* have been used successfully with teenagers, in Read, Horton, Fitton et al. (2013) and Bowen et al. (2013). In the work by Bowen et al. (2013), the personas were created in a form of a Facebook profile.

Idea generation: Methods for idea generation include contextual methods and methods based on drawing. The contextual methods contain *Mixing ideas* (Guha et al., 2004), *Sticky notes* (Guha et al., 2013), *embodied narratives* (Giaccardi, 2012), and *Fictional inquiry* (Iversen & Dindler, 2008). *Mixing ideas* method (Guha et al., 2004) is based on *cooperative inquiry* (Druin, 1999), but it starts with idea generation stage based on observations of classmates. Within the next phases, the ideas are being mixed together to create the "big idea" (Guha et al., 2004). *Sticky notes* method (Guha et al., 2013*)* is also based on *cooperative inquiry* (Druin, 1999). *Sticky Noting* begins with all adults and children using a technology; as they are working, all partners write down on Sticky Notes what they like or dislike about the current technology, and any suggested changes to the technology (Guha et al., 2013). *Embodied narratives* method (Giaccardi, 2012) contains phases of brainstorming, performing, shooting, printing, and sharing. The brainstorming phase comprises of the children brainstorming and exploring surroundings. In the performing phase the children set the scene collaboratively in order to be ready for the shooting phase. The shooting phase involves children taking pictures of the set they have made. Finally, they print and share the pictures. In addition, the children are asked to explain the pictures they have taken. *Fictional inquiry* method (Iversen & Dindler, 2008) contains contextual elements as well as narrative elements. The participants are given a letter explaining that the people of Atlantis needed the help from the family to create new fantastic experiences. Then the family was given different items (magic tools from the king of Atlantis) with which to explore the surroundings. At the end of the session, the family members presented the ideas. Methods based on

drawing include *Future cinema* (Bowen et al., 2013), *the Primed Design Activity (PDA)* (Fitton et al., 2014) and creation of *comics* (Moraveji et al., 2007; Read, Fitton & Horton, 2013). *Future cinema* method (Bowen et al., 2013) was used in a diabetes concept design process with teenagers. The participants had to complete unfinished scenarios (created by researchers) in *future cinema* style: draw on the paper how the ending would be in a movie in the future. *The PDA* method (Fitton et al., 2014) was also planned for teenagers and addressed the importance of the participants to understand the tasks. The PDA method contains four following activities: *A five Ws and one H*, *Ideas*, *Scenario Sketch*, and *Drawing screen designs on an acrylic "Phone Pad"*. The first and third activity provided instructions and directions to the design task whereas the second and fourth concentrated on ideation. *A five Ws and one H* stand for different questions asked (What, Who, Where, When, Why and How). The questions from the design process with answers were provided to the participants. *Ideas* included a sheet of paper with questions in which the participants answered. The *Scenario Sketch* and the *Drawing designs* phases are included in the following *creation of concept* phase. Finally, *comics* (Morajevi et al., 2007; Read, Fitton Horton et al., 2007) have been used as a tool for facilitating ideation. In a study by Moraveji et al., 2007, the researcher used special comic books to generate brainstorming sessions with children whereas Read, Fitton and Horton (2013) used comics as a tool for facilitating the explaining of the workshop contents.

One additional method which has been developed for adult users but which has also been studied also with child and teen participants is *obstructed theatre*, which could be used, for example, in the beginning of the ideation session or creation of the design session. It is designed to give the instructions as clearly as possible without biasing the participants, i.e., giving them unintentionally ideas beforehand. The idea is to show the participants a video or a recording of a scene in which people talk about the subject to be developed without revealing the essence of the service under development. (Read et al., 2010; Read, Fitton & Horton, 2013)

Creation of the concept: Most of the methods for creating the concept have been various low-tech prototyping methods, but also methods containing games (Vaajakallio et al., 2010), drawing (e.g., Bowen et al., 2013), role play (Vaajakallio et al., 2010), and moodboard (Kokil & Jeanne, 2008) have been used. The low-tech prototyping methods include *participatory design* (Druin, 1999), *Bags of Stuff* (Guha et al., 2013) and *make tools* (Vaajakallio et al., 2012). *Participatory design* is part of

the *cooperative inquiry* approach in addition to the previously discussed *technology immersion* and *contextual inquiry* (Druin, 1999). *Bags of Stuff* method (Guha et al., 2013) is based on *participatory design*. The method includes big bags filled with art supplies tailored for a specific project. After the low-tech prototypes are created by groups of two to three children and one to three adults working together, each group presents their ideas to the whole team. One adult team member takes notes on the *Big Ideas* on a white board during these presentations. Similar method to the *Bags of stuff* was used with teenagers in co-design session in which wearable technology called "telebeads" was developed. In the session, the researchers gave the participants an electronic sewing kit that contained a patch of fabric, a fabric switch, two LEDs, a needle, conductive thread, and a battery attached to snaps (Labrune & Mackay 2006). In addition, Mazzone et al. (2008) used low-tech prototyping for creating an interface with children. They also used specific material for four types of contents (e.g., pictures) and four types of buttons (e.g., links), which represented possible information and actions. Furthermore, the *Make tools* method consists of low-tech prototyping, though it was complemented by the *design games* in the work by Vaajakallio et al. (2010). A *moodboard* method has been used in the concept creation phase (thus it could be part of the ideation phase as well) – it was used in designing an educational garment game with children; the children created a picture collage out of the given suitable material (Kokil & Jeanne, 2008). Role play was used in workshops called *x-factor* and *dragon's den* in a diabetes concept creation process with teenagers. In the *x-factor* workshop, the participants developed the service ideas (innovated in previous workshops) similarly to the training boot camps in The X Factor TV series, and in the *dragon's den* workshop, the developed ideas were further developed in the same manner as in the TV series called Dragon's Den; the participants had to criticize and evaluate the ideas and make suggestions for the development (Bowen et al., 2013). Methods including drawing consisted of *Wallace and Gromit* (Bowen et al., 2013) and *The PDA* method (Fitton et al., 2014). In the *Wallace and Gromit* workshop, the participants made a Wallace and Gromit –style visualization of the service as an information factory with inputs (pipes) and outputs (conveyors) (Bowen et al., 2013). The PDA method (Fitton et al., 2014) contained phases *Scenario sketch* and *Drawing screen designs* in addition to the formerly discussed *5 Ws and H* and *Ideation*. A *scenario sketch* was given to the participants to help them to understand the social aspects of the service. Reverse side of the paper introduced the task. The *Drawing screen designs* phase included a phone pad which

contained acrylic sheet base with post-its on it resembling a mobile device on which the participants could draw the designs.

Evaluation of concepts: All the methods suitable for the evaluation of a concept require a base design. The methods were various containing drawing (Guha et al., 2013), role playing (Bowen et al., 2013), user testing (Bowen et al., 2013), card-sorting (Kokil & Jeanne, 2008) and contextual approach (Kelly et al., 2006). Drawing is included in a method called *Layered elaboration*. *Layered elaboration* method (Guha et al., 2013) includes a sheet of clear acetate which is laid over the original design for each group. The groups can then draw their ideas on the sheet and quickly explain the design. Role play and user testing with think aloud method were used in the last workshops called *Role Playing* and *Show and Tell* in the diabetes concept design process with teenagers (Bowen et al., 2013). *Role Playing* workshop involved role playing and discussion of the finalized service and the interactions in it, and the *Show and Tell* workshop used methodology similar to user testing; the actual tangible aspects of the service were tested and discussed (Bowen et al, 2013). *A card sorting* method was used in order to categorize and choose the best suggestions for an educational garment game for children – the children could sort the cards representing the designs in an order they preferred (Kokil & Jeanne, 2008). Contextual approach was visible in the *Bluebells* method. The *Bluebells* method (Kelly et al., 2006) contains four following activities: *I-Spy*, *Hide & Seek*, *Tig*, and *Blind Man's Buff*. The *I-Spy* comprises of the researchers observing children with the application. The *Hide and Seek* activity gathers information about content for the application of product. First, the children are introduced to the context with images and narrative. Then, in the hide part, the children are asked to produce lists of words that they associate with the application. In the seek part, the children are shown a wireframe of an interactive prototype of the product and given a blank paper artefacts on which they add content. The *Tig* phase is intended to gather information about navigation and control. Children are given artefacts and several locations (screens) and asked to place artefacts within locations and demonstrate how to move from one to another. The result resembles a state chart. In the last activity, *Blind Man's Buff*, children participate in pairs, with one child imagining the interface while the other draws.

In addition, evaluation methods with children could be used in the evaluation phase although they were not referred specifically as co-design methods, since the

suggestion for the concept is ready in the evaluation phase, they are similar to the previously presented methods, and children's role in the design phase can change as discussed earlier (Markopoulos et al., 2008). Evaluation methods include, for example, the *Drawing Intervention* method (Xu et al., 2009), *the Fun Toolkit (Read & MacFarlane, 2006)* and the *Laddering method* (Zaman & Abeele, 2010). The *Drawing Intervention* method (Xu et al., 2009) consists of three parts – *experience it*, *draw it* and *rate it*. First, the children are introduced to different technologies or something similar to the service and then immediately asked to draw; after this, the researchers rate the different technologies based on the drawings (Xu et al., 2009). There might be possibilities to not only use the drawings to the rating of the existing technologies, but also to use them to develop the current technology: especially, if the children are further given a task to draw what was missing from it, or how it could be improved. *The Fun Toolkit* is a widely used evaluation method that has been specifically designed for young children. The *Fun Toolkit* (Read & MacFarlane, 2006) has four following tools: *Smileymeter*, *Funometer*, *Again-Again table* and *Fun Sorter*. *Smileymeter* is similar to Likert scale, but the options are given to children with smiley-faces – from sad to really happy one. *Funometer* is similar to *Smileymeter*, but it uses a continuous scale. In the *Again-Again table* children have to choose if they would like to do the activity again (yes, maybe, no). *The Fun Sorter* is meant for children to sort the activities – which was the most fun and which was the least fun. The *Laddering* method (Zaman & Abeele, 2010) was originally used with adults but it has been adapted for older children: the children are being asked several times "why?". The first questions may be "why is this important to you?", "why did you choose this?" or "what does this mean to you?". Then, after the child's response, the researcher asks "why?" several times. Some other evaluation methods that were mentioned in the child-computer literature are the PIPC (problem identification picture cards), (spontaneous) thinking aloud, constructive interaction, peer-tutoring, post-task interviews and SAM (self-assessment manikin) (Zaman & Abeele, 2010).

Table 5 below summarizes the methods that could be used in a specific design phase. The division helps to get an overview of the methods and consider the applicability of the method by the design phase.

Design phase	Suitable method
Know the user and the context of use	**Contextual methods:** Technology immersion,

	Contextual inquiry, Kidreporter **Narrative methods:** Mission from Mars/Talking to an Alien **Organizing pictures:** The Cool Wall **Personas:** Creating of Facebook-personas
Idea generation	**Contextual methods:** Mixing ideas, Sticky Notes, Embodied narratives, Fictional Inquiry, **Drawing:** Future Cinema, PDA: 5 Whys and Ideation, Comics (Obstructed theatre as a facilitating method)
Creation of concepts	**Low-tech prototyping:** Participatory design, Bags of stuff, Make tools **Role play:** X-Factor, Dragon's den **Drawing:** Wallace and Gromit, PDA: Scenario sketch, Drawing design on a phone pad Design games Moodboard
Evaluate concepts	**Co-design tradition:** Layered elaboration, Drawing intervention method, Role playing, Show and tell, card sorting method, Bluebells **Evaluation tradition:** Drawing intervention method, the Fun Toolkit, the Laddering method, PIPC (problem identification picture cards), (spontaneous) thinking aloud, constructive interaction, peer-tutoring, post-task interviews and SAM

Table 5 – Co-design methods with children

It is demanding to compile a complete list of suitable co-design methods with children. One challenge lies within the division of the methods, since some of the methods are similar. This thesis made the division, in addition to the design phase, by the nature of the activity in the method; for example, methods containing comics were grouped together. However, the methods suitable for evaluating concepts were divided on whether they were part of the co-design tradition or evaluation tradition, since similar methods, which did not specifically claim to be part of co-design tradition, for evaluating concepts with children were also described in child-computer literature. Additionally, some authors consider the co-design field to be

wider than the others, which is related to the debate of the children's role in co-design process (see Section 2.2).

The co-design methods described above were mostly developed for a specific service design case, though some of them were used again in later studies. For example, *Kidreporter* (Bekker et al., 2003) was developed in order to design an animal game in the context of a zoo. Only the *cooperative inquiry* (Druin, 1999) is a method designed for wider usage, though it is not developed to a detailed level. The study made by Vaajakallio et al. (2010) did not have a special design agenda either, but the design case was still very specific. The current co-design tradition seems to be developed around education and games, although there are some exceptions. Bowen et al. (2013) described a co-design process in which teenagers co-designed a service for diabetics. None of the services developed were similar to the concept described in this thesis: A financial service for children. It is also worth noting that *probes* (see, e.g., Gaver, 1999) have not been used when co-designing with children, although children are common with the concept of homework at school. In addition, *probes* have been seen as a suitable tool for co-design (Mattelmäki, 2008).

Including families into co-design

There are not many design methods that would address the interaction between the parent and the child. Lauricella et al. (2014) examined how parents and children interacted during traditional and computer storybook reading at their home. Children read both a traditional book and a computer storybook with a parent and the events were video recorded; the researchers qualitatively examined the interactions between children and parents from the videotapes, for example, how the parent and the child were sitting, and where they read the books (Lauricella et al., 2014). Parents were involved in some of the co-design methods discussed in the previous section, but in most of them mainly in a facilitator's role or by necessity (for example, in Bowen et al., 2013). In a method called *Fictional inquiry,* the parents were included as participants, the target unit was a family and family members, but no specific note was made about the interaction between family members and the method seemed to address the child participants (Iversen & Dindler, 2008). Merely, a work by by Dawe (2007) included co-designing with families, but in the study the children were grown-ups and had cognitive disabilities and thus the case was somewhat different. Dawe (2007) described that parents role in child-computer interaction is usually a *proxy user* whereas in their study they were active participants. The case involved

developing mobile phone functionalities, mainly calling and receiving calls (thus the interaction between the child and the parent was the focus of the service), and the methods included ethnographic interviews, testing and creating paper prototypes together, as well as testing functional prototypes (Dawe, 2007).

Deciding on the methods

Even though there is a broad range of co-design methods and activities used with children and teenagers, it is not trivial to decide on the right methods. Sluis-Thiescheffer et al. (2011) suggested that the researcher should choose the methods based on the skills that are dominant at a certain age. The dominance of the skill varies; spatial visual skills are dominant from kindergarten to fifth grade, bodily-kinesthetic skills are dominant on the sixth grade, and interpersonal skills are dominant from middle school to high school (Sluis-Thiescheffer et al., 2011). Since this thesis mainly focuses on children aged 7 to 14, the range is wide from second grade to middle school. In general, the spatial visual dominates the whole age group from 7 to 14 and thus methods requiring spatial-visual skills should be addressed in this study (note: In Finland school is starting a year later than in the Netherlands where study was made, e.g., The World Bank, 2014). Sluis-Thiescheffer et al. (2011) listed the methods to be used with children, although they addressed that it is more important to consider the skills the children have at a certain age, not the level of engagement of the child. Thus some of the listed methods may not be considered as co-design methods (see Table 6). Additionally, some of the methods described earlier were developed after the work of Sluis-Thiescheffer et al. (2011) was published; therefore, they are not included the table.

Skill(s) required	Design method
Linguistic skills	• Articles • Descriptives • Free word association • Nominal group technique • Object based solution generation • Questionnaires • Sittings • Storytelling • Workshops
Linguistic and interpersonal skills	• Brainstorming • Games • Interviews • Language • Mission from Mars • Scenario base discussion

	• Subgroup discussion on ideal solutions • How-How diagrams (requires also logic-math skills)
Spatial visual skills	• 2-dimensional layout modeling • Drawing • 3-dimensional layout modeling and mockups (requires also bodily-kinesthetic skills) • Social diagram drawing (requires also interpersonal skills) • On-line illustrator (requires also linguistic skills) • Collage/Moodboard (requires also intrapersonal skills) • Cognitive map (requires also logic-math skills)
Methods involving more than three skills	• Dramas • Simulation and Roleplaying • Prototyping

Table 6 - Design methods and skills required to perform the method (adapted and simplified from Sluis-Thiescheffer et al., 2011)

On the other hand, also the context, platform and subject of the design have to be considered when choosing the right methods. It is not viable to, for example, plan a financial service for children by using the *Kidreporter* (Bekker et al., 2003); children may not be interested in making a magazine of ways of consuming and perceiving money. Additionally, the methods well suited for designing a mobile interface should be addressed. Of course, the chosen methods have to be tailored to be suitable to the specific context. An insight from the PDA method is added as well; clear instructions all the times for the participants (Fitton et al., 2014). Moreover, the process has to be iterative as defined in the standard for human-centered design process (ISO 9241-210, 2010). Furthermore, the families and interaction within the families has to be addressed in the design process. Children cannot follow freely their preferences, since their parents set boundaries for them. Especially in the context of money and consumption – Children cannot buy if their parents do not give them money. The first *know the user and the context of use* phase should include an interview or similar method for gaining knowledge with families that have children aged 7 to 14 in order to ensure the knowledge about the context and the users before the co-design process with children. However, the actual design should be conducted with the children to ensure that imagination and creativeness is being added to the process by them. Even if the adults would be as creative as children, their presence in the workshop situation might significantly affect the children's ability to make

their own creations (Kuure et al., 2010). The chosen methods embedded in the design process can be seen in Figure 5 below.
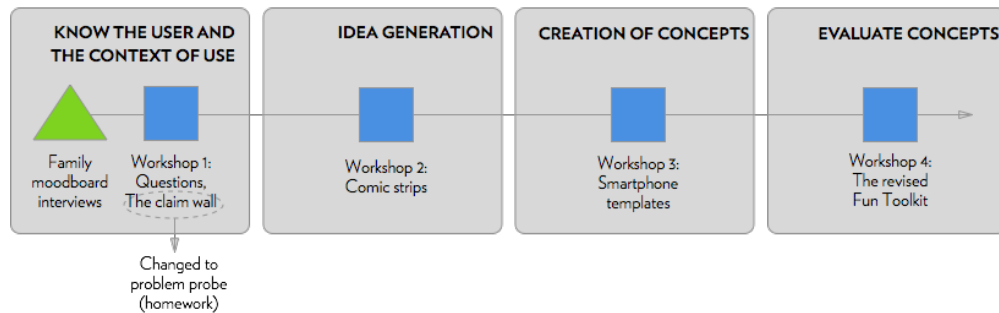
Figure 5 – The chosen methods for the empirical study

The empirical study contains four phases and five different methods. Firstly, the parent-child interaction is addressed in the interviews. The interviews were facilitated by taking inspiration from the *moodboard* method (Kokil & Jeanne, 2008) – the families were advised to form a picture collage of their money consumption during the interview. The method used in the first workshop was inspired by the first part of *PDA* method: answering the questions (Fitton et al., 2014). The idea was, however, to let the children see the other groups' answers as well in order for them to learn about the context while creating it. Additionally, it was planned to use a claim wall similar to the Cool Wall (Fitton et al., 2012), but due to lack of time the probe-method (Gaver et al., 1999; Mattelmäki, 2008) was tried, as that method allows the tasks to be given as homework. The method used in the second workshop was inspired by the methods including drawing (e.g., the *Future cinema* in Bowen et al., 2013) and *comics* (e.g., Moraveji et al., 2007; Read, Fitton & Horton, 2013). The method from the third workshop was also inspired by the *PDA* method (drawing design on a phone pad in Fitton et al., 2014) as well as other low-tech prototyping (e.g., Mazzone et al., 2008 and *Bags of stuff* in Guha et al., 2013) and drawing methods (e.g., *Bluebells* in Kelly et al., 2006). The fourth workshop's theme was evaluation and thus *the Fun Toolkit* (Read & MacFarlane, 2006) was used – but in revised form in order to gather the reasoning behind the answers (see the *Laddering* method in Zaman & Abeele, 2010). When choosing the methods, several aspects were considered: the interaction between parents and children in the context, the context of mobile design, suitability of the method to study a field as abstract as the field of money, and the dominance of the spatial visual skill. The next chapter presents the empirical process in more depth.

3 METHOD

This chapter depicts the study design and the contents of the used procedure: the family moodboard interviews, workshop pilots, and the co-design workshops. Furthermore, ethical issues and special characteristics concerning studies with children are discussed.

3.1 STUDY DESIGN

Participants

The target group for the service being designed was planned to be 7 to 14 years. Participants were recruited from a school class containing both second and sixth graders (aged seven to eight, and eleven to twelve).

Before the actual co-design workshops with groups of children, family interviews were conducted. The participants of the interviews were found from the intranet of the company and from Facebook group of an organization for people interested in usability (*Käyttäjän ystävät*). It was surprisingly difficult to find participants and consequently only four families enrolled in the moodboard interviews. The message promised a small compensation for their time, described the content of the study, mentioned that it is part of a master's thesis study and the company's service design as well as that at least one of the parents and one of the children from aged 7 to 14 needs to be present.

For the workshops with children, a small school, which had participated external collaboration projects before, was contacted. A teacher with a suitable class was interested in participating in the project. There were altogether 22 children out of whom eight were sixth graders (aged 7 to 8) and fourteen second graders (aged 11 to 12). Before the workshops, a meeting was held within the school in which the project and its initiatives were presented to the students and the teacher in order for them to decide whether they wanted to participate. Then, a schedule was drafted and the forms of agreement were sent to the teacher to forward them to the parents. Table 7 below illustrates the participants of each session.

The session	Users participating	Researchers/Facilitators
Family moodboard interview 1	Two families: Family 1: Mother and children aged 7 and 9 years; Family 2: Mother and 9-year-old child	Author
Family moodboard interview 2	One family: Mother and children aged 10 and 11 years	Author
Family moodboard interview 3	One family: Mother and children aged 7 and10 years	Author
Workshops 1-3	22 students: 8 sixth graders and 14 second graders	Author, one member of the Elisa Service Design team, teacher
Workshop 4	22 students: 8 sixth graders and 14 second graders	Author, two members of the Elisa Service Design team, teacher

Table 7 - Participants

The design brief

A user research plan was made in order to form the goals and suitable methodology. The suitable methodology is based on the literature review presented in Chapter 2. Yet, the methodology could not be drawn directly from the literature review, but it had to be adapted for various reasons. Firstly, many of the methods described were contextual, that is, contained the children and researchers to get familiar with the environment and/or technology of the service under development, which was not easily possible in the context of money and payment. Secondly, none of the cases included a developing a service around payment and funds and therefore this special context had to be addressed. Thirdly, the interaction between the parent and the child needed to be considered. Finally, each workshop was given the duration of one school class (45 minutes) – the time constrained the complexity of the chosen activities.

In addition, a design brief was made. The design brief is a document that describes the goals of the study (Nieminen, 2006). In this study, the design brief contains three following parts: theme, target group and mission statement. Table 8 below describes the contents of the design brief.

Theme	Help children to use money in a safe way that is fun and supports learning about managing money. Help parents to control their children's use of money and feel safe about it.
Target user group	Children aged 7 to 14 years and their parents.
Mission statement	Design mobile service functionalities that allow children to use pocket money in a safe and fun way and support the learning of using money.

Table 8 – The design brief

Prior to the workshops, family moodboard interviews were held with families to gather context specific information. The interviews were semi-structured. The questions and examples of pictures used can be found in Appendices 1 and 2. The main goal of each workshop was the following:

- Workshop 1: Gather more knowledge about the context and the users.

- Workshop 2: Innovate ideas for the design.

- Workshop 3: Create possible designs.

- Workshop 4: Evaluate created designs

In addition, the goal of each workshop was also to prepare the children to the next workshop, since the subject of the workshops, payment and money, is abstract and thus may be difficult for children.

3.2 PROCEDURE

The whole process contained first moodboard interviews with families and then workshops with children. The workshops with the children were the actual co-design process, although it was important to conduct the interviews to gain contextual knowledge before the workshops. Table 9 below summarizes the contents of the whole process with the used methods.

Process phase	Method name	Goal	Method description
Know the user and the context of use	Family moodboard interview	Gather more knowledge about the context and parent-child interaction within the field	Moodboard interview: The family was asked to form a picture collage of their children's consumption during the interview
	Workshop 1	Gather more knowledge about the context and the users and familiarize the children to the context	Questions on paper Problem probe (homework): Invent a money-related problem
Idea generation	Workshop 2	Innovate ideas for the design	Drawing ideas on paper in a form of a comic: Depict the problem and try to create a solution
Creation of concepts	Workshop 3	Create possible designs	Low fidelity prototyping: Drawing ideas on sheets of papers with pictures of smartphone templates
Evaluate concepts	Workshop 4	Evaluate created designs and improve them	Evaluating clickable prototypes with the fun toolkit Feedback from the workshops

Table 9 – Summary of the design process and methods

Moodboard interview

Prior to the co-design workshops with children, moodboard interviews were conducted with four families, since although the user of the application for children will be the child, it is also important to see the parent's perspective as the parent will be the buyer of the service. Additionally, parent may be a good interpreter of the child's behavior. Furthermore, the child's service does not work independently – the main functionality is the interaction between the parent and the child; for example, in the form of a parent transferring weekly allowance from their service to the child's service. Four families were interviewed. The first and the second family were interviewed in one session; thus three interviews altogether were conducted. A total of seven children participated in the interviews. The children were aged from 7 to 11 years. The interviews were held in the participants' homes. First, the study was briefly presented and an agreement forms for the parent were introduced. Permission

for recording and pictures was asked. The interview was semi-structural; the questions can be seen in Appendix 1 (translated to English). The interviews were facilitated with a creation of a moodboard (see, e.g., Kokil & Jeanne, 2008). Families were given a task: make a picture collage that represents your children's behavior regarding money. After each theme was introduced, a set of pictures was given to the family and they could choose the most suitable ones for their collage. The pictures were preselected from a picture database in order to ensure that no extra time was needed for the family to search photos about such a specific subject as children and payment. They were provided with glue and markers to draw or write additional information; they were encouraged to draw if there was no suitable card. At the same time as they played with the pictures, the set of questions regarding the theme were asked. An example of the set of cards can be seen in Appendix 2. The key objective of this study was to find out more about the context of children and payment; how children consume and understand money. Additionally, design possibilities were already identified.

Pilot studies for the workshops

Some of the workshops were piloted before the execution of the actual workshops. During the fall, there were two 14-year-old students in Elisa one day as a part of their school's work practice program. With the first student, a modified *PDA* approach was piloted (more about *PDA* approach in Section 2.4). The insight from the study was that drawing to the base of mobile phones was engaging for the student, but it was difficult to try to innovate ideas – although the reason might have partly been in vague instructions or language difficulties (the primary language for the student was Swedish, though both Finnish and Swedish were used in the workshop; for example, the material was in Finnish). As a result of the workshop, the student had an idea of a wish list inside the application (see Figure 6).
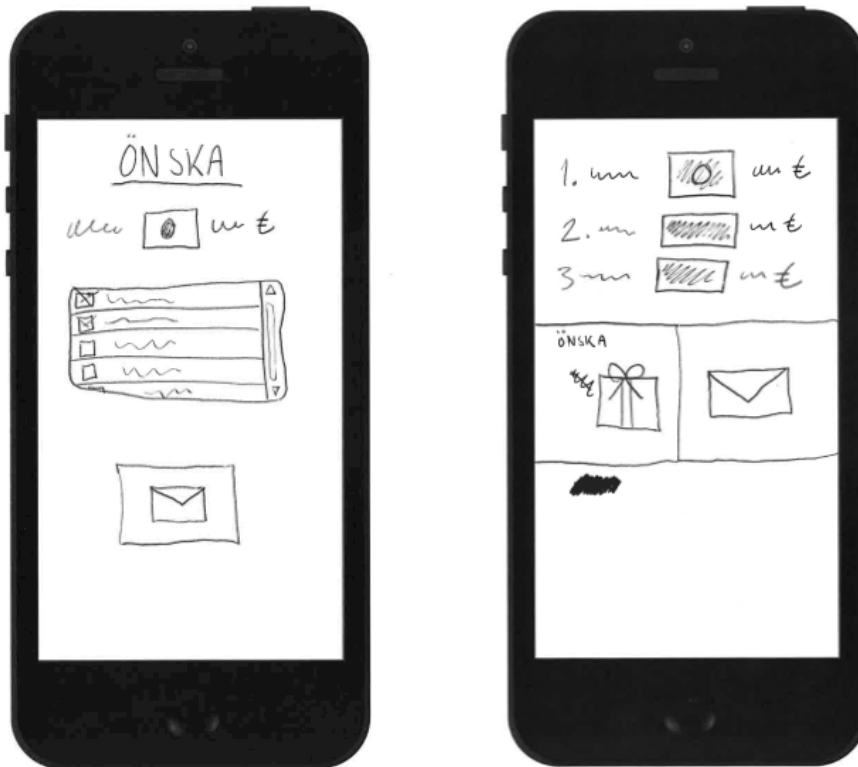
Figure 6 – Pilot test result: A wish list inside the application

After the first pilot, plans for the workshops were further defined. With the other student, the contents of the first workshop were tested. The student answered to the same questions that were planned for the children to go through in groups in the first workshop. Additionally, the student categorized problem-cards (see Figure 7) with a picture and a claim (for example, "saving is hard"). The student organized the claims – to the other end of the table claims that are always true, and to the other end of the table claims that are not true, and in the middle claims that are sometimes true. The feedback was that the questions were easy enough to answer and organizing the claims happened really quickly and intuitively.

Figure 7 - Examples of money-related problem claims cards for pilot test: "It is hard to store all the money got as a birthday present", "It is easy to buy with a phone by accident", "Cash is hard to calculate", "Saving is difficult"

Co-design workshops

The workshops were held in a small school in Helsinki area with a school class of fourteen second and eight sixth graders (aged 7–8 and 11–12 years). Some of the activities were piloted with two 14-year-old children. All of the workshops were facilitated by the author and a member of the Service Design team of Elisa. The teacher was present as well.

Workshop 1

The first workshop involved contextual knowledge gathering, but the aim was also to prepare the children to the following workshops. Firstly, the overall process was explained to the children; what is user-centered research and what will be the contents of the workshops. Then, the children were given a task to orientate to the subject: tell an activity you did last weekend and tell whether it cost something or whether it was free. After the orienting task, the children were introduced to the first actual activity. The children were first divided into four groups, so that in every group there were two sixth graders to help the younger children. The children were familiar with the groups due to their formerly arranged tutoring groups. Then, the children went besides the tables. On each table, there was an A3 sheet of paper with

questions about the context of money (see an example of the question paper in Appendix 3). The questions were based on the questions used in moodboard interviews (see Appendix 1). The children answered to the questions in groups and they had 5 minutes to write down their answers to the sheet (see Figure 8). After five minutes, the children changed the table. The children were seeing the previous groups' answers as well in order to gain knowledge about the field while they created it. This was certainly affecting their opinions, but it was not considered to be a concern, as the essence of the workshop was that they gain understanding of the topic.
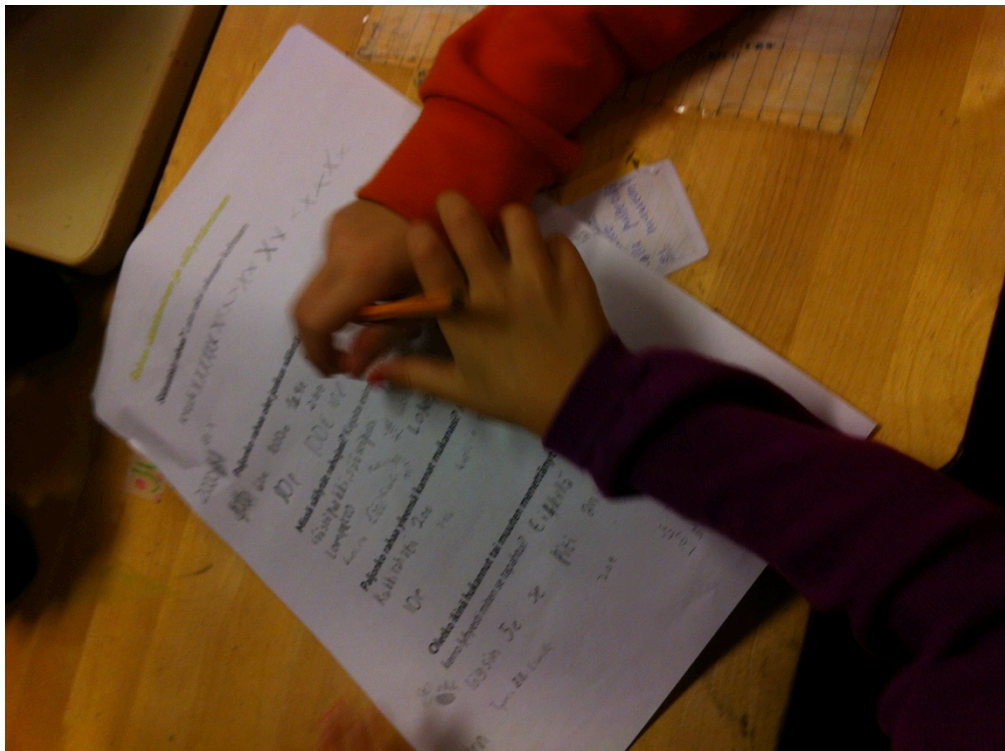
Figure 8 - Children answering to money-related questions in groups

In the end of the first workshop, there was supposed to be an activity called a *wall of claims* (based on *the Cool Wall*, e.g., Bowen et al., 2013). The children were supposed to be given cards with a picture and a claim (such as "It is hard to save money") that were formed based on the results from moodboard interviews and piloted before the workshops. The children would have been advised to place the cards on the wall according to whether the claim is true or not; to the other end of the table the claims that are for sure true, to the other end claims that are not true, and in the middle claims that are sometimes true. However, the time period was not

sufficient for that and instead the children were given homework (probe) in order for them to create the problems themselves. The task was inventing a money-related problem that one might have and write it down on the paper. We named the method *the problem probe* (see Appendix 4). The teacher gathered the returned homework during the week and placed them on the classroom door (see Figure 9).

Figure 9 - Pieces of homework gathered during the week – The problem probe

Workshop 2

The second workshop concerned ideation. At the beginning of the workshop, the results of the homework were revised and written to the blackboard – the children got an opportunity to raise their hands and depict the problems they had in their *problem probe*. Then the children were given a task to depict a problem of their choice in the form of a comic. Before the children started to draw, some possible characters and settings were brainstormed for their story. They were also advised to try to develop a solution to the problem – how the comic would end in a happy way. They were also hinted to use future technology. The children could choose from three different templates of comics to draw (see Appendix 5). The children did this task individually (see Figure 10). Some of the children did not finish within the given time period and they took the comics as homework.

Figure 10 - A child drawing a comic strip during workshop 2

Workshop 3

In the third workshop, the children were first given an orienting task to introduce their favorite applications on the phone and tell why they prefer them. In the beginning of the workshop, the concept of application was discussed to make sure that the second graders also understand it. After that, the problems and solutions from the last workshop were summarized, and elaborated together how to make them into a form of an application. For example, children had a problem of not having enough money and the solution was to save. The application could thus be an application that would help to save. The children mentioned also other money-related ideas for an application and they were written on the black board. The children were then given sheets of paper with smartphone templates (see Appendix 6). The children could choose a topic from the black board or come up with their own idea for a money-related application. The first thought was to encourage the children to use different elements (links, doing, input-fields, videos) related to the work of Mazzone et al. (2008). For example, different-colored post-its or cut pieces of paper with text/picture. However, it was decided not to limit the children's creativity and observe what kind of elements they think are suitable for a mobile application. This activity was planned to be conducted in pairs, yet some of the

children wanted to create the design in groups of three. Figure 11 below depicts the situation of the third workshop.

Figure 11 - Children designing a mobile application

Workshop 4

For the fourth workshop, two clickable prototypes were created. The prototypes were based on the ideas from workshops 1 to 3. The prototypes are discussed in more detail in Section 4.2. Additionally, the technology familiar from the service Elisa Wallet was exploited in the idea – that is, to utilize a mobile phone as a means of payment. Prior to the workshop, the prototypes were installed on tablets. In the beginning of the workshop, a concept of a prototype was explained. Then, the children were explained that these prototypes were built based on their ideas, and even if they could not see their ideas clearly there, it does not mean that their ideas were not valuable – all the ideas were taken into consideration, not just the ones visible in the prototypes. In the next step, the children were divided into pairs and each got a tablet and short instructions for the testing of the prototypes. For the first prototype, the children were asked to explore what functionalities can be found from the menu and to remember that the functionalities are not ready – they have to use their imagination (see Figure 12). For the second prototype, the children were asked to imagine that they have a weekly allowance of 5 euros and they want to save for a

Lego package which costs 42 euros. After the children had tried both of the prototypes, they were given feedback forms to fill in individually. The feedback form was based on the Fun Toolkit: *How much fun was it to do that activity?; Which was the most/least fun?; Would you like to use it again?* (Read & MacFarlane, 2006). One aspect was added to the Fun Toolkit in order to gather the reasoning behind the answers due to lack of time to individually talk with each child in the classroom situation. After each question, a question "why?" was added (based on the ideology of the Laddering method, in Zaman & Abeele, 2010). It was hoped to gather also suggestions for improving the prototype. The revised Fun Toolkit can be seen in Appendix 7. In addition, pictures of the prototypes were added to the form in order to make sure the children were aware of which application they were grading in each section. Moreover, a feedback form was gathered that asked to write down or draw the best activities, the most boring activities, and other ideas for the project. Finally, a diploma was given to the children for the workshops. The diploma can be seen in Appendix 8.

Figure 12 - The children testing the first prototype with multiple functions

After the workshops, an interview with the teacher was conducted to avoid misinterpretations and gather more knowledge of the children's behavior – whether they acted in a normal way when researchers were present. Additionally, some ideas and feedback from the workshops were gathered through the interview.

Technology research and other sources of information

Before the actual co-design phase, it was important to briefly benchmark some similar services. The Elisa Wallet team was already acquainted of some similar services and further research had been done by using online sources.

In addition, the material Elisa Wallet had from previous studies and external partners was analyzed when creating the possible concept. Before creating the concept, the context of children and payment needed to be understood. When analyzing the user research for that purpose, the results were reflected to behavioral studies already made on the subject.

3.3 ANALYSIS AND DOCUMENTATION

The data gathered in this thesis was qualitative data: notes, pictures of the workshops, recordings from the interviews and various materials created by the children. Some analysis was made in between the workshops in order to make sure the next workshop was planned properly. More detailed analysis was conducted afterwards. As Mannonen and Nieminen (2007) suggests, there are no exact common ways to analyze user research data, though some common guidelines apply. In this thesis, the qualitative analysis was mainly followed by the process depicted in Taylor-Powell and Renner (2003) and Markopoulos et al. (2008). In general, the process was the following: reading the data carefully through, categorizing data, finding patterns and phenomena, interpreting and deciding on the most important findings. Additionally, the key questions the data was answering to were addressed, as Taylor-Powell & Renner (2003) suggest. After determining phenomena and most important findings, *design perspectives* were made to facilitate the design process. A design perspective is "a sample of abstracted cross-category user research results" (Mannonen & Nieminen, 2007). Mannonen and Nieminen (2007) suggest that creating design perspectives can be a step between user research and concept development phases, which makes the entire process more efficient.

When working with children, the researchers have to be extra careful with privacy, as also Markopoulos et al (2008) suggests. The anonymity has to be protected (Markopoulos et al., 2008). No material with the children's names or other personal data was published for this thesis. For example, when scanning the designs children made to the smartphone templates, the names were covered with parts of white paper. Markopoulos et al. (2008) also warn to make misinterpretations of the data, for example, a child may occasionally try to please the adult. For this thesis, the teacher was also interviewed after the workshops to avoid misinterpretations.

After the co-design workshops with children, two workshops for the design team of the company were conducted to analyze and to communicate the findings. The form of the first workshop was inspired by the methods *affinity diagram* and *brainwriting*. The participants wrote their ideas on different-colored post-its according to the contents: observations on blue, interpretations on green, design perspectives on pink and concept ideas on yellow. One group concentrated on material of one workshop at a time and after approximately 10 minutes the group changed the table. They had first to read the previous groups' post-its before writing their own. Figure 13 below illustrates the situation. More about *affinity diagram*, e.g., in Holtzblatt (2005), and more about *brainwriting* in Heslin, (2009). The material of the workshops was analyzed and design perspectives were created based on the workshops' results and author's analysis on the material and observations in the workshops. The second workshop concentrated on the design. The participants were given a task: draw the money-related application for children and follow the design perspectives. Additionally, they were given the children' designs from the third workshop and other creative material to be inspired. The method was mainly the same as the children used in the third workshop. The groups drew the designs on the smartphone templates. Additionally, the participants were given a possibility to draw a use case on the comic template. Then, the groups presented the ideas and the best screen-ideas were voted for.
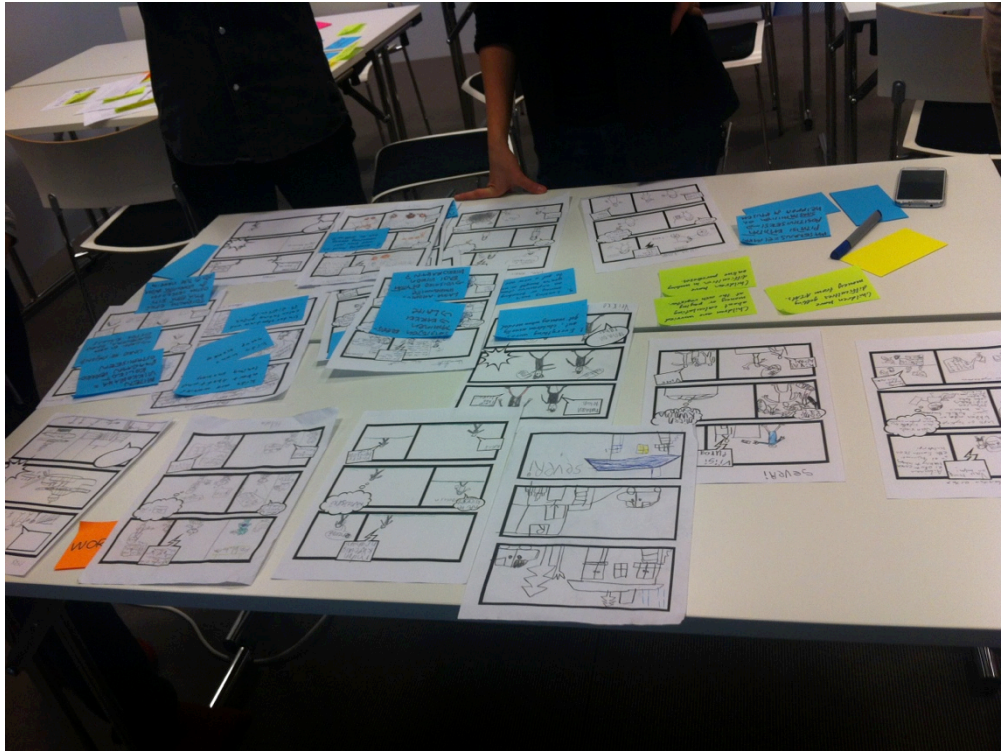
Figure 13 - The analysis workshop with the Service Design team

The family interviews were documented by using notes, by a tape recorder in a smartphone, and by taking pictures of the situation. The workshops were documented by taking notes, taking pictures and by the material the children designed. The note-taking was facilitated by a template for documentation that was inspired by the IDEO Toolkit (IDEO.org, 2011): after each workshop, the template's questions were answered by those researchers who participated in that workshop: *Things the participants said or did that surprised you or most memorable quotes; Things that matter most to the participants; Main themes or learnings that stood out from this interview; New topics or questions to explore in future interviews*. Furthermore, a *persona* of the child and a parent was made in order to communicate the finding to the Elisa Wallet team (see, e.g., Pruit & Grudin, 2003)

3.4 PRACTICES FOR WORKING WITH CHILDREN

Ethical considerations

Ethical issues have to be addressed when making research with children. Firstly, the researchers must ensure that the situation does not cause any harm to the children. There should always be at least two adults with the children, so that one of them can act as a witness if something happens. In general, when doing a research, the

participants should be able to give an informed consent, which means that they understand the research and their role in it, in addition to the willingness to participate to the study (Markopoulos et al., 2008). With children this might be problematical, since they might have problems in understanding the nature of the research, especially if the research theme is complex and/or the children are young. It is common to ask the consent from the parent, because they can give it on the behalf of the child according to the law in many countries (Markopoulos et al., 2008). According to the constitutional law in Finland, the children should be allowed to influence matters concerning them to a degree corresponding to their level of development. However, according to the law about child custody, parents can give their consent on behalf of the child (Act on Child Custody and Right of Access, 361/2009). Markopoulos et al. (2008) recommend asking the consent both from the parent and the child. In this study, a written consent was asked from the parents. Additionally, the children were asked whether they were interested in participating the study after the nature of the study was depicted. Furthermore, no younger children than 7-year-old were participating in this study and thus it can be argued that the children were old enough to understand the nature of the study to some extent. Privacy is also an important issue. As Markopoulos et al. (2008) note, no data should be published in any way that allows the identification of the participant without a full consent – and even with a full consent, the evaluator needs a good reason to violate the person's privacy. In this study, the participants and parents were informed about the privacy and no identifiable data was published in any part of the process.

Researcher's effect on results

There are some special characteristics to consider when working with children: they tend to imitate, please the adult, require precise instructions, need to see their contributions in the end-result, and obligate great flexibility from the researcher. The tendency to imitate obstructs the gaining of original ideas from children and therefore should be considered when planning, executing, and interpreting the results of the study (Kuure et al., 2010, Kafai et al., 1997). However, although children imitate, they combine and further develop the ideas in creative ways thus the imitating may not be an issue (Kuure et al., 2010). Furthermore, Read & MacFarlane (2006) reckon that children may also want to please the adult and consequently say something they may not mean. For this reason, it is important to not to lead the child in any case. Instructions given to the children need to be precise and cover what

constitutes a good design in order for the children not to feel too much pressure and to be able to create usable designs (Kafai et al., 1997). This seems to be challenging with the note that the children tend to imitate – how to provide the children precise instructions without leading them and not restricting their creativity? In this study, we diminished the possibility for children to imitate the researchers' ideas by using results from previous workshops and interviews as examples. Additionally, in some of the workshops, the tendency to imitate was used intentionally to give hints to the children to lead them to be creative, such as the hints to use future technology in the workshop in which the children draw comics. Furthermore, orienting tasks were used in the beginning of the workshops to facilitate the creativity of children; for example, the children were asked to explain their favorite mobile application before the mobile design workshop. However, the teacher interviewed after the workshops did not feel that the children tried to please the researchers in this study; the teacher felt they answered honestly and acted normally. Conversely, Vaajakallio et al. (2010) state that the main goals for the researcher are the same as working with adults – facilitate the discussion between participants and support creativity. Nevertheless, they mention that working with children requires greater flexibility as well as considering the group dynamics and differences between individuals' skills as compared to when working with adults (Vaajakallio et al., 2010). Not everything can be planned beforehand when doing research with children; the researchers should be prepared to change their plans even in the middle of a workshop (Kuure et al, 2010) as it was noticed in the first workshop.

4 RESULTS OF THE EMPIRICAL STUDY

This chapter presents the results of the empirical study. The results are threefold. Section 4.1 describes them from the aspect of children and money and presents the various phenomena in the context. Section 4.2 depicts the design opportunities and challenges emerging from the data as well as presents illustrations and design perspectives of the new concept. Section 4.3 analyzes the suitability of the method created for this study and discusses the best practices learned from the co-design process with children.

4.1 KNOW THE USER AND THE CONTEXT OF USE

This section presents the results and analysis of the workshops and family moodboard interviews by an emerging phenomenon from the data: how children understand money, learn about money, save money, and understand digital money. In addition, the preference of gamification elements and age sensitivity as well as the concerns children and their families have in the context are presented. The main results divided by the method can be found in Appendices 9–14. The material the children created is illustrated in Appendices 15–19 divided by the method.

Understanding the concept of money

Young children face difficulties in understanding the concept of money. In the family moodboard interviews, when asking what is money, especially the younger children faced difficulties in answering the question. One family depicted that they used Lego packages as a tool for understanding the value of money – parents may, for example, say that the new expensive sofa cost ten Lego packages. Conversely, in the first workshop, the children answered mainly "no" to the question whether it is hard to learn to use money. However, it can be assumed that group pressure affected the children and the second graders did not have the courage to admit whether they have difficulties. Two of the comics (17 of them were returned) drawn in the second workshop demonstrated the lack of understanding the value of money (see Figure 14 as an example). In the third workshop, the difficulties in understanding the concept of money was distinct when the second graders had difficulties in answering when asked whether the money is real or fake in their designs. One child answered *yes* to the question whether the money is real but then quickly changed the answer to *no* when asked where does the money come from. Another second grader claimed that the money come from the bank to their game. Yet, they had difficulties in explaining

why the bank would give them money. In the fourth workshop, some of the younger children had difficulties in filling in the feedback form – their explanations implicated that the service is irrelevant for them because they do not handle nor understand money. This phenomenon is similar to the one described in the study made by Ruckenstein (2010): preschool children answered to the question about the essence of money by stating how much money they have, which indicated they did not understand the question. In addition, it was common for the preschool children to replicate the ideas and opinions their parents had about money without ability to explain them (Ruckenstein, 2010), which was also apparent in the family moodboard interviews.
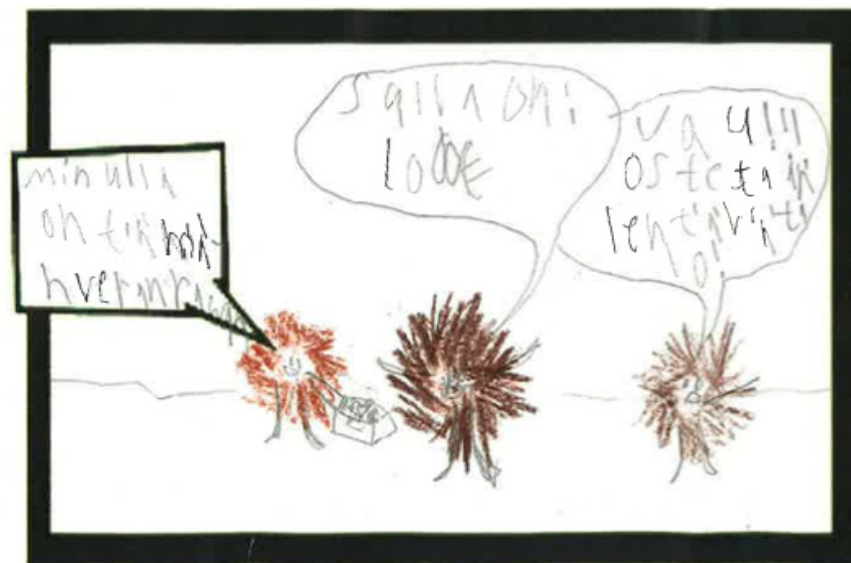
Figure 14 - An example of a comic panel which depicts the lack of understanding the value of money: The first character: "I have this much money..", The second character: "You have 1000€!", The third character: "Wow!! Let's buy the flying house"

Children might have better ability to understand the digital money if they would be more accustomed to it, even though two parents in moodboard interviews claimed that a weekly allowance service with digital money would be more difficult for the children to understand due to the decreased level of concreteness. Children encounter digital money earlier than cash with their smartphones and tablets. For example, families described in moodboard interviews that children often make purchases accidentally with their smartphone or tablet. Children aged 10 and 11 years in one of the interviewed families had already debit cards, but the parents managed their accounts. The children described the usage and saving of money to be now easier than before they acquired the debit cards. When the money is in digital

form and in one account, they can see with one glimpse how much money they have altogether with no need to calculate the money. It can be assumed that for a young child without an ability to think abstractly, it can be inconceivable to understand that coins they had as weekly allowance may be applicable to use in an application store that is inside their phones (when first transferred to bank account).

Learning about money

According to the moodboard interviews, children mostly learn about money at home in connection to weekly allowances. All of the parents also talk about the importance of saving and similar issues to their children, although one parent told us to have discontinued that because she wants to let the children learn themselves with the weekly allowance by letting them use their allowance freely. However, one parent did the opposite; she felt there is no need to let the children learn with the weekly allowance, their children know the importance of saving money and not spending too much, because the parents have always told them how expensive everything is and how money should be used carefully. Teachers do not teach about money – only how to calculate it. One child even claimed that: "They teach at school only how to spend money" (author's translation). In the first workshop, the children described methods for the learning about money to be *buying items*, *thinking carefully what to buy*, *with saving*, *playing shop*, *in math class* and *with the researchers application* (Note: before the workshops, the children were explained that the result of the workshops could be an application). In addition, some studies have claimed that it is important for children to learn about money. Allen & Olivia (2001) address the importance of parents to teach about the money. Numminen and Götenstedt (2011) as well as Abramovitch et al. (1991) suggest that weekly allowance would be a good tool for teaching about money.

None of the children in the moodboard interview gained money regularly from participating in household chores whereas children in two out of four families acquired from good grades, bigger chores or other achievements. One parent was especially strict about the importance of the children to completing household chores without financial initiative from it. However, the children in three families acquired extra money from special achievements – good grades, good certificates or extra work that does not include in the child's normal housework. Nevertheless, the children reported in the first workshop to have extra money from good grades or household chores. Only two crosses out of 18 were in the "No" section. However, it

is difficult to say from those answers whether they reflect the same principle of not having the extra money regularly from household chores.

Saving money

Although children have difficulties in understanding money, they have relatively large amounts of money. Most of the children have a small weekly or monthly allowance, but the children also receive quite large amounts of money as a present. The family interviews revealed that in three families out of four the children had weekly allowance. In one family the children got money only when needed, although they had own money as well, that was received as a gift. The mother mentioned them even to receive "too much money" as a present. In the first workshop, the children answered to the question how much money they got as a present values from 10 to 400 euros.

It is common for children to save money. Most of the children interviewed in the moodboard interviews claimed to save money regularly. Only one of the seven children stated not to be a good saver, although parents had supported the child to save. The children that participated in the moodboard interviews described having saved several hundreds of euros. For example, one 11-year-old boy described that he bought a laptop with the money he had saved. In the first workshop, the children wrote that they had saved amounts from 52 euros to 1000 euros (see Figure 15). Ruckenstein (2001) also had similar results in the interest of children to save – even some preschool aged children saved, or as the youngest children described it, *collected money*.

Figure 15 - An example piece of material from the first workshop describing how much money the children have saved

Children would like to have assistance for saving. One child described in the moodboard interviews that she has problems with saving. Once her parents even supported her to save, they gave her extra money when she had saved a certain sum. In the workshops, it was revealed that the children's biggest problem related to

money was the worry whether there is enough money for them to purchase and saving was seen as the most common solution for that problem. 9 out of 16 homework described the problem to be if there is not enough money to purchase or if money runs out. One even described the problem to be saving, because "If you want something, you have to save" (author's translation). In the second workshop, the children described their biggest problem again to be that they do not have enough money. 8 out of 18 comic strips received portrayed this problem. There were 14 solutions to the problems demonstrated in the comic strips. The most common solution was asking or acquiring more money from parents, friends, or sales assistant (7 answers). However, saving aspect was also visible: two of the solutions described saving to be the solution. In the third workshop, saving was the concept of all of the three designs the sixth graders did. In one of them, the concept included a calculator – how many days the user has to save in order to reach the target when the weekly allowance is a specific amount. In two of them, the saving functionality also included social aspects – You could see your family's saving targets as well. Figure 16 below presents an example of a saving application design from the sixth graders with a function to see the family's targets.

Figure 16 - An example design from sixth graders from the third workshop: "Saving land"

Understanding and using digital money

Children have a need for online purchasing, in mobile and web environments, and thus would need access to digital money. In-app purchasing is very common in games, which children play with their smart phones. However, also the parents must have the possibility to restrict their children's purchases online. All of the four

families interviewed in the moodboard interviews described some issues concerning children buying accidentally with a phone or a tablet. However, in one family, the children that had their own debit card stated that they compared prices; thus, making planned buying decisions was easier. Yet, the other child in the same family had a serious discussion with his parent because of his 70-euro in-app purchase in a game. The need for online purchasing was distinct also in the workshops. In the first workshop, one answer was, when asking about the means of payment, "account inside phone" (author's translation). In the first workshop's homework, one child described the problem to be that "all the mobile games cost something" (author's translation). Another child described the problem to be that "I don't know how to buy from a web store" (author's translation). In the second workshop, one comic strip described the problem to be that the child wants to buy a 2,50-euro game from the application store of the phone, but he does not know if the money is a lot nor how to "put the money inside the phone" (see Figure 17). The described solution is that the mother buys the game and takes the 2,50 euros from the child's biggy bank. Furthermore, another comic strip described that the problem is that the child do not know how to buy from the web store. The solution is that the parents help the child to buy.

Figure 17 – An example comic in which a child reasons how to buy with cash from piggy bank in an application store

Even though children would like to buy online, the main capital for them is still cash, with which the purchasing online is not possible. In three families out of four, the children used only cash as their capital in the family interviews. In some occasions, parents could buy something for them online or with a card in a store and then take the amount out of their children's funds. Cash was the main capital even though in two families out of four the parents reported problems or inconveniences related to the usage of cash. One family complained that the cash gets mixed up between the

51

siblings. One family depicted that handier system than using cash in snack paying in school was a printed piece of paper to which the cashier marks how much the child had bought from cafeteria. Additionally, in the first workshop the children described to use cash as a means of payment. However, it was also mentioned that the sixth graders use more cards than second graders. Moreover, internal account in phone was mentioned as a means of payment.

Children also described that cash is hard to calculate – both in the moodboard interviews and in the workshops. One child in the moodboard interviews said that she likes paper bills more than coins because they are easier to calculate. The children who already used debit cards said that it was harder to calculate money before they had their bank account. The worry of not knowing how to calculate money appeared especially in the second workshop in which 3 out of the 18 comics described a problem related to not knowing how to calculate money (see Figure 18 as an example).

Figure 18 - An example comic panel depicting the difficulties in calculating cash: "Oh no, I can't calculate money"

Gamification in a financial application

To play is an important part of childhood, and even in the context of handling funds, children would like it to be fun and game-like. In all of the children's designs they created in the third workshop included games or other gamification elements (see Figure 19). Gamification is defined in this thesis as *enhancing services with gameful*

experiences, such as badges, leaderboards and challenges (Deterding et al., 2011). Even the sixth graders' designs included games or gamification even though the main concept was saving. Two out of three of the sixth graders' designs included a game-like application for learning how to save. One did not include a game per se, but the saving was made game-like: fill-in your weekly allowance and target, and the application will calculate the time you need to save in order to reach your target. All of the second graders' designs were games or included a game. Additionally, one of the second graders' design even included further considered gamification elements – different levels and choosing a character. The gamification and fun elements were also appealing in the prototypes tested in the fourth workshop, for example, choosing a furry character was seen as fun. In addition, the game in the multifunctional prototype was mentioned as an appealing feature. The findings are supported by the work of Gelderblom and Kotzé (2008). They state in their design guideline that "Do not separate the instructional part and the fun part of the product" which seemed to be especially the case of the younger children in this study. However, that might also relate to the lack of understanding of the concept of money, and games were the only aspect they could relate to. Furthermore, the association between money and gaming is not surprising, since game progress is often measured in some sort of game-internal currency.

Figure 19 - Screens by the second graders' which all depict a game or game-like elements

Age sensitivity in the understanding and usage of money

The target group of this study, children aged 7 to 14 years, is relatively wide. Within this group there are children that do not use money or understand what it is, but also

children that already use debit cards under their parents' supervision and compares prices online. The difference between the different age groups was present with the second and sixth graders especially in the third and fourth workshop. In the third workshop, almost all of the second graders' designs were games whereas all of the sixth graders created saving applications with different functions, though two of them also included games. One of the second graders' designs was based on the need for age sensitive content for children. The children had drawn children's Youtube, Gamestore and Google (see Figure 20). The fourth workshop's feedback forms revealed that the younger children preferred the prototype that was less complex and had furry characters (7 out of 11) whereas the older children preferred the prototype with multiple functions and leaner outlook (6 out of 8). The most common reason for the preference of the younger children was that the other prototype was too complex or the characters were funny. The older children explained the less complex to be too simple.

Figure 20 - Own versions for children of Youtube, Google and Game Store

Social aspects

According to the moodboard interviews, the parents have very different levels of the needed interaction with their child when handling funds. In one family, the children did not get weekly allowance and all the purchases were individually discussed together with the child. In two families, the children could decide freely how to use

their capital. In one family, the child could decide about the purchases, but the parents wanted to discuss with the child about them before the purchasing decision. In only one family, the children could also freely buy from the Internet and with a phone; all the other parents had disabled the buying possibility in their children's phones and/or had strictly forbidden them to purchase with their phone. The children in those three families did not have debit cards thus making it impossible to purchase also from the web.

Children perceive purchasing as a social construct due to multiple observations. In the class, the children described situations, in which they gathered money or bought something together, for example, gathering empty bottles and buying candy together with the money received from the bottle deposit. The social aspects were otherwise present in the comics, as all of them included some social interaction. Furthermore, the most common solution for the children in their comic strips was to ask assistance from parents, friends or cashier. Additionally, it might be fun for children to share their saving targets with their families. In two out of the three saving applications the sixth graders did, it was possible to see the parents' savings as well.

Although children were social with the money-related issues, their parents and other adults may not be as open as the children. As mentioned in Chapter 3, it was demanding to gather participants for the family moodboard interviews even with a small initiative. This may be a result of them not being comfortable with money-related discussions. Additionally, one parent mentioned in the moodboard interviews that the children are not allowed to bring their school more than a few euros, because the families are from different economical status in that area.

Safety concerns

Children have safety concerns relating to money. In the moodboard interviews, a child depicted a debit card to be a good means of payment due to the pin-code – there is no point to steal the card without knowing the pin-code. A worry of stealing money was also visible in one comic strip and in a piece of homework (see Figure 21). All of the parents had also a story to tell about an unfortunate event in which the child had accidentally bought something with phone or tablet. In three families out of four, the parents were clearly concerned about the accidental payments. One parent told that she is really strict about the payments and often addresses the importance of not to purchase anything with a phone to her children. Another parent

shared a case about her child's schoolmate, who had accidentally made a 500-euro bill with a phone, to address the threat the in-app paying possibilities and another online paying possibilities may cause. Also the worry of losing or breaking a phone was apparent. One parent familiar to Elisa Wallet service was worried about the money in the phone due to children's tendency to break their phones. In addition, one child depicted a worry about breaking a phone in a comic in the second workshop. The perceived reliability on the mobile usage has been discussed in the work by Rämänen (2009); half of the users in the study did not use mobile banking due to concerns related to safety. However, as the mobile banking usage has risen significantly in the past few years after the study was made (Danske Bank, 2014), the safety perceptions of mobile applications may have changed.
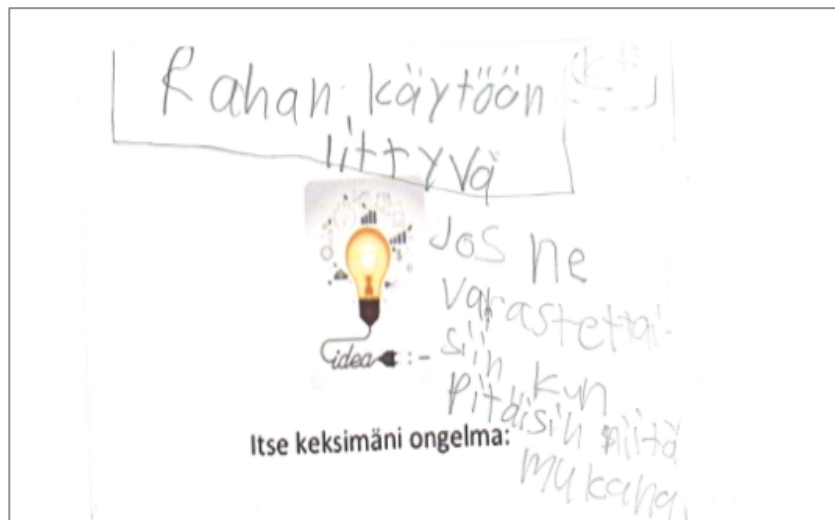
Figure 21 - A problem probe describing a worry of money being stolen

Children also reported having lost money. In the first workshop, the children answered to the question whether they have lost money and how: "Yes&No", "Yes", "20e", "I dropped 20 euros in the amusement park" (author's translation). Additionally, in the second workshop, the teacher asked a permission to tell how one of the children had within a week lost his whole wallet with money for a school trip. Luckily, the wallet was later found. In addition, a comic described a fear of losing money (see Figure 22).
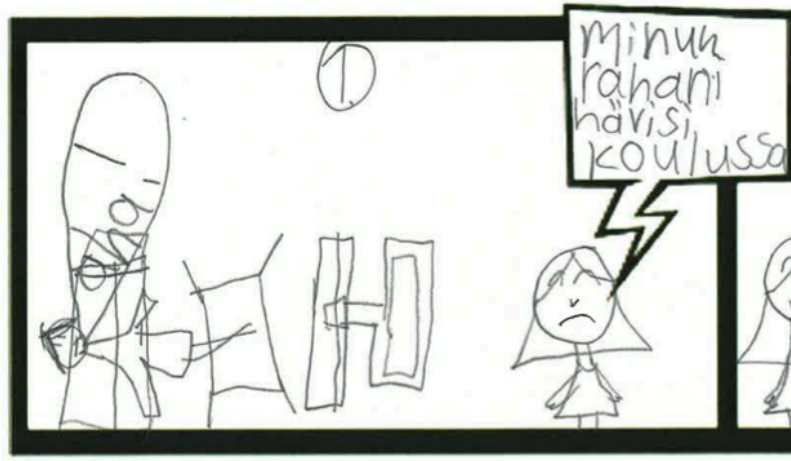
Figure 22 - A comic panel describing a worry of losing money:
"My money was lost at school"

Concerns related to purchasing decisions

Children also described other concerns related to not having enough money or not making "right" purchasing decisions. The homework from the first workshop described problems, such as getting addicted to purchasing, "having" to buy too much or spending all the money. When we discussed with the children, some of them recognized that the joy from a purchase does not necessarily last long. Figure 23 depicts the problem whether the child should buy an item or not. Three out of 18 of the comic strips from the second workshop described the worry of not knowing if the child had made "right" purchasing decision. The most common concern in the homework (5 out of 17) and the comic strips (8 out of 17) was the concern of not having enough money.

Figure 23 – A comic which depicts the difficulty to determine whether to buy

4.2 CONCEPT IDEATION, CREATION AND EVALUATION

This chapter describes the design opportunities and challenges emerging from the user research data and children's designs. Additionally, design guidelines based on them are suggested. Finally, the process of different prototype iterations and a final concept is presented.

Preliminary studies

There are already some money-related services for the children on the global market. Dunham (2013) lists three different weekly allowance services: Allowance manager, iAllowance and Tycoon. The free version of Allowance manager is only for tracking the weekly allowance. The paid version is, however, with an actual card and parents can transfer real money on it automatically, also restricting certain places if wanted to. The iAllowance is for allowance tracing as well as a reward and spending tool, but no real money is actually being exchanged. Lastly, the Tycoon application is only for tracking the allowance and a reward-tool. It can also be used when paying something online, thus parent's credit card is needed for that due to the absence of real money. Only paid version of the Allowace manager is similar to the Elisa Wallet service, as there is real money involved. Additionally, in Finland there is a similar service provided by another telecommunications company called DNA (Kautonen, 2015). The DNA service is, however, built around a traditional payment card and thus it is possible for the parent to use mobile device for the transaction to the card. In addition, there is no own application for the children. However, also cash and cards from banks given to children are competitors. The usability and handiness of the service should be at least at the same level as the current main competitor, cash. (Dunham, 2013; Kautonen, 2015)

Additionally, Elisa has already carried out a pilot study in which children paid their snacks at school with their phones using Elisa Wallet application and a payment sticker that was on the children's phones. Another pilot study was ongoing concurrently with this study. The results from the first study were promising. The study was conducted in three schools in Vantaa during April and May 2014. In addition to the possibility for the children to pay the snacks with the device, the

families were given a pre-survey, surveys during the pilot, and a post-survey. There were 41 families signing up for the study out of which 59% actually participated. Altogether 24 families used the service and 28 stickers were activated. According to the survey, the parents were very pleased with the service; 85% of the participants were very pleased or pleased. 46% reported that they had difficulties with their children's usage of money weekly (for example, cash had disappeared, no cash to give for the child, child in different place, impossible to give). All of the participants thought that the service would be a good service for learning about money and 60% thought it would be a good service for paying the weekly allowance. Most of the participants hoped own accounts for each child. 35% of the participants also claimed that they would be willing to pay for the service with the right pricing. 82% of the participants thought it would be important that the child would have her/his own application for checking the balance and transactions. The focus in this design challenge lies within this finding – it aims to answer the questions what needs children have for financial mobile application and what kind of a new service could fulfill these needs.

After the pilot study, a brief suggestion from external partners was offered for the functionalities of the service for children. The suggestion contained functionalities for managing the account, different means of payment, possibility to link the payment for a certain location and function for saving (see Figure 24). It was not based on user research and it did not address the children's viewpoint. It contained functionalities, such as restricting the payment possibility to a certain place or adding household chore targets in order to gain money.

Figure 24 - A preliminary suggestion from external partners of the service for children

Design opportunities and challenges

There were many apparent design opportunities emerging from the results of the moodboard interviews and the co-design workshops (see the previous section). Children feel that saving is important and they are interested in having application that would support that. In addition, young children have difficulties in understanding the value and concept of money – technology could help with that. Children might even prefer digital money to cash. Children also own money and receive it as a present, even though they have difficulties in understanding the concept. In addition, weekly or monthly allowance is common and parents perceive it as a good tool for learning. Furthermore, there is a clear need for safe in-app paying possibility, since children described in the workshops the need to purchase online and parents reported from accidental in-app paying occasions. The design opportunities are listed below.

- Children want help with saving
- Children need help with understanding the concept of money
- Possibly preference of digital money to cash
- Children get money as a present
- Children have and use money
- Weekly/monthly allowance is common and seen as a good tool for learning
- Safe in-app and mobile paying possibilities are needed

However, there were also some challenges emerging from the data that need to be considered before creating the application. The main issues are that the diverse skills of children and the various ways the parents interact with their children require great flexibility from the application. Some parents want to make all the purchasing decisions together with the children and some want to let the child to use the weekly allowance freely in order to learn. It is also difficult to embrace the age sensitivity without a separate application; the second graders clearly preferred the simple prototype with funny characters better than the prototype with multiple functions, whereas the sixth graders preferred the one with multiple functions. In addition, the safety concerns need to be addressed and communicated to the users, as children and their parents both had concerns related to safety. In addition, one parent mentioned in a moodboard interview that some schools have limits for the amount of money a child can carry at school, which would be troublesome if the child would like to carry her/his saving within the application in a phone. Furthermore, the application is not useful if it is not working where the children purchase. Currently, the contactless payment option is available with most of the big retail chains, but not yet in smaller places which, to some extent, are the ones the children use – the nearest kiosk or the snack place at school or tournament. The design challenges are listed below.

- The ways of using money differ considerably between families; some parents want to make the buying decision with the child
- Older children have different needs for the application than younger children
- Younger children may not understand the concept of money even if supported with visual application
- Some schools have limits for the amount that the child can carry at school
- Safety concern: losing money or breaking phone
- The contactless payment option needs to be available where the children make purchases

Design perspectives

Design perspectives, a sample of abstracted cross-category user research results (Mannonen & Nieminen, 2007), were created from the user data. The creation of the design perspectives was facilitated by an analysis workshop which was organized within the Service Design team at Elisa. This process is explained in more detail in Section 3.3. The design perspectives are the following:

1. Support understanding and learning about money
2. Easy online and in-app purchasing (and restriction)
3. Help children to save
4. Include gamification elements
5. Consider social aspects and interaction with the parent
6. Embrace age sensitivity

Some assumptions were not included in the design perspectives. Even though the application should, for example, support saving, the main functionality is still to show the balance to the children – tell how much money the child has, does he/she have enough money to purchase an item. Indeed, the children's biggest concern according to the workshop was whether they have enough money. In addition, the children and parents had safety concerns. It was not mentioned that the application should be safe and preserve the money properly, yet it is included in the assumption of a banking application.

The prototypes

First prototypes for this thesis were made based on the children's designs from the third workshop. Additionally, the technology familiar from the service Elisa Wallet was exploited in the idea – to utilize a mobile phone as a container of the money and as a means of payment. Prototyping program called InVision (*http://www.invisionapp.com*) was utilized in order to make the screens clickable on tablets for the fourth workshop during which the children tested the prototypes.

The first prototype was based on the idea of a multifunctional program with possibilities, for example, to load a travel card and keep gift cards (see Figure 9 in Appendix 13). In addition, the saving idea from another sixth grader was used (see Figure 8 in Appendix 13). The game element was based on the idea of a game in which coins were dropping (see Figures 1 and 3 in Appendix 13). Figure 25 contains the screens from the design (the starting screen is the one on the left, from which the other four screens could be opened).

Figure 25 - The prototype with multiple functions

The second prototype was based mainly on the children's idea of the calculating saving application (see Figure 10 in Appendix 13) and the possibility to choose the user's character (see Figure 4 in Appendix 13). Additionally, possibility to take a picture from the saving target was added; it was assumed that it could be fun for the children. In addition, one of the children's design contained instructions for photographing (see Figure 5 in Appendix 13). Figure 26 contains the screens from the prototype. The interaction flow starts from the left upper corner.
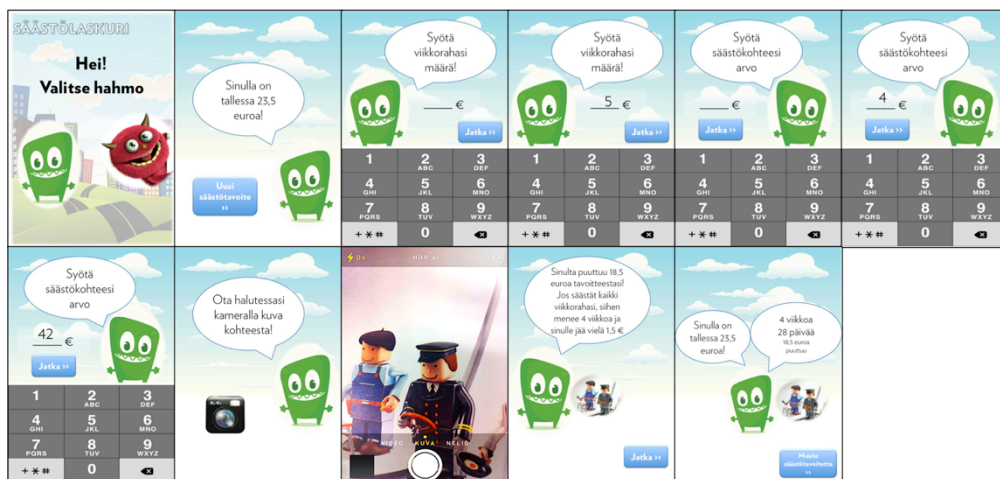
Figure 26 - The prototype with furry characters

The prototypes, design guidelines, and results from the workshops were further analyzed and developed in design workshop with the Elisa's Service Design team. After discussion, the teams drew concept designs on smartphone templates similar to the ones children used in the third workshop. Then, the participants voted their favorite screen ideas. Additionally, the comic board templates similar to the ones in the second workshop were in use, however, the participants were advised to draw the use case in them. Figure 27 below displays an example design with the voting results.
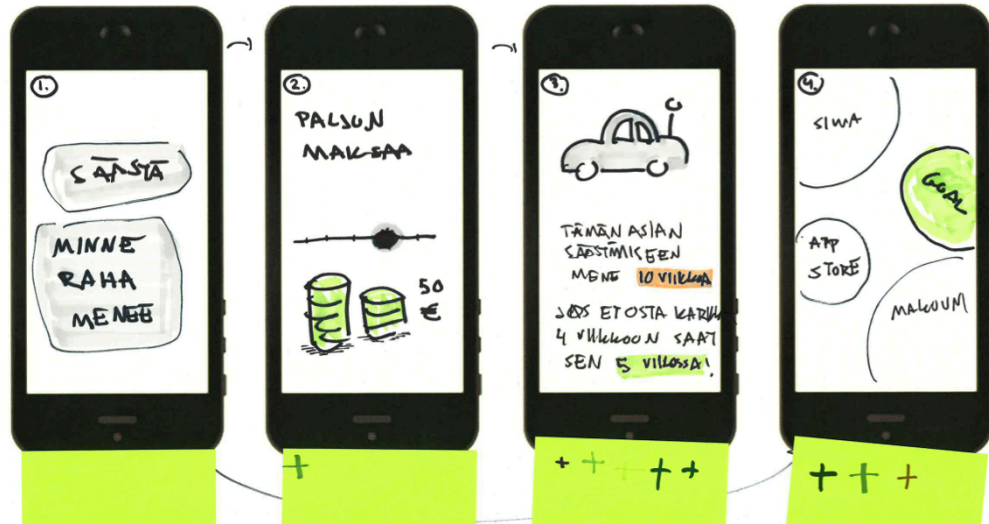
Figure 27 – An example design that was created in the Design Workshop

The final concept prototype was based on the ideas emerging from the design workshop, design perspectives, and the previous prototypes. The final prototype visualizes an account balance, transactions, and a saving target. The first design perspective, *support understanding and learning about money*, is addressed in the visualizations of the amounts of money. In addition, the application is as simple as possible. The second design perspective, *easy online and in-app purchasing (and restriction)*, is apparent in the possibility for the parent to restrict the amount their child uses in an application store. However, the possibility for the child to purchase with the money he/she has in the service being designed in his/her phone's application store is a technological back-end issue and should not be visible in the interface; the child should be able to use the money without any further actions needed. The third design perspective, *help children to save*, is addressed in the function for the children to add their saving target and follow their progress. The fourth design perspective, *include gamification elements*, is complex, since it is related to the problematic age sensitivity – what was fun for the second graders in the workshop was not as fun for the sixth graders. In addition, children grow and mature quickly and the contents of the service should develop concurrently. One option without the need to make separate apps would be to allow the personalization in the settings of the application and show thus the visualizations in different ways – younger children could use, for example, animals and vehicles and older could use lean shapes, for example, bars and circles. However, this design perspective is addressed so that the design is colorful and fun looking. Additionally, as the child can see the family's saving targets, it adds the gamification elements because the

children may want to compete with his/her siblings. The fifth design perspective, *consider social aspects and interaction with the parent*, is embraced in the possibility for the children to see their family's account information and saving targets. The application itself is not explicitly teaching about the money, but the simple layout without much further advise is to support children and their parents to discuss about money-related issues and learn to use it together, especially with young children. The sixth design perspective, *embrace age sensitivity*, is complex as discussed already earlier. It is not viable to make multiple applications. One option would be to allow personalization in the settings as mentioned before. Appendix 20 contains all the screens from the final concept. In addition to the screen visuals made, there would be the settings for personalization and the possibility to send and receive money. Figure 28 below gives an example what the homescreen could look like with a saving target.
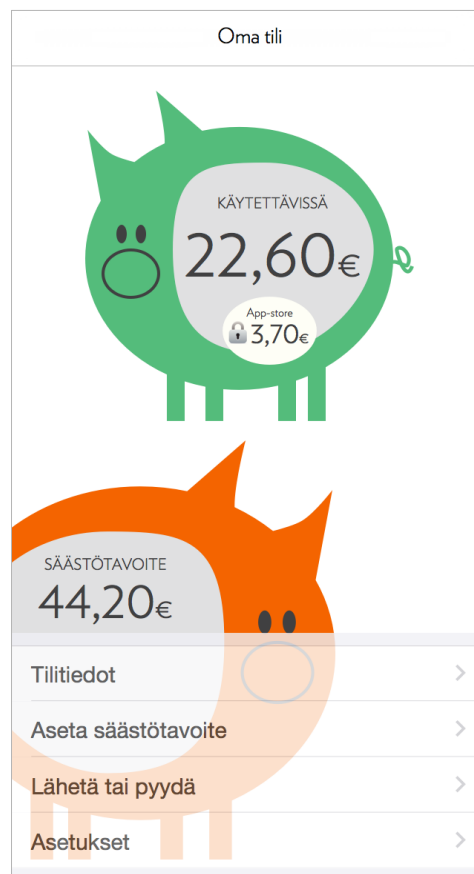
Figure 28 – The homescreen of the application with a saving target

Various functionalities were considered but left out from the final prototype. According to the results from the third and fourth workshop, children are fond of

games and would need support to learn about money-related issues. However, teaching children to save with a game is not the focus of the service; in order to make it simple, we focused on the following main functionalities: saving, and showing the balance and transactions. There are already fun games for learning about money, for example, POP Bank's *Poppikaijan seikkailut* (*https://www.poppankki.fi/poppikaijanseikkailu*). In addition, this application would hopefully support the interaction between the parent and the child to discuss face-to-face about money-related issues. Furthermore, a gamification with household chores was a preliminary idea suggested by the consultants in the beginning of the process (see Figure 24). However, the idea was not supported in this thesis, since the children did not gain regular money from household chores according to the family moodboard interviews, and it did not occur in the workshops.

Next design steps

The next step would be to build a functional prototype and test it with children. The further evaluation and suggestions of the product could be done by using co-design or other user-centered methods. Most important is that the users are involved in the process, since the children have not even seen the final concept prototype yet. The process would continue from the first functional prototype as the user-centered design process suggest – building new versions and iterating them with users. The back-end of the system should be built so that it is easily possible to modify the interface.

4.3 CO-DESIGN WITH CHILDREN

This chapter evaluates the suitability of the chosen methods and presents guidelines engaging the children in co-design sessions according to experiences of this thesis' design process.

Evaluation and comparison of the methods

The empirical study of this thesis contained six design methods: a family moodboard interview and five various co-design workshops with children as well as homework (*the problem probe*). Family moodboard interviews were good for gathering the ground knowledge – parents could make interpretations better than children. Additionally, the developing of the service could not happen without inquiring the opinions from parents and observing the interaction between the children and the

parents in the context of payment. However, the methods for co-designing with families remain limited. The first workshop's question group work was easy to set up and it was an efficient way to create content while the children learned about the context. The problem probe in the end of the first workshop worked well, as the children were familiar to the concept of homework. In addition, it gave the children time to reflect the complex topic with parents and peers. It can be argued to be surprising that probes have not been used before in co-design with children. Children seemed to perform well in designing thus co-design is most beneficial with them. Second and third workshop focused mostly in the co-design and the results from them were better than anticipated. The fourth workshop could have been done in smaller groups or even individually with one child and one researcher, since the children were not skilled at giving feedback in written form. It would have been beneficial to have time after the fourth workshop to iterate the products immediately, but for the smaller children that may have been too difficult as the concept of money was hard for them to understand, although it did not prevent them for designing applications and describing their money-related problems. The suitability of the process and the methods were reflected to the opinions of the Service Design team. Immediate feedback was gathered from the member(s) of the Service Design team that participated to a workshop. In addition, feedback of the process and method were gathered in a Service Design team meeting in which the co-design methods and process were presented. Table 10 below summarizes the main advantages and disadvantages of each method.

Design phase	Suitable method	Advantages	Disadvantages
Know the user and the context of use	**Family moodboard interview**	The pictures facilitate the discussion of an abstract subject. Good way to gather knowledge about parent-child interaction.	Material preparation requires longer time compared to normal interview
	Workshop 1: Answering questions on paper in groups. Changing which group answers which question set in fast phase.	Children liked the method. Good and easy way to orientate the children to the subject as they create the content while learning.	The gathered material is not as reliable because the children see all the previous answers.
	Problem probe	Children had time to	Children may not

	(homework): Creating money-related problems on notes	think and discuss, for example, with parents about the homework.	remember to bring the homework back or do it at all.
Idea generation	**Workshop 2:** Creating comics based on the generated problems. Main task is to depict the problem but also to encourage children to create a solution, hinting that new technology could help.	Children like to draw comics. Good way to gather the stories from the children's world, even from abstract subject.	Some of the comics were hard to interpret. Individual time with the children in order for them to describe the idea would have been beneficial.
Creation of concepts	**Workshop 3:** Creating designs on smartphone templates based on the previous ideas from the comics.	Children are good mobile designers and they enjoyed the activity.	It may have been hard for the younger children to understand a money-related service.
Evaluate concepts	**Workshop 4:** The revised Fun Toolkit used with clickable tablet prototypes (made by the researcher based on Workshop 3 results).	Children were excited to see their ideas in the design.	Children are not so good at giving feedback in written form. The children could have ideated the design further if there would have been more time.

Table 10 - Advantages and disadvantages of the methods

In addition to choosing the right co-design methods, particular factors need to be applied to the process when working with children. The following guidelines were created for co-designing with children: the facilitator should be flexible, the workshops should be facilitated with orienting activities, the results have to be interpreted with great caution, children's creativity should be supported, and the age and role of the children should be considered and altered to be suitable to the design topic.

Facilitator of the workshop should be flexible

When working with children, it is extremely important that the researcher is flexible and willing to change the plans even in the middle of the workshop. For example, when we noticed that the time is not sufficient for the second activity in the end of the first workshop, we changed the plans and gave the children homework (the problem probe), which we had planned beforehand as an alternative activity. In addition, the researchers should be ready to explain the concepts and rationalize the

reasons for the activities, children may not understand everything and they are accustomed to ask questions at school. These observations are supported by the work of Vaajakallio et al. (2010).

The facilitator of the workshop should also be flexible due to timing constraints. Already after the first workshop, we noticed that the lesson time is quite short. Even though the lesson time is officially 45 minutes, the actual active time is less due to the children's tendency to come a bit late to the class and needing a bit time to quiet down. Additionally, at the end of the lesson the children could not concentrate anymore thus making the actual active time only approximately 30 minutes. Furthermore, it was important that the children did not feel bored, because the peace in the classroom would then be immediately disturbed. It was challenging, as the children are ready with the given task at different times. It demanded from the facilitator ad hoc timing decisions and activities.

The facilitator of the workshop should agree the roles with the teacher if the co-design workshops are organized in a classroom context. The teacher in our workshops was participating more in the beginning: she calmed the children down and introduced us to them. After each workshop started, the teacher was mainly in the background. This arrangement was good, as the teacher did not interfere too much but she had tools for making the specific child group quiet. The teacher reported also to be pleased and inspired in observing the workshops.

Orienting activities

We assume that the orienting activities and previous workshops helped the children accomplish the design activities around a complex theme. In addition, the orienting activities may reduce the children's tendency to imitate the adult leading or offering the material. It is problematic that the instructions given to the children needs to be precise (Kafai et al., 1997; Fitton et al., 2014) but the facilitator cannot give the children examples due their tendency to imitate or please the adult (e.g., Kuure et al., 2010). Orienting activities, the content of which is based on the children's opinions and material from previous workshops, seemed to be helpful in the process of this thesis. In addition, the goal of the first workshop was also to orientate the children to the context. For example, in the beginning of the second workshop with the comics, we went through the possible characters, locations and problems to be depicted together with the class. The contents were gathered so that the children could raise

their hands and suggest topics and the facilitator wrote them down to the black board. Only few of the children asked for further help and had difficulties in inventing the theme for their comics in the beginning of the design work. At the beginning of the third workshop, the children were asked what is their favorite application and why. In the third workshop, all of the children started drawing immediately, but some of the children wanted to do the design in groups of three instead of pairs. Consequently, we observed only little imitating and mostly in the children's tendency to imitate their peers. A few comics were similar to each other. However, the answers were mainly original and creative.

In addition, we tried not to lead the children into any direction if it was not intended to. In the second workshop, we gave the children a hint that the solution could be from the future, they could use also future technology to solve the problems. However, none of the children used future technology when solving the problem depicted. Children may not have been familiar with any of the possibilities of new technology thus not prepared to use them. A contextual method before the activity may have been helped.

Analyze the results with great caution

User research results should always be analyzed with caution. However, user research carried out with children contains special issues that should also be considered (see, e.g., Markopoulos et al., 2008). Children's input is affected by group dynamics, varying skills and emotional states as well as the earlier mentioned imitating and pleasing the adult. Group dynamics in the children's groups should be considered when arranging activities with various group compositions. We used different types of activities with the children in the workshops and interviews: group discussion, group work, pair work and individual activities. The family moodboard interviews included mainly group discussion: the parents and children answered together to the questions while some of the questions were targeted more for parents and some for children. We anticipated that the parents could dominate the moodboard interviews or affect the answers of the children. However, the children seemed to be active in the discussion as well as disagreeing with the parent. For example, one parent told that their children do not buy candy, but the child corrected that she indeed does buy candy during breaks at school. The first workshop revealed that the ability of the sixth graders to engage all of the children to the group work varied. The children were arranged into groups they were already familiar with;

tutoring groups including both sixth and second graders. Some of the sixth graders assured that all the participants in the group contributed to the activity while some of the sixth graders dominated the activity, and the researchers had to remind them to engage also the second graders. The third and fourth workshop included pair work. Pair work functioned well in the second workshop in which the children were able to decide themselves the pairs whereas the fourth workshop caused disagreement, since the teacher paired the children up, which may have affected on the results. Some of the children later complained that their pair did not let them to try out the prototype on tablet and we had to intervene to the situation in the fourth workshop. Even though some researchers believe that one of the main goals for co-design workshop is to support the discussion between participants (Vaajakallio et al., 2010), the individual work also succeeded – the children managed to depict elaborately the abstract context of payment and funds. Vaajakallio et al. (2010) also mention the varying skills having an impact on the workshops. When interpreting the material acquired, it has to be considered that, for example, the reason why all the second graders designed games in the third workshop may not be that they want a game teaching them to use money but that the money-related games were the way they were capable of processing complex topic of money. It can also be assumed that children are not as accustomed as adults to control their emotional state. For example, in the fourth workshop, the children were clearly restless, arguing with each other and not listening to instructions. The teacher also verified the observation. The results may have been different if the workshop would have been done on different day. We interviewed the teacher after the co-design process to further avoid the misinterpretations.

Children are creative designers

Children can quickly execute complex design tasks with great imagination, at least with the support from previous workshops and design activities. In addition, they seem to understand mobile technology already at second grade since they succeeded in designing mobile applications in the third workshop. Elements such as menus and buttons were used without further advice. In addition, the second workshop succeeded; the children depicted well such abstract theme as money-related problems and most of the children created a solution to their problem. In addition, Vaajakallio et al. (2010) agree on the notion to support creativity.

Designing seemed to be easy for the children and most of the children liked it. Especially the second and third workshop contained designing whereas the first workshop focused on orienting the children to the following activities and the fourth workshop's time was spend on the testing and giving feedback. Children seemed to be better at designing than giving feedback. One child mentioned in the last workshop that: "This workshop was boring" (author's translation). Additionally, in the feedback forms gathered the children preferred the second and third workshop. This finding is related to the work of Sluis-Thiescheffer et al. (2011) about the skills dominant at certain age. Most of the class was second graders, which are dominant with spatial-visual skills whereas sixth graders has spatial-visual skills as second dominant after bodily-kinesthetic skills. Linguistic skills were only the fourth dominant skill (from second to third grade) or not dominant at all (from fourth to sixth grade). Consequently, drawing and other spatial-visual form of giving feedback may be more natural to children. However, the fact that the children were that day restless even before the workshop might also have had an impact on the results of the fourth workshop. Usually the children were behaving well, but that day they were noisy, complaining how the pairs were divided, did not listen to the instructions properly, and fighting over the tablets. The teacher also verified the observation.

Age and role of the children in the design process

The designer should consider the age of the children when co-designing abstract issues. Younger children are certainly a valuable source of information when describing their everyday lives and problems. However, when testing prototypes or designing abstract services the results from the young children should be at least analyzed with great caution. For example, the reason why the second graders did only money-related games in the third workshop might be only because they could not reach the level of abstract thinking that would have needed in order for them to design other applications than games.

The age is related to the discussion in Section 2.3; what should the children's role be in the design process? As mentioned before, the children's role can vary from an active design partner to passive user (Druin, 2002). In this thesis, the viewpoint of Markopoulos et al. (2008) was favored: the role of the children may vary inside the design process. The methods were mainly selected for their suitability to the context. Nonetheless, the chosen methods were mainly included in the co-design tradition. The context and the children's age affect the role a child can adopt in the design

process: when designing a concept around such an abstract subject, young children cannot make all the design decisions as equals to adult designers, since they may not even understand the nature of the project. However, that does not mean that young children should be left outside from the design process, they offer extremely valuable contextual information. In addition, they seem to be excellent designers due to their creativity and attitude. Co-design methods are also good tools for inquiring the contextual knowledge, since children seemed to manage depicting abstract themes in a creative form, for example, in a form of a narrative (i.e., comics in the second workshop). It can be assumed that the children would not have been able to succeed in the description of difficult topic as well if only asked with "traditional" interview. However, the age of the children does not always tell how mature the child is, within the same age group the skills of children may vary significantly (Vaajakallio et al., 2010) as was mentioned before. The researcher has to be sensitive and adapt the methods if necessary.

5 CONCLUSIONS

This thesis successfully achieved its objective introduced in chapter 1: A user-centered concept design process was planned and conducted. In addition, this thesis increased knowledge on the context of children and digital money and suggested a financial mobile concept for children and their families. Furthermore, the co-design methods around the theme were evaluated. Section 5.1 answers to the research questions. Section 5.2 discusses the practical implications of this thesis. Section 5.3 proposes future research possibilities. Section 5.4 discusses the limitations and advantages of this research.

5.1 ANSWERS TO THE RESEARCH QUESTIONS

How children consume and understand money in the context of mobile payment?

The findings related to the context of children and payment are depicted in Section 4.1 with examples from the material. The findings are as follows:

- Young children have difficulties in understanding the concept and value of money
- Cash is inconvenient: Difficult to calculate, save, and buy online
- Children want to make web and mobile purchases (and parents want to restrict them)
- Children are fond of playful and age sensitive content even in the context of mobile payment
- Payment contains social aspects: Children's buying is social whereas parent-child interaction varies in the context of payment
- Children have and save money, but the purchases may be controlled by parents (while some parents want to give freedom to make purchases due to learning)
- Children (and parents) have safety concerns related to money
- Children have also other concerns related to money, such as whether they have enough money, or whether they make the "right" purchasing decision

In addition, it should be stressed that parents, family members and friends contribute greatly to child's learning about money and consumption. For example, the child does not have weekly allowance if the parent decides so. Furthermore, consumption and payment patterns may be different in different countries, which may have an affect on the children's consumption and understanding of money. This study was made for the Elisa's Service Design organization in Finland. Whether these results would be applicable abroad is not considered in this thesis.

What kind of a new service could fulfill the needs children and their families have for a financial mobile application?

To answer the question, one must first consider what needs children and their families have. The needs emerged from the user research data and the contextual knowledge of children and mobile payment were applied as a base for design perspectives. The design perspectives are as follows:

1. Support understanding and learning about money

2. Easy online and in-app purchasing (and restriction)

3. Help children to save

4. Include gamification elements

5. Consider social aspects

6. Embrace age sensitivity

Based on the guidelines and design workshop made within the service design team a following suggestion has been made for the concept (see Figure 29).
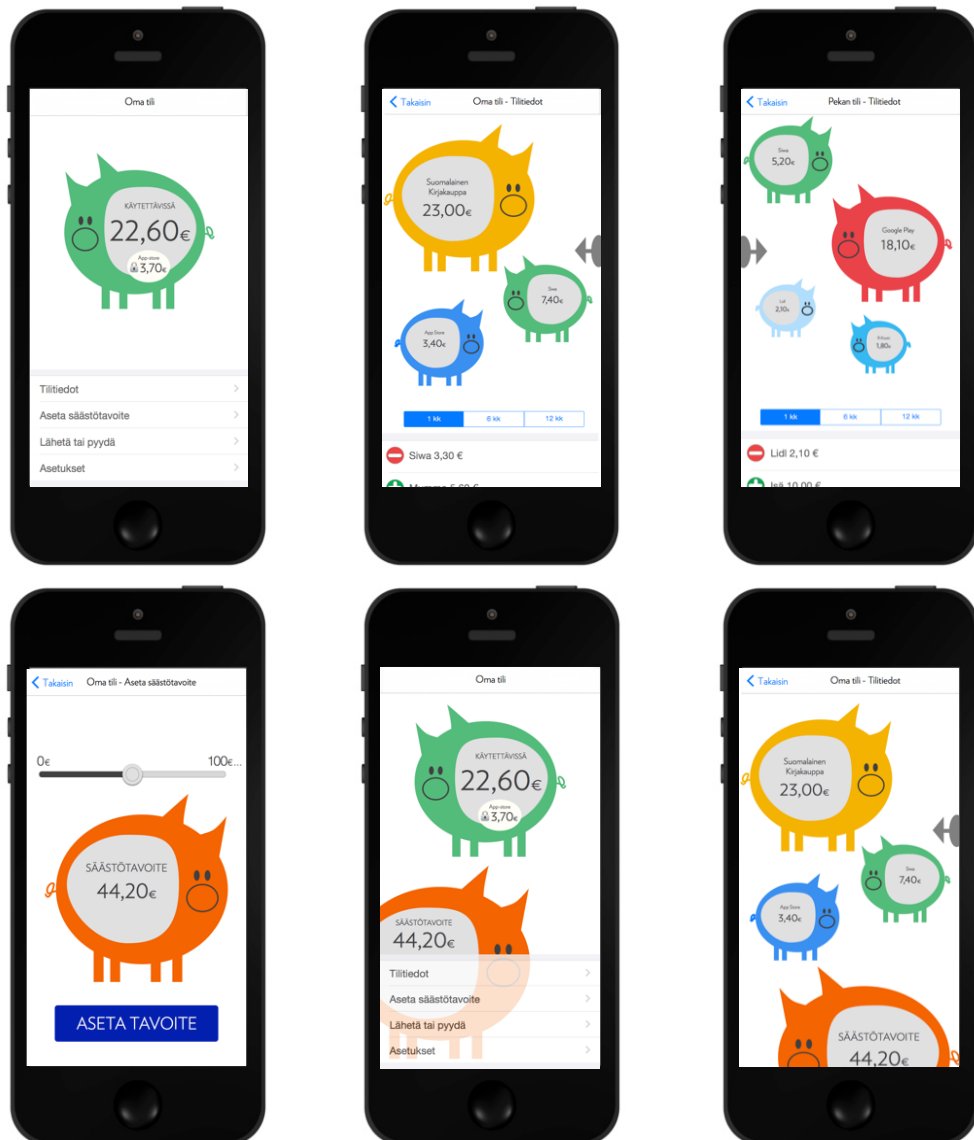
Figure 29 - The final concept design. The homescreen contains balance and restrictions in a visual form. Transactions are visualized and saving target are visualized. The child can see sibling's transactions and saving targets as well. Colorful animals add the fun factor.

The final concept design visualizes account balance, transactions, and saving target to support the understanding of money. In addition, the user interface is as simple as possible. In-app and mobile purchase restriction is visible. Social aspect and gamification is addressed in the possibility to see family's transactions and possible saving target. The colorful pigs add the fun factor, however, it would be good if the visualizations could be changed from the settings in order to emphasize the age sensitivity. However, the application can also be easily used only to the core function – To show whether the child has enough money to make a purchase. The registration and signing-in to the application is not considered in this thesis. In addition, the

interface of the parent was not focus of this thesis. However, the service being designed is not solely a result of personal preferences and competences of the child, but the parent is the buyer and secondary user of the service. In addition, the simple interface is also designed to encourage parent-child interaction about discussing money-related issues. The current visuals are done by the author and they would be finalized by graphic designer before the functional prototype.

What are suitable co-design process, methods, and practices for developing a financial mobile concept for children and families?

We propose the concept creation process to comprise fours steps after the planning of the process: (1) Know the user and context of use, (2) Idea generation, (3) Creation of concepts, and (4) Evaluation and further development of concepts (see Table 11). The process is based on user-centered service and concept design processes depicted in Section 2.1 (e.g., ISO 9241-210, 2010; Nieminen, 2006). The process should also be iterative (e.g., ISO 9241-210, 2010). The role of children in the process should be adapted to suit the age and competences of the children and complexity of the design topic, whereas the role of children can also change within the process. The methods selected and developed on the basis of the literature review were suitable as evaluated in the Section 4.3. The only improvement would be to divide the testing of the prototypes into smaller groups and further ideate with children, if the given resources make it possible. The children chosen for further ideation could be older than second graders, as the second graders had some difficulties in understanding the idea of a prototype and the concept of money. Additionally, further research should be conducted in order to know how to study parent-child interaction and co-design together with the family. Furthermore, the probe method was successful and it could have been adopted multiple times.

Design phase	Suitable method
(Plan the process)	(Design brief. Decision on suitable methods.)
1. Know the user and context of use	**Family mood board interview**
	Technology research
	Workshop 1: Answering a set of questions on paper in groups. Changing the set of questions after each group is ready.
	Problem probe (homework): Create money-related problem and write it on a note

2. Idea generation	**Workshop 2:** Creating comics based on the generated problems. The main task is to depict the problem but also to encourage children to create a solution, hinting that new technology could help.
3. Creation of concepts	**Workshop 3:** Creating designs on smartphone templates based on the previous ideas from the comics.
4. Evaluate concepts	**Workshop 4:** The revised Fun Toolkit method used with clickable tablet prototypes.

Table 11 - Summary of the phases and design methods of this thesis

However, the co-design methods with families remain vague. In the literature (see Chapter 2), there were only few suggestions for co-design methods with families. Although the parents were many times present in the co-design sessions, they mainly acted as facilitators, not participants. In this thesis, the actual co-design was executed with children at school, but the family aspect was addressed by organizing moodboard interviews with families before the co-design workshops to understand the interaction between parents and children in the context of money. The moodboard interview was a functional method and thus recommended for gathering contextual knowledge about families, but further research is needed to assess the suitability of other methods.

The following guidelines were created to ensure establishment of the best practices within co-design with children: the facilitator should be flexible, the workshops should be facilitated with orienting activities, the results have to be interpreted with great caution, children's creativity should be supported, and the age and role of the children should be considered and altered to be suitable to the design topic. These guidelines are discussed in more depth in Section 4.3. The suitability of the presented methods, process, and practices were adapted to the Elisa Service Design organization. This thesis does not discuss of the applicability of the presented results to other organizations.

5.2 PRACTICAL IMPLICATIONS

The suggestion for the designers and developers for future work can be found from Section 4.2. Indeed, the design process continues as iterative process and more user testing and user research has to be done after functional prototype is ready. One topic that would need more user research could be the parent's opinion: what

functionalities they would need, since the moodboard interviews were conducted only with four families. The development of the functionalities could already be started, as the alternative solutions for the design has similar requirements from the system. The development should be done in such manner that changes to the design are easy to make afterwards.

Implications to the service design of Elisa

Elisa Service design team has an objective to improve concept design capabilities in their current processes with special focus on the co-design due to the higher-level aim of engaging users to the service design process. This thesis process acted as an example of a succeeded concept design process, which may lower the barrier to start similar projects. Not only it gave specifications for the following design phases, it innovated material for immediate improvements and to some extent affected on creative problem solving and team spirit (see Keinonen (2006) for the various objectives in concept design). The material from the research has already been used for marketing excising products of Elisa. The team members of Service Design team agree on the note that co-design insight is useful in everyday work (co-creation) and co-design methods should be used more in addition to "traditional" user research methods, such as interviews and user tests. For example, the smartphone template design session worked also well with adults when done with Service Design team. In addition, the selected target group (children and families) have been identified valuable in several business areas, but difficult to address with typical user research methodologies.

The co-design process is implacable to the excising processes partly. Such a throughout process were seen worthy but the reality, money and time constrains, usually affects so that the concepting is occasionally done by external partners and based on only one user research activity. Consequently, the process is not recommended to be seen as a step-by-step guideline, but as flexible. For example, when a project needs contextual information, a co-design workshop or similar gathering contextual information is organized whereas when a project is in need of multiple ideas, an ideation workshop could be organized. If multiple sessions are organized with same user group, it is advised to use the probe methodology.

5.3 FUTURE RESEARCH

The co-design methods with families have typically been described in vague terms. In the literature found, there were not many suggestions for co-design methods within families. Although the parents were many times present in the co-design sessions, they mainly acted as facilitators, not participants (e.g., Fitton et al., 2014). The method called Fictional Inquiry (Iversen & Dindler, 2008) did include parents as participants according to the description of the method, but the researchers' aim did not particularly include investigating the co-design methods with families but with children. Lauricella et al. (2014) studied the interaction between children and parent's when reading digital storybook comparing to traditional one, but that study did not involve co-design elements. Dawe (2007) mentioned that in her study also the family participated, but as the case was with adult children with cognitive disabilities thus it is not completely comparable. In this thesis, the actual co-design happened with children at school, but the family aspect was addressed by organizing moodboard interviews with families before the co-design workshops to understand the interaction between parents and children in the context of money. The moodboard interview was very functional method and thus recommended for gathering contextual knowledge about families, but further research is needed to gain more knowledge about multiple methods how to co-design within families.

This thesis used probes as a co-design method with children. The results from it were promising, but further research has to be done in order to assess their suitability in co-design with children. In addition, there are no previous studies within the field of co-design with children in the context of mobile payment. Due to the tendency of children to start using smartphones from very early ages, they encounter the digital money in the application stores and games of the phone. Consequently, further studies should be done on mobile payment with children.

Hopefully the application would also engage the users, the child and the parent, to face-to-face interaction – The parent to teach about money and the interface would only be a supporting artifact. However, as Jarusriboonchai et al. (2014) describes, not much research has be done to analyze how mobile user interfaces could be social, that is, to engage the users in face-to-face interaction. According to Jarusriboonchai et al. (2014), the mobile designers have designed the devices thinking the users as personal, not shared or collaborative.

Furthermore, more research could be conducted around the subject how children and their parents understand the world of money and what is the meaning of mobile financial interface inside it. This study implicates that co-design methods are sufficient tools for gathering detailed contextual understanding. Mannonen (2010) presents a concept called technology culture to describe the differences within the understanding and know-how of technologies. Mannonen (2010) sees that these technology cultures are important factor when considering usability, acceptance, and even utility of new technologies. It would be interesting to determine with co-design methods further how people understand the technology of mobile payment and how it affects on the acceptance and utility of the service.

5.4 EVALUATION

Reliability and Validity

The conducted study was a small-scale study thus lacks reliability if not reproduced. However, a few qualitative results may be more important for the end-quality of design than quantitative results based on multiple inputs (Markopoulos et al., 2008). In addition, the amount of material gathered was extensive if compared to similar studies from the field (e.g., Iversen & Dindler, 2008; Bekker et al., 2003).

There are not many studies made that assess the validity and reliability of the children's responses (Markopoulos et al., 2008). However, researchers' note that analysis of the children's answers need to be done with caution because it can be affected, for example, the children's tendency to imitate (Markopoulos et al., 2008). The validity of the research was ensured by interviewing the teacher and noticing the effects that might affect on the children's answers in order to avoid misinterpretations.

Limitations of the research

An extensive amount of material was gathered to form a throughout picture of the context of children and mobile payment, but the research of the parent-child interaction in this context remain vague. Even though participants for family interview were tried to reach through multiple media, yet only four families participated to the interviews. However, the child's opinions and experiences were the focus of this thesis.

Conclusions

One might also claim that there is no need to develop a financial service for children, since children do not even seem to understand properly the concept and value of money. However, young children already encounter the digital money in their smartphones and tablets. It is not viable to prohibit the children to use technology to protect them from the digital money, but to teach them in safe way to control their consumption. In addition, since children seem to own some capital, they should be able to use it also to purchase applications that might develop sills, such as coordination and understanding of technology rather than use the money to buy, for example, candy.

REFERENCES

Abramovitch, R., Freedman, J.L., Pliner, P., 1991. Children and money: getting an allowance, credit versus cash, and knowledge of pricing∗. Journal of Economic Psychology 12, 27–45. doi:10.1016/0167-4870(91)90042-R

Act on Child Custody and Right of Access, 2009. FINLEX ® - Translations of Finnish acts and decrees: 361/1983 English [WWW Document]. URL http://www.finlex.fi/en/laki/kaannokset/1983/en19830361 (accessed 2.4.15).

Allen, M., Oliva, J.C., 2001. Teaching children about money: Applications of social learning and cognitive learning development theories. Journal of Family and Consumer Sciences 93, 26–29.

Anthony, L., Brown, Q., Tate, B., Nias, J., Brewer, R., Irwin, G., 2013. Designing smarter touch-based interfaces for educational contexts. Pers Ubiquit Comput 18, 1471–1483. doi:10.1007/s00779-013-0749-9

Bekker, M., Beusmans, J., Keyson, D., Lloyd, P., 2003. KidReporter: a user requirements gathering technique for designing with children. Interact. Comput. 15, 187–202. doi:10.1016/S0953-5438(03)00007-9

Beyer, H., Holtzblatt, K., 1997. Contextual Design: Defining Customer-Centered Systems. Elsevier.

Bowen, S., Sustar, H., Wolstenholme, D., Dearden, A., 2013. Engaging teenagers productively in service design. International Journal of Child-Computer Interaction 1, 71–81. doi:10.1016/j.ijcci.2014.02.001

Bruckman, A., Druin, A., Inkpen, K., Preece, J., 2001. "The Children's Challenge: New Technologies to Support Co-located and Distributed Collaboration" Report on the CSCW 2000 Panel. SIGCHI Bull.: suppl. interactions 2001, 6–ff. doi:10.1145/967181.967187

Danske Bank, 2014. Mobiilipankkitutkimus.

Dawe, M., 2007. "Let Me Show You What I Want": Engaging Individuals with Cognitive Disabilities and Their Families in Design, in: CHI '07 Extended

REFERENCES

Abstracts on Human Factors in Computing Systems, CHI EA '07. ACM, New York, NY, USA, pp. 2177–2182. doi:10.1145/1240866.1240976

Deterding, S., Dixon, D., Khaled, R., Nacke, L., 2011. From Game Design Elements to Gamefulness: Defining "Gamification," in: Proceedings of the 15th International Academic MindTrek Conference: Envisioning Future Media Environments, MindTrek '11. ACM, New York, NY, USA, pp. 9–15. doi:10.1145/2181037.2181040

Dindler, C., Eriksson, E., Iversen, O.S., Lykke-Olesen, A., Ludvigsen, M., 2005. Mission from Mars: A Method for Exploring User Requirements for Children in a Narrative Space, in: Proceedings of the 2005 Conference on Interaction Design and Children, IDC '05. ACM, New York, NY, USA, pp. 40–47. doi:10.1145/1109540.1109546

DNA Oy, 2014. Koululaistutkimus 2014.

DNA Oy, 2011. Koululaistutkimus 2011.

Druin, A., 2009. Mobile Technology for Children: Designing for Interaction and Learning. Morgan Kaufmann Publishers Inc., San Francisco, CA, USA.

Druin, A., 2002. The role of children in the design of new technology. Behaviour and information technology 21, 1–25.

Druin, A., 1999. Cooperative Inquiry: Developing New Technologies for Children with Children, in: Proceedings of the SIGCHI Conference on Human Factors in Computing Systems, CHI '99. ACM, New York, NY, USA, pp. 592–599. doi:10.1145/302979.303166

Dunham, D., 2013. Need To Manage Your Kid's Allowance? There's An App For That [WWW Document]. Forbes. URL http://www.forbes.com/sites/learnvest/2013/06/11/need-to-manage-your-kids-allowance-theres-an-app-for-that/ (accessed 2.18.15).

Elisa Oy, 2014a. Elisan asiakastutkimus: Pelit matkapuhelimissa.

Elisa Oy, 2014b. On Elisa [WWW Document]. Corporate Elisa. URL http://corporate.elisa.com

REFERENCES

Elisa Rahoitus Oy, 2014. Elisa Lompakko [WWW Document]. Elisa Lompakko. URL http://elisa.fi/lompakko/ (accessed 1.28.15).

Fitton, D.B., Horton, M., Read, J.C., 2014. Scaffolding Design Sessions with Teenagers: The PDA Approach, in: Proceedings of the Extended Abstracts of the 32Nd Annual ACM Conference on Human Factors in Computing Systems, CHI EA '14. ACM, New York, NY, USA, pp. 1183–1188. doi:10.1145/2559206.2581350

Fitton, D., Horton, M., Read, J.C., Little, L., Toth, N., 2012. Climbing the Cool Wall: Exploring Teenage Preferences of Cool, in: CHI '12 Extended Abstracts on Human Factors in Computing Systems, CHI EA '12. ACM, New York, NY, USA, pp. 2093–2098. doi:10.1145/2212776.2223758

Frauenberger, C., Good, J., Keay-Bright, W., Pain, H., 2012. Interpreting Input from Children: A Designerly Approach, in: Proceedings of the SIGCHI Conference on Human Factors in Computing Systems, CHI '12. ACM, New York, NY, USA, pp. 2377–2386. doi:10.1145/2207676.2208399

Gaver, B., Dunne, T., Pacenti, E., 1999. Design: Cultural Probes. interactions 6, 21–29. doi:10.1145/291224.291235

Gelderblom, H., Kotzé, P., 2009. Ten Design Lessons from the Literature on Child Development and Children's Use of Technology, in: Proceedings of the 8th International Conference on Interaction Design and Children, IDC '09. ACM, New York, NY, USA, pp. 52–60. doi:10.1145/1551788.1551798

Gelderblom, H., Kotzé, P., 2008. Designing Technology for Young Children: What We Can Learn from Theories of Cognitive Development, in: Proceedings of the 2008 Annual Research Conference of the South African Institute of Computer Scientists and Information Technologists on IT Research in Developing Countries: Riding the Wave of Technology, SAICSIT '08. ACM, New York, NY, USA, pp. 66–75. doi:10.1145/1456659.1456668

Giaccardi, E., Paredes, P., Díaz, P., Alvarado, D., 2012. Embodied Narratives: A Performative Co-design Technique, in: Proceedings of the Designing Interactive Systems Conference, DIS '12. ACM, New York, NY, USA, pp. 1–10. doi:10.1145/2317956.2317958

REFERENCES

Guha, M.L., Druin, A., Chipman, G., Fails, J.A., Simms, S., Farber, A., 2004. Mixing Ideas: A New Technique for Working with Young Children As Design Partners, in: Proceedings of the 2004 Conference on Interaction Design and Children: Building a Community, IDC '04. ACM, New York, NY, USA, pp. 35–42. doi:10.1145/1017833.1017838

Guha, M.L., Druin, A., Fails, J.A., 2013. Cooperative Inquiry revisited: Reflections of the past and guidelines for the future of intergenerational co-design. International Journal of Child-Computer Interaction 1, 14–23. doi:10.1016/j.ijcci.2012.08.003

Heslin, P.A., 2009. Better than brainstorming? Potential contextual boundary conditions to brainwriting for idea generation in organizations. Journal of Occupational & Organizational Psychology 82, 129–145.

Hewett, T.T., Baecker, R., Card, S., Carey, T., Gasen, J., Mantei, M., Perlman, G., Strong, G., Verplank, W., 1992. ACM SIGCHI curricula for human-computer interaction. ACM.

Holtzblatt, K., 2005. Rapid contextual design: a how-to guide to key techniques for user-centered design, The Morgan Kaufmann series in interactive technologies. Elsevier/Morgan Kaufmann, San Francisco.

IDEO, 2011. IDEO HCD ToolKit, 2nd edition. ed.

IDEO, No Date. Methods - Design Kit [WWW Document]. Design Kit. URL http://www.designkit.org/methods (accessed 1.26.15a).

IDEO, No Date. What is Human-Centered Design? [WWW Document]. Design Kit. URL http://www.designkit.org/human-centered-design (accessed 1.26.15b).

ISO 9241-210, 2010. Ergonomics of human-system interaction -- Part 210: Human-centred design for interactive systems [WWW Document].

Iversen, O.S., Dindler, C., 2008. Pursuing Aesthetic Inquiry in Participatory Design, in: Proceedings of the Tenth Anniversary Conference on Participatory Design 2008, PDC '08. Indiana University, Indianapolis, IN, USA, pp. 138–145.

REFERENCES

Iversen, O.S., Smith, R.C., 2012. Scandinavian Participatory Design: Dialogic Curation with Teenagers, in: Proceedings of the 11th International Conference on Interaction Design and Children, IDC '12. ACM, New York, NY, USA, pp. 106–115. doi:10.1145/2307096.2307109

Jarusriboonchai, P., Lundgren, S., Olsson, T., Fischer, J., Memarovic, N., Reeves, S., Woźniak, P., Torgersson, O., 2014. Personal or Social?: Designing Mobile Interactions for Co-located Interaction, in: Proceedings of the 8th Nordic Conference on Human-Computer Interaction: Fun, Fast, Foundational, NordiCHI '14. ACM, New York, NY, USA, pp. 829–832. doi:10.1145/2639189.2654840

Kafai, Y.B., Carter Ching, C., Marshall, S., 1997. Children as designers of educational multimedia software. Computers & Education 29, 117–126. doi:10.1016/S0360-1315(97)00036-5

Kankainen, A., 2003. UCPCD: User-centered Product Concept Design, in: Proceedings of the 2003 Conference on Designing for User Experiences, DUX '03. ACM, New York, NY, USA, pp. 1–13. doi:10.1145/997078.997087

Kautonen, E., 2015. Millaisia maksukortteja alle 15-vuotias saa? [WWW Document]. Helsingin Sanomat. URL http://www.hs.fi/kuluttaja/a1422852135177? (accessed 5.2.15).

Keinonen, T., 2006. Introduction to Concept Design, in: Keinonen, T., MSc, R.T. (Eds.), Product Concept Design. Springer London, pp. 1–31.

Kelly, S.R., Mazzone, E., Horton, M., Read, J.C., 2006. Bluebells: A Design Method for Child-centred Product Development, in: Proceedings of the 4th Nordic Conference on Human-Computer Interaction: Changing Roles, NordiCHI '06. ACM, New York, NY, USA, pp. 361–368. doi:10.1145/1182475.1182513

Kokil, U., Jeanne, J., 2008. Designing Wearable Educational Games for Children, in: Proceedings of the Tenth Anniversary Conference on Participatory Design 2008, PDC '08. Indiana University, Indianapolis, IN, USA, pp. 320–321.

Kuure, L., Halkola, E., Iivari, N., Kinnula, M., Molin-Juustila, T., 2010. Children Imitate!: Appreciating Recycling in Participatory Design with Children, in:

REFERENCES

Proceedings of the 11th Biennial Participatory Design Conference, PDC '10. ACM, New York, NY, USA, pp. 131–140. doi:10.1145/1900441.1900460

Labrune, J.-B., Mackay, W., 2006. Telebeads: Social Network Mnemonics for Teenagers, in: Proceedings of the 2006 Conference on Interaction Design and Children, IDC '06. ACM, New York, NY, USA, pp. 57–64. doi:10.1145/1139073.1139092

Lauricella, A.R., Barr, R., Calvert, S.L., 2014. Parent–child interactions during traditional and computer storybook reading for children's comprehension: Implications for electronic storybook design. International Journal of Child-Computer Interaction. doi:10.1016/j.ijcci.2014.07.001

Mannonen, P., 2010. Chapter 5 Technology Cultures, in: Handbook of Research on Culturally-Aware Information Technology: Perspectives and Models: Perspectives and Models. IGI Global.

Mannonen, P., Nieminen, M.P., 2007. Design perspectives: sampling user research for concept development, in: Engineering Psychology and Cognitive Ergonomics. Springer, pp. 108–117.

Markopoulos, P., Read, J.C., MacFarlane, S., Hoysniemi, J., 2008. Evaluating Children's Interactive Products: Principles and Practices for Interaction Designers. Morgan Kaufmann Publishers Inc., San Francisco, CA, USA.

Mattelmäki, T., 2008. Probing for co-exploring. CoDesign 4, 65–78. doi:10.1080/15710880701875027

Mazzone, E., 2008. Determining Value in Informant Design with Children, in: Proceedings of the 22Nd British HCI Group Annual Conference on People and Computers: Culture, Creativity, Interaction - Volume 2, BCS-HCI '08. British Computer Society, Swinton, UK, UK, pp. 251–252.

Mazzone, E., Read, J., Beale, R., 2008. Understanding Children's Contributions During Informant Design, in: Proceedings of the 22Nd British HCI Group Annual Conference on People and Computers: Culture, Creativity, Interaction - Volume 2, BCS-HCI '08. British Computer Society, Swinton, UK, UK, pp. 61–64.

REFERENCES

Moraveji, N., Li, J., Ding, J., O'Kelley, P., Woolf, S., 2007. Comicboarding: Using Comics As Proxies for Participatory Design with Children, in: Proceedings of the SIGCHI Conference on Human Factors in Computing Systems, CHI '07. ACM, New York, NY, USA, pp. 1371–1374. doi:10.1145/1240624.1240832

Mäyrä, F., Ermi, L., 2014. Pelaajabarometri 2013 : Mobiilipelaamisen nousu. Tampereen yliopisto.

Nielsen, J., 1994. Usability engineering. Elsevier.

Nieminen, M.P., 2006. Process and methods of user-centered concept development.

Nieminen, M.P., Viitanen, J., 2008. Time machine: creating a mixed reality experience for children. Human Computer Interaction 611, 14–23.

Nousiainen, T., 2009. Children's Involvement in the Design of Game-Based Learning Environments, in: Kankaanranta, M., Neittaanmäki, P. (Eds.), Design and Use of Serious Games, Intelligent Systems, Control, and Automation: Science and Engineering. Springer Netherlands, pp. 49–66.

Numminen, A., Götenstedt, P., 2011. Vanhemmat lasten rahankäytön opastajina ja roolimalleina. Nordea.

Pruitt, J., Grudin, J., 2003. Personas: Practice and Theory, in: Proceedings of the 2003 Conference on Designing for User Experiences, DUX '03. ACM, New York, NY, USA, pp. 1–15. doi:10.1145/997078.997089

Rämänen, J., 2011. Koettu turvallisuus matkapuhelimella tapahtuvassa tunnistautumisessa.

Read, J.C., Bekker, M.M., 2011. The Nature of Child Computer Interaction, in: Proceedings of the 25th BCS Conference on Human-Computer Interaction, BCS-HCI '11. British Computer Society, Swinton, UK, UK, pp. 163–170.

Read, J.C., Fitton, D., Horton, M., 2014. Giving Ideas an Equal Chance: Inclusion and Representation in Participatory Design with Children, in: Proceedings of the 2014 Conference on Interaction Design and Children, IDC '14. ACM, New York, NY, USA, pp. 105–114. doi:10.1145/2593968.2593986

REFERENCES

Read, J.C., Fitton, D., Horton, M., 2013a. Theatre, PlayDoh and Comic Strips: Designing Organic User Interfaces with Young Adolescent and Teenage Participants. Interact. Comput. 25, 183–198. doi:10.1093/iwc/iws016

Read, J.C., Fitton, D., Mazzone, E., 2010. Using Obstructed Theatre with Child Designers to Convey Requirements, in: CHI '10 Extended Abstracts on Human Factors in Computing Systems, CHI EA '10. ACM, New York, NY, USA, pp. 4063–4068. doi:10.1145/1753846.1754103

Read, J.C., Horton, M., Fitton, D., Little, L., Beale, R., Toth, N., 2013b. On Being Cool: Exploring Interaction Design for Teenagers, in: Proceedings of the 27th International BCS Human Computer Interaction Conference, BCS-HCI '13. British Computer Society, Swinton, UK, UK, pp. 10:1–10:10.

Read, J.C., MacFarlane, S., 2006. Using the Fun Toolkit and Other Survey Methods to Gather Opinions in Child Computer Interaction, in: Proceedings of the 2006 Conference on Interaction Design and Children, IDC '06. ACM, New York, NY, USA, pp. 81–88. doi:10.1145/1139073.1139096

Read, J.C., Markopoulos, P., 2013. Child–computer interaction. International Journal of Child-Computer Interaction 1, 2–6. doi:10.1016/j.ijcci.2012.09.001

Read, J., Horton, M., Mazzone, E., 2005. The design of digital tools for the primary writing classroom.

Ruckenstein, M., 2010. Time scales of consumption: Children, money and transactional orders. Journal of Consumer Culture 10, 383–404. doi:10.1177/1469540510376904

Saffer, D., 2006. Designing for Interaction: Creating Smart Applications and Clever Devices, First. ed. Peachpit Press, Berkeley, CA, USA.

Salovaara, A., Mannonen, P., 2005. Use of Future-Oriented Information in User-Centered Product Concept Ideation, in: Costabile, M.F., Paternò, F. (Eds.), Human-Computer Interaction - INTERACT 2005, Lecture Notes in Computer Science. Springer Berlin Heidelberg, pp. 727–740.

Sanders, E.B.-N., Stappers, P.J., 2008. Co-creation and the new landscapes of design. CoDesign 4, 5–18. doi:10.1080/15710880701875068

REFERENCES

Scaife, M., Rogers, Y., Aldrich, F., Davies, M., 1997. Designing for or Designing with? Informant Design for Interactive Learning Environments, in: Proceedings of the ACM SIGCHI Conference on Human Factors in Computing Systems, CHI '97. ACM, New York, NY, USA, pp. 343–350. doi:10.1145/258549.258789

Sluis-Thiescheffer, R.J.W., Bekker, M.M., Eggen, J.H., Vermeeren, A.P.O.S., Ridder, H. de, 2011. Development and application of a framework for comparing early design methods for young children. Interact. Comput. 23, 70–84. doi:10.1016/j.intcom.2010.10.002

Steen, M., Kuijt-Evers, L., Klok, J., 2007. Early user involvement in research and design projects–A review of methods and practices, in: 23rd EGOS Colloquium, Vienna. Citeseer, pp. 1–21.

Taylor-Powell, E., Renner, M., 2003. Analyzing qualitative data. University of Wisconsin–Extension, Cooperative Extension.

The World Bank, 2014. The World Bank - Data [WWW Document]. Primary school starting age (years). URL http://data.worldbank.org/indicator/SE.PRM.AGES (accessed 1.2.15).

Vaajakallio, K., Mattelmäki, T., Lee, J.-J., 2010. Co-design Lessons with Children. interactions 17, 26–29. doi:10.1145/1806491.1806498

Xu, D., Read, J.C., Sim, G., McManus, B., 2009. Experience It, Draw It, Rate It: Capture Children's Experiences with Their Drawings, in: Proceedings of the 8th International Conference on Interaction Design and Children, IDC '09. ACM, New York, NY, USA, pp. 266–270. doi:10.1145/1551788.1551849

Young Workers' Act, 1993. FINLEX ® - Translations of Finnish acts and decrees: 998/1993 English [WWW Document]. URL http://www.finlex.fi/en/laki/kaannokset/1993/en19930998 (accessed 2.4.15).

Zaman, B., Abeele, V.V., 2010. Laddering with Young Children in User eXperience Evaluations: Theoretical Groundings and a Practical Case, in: Proceedings of the 9th International Conference on Interaction Design and Children, IDC '10. ACM, New York, NY, USA, pp. 156–165. doi:10.1145/1810543.1810561

REFERENCES

Pictures used for the workshop material are from *Thinkstockphotos* (http://www.thinkstockphotos.com) image gallery and they had suitable license.

APPENDICES

APPENDIX 1 – THE QUESTIONS FOR MOODBOARD INTERVIEWS (TRANSLATED)

- *Introduce the project*
- *Inquire signatures to agreements forms*
- *Inquire possibility to record the interview*
- *Present the contents of the interview*

1. Consumption

    1. How much money the children consume themselves?
    2. Which means of payment is in use? (Card, cash, phone, on web)
    3. Are the means of payment in use practical?
    4. What do the children purchase?

2. Weekly/monthly allowance

    1. Do children receive weekly/monthly allowance?
    2. How much?
    3. How the weekly/monthly allowance is paid to the children?
    4. If no weekly/monthly allowance is in use, do children own money earned/obtained from other sources?
    5. Is there some challenges related to the paying the weekly/monthly allowance?
    6. How the weekly/monthly allowance is tracked: How it is used/When it was paid

3. Earning and obtaining capital

    1. Does the children earn money by doing household chores? Examples?
    2. Do children acquire money as a present?

4. Saving

    1. Does the children save money?
    2. Are children encouraged to save?
    3. How saving could be easier (if necessary)?

5. Learning

    1. What money is?
    2. How have you learned about money? At home/at school
    3. What is the best way to teach the children money-related issues?

6. Transporting and storing of money

    1. How much money children carry with them? At least/At most
    2. Where the money is transported?
    3. Where the children store the money at home?
    4. Can you tell example cases related to the transporting and storing of money? E.g., cash dropped from pocket.

7. Safety concerns

    1. Do you have safety concerns related to this topic?
    2. Can you tell example cases related to safety?

8. New innovations

    1. Do you have any ideas related to this topic, how the discussed concerns could be solved? How would you feel if the children would have the money inside the phone?

    Thank the participants and hand the reward

APPENDIX 2 – AN EXAMPLE SET OF CARDS USED IN MOODBOARD INTERVIEW
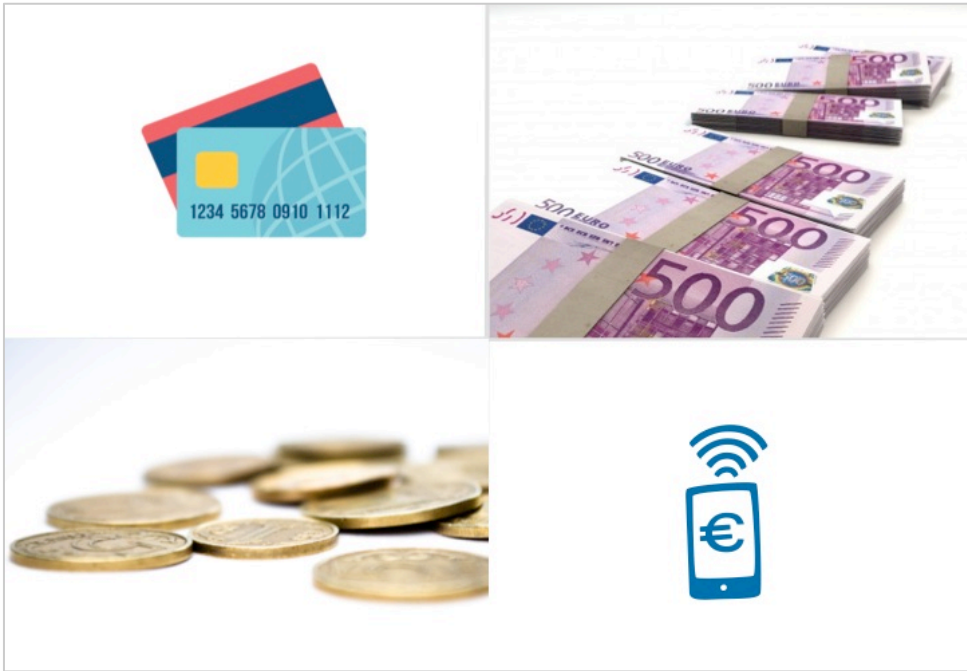
APPENDIX 3 – AN EXAMPLE QUESTION PAPER USED IN WORKSHOP 1

Rahan käyttäminen

Käytätkö käteistä (kolikot, setelit) vai korttia vai jotakin muuta välinettä maksamiseen? Kirjoita tähän käyttämäsi väline:

Mitä ostat omalla rahallasi? Kirjoita esimerkkiostos tähän:

Paljonko rahaa käytät yleensä kerralla? Kirjoita numero:

APPENDIX 4 – THE PROBLEM-PROBE (HOMEWORK) GIVEN TO THE CHILDREN AT THE END OF THE WORKSHOP 1

Itse keksimäni ongelma:

APPENDIX 5 – AN EXAMPLE OF A COMIC TEMPLATE USED IN THE WORKSHOP 2
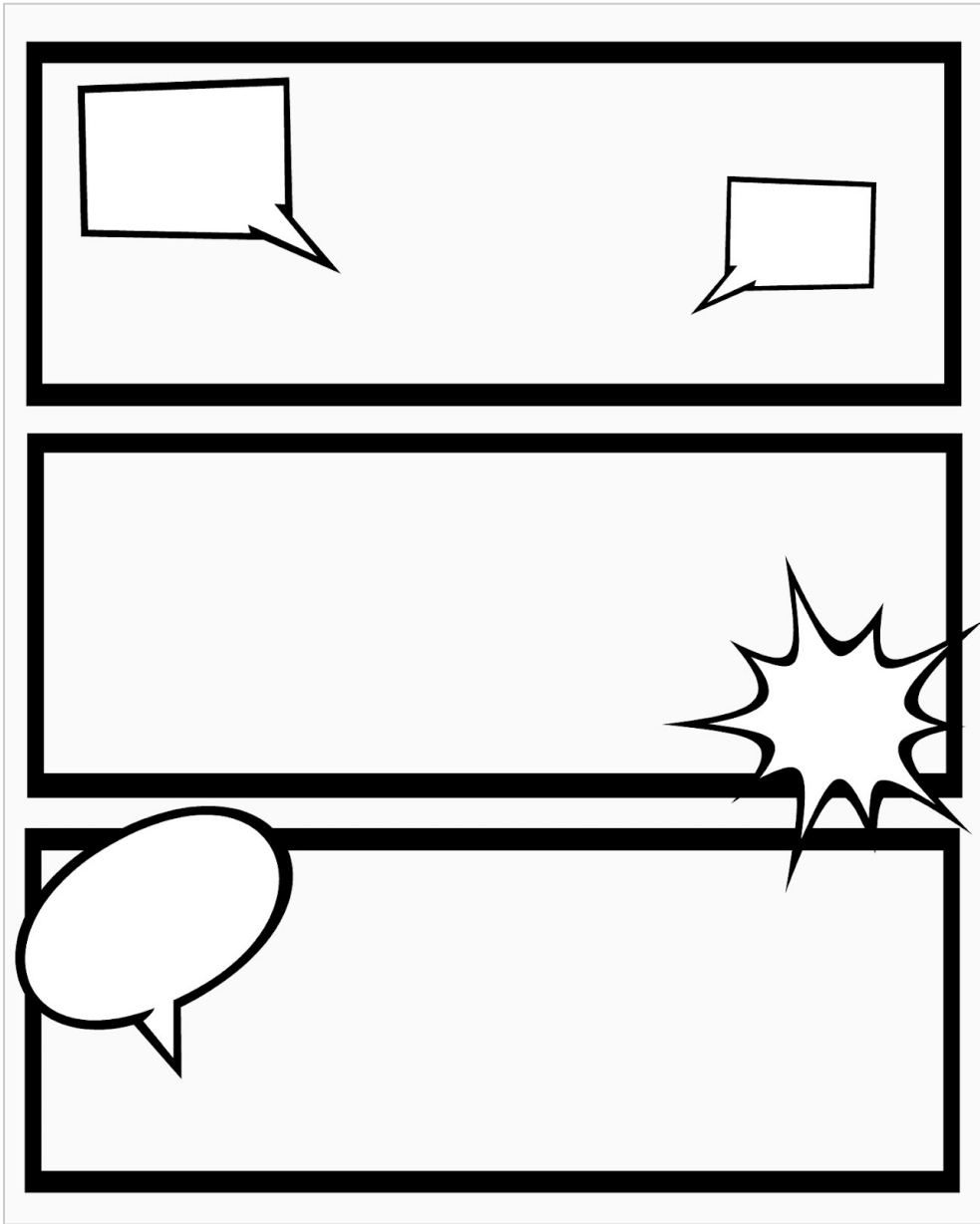
APPENDIX 6 – A SMART PHONE TEMPLATE FOR THE WORKSHOP 3
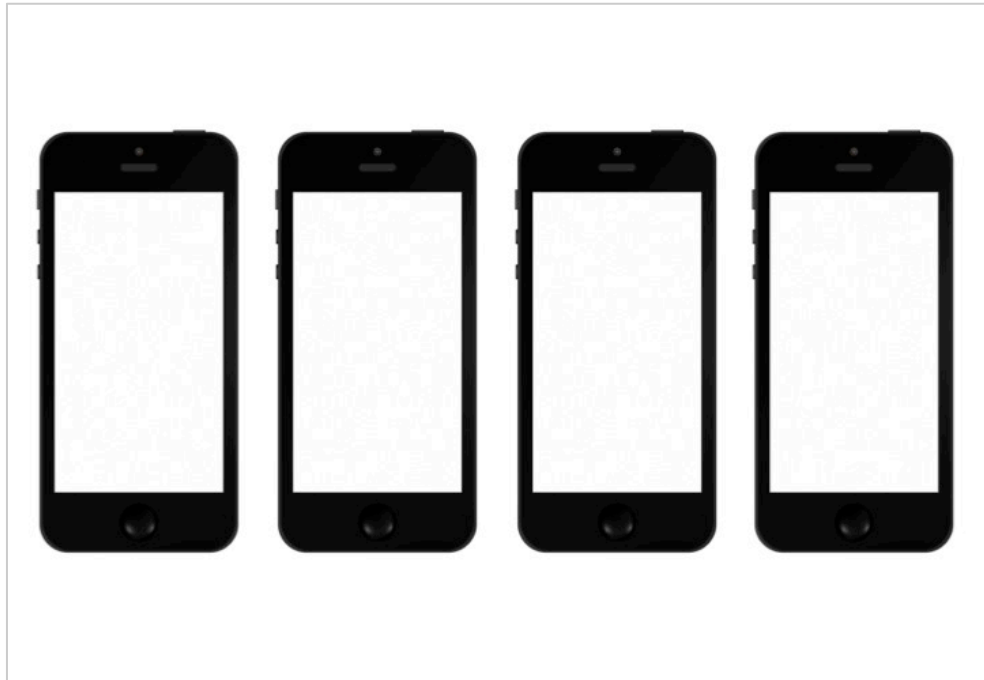
APPENDIX 7 – THE REVISED FUN TOOLKIT FOR THE WORKSHOP 4

Nimi: Ikä:

1. Kuinka hyvä oli RAHATASKU-sovellus ja sen idea? Ympyröi:

😃 ☺ 😐 😣

Miksi?

2. Kuinka hyvä oli SÄÄSTÖLASKURI-sovellus ja sen idea? Ympyröi:

😃 ☺ 😐 😣

Miksi?

2. Laita sovellukset (RAHATASKU, SÄÄSTÖLASKURI) järjestykseen paremmuuden mukaan:

1.

2.

Miksi?

3. Haluaisitko käyttää tämänkaltaista sovellusta? Laita raksi.

	Kyllä	Ehkä	En
RAHATASKU			
SÄÄSTÖLASKURI			

Miksi?

APPENDIX 8 – THE DIPLOMA GIVEN TO THE CHILDREN AT THE END OF WORKSHOP 4
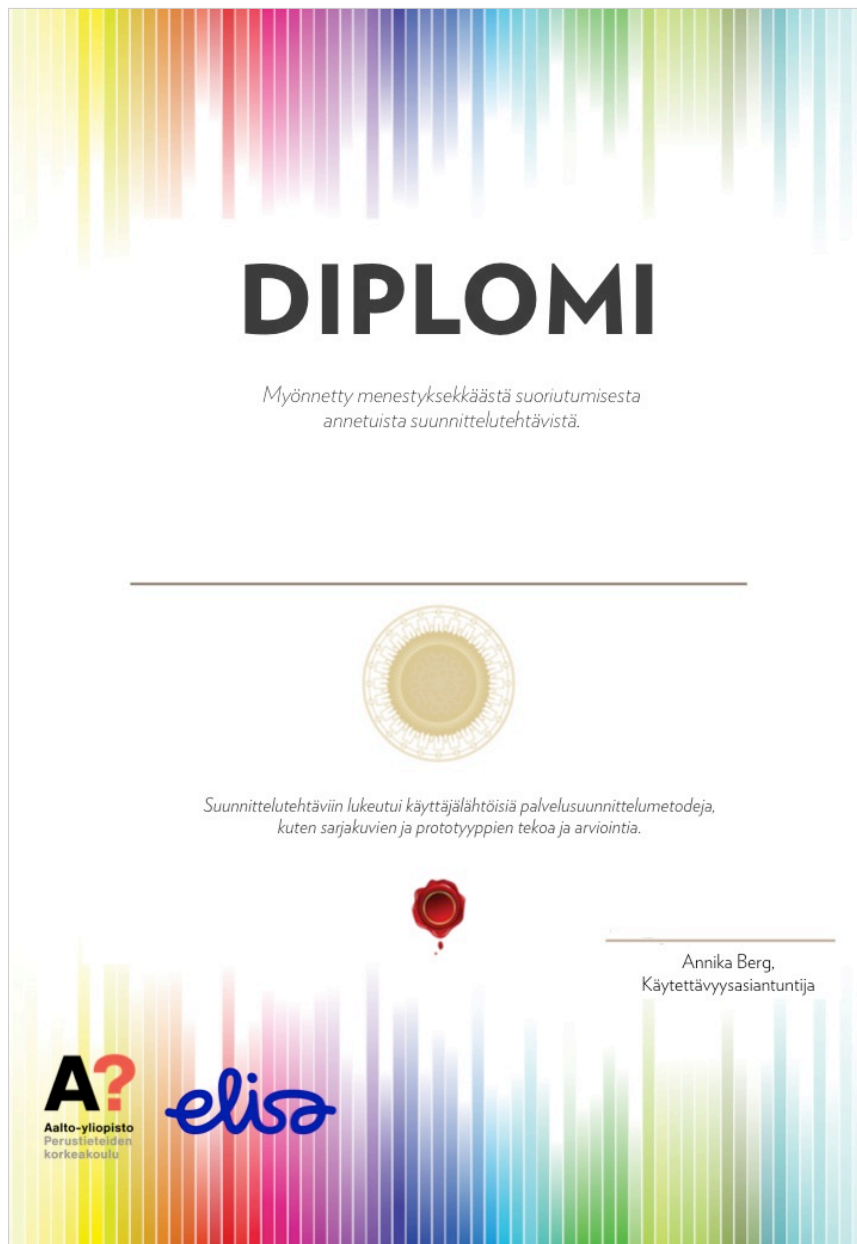
APPENDIX 9 – THE MAIN RESULTS FROM THE MOODBOARD INTERVIEW

	Family 1	Family 2	Family 3	Family 4
(Family composition)	2, 5, 7 and 9-year old children	9-year-old child	10 and 11-year old, parents divorced	7 and 10 year-old children
How the children pay	(Cash) Parents pay for them	Cash	Debit cards, also online	Cash and list for snacks at school
What children buy	Snacks	Sports equipment	Electronics	Candy, snacks, crafts
Weekly/Monthly allowance	No	Monthly allowance 12 e	Monthly allowance 10 e per parent	Weekly allowance 5 e
Earning/Getting money	"Too much" as a present, definite no about getting money from chores	A lot of money as a present, not really from chores	Not really from chores, sometimes for a good school certificate	From good grades, from bigger chores
Saving money	Good savers, parents have told about saving	Good saver, though parents control	Good savers, can use independently, compares prices online	The other good saver, the other uses right away
Learning to use money	Don't have weekly/monthly allowance. Parents have told about how pricey are things.	Parents have to control the usage of money, although has had weekly allowance since five	Says that the digital money has helped with saving, now easier to know how much money have	Parents first told about saving but then realized it is better to let them learn themselves
Money transformation and storage	Children have in their wallets. The children don't really carry the money.	Child has in his wallet.	Card easy as the parents can transfer quickly money when needed	Carry within wallet or similar. The younger child would be interested in using card.
Safety	The children don't make purchases on their own. In-app purchases are intimidating.	The child has quite a lot of money but cannot control the usage of it.	Pin-code brings safety. Cards brings safety as the parent can transfer money to it when needed.	Once the child bought by accident with iPad, in-app purchases disabled in phones.
Attitude towards new	Would like the idea of keeping the	Would like to have teaching	Young people are early adopters.	Could help with snack

paying ideas	children's money separate, but otherwise a bit skeptic. Mentioned the possibility for children to broke e.g. phone.	aspect in it. Concerns if it would not be enough concrete for the child.	Visualizations of savings could be good. Pin code brings safety.	paying at school in small scale. Younger child have wanted debit card.
Problems concerning money	Children mix their cash in their games, hard to preserve all the present money, hard to understand concept of money	In-app purchases accidentally, sometimes the parents forgot to pay the allowance, hard to understand concept of money	Card is not valid everywhere, not every bank give cards under 15-year old	Saving is hard, coins hard to calculate, hard to understand concept of money

APPENDIX 10 – THE MAIN RESULTS FROM THE WORKSHOP 1

Theme	Results
Usage of money	Children use cash, 6-graders might use card, app-store. They buy clothes, candy, books, games, toys, Legos and cosmetics. They use 0.5e to 50 e at once.
Receiving and earning money	15 have weekly/monthly allowance, 3 don't. 1 unsure. They have 2 to 10 euros as allowance. Most of the children get extra money from good grades or household chores. Most gets money as a present: 10 to 400 euros.
Saving and storing money	Only one announced that don't save money. They have saved from 52 to 1000 euros. The most common place to store the money is wallet. Children usually carry coins with them or from 2 to 20 euros. One claimed to carry all of his/her money. Three children reported that they had lost money. Two also told that they had found money.
The concept of money and learning about money	Money was explained to be something with which one can buy items. Also "valuable" and "currency" were mentioned. All the students claimed that is not hard to learn how to use money. They had the following ideas on how to learn how to use money: Buying, Saving, Playing store, in math class, thinking carefully what to buy, with the researcher's phone application (writer's note: we talked about applications when introducing the design challenge).

APPENDIX 11 – THE MAIN RESULTS FROM THE PROBLEM-PROBE GIVEN AT THE END OF THE WORKSHOP 1

Emerging theme	How many mentioned (17 total)
Not enough money	5
Spending too much and/ or running out of money	6
Other: Not knowing how to buy from web store, Not knowing how much can spend with the money, Getting addicted to buying, Getting robbed, "Groceries", If we run out of metal	6

APPENDIX 12 - THE MAIN RESULTS FROM THE COMICS MADE IN WORKSHOP 2

The problem	How many mentioned (total 17 returned comics)
Not having enough money	8
The difficulty to count money	2
Difficulties to buy from phone/web	2
Other: Losing money, Not having enough money in travel card, Not knowing if did the right decision about buying, Not knowing how to use ATM, Broking phone thus needing more money, Buying accidently same thing twice, Not knowing the value of money, Worried about paying at cashier	8

The solution	How many (total 17 returned comics)
Asking advice from friends/parents/sales assistant	4
Getting money from friends/parents	3
Getting money by fighting	2
Saving money	2
Other: Selling extra item online, Getting money by helping others, Loading more money to the travel card, careful reasoning, finding the lost money together	5

APPENDIX 13 – THE MAIN RESULTS FROM THE DESIGNS MADE IN WORKSHOP 3

Grade	Concept	Description
2	Money-related game	Four different money-related games
2	Money-related game	Jumping game in which the user gathers coins. Different levels.
2	Money-related game	Different games, for example, avoid dropping objects
2	Money-related game	Game with gamification elements – Different levels and choose a character.
2	Games and other applications that cost something	Different applications that cost something; Selfie instructions, What's App with drawing functionality, games
2	Game/Buying application	The child explained the application to be "some game", but it seems to be a gamestore working with TV
2	Own versions of existing services for children and one existing game	Children's Youtube, Children's own game store, Children's Google and Angry birds – game.
6	Saving application with social aspect	"A saving land" A multifunctional application for saving (games, visualizations of savings). The user can also see the family's saving targets.
6	Saving application with social aspect	Multifunctional application for saving. Also games and gift card functionality. Possibility to see also family's savings and transactions.
6	Saving application	The user enters the amount of the weekly allowance and the application calculates and shows how many weeks the user has to save.

APPENDIX 14 – THE MAIN RESULTS FROM THE WORKSHOP 4

Prototype	Tester's grade	Mean value from 1 to 4	Preference	Would you like to use it *	Reasons for positive feedback	Reasons for negative feedback
"Rahatasku" Prototype with multiple functions	2	2,07	3 out of 14	Yes:2 Maybe:8 No:4	More functions, Game was fun	Too complex, Visualization should be different, not fun, boring, it was not ready
	6	3,44	6 out of 8	Yes:6,5 Maybe:0,5 No:0	Clear, could learn saving, easier to use, More functions, really good, fun	User have to be able to buy with mobile, More games, Something was missing
"Säästölaskuri" Prototype with furry characters	2	2,86	10 out of 14	Yes:6 Maybe:5 No:3	Lovely! Fun! Sounds good, makes the user laugh, more fun, handy, nice characters, can learn saving	The money should be put to vault, it was not ready: The user could not choose the character
	6	3	2 out of 8	Yes:4 Maybe:1,5 No:1,5	Clear, Perfect	Too simple, the other character did not work, it was for younger children, hard to understand the idea

*when child crossed two options, a selection was calculated as a half point

Rahan käyttäminen

Käytätkö käteistä (kolikot, setelit) vai korttia vai jotakin muuta välinettä maksamiseen? Kirjoita tähän käyttämäsi väline:

Käteinen

Mitä ostat omalla rahallasi? Kirjoita esimerkkiostos tähän:

Karkkia

Paljonko rahaa käytät yleensä kerralla? Kirjoita numero:

Rahan saaminen ja ansaitseminen

Saatko viikko tai kuukausirahaa? Laita tähän raksi oikeaan kohtaan:

KYLLÄ: X X X X X X X X X X X X X X +

EI: X X

Kuinka paljon? Kirjoita tähän numero:

Ansaitsetko joskus lisärahaa jotenkin, kuten tekemällä kotitöitä tai saamalla hyviä arvosanoja? Laita raksi oikeaan kohtaan.

KYLLÄ: X X X X X X X X X X X X X

EI: X X

Saatko lahjaksi rahaa? Laita raksi oikeaan kohtaan:

KYLLÄ: X X X X X X X X X X X X

EI: X +

Paljonko olet saanut lahjaksi rahaa? Kirjoita tähän numero.

Rahan säästäminen ja säilyttäminen

Säästätkö rahaa? Laita raksi oikeaan kohtaan:

KYLLÄ: X X X X X X X X X X X X X X X X X

EI: X

Paljonko rahaa olet joskus säästänyt? Laita tähän numero:

Missä säilytät rahojasi? Kirjoita esimerkkipaikka.

Paljonko rahaa yleensä kannat mukanasi? Kirjoita tähän numero:

Oletko ikinä hukannut tai muuten menettänyt rahaa? Jos olet, kerro lyhyesti miten se tapahtui?

Rahan käsite ja rahankäytön oppiminen

Mitä on raha?

Onko rahankäytön oppiminen vaikeata? Merkitse rastilla.

KYLLÄ:

EI: X X X X X X X X X X X X X X X X X X

Miten rahan käyttöä voisi opetella?

APPENDIX 17 – THE COMIC STRIPS DRAWN IN WORKSHOP 2

Figure 5

Figure 6

Figure 7

Figure 8

Figure 9

Figure 10

Figure 11

Figure 12

Figure 13

Figure 14

Figure 15

Figure 16

Comic strip 17

APPENDIX 18 – THE APPLICATION DESIGNS MADE IN WORKSHOP 3
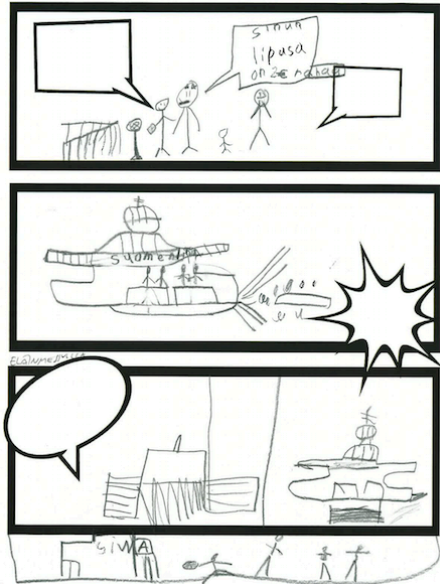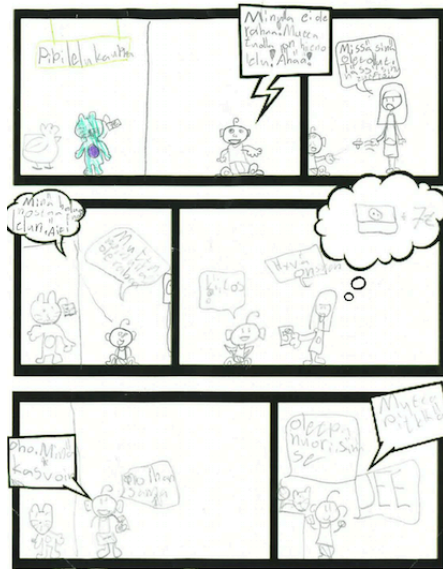
Figure 1	
Figure 2	
Figure 3	
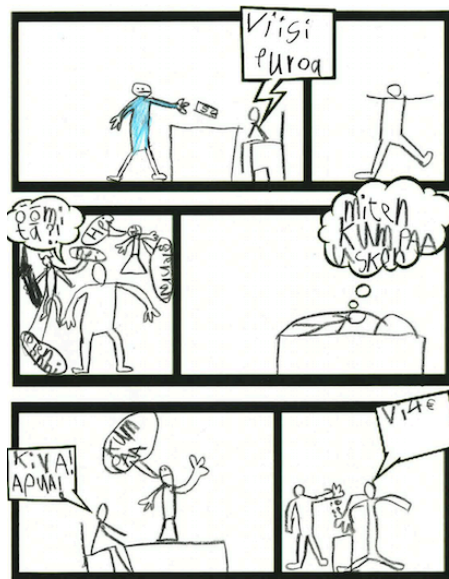
Figure 4	
Figure 5	
Figure 6	

Figure 7	
Figure 8	
Figure 9	

APPENDICES

| Figure 10 | |

APPENDIX 19 –THE FEEDBACK FORMS FROM WORKSHOP 4

The feedback forms from second graders:

Figure 1

Figure 2

Figure 3

Figure 4

Figure 5

1. Kuinka hyvä oli RAHATASKU-sovellus ja sen idea? Ympyröi:

Miksi? Ei ollu niin hauska

2. Kuinka hyvä oli SÄÄSTÖLASKURI-sovellus ja sen idea? Ympyröi:

Miksi? Koska se oli niin hikonhkumeivo

2. Laita sovellukset (RAHATASKU, SÄÄSTÖLASKURI) järjestykseen paremmuuden mukaan:
1.
2.

Miksi? Oltniin peesta

3. Haluaisitko käyttää tämänkaltaista sovellusta? Laita raksi.

	Kyllä	Ehkä	En
RAHATASKU		X	
SÄÄSTÖLASKURI		X	

Miksi? nrolihuohoja

Figure 6

1. Kuinka hyvä oli RAHATASKU-sovellus ja sen idea? Ympyröi:

Miksi? Tylsä' mten ihan kiva

2. Kuinka hyvä oli SÄÄSTÖLASKURI-sovellus ja sen idea? Ympyröi:

Miksi? Se oli ihana!

2. Laita sovellukset (RAHATASKU, SÄÄSTÖLASKURI) järjestykseen paremmuuden mukaan:
1. Säästölaskuri
2. Rahatasku

Miksi? koska säästölaskyri on hauska

3. Haluaisitko käyttää tämänkaltaista sovellusta? Laita raksi.

	Kyllä	Ehkä	En
RAHATASKU		X	
SÄÄSTÖLASKURI	X		

Miksi? En ole ihan kiinnostunut rahataskusta, mutta säästölaskuri on kätevä ja hyödyllinen

Figure 7

1. Kuinka hyvä oli RAHATASKU-sovellus ja sen idea? Ympyröi:

Miksi? Koska sitä oli ihan kiva tehdä

2. Kuinka hyvä oli SÄÄSTÖLASKURI-sovellus ja sen idea? Ympyröi:

Miksi? koska se oli ihan kiva mutta ei niin

2. Laita sovellukset (RAHATASKU, SÄÄSTÖLASKURI) järjestykseen paremmuuden mukaan:
1. Rahatasku
2. Säästölaskuri

Miksi? koska Rahataskussa oli enemmän ja säästölaskurissa oli vähän tylsää mutta ei ole niin

3. Haluaisitko käyttää tämänkaltaista sovellusta? Laita raksi.

	Kyllä	Ehkä	En
RAHATASKU	X		
SÄÄSTÖLASKURI		X	

Miksi? Siksi

Figure 8

1. Kuinka hyvä oli RAHATASKU-sovellus ja sen idea? Ympyröi:

Miksi? emberedd

2. Kuinka hyvä oli SÄÄSTÖLASKURI-sovellus ja sen idea? Ympyröi:

Miksi?

2. Laita sovellukset (RAHATASKU, SÄÄSTÖLASKURI) järjestykseen paremmuuden mukaan:
1.
2.

Miksi?

3. Haluaisitko käyttää tämänkaltaista sovellusta? Laita raksi.

	Kyllä	Ehkä	En
RAHATASKU		X	X
SÄÄSTÖLASKURI			

Miksi?

Figure 9

Figure 10

Figure 11

Figure 12

Figure 13

Figure 14

The feedback forms from sixth graders:

Figure 15

Figure 16

Figure 17

Figure 18

Figure 19

Figure 20

Figure 21	Figure 22

APPENDIX 20 – THE FINAL CONCEPT DESIGN

Oma tili

KÄYTETTÄVISSÄ

22,60€

App-store
🔒 3,70€

Tilitiedot	›
Aseta säästötavoite	›
Lähetä tai pyydä	›
Asetukset	›

‹ Takaisin   Oma tili - Tilitiedot

Suomalainen
Kirjakauppa
23,00 €

Siwa
7,40 €

App Store
3,40 €

1 kk	6 kk	12 kk

⛔ Siwa 3,30 €

➕ Mummo 5,60 €

⛔ Suomalainen kirjakauppa 23,00 €

⛔ App store 3,40 €

⛔ Siwa 4,10 €

APPENDICES

Oma tili

KÄYTETTÄVISSÄ

22,60€

App-store
🔒 3,70€

SÄÄSTÖTAVOITE

44,20€

Tilitiedot ›

Aseta säästötavoite ›

Lähetä tai pyydä ›

Asetukset ›

< Takaisin   Oma tili - Tilitiedot

Suomalainen
Kirjakauppa
23,00€

Siwa
7,40€

App Store
3,40€

SÄÄSTÖTAVOITE
44,20€

| 1 kk | 6 kk | 12 kk |

⊖ Siwa 3,30 €

⊕ Mummo 5,60 €

⊖ Suomalainen kirjakauppa 23,00 €

⊖ App store 3,40 €

⊖ Siwa 4,10 €