University of Bergen

Child-Computer Interaction in Digital Literature Dissemination for the Pre-adolescent Public Library Users

Master Thesis

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ABSTRACT

This master thesis presents the research on digital literature dissemination for library users of public library, specifically on pre-adolescent users of the library. Digital Literature Dissemination can be defined as the process of conveying literature, both digital and physical using an application instead of communication with a librarian. Building on research in Child-Computer Interaction (CCI) led to the research question: How can we design a mobile application that will assist preadolescent readers in choosing a book at the public library?

This Design and Creation research study conducted a literature review that revealed the scarcity and challenges of conducting empirical studies of child-computer interaction in public spaces. In addition, it was discovered that User Experience(UX) and Interaction Design (IxD) are relatively young concepts in the field of Library and Information Sciences (LIS). The findings found in the literature review was the basis of designing "*Super Bibben – ebarnebibliotekar*", a user-centered prototype that assists preadolescent children in choosing the books to read while present at the library.

The creative process was accomplished through four design iterations. Field studies were conducted at Bergen Public Library to investigate how interactions occurred between a librarian and a user during literature dissemination. This resulted in the discovery of scenarios that became the backbone of the prototype. The collaboration with the UX experts and children librarians through workshops, conceptualized initial designs and user requirements for the prototype. A digital prototype was developed in the last two iterations of this research study. Usability tests with pre-adolescent participants and heuristic evaluations with the domain experts were conducted to ensure quality of the prototype and that it met with child-friendly usability goals and design principles.

The results and evaluation opened discussions with regards to design and ethical challenges when working with and for children in a research study. Nevertheless, together with the child's evolving perspective towards technology and the merging of both the physical and digital aspects of the library, this thesis aims to fill in a gap in the knowledge base in the CCI field by using different UX methods and tools in designing a prototype of a possible system that would help children choose a book to read.

TABLE OF CONTENTS

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To my love, who gave me back my strength, I cannot wait you hold you in my arms.

And finally, to *God*, who makes everything possible in His perfect time.

LIST OF FIGURES

LISTS OF TABLES

CHAPTER 1

INTRODUCTION

From ancient times on, libraries have functioned as centers of knowledge that accommodated physical collections, most often in written form, such as books and articles. Public libraries still carry this function, however, lately, in times where knowledge can be found in other places such as the Internet, they have transitioned into arenas for both culture and literature.

Most Norwegian public libraries house a wide range of activities to fit young and old, foreign and native. The Bergen Public Library arranges programming courses, language cafes, and lectures on current affairs such as climate and politics, but still has its main function to host books and advice people on which could be of interest for them.

According to a survey by *Nasjonalbibloteket*[1] in 2015, two-thirds of the users of Norwegian libraries are of ages 0 - 16. In a world where media advances such as apps, games, and social media, are competing for the time and interest of people, the reading interest from the younger generation is declining and it can sometimes even be a challenge to see why children would want to read for pleasure.

For years, Bergen Public Library has recognized the need to include technology and interaction design in public spaces. It has initiated several projects[2][3][4] to promote user experience and digital literature dissemination for the users of the library.

Applying User experience(UX) to physical places such as public libraries can help libraries compete and stand ground in the digital age.

Together with the child's evolving perspective towards technology and the merging of both the physical and digital aspects of the library, this thesis aims to fill in a gap in

[1] National Library of Norway(Nasjonalbiblioteket) collaborate with Statistics Norway(Statistisksentralbyrå) with regards to the library usage. Link to the report: https://www.ssb.no/kultur-og-fritid/artikler-og-publikasjoner/_attachment/235448?_ts=14efd8429f0

[2] https://kunnskapsbase.bibliotekutvikling.no/prosjekter/digital-arena/

[3] https://kunnskapsbase.bibliotekutvikling.no/prosjekter/kreative-laeringspakker/

[4] https://kunnskapsbase.bibliotekutvikling.no/prosjekter/nettvarder-lokasjonsbaserte-tjenester/

the knowledge base in the CCI field by using different UX methods and tools in designing a prototype of a possible system that would help children choose a book to read.

This thesis describes a collaboration with the Bergen Public Library to design a user-centered mobile application for the preadolescent users of the public library to help them choose a book to read.

1.1 RESEARCH QUESTION

How can we design a mobile application that will assist preadolescent readers in choosing a book at the public library?

1.2 RESEARCH OBJECTIVES

In order to answer the main research question, the following research objectives have been established.

1. Identify the process and techniques of suggesting/choosing books for children at the Public Library
2. Design a mobile application that will assist pre-adolescent readers in choosing a book
3. Design an interface based on collected data
4. Test the artefact with target group and the experts
5. Apply User Experience (UX) methods in physical spaces such as libraries

1.3 SCOPE AND LIMITATION OF THIS RESEARCH

This master thesis reports on a focused on UX research. It describes both the steps taken during the design of the prototype, as well as the investigative studies prior to the design (field research, heuristic tests, and user studies).

The central theme of the research was on Child-Computer Interaction and User Experience methods and techniques that can be applied to recommender systems and public libraries.

The final artefact presented is a clickable prototype.

1.4 PERSONAL MOTIVATION

The personal motivation for this research study is the interest in using user experience methods and techniques among special user groups such as children in public spaces such as the library. The author was recently employed as a digital consultant for Bergen Public Library. The goal of the position is to research with the possibility of implementing creative and innovative digital and literary-related solutions, specifically for the younger users of the public library.

The combination of the researcher's work position in the library and this academic research is an advantage because the findings would be relevant and available through the knowledge base of public libraries globally.

Topics relating human-computer interaction, interaction design and technology-enhanced learning for children as users has been present throughout the authors academic projects.

1.5 TARGET GROUP

Bergen Public Library groups children between 0 – 12 years old in the 'younger user group'. This user group is then divided into three smaller segments groups.

Small children (mindre barn) 0 – 6 years old which are usually accompanied by parents and Kindergarten teachers (barnehagelærer). No reading competency is present among these group and most likely requires an adult to assist them with reading.

Primary children (barnetrinnsbarn) 6/7 – 8/9 years old are children that have be just began school or are at the first 3 years of school and are still at the early stages of reading competency. They mostly come parents or together with school visits.

Lastly, Preadolescents (mellomtrinnsbarn) 9-12 years old are competent in reading and have a general understanding of genres and literature.

This study is focused on the last group, the preadolescent users.

1.6 DIGITAL DISSEMINATION AT BERGEN PUBLIC LIBRARY: KLIKK OG LES (CLICK AND READ)

For years, Digital Dissemination has been a very important area for Bergen Public Library. As mentioned above, projects have been completed the pass that promote the merging of technology and literature in this public space. *Klikk og les* (Click and Read) is an example of how digital dissemination is being conveyed in Bergen Public Library.

Klikk og les[5] is a project funded by the National Library of Norway and is conducted in Bergen Public Library. The aim of this project is to research and implement innovative ways of disseminating digital literature for children and young people. The project is divided into two major parts: (1) disseminating literature through digital media and (2) disseminating literature through physical and tangible exhibitions. For the relevance of this research I will only present the first part of the project as it is relevant for this research. The first part focuses on disseminating literature through the use of e-books, audio books, games, and apps in collaboration with the library purchasing scheme (*Innkjøpsordiningen*). This project aims to reveal the problems of limited resources and finding better solutions. In addition, the library has collaborated with the author of this thesis to collect data on the users that may be helpful to understanding their reading habits. The library is particularly interested in applying helpful digital solutions for their users.

The purchasing scheme is managed by *Biblioteksentralen* which decides which books and digital media can be borrowed by the public. All libraries must purchase all literary media from *Biblioteksentralen*. However, the main issue is the lack of resources

[5] "Klikk og Les" (Click and read) project is still an ongoing project due in March 2020. Link to application: http://bit.ly/2CEFAGF *Permission has been granted to share the application for this master thesis by Bergen Offentlige Bibliotek.

available to the libraries since the company is very slow to update their resources. Therefore, this limits the possibilities for the users of the public library, most especially children and youth.

With this collaboration, the author has gained permission to use the library for domain expert meetings, workshops, focus groups and user testing pertaining to the research study. The author has also been granted permission to collaborate with librarians and teachers in-charge of school visits for user tests. The data collection for the research has been approved by NSD.

1.7 STRUCTURE OF THIS MASTER THESIS

This master thesis is structured as follows:

Chapter 1: Introduces the research, the research question and objectives, and how the study will be accomplished.

Chapter 2: Presents the literature review, theoretical focus and related works.

Chapter 3: Presents the role of CCI in public spaces such as libraries and the application of interaction design in digital literature dissemination in helping young users navigate the children's department.

Chapter 4: Details the use of Design and Creation as a research methodology and user-centered methods was used in the research study.

Chapter 5: Presents the iteration user research that was conducted and the requirements that was established for the artefact development.

Chapter 6: Describes in detail the iteration of the prototype development while it discusses and evaluates the results from the user test and the meetings with the domain and UX experts.

Chapter 7: Discusses findings and results during the research.

Chapter 8: Concludes the results of the research and proposes the possibilities of.

CHAPTER 2

LITERATURE REVIEW

This chapter presents relevant literature and key theories. First, an introduction to Child-Computer Interaction, then a brief introduction to User Experience (UX) and Interaction design (IxD) technique. It also presents topics on ethical consideration when doing research with children and briefly present recommender systems and how they can be designed for young users.

2.1 CHILD-COMPUTER INTERACTION (CCI)

Children are considered special users because they have a different perspective towards using technology than adult users. Child-computer interaction (CCI) is a multidisciplinary area of scientific investigation that revolves around the phenomena on the interaction between children and computer technologies (Read & Markopoulos, 2013). CCI is a subfield of Human-Computer Interaction (HCI) which involves a broader perspective of users. The majority of research methods and practices that have been used in CCI have been inspired from HCI.

Having taken the nature of HCI to CCI, Read and Bekker (2011) proposed that the definition and nature of CCI be:
"A study of the Activities, Behaviors, Concern and Abilities of Children as they interact with computer technologies, often with intervention of others (mainly adults in situations that they partially (but generally do not fully) control or regulate" (p. 7)

This research aims to design a digital artefact that will help children with choosing a book to read. To create such artefact, this research must first explore the interaction of literature advisory between a librarian and a reader, specifically pre-adolescent library readers.

Seymour Papert (Read, Hourcade, Markopoulos, & Druin, 2011) , one of the key contributors in the emergences of CCI and child participation saw the significance of investigating the benefits of using children in computing while at the same time applying Jean Piaget's theory of cognitive development (Hourcade, 2008; Read & Markopoulos, 2013). Furthermore, according to Piaget's theory (Druin, 2002), children

can actively construct their own knowledge through their experiences and they actively adapt to the environment. Having this theory in mind can beneficial be towards understanding how children perceive, use, and understand technologies in different environments.

One of the challenges in CCI that Read & Markopoulos (2013) point out is that children and their participation as *users, social actors, and designers* needs further studies and explorations. Designing technology for children is different from designing for adults. Subchapter 2.2.3, "Involving Children in the Design Process" theories on the different roles that children represent when designing newer technology are presented. There, has been very little research addressing guidelines for designing and developing for children and understanding their interaction with technology at a deeper level (Hourcade, 2008). As one issue, the HCI community does not find experimental data on children's abilities to be attractive as it is not as innovative and does not necessarily provide immediate results (Hourcade, 2008).

There is still the need for improving research methods in this field. Despite the many research themes being studied in CCI (Read & Markopoulos, 2013), there is still a lack of empirical studies that can support the researchers work. For example, the review written by Zaman, Vanden-Abeele, Markopoulus, Marshall (cited in Read & Markopoulos, 2013) on tangible interfaces for children suggests that although it strongly presents the advantages of using tangible interfaces, empirical research is still insufficient. In addition, other actors and other contexts other than the typical actors (students and parents) and environments (schools and other educational institutions) in CCI still needs further explorations. In light the abovementioned concerns, this research study contributes to the knowledge base addressing "*other actors and other context in the space*". With this referring to both CCI and Public Spaces, and more specifically in public libraries.

2.2 INTERACTION DESIGN AND CHILDREN

In general terms, Interaction Design (IxD) is designing products that are interactive and can support an individual's everyday life and activities. The central focus of interaction design is the practice but most importantly how User Experience (UX) itself can be designed and how users can interact with the product in the real world. Through a range of methods, frameworks and different techniques, IxD can be used in different aspects of design such as interface design, product design, (Sharp, Rogers, & Preece, 2007).

2.2.1 DESIGN PRINCIPLES IN UX

When designing artefacts with user experiences, design principles can be beneficial in aiding a designer to improve and implement their designs towards technology. Design principles and usability goals are also relevant for Childe-Computer Interaction and it that has been pointed out by Chiasson and Gutwin (2005) that a common pitfall for a designer is to assume that an interface designed for adults and adding a few assumed animations and bright colors would be enough to pass on as child-appropriate. They also claim that design principles for children are hard to find. Rogers, Preece and Sharp (2007)discovered through knowledge-based research, common sense and experience, the most common design principles for user-interfaces are visibility, feedback, constraints, consistency and affordance. These principles can be applied to all kinds of users. This does not mean that it would lock a designer into using fixed designs but rather these would act as triggers that would remind them to apply specific features to specific users. In addition, Chiasson and Gutwin (2005) includes the social and emotional elements as an important design principle when designing technology for children, as all application are related to these elements.

Table 1 presents a short overview of the design principles proposed by Preece, Sharp and Rogers (2007) and Chiasson and Gutwin (2005). This thesis investigates how 5 basic design principles can be applied when the target-user for the user-interface being designed for children. These principles are visibility, feedback, constraints, consistency and affordance.

Visibility

Visibility refers to the transparency of information that is being conveyed in an information system. For example, a vending machine: the function of the automated vending machine is to deliver an item when someone pays and chooses pressing their preferences. Both the end product and the functions are visible to the user. All the controls such as the card reader, coin/notes receiver, and the screen pad are available for the user to use. The user can easily see how the "machine" works in order for it to release the product.

Visibility plays a huge role in designing interfaces for children. In adult user-interfaces it is often assumed that users are proficient in reading and have extensive vocabularies. However, this assumption can be very challenging for children as reading levels vary significantly with them (Chiasson & Gutwin, 2005). Druin (2001), while investigating on creating digital libraries for children, suggested that interface for children should be strongly visual to reduce cognitive load. The use of metaphors with specific contents should be applied to help children navigate the interface easier. Imagination could easily be visual and audio cues can be useful as long as the information being conveyed are age-appropriate and easy-to-understand.

Table 1 - Principles for general design (Sharp et al. (2007)) and children (Chiasson & Gutwin (2005)).

Sharp et al. (2007)	Chiasson & Gutwin (2005)	
Visibility	COGNITIVE	Literacy
Feedback		Feedback and Guidance
		Mental Development
Constraints		Imagination
Consistency	PHYSICAL	Motor Skills
Affordance		Tangibility
	SOCIAL/EMOTIONAL	Motivation and Engagement
		Social interaction
		Collaboration

Feedback

Feedback is closely related to the principle of visibility. It is the communication between the user and user interface. By sending immediate information back when an action is initiated, the user is able to continue with the next step to the activity. In interaction design, a combination of visual, audio, tactile, and verbal are used as forms of feedbacks in interfaces.

Children need both feedback and guidance. Impatience is a common characteristic of a child (Chiasson & Gutwin, 2005) and without proper feedback a child would not be able to understand the task and would repeat its actions until an acceptable result is given. Visual cues for processing should be given so that the child user would know when to wait and when to proceed with the next task. Useful feedbacks, however, should also be the tool to help children learn new concepts. Researchers Sedighian & Klawe (2003) found that by slowly eliminating concrete types of feedback in educational games, motivated children into stimulating cognitive engagement and creativity. Simple but clear messages help a child remember how to accomplish different tasks and adapt to gradual change when presented with new technology.

Constraints

Constraints is a design concept that refers to the ways that hinder interaction from the user (Sharp et al., 2007). By implementing certain constraints on the interface, the user is able understand how to navigate around. For example, certain functions of a graphical interface can be disabled for the users or physical designs of a device can be limited by allowing specific slots to fit in it (Sharp et al., 2007).

When it comes to child-friendly interfaces, the challenge is having lesser individual functions without compromising the interactions. Yet, constraints are still necessary to avoid cluttering of interactions in the interface (Eriksson & Lykke-Olesen, 2007). Constraints in interface design are barely mentioned as a challenge in CCI studies (Chiasson & Gutwin, 2005; Detken, Martinez, & Schrader, 2009; Eriksson & Lykke-Olesen, 2007; Malinverni et al., 2014) but rather more is presented about the underlying constraints that personalities that children may have and how to adjust the design to cater the needs based on the personality.

Consistency

When designing interfaces, certain functions and operations that use similar elements in the achieving a task should maintain *consistency*. A consistent interface follows a set of rules such as using similar operations in performing similar task (Sharp et al., 2007). For example, the use of arrows in an application that indicate where the next task will be, the number of clicks in the mouse pad, or the swipe patterns in a touch screen. Consistency is optimal, however, when applied to simple interfaces with very few tasks. Complicated systems such as word processors and photo editing tools can be more challenging to incorporate consistency because they are designed to perform many different and intricate operations.

Inconsistent interfaces are even more challenging when children are the users of the interface. Children, especially the younger ones, may have difficulty to perceive and understand abstract concepts. It is therefore important to consider basic consistency. Druin's et al., (2001) research on children and designing information database discovered how they mentally interpret and organize information. Children may not find the appropriate terms for functions or navigate through an organized structure immediately, but the most usual approach would be a "trial and error" approach (Chiasson & Gutwin, 2005).

Affordances

Affordance is an attribute in interaction design that refers to "the attribute of an interface that allows its users to "know how" to use it". According to Normann (cited in Sharp et al., 2007) there are two types of affordances: perceived and real. Real affordance is for example a teapot, a physical object. One grasps the pot to pour out the liquid through he the hole. While user interface, on the other hand, tries to "mimic" to notion of affordances.

Children have a great deal of imagination and can easily immerse themselves in pretend situations. In addition, children of certain ages may not have a fully developed their motor skills and may have difficulty understanding abstract situations if the object in the user system does not make sense for them. This is where metaphors can be useful. Children expect that such metaphors are similar of the real world (Chiasson & Gutwin, 2005). Most children are already used to using tablets and smartphones. Studies (Detken et al., 2009; Druin et al., n.d.; Eriksson & Lykke-Olesen, 2007; Protti, Fontana, Maccaferri, Giudici, & Montanari, 2013) discovered that children interact more with a

system that they are able to relate, with and are in control of. Most importantly they understand the tasks that are expected of them by looking at the objects that define those tasks.

2.2.2 USABILITY GOALS

Usability goals are a set of goals that ensure quality in the user experience and the elements found in an interactive product. Since this research study involves children as users and they have different cognitive abilities to adults, it would useful to use such goals while creating the artefact in mind. *Table 2* presents an overview of Preece (2007) 6 usability goals with their corresponding guide questions. Such detailed questions aid the UX designer to alter or improvise the product, whether necessary, throughout the design process.

Table 2 - Usability Goals with guide questions for UX designers Preece (2007)

Usability Goal	Guide Questions
Effectivity	Is the product capable of allowing people to learn, carry out their efficiently, access the information that they need?
Efficiency	Once users have learned how to use the products to carry out their tasks, can they sustain a high level of productivity?
Safety	What range of errors that are possible using the product and what measures are to permit users to recover easily from them?
Utility	Does the product provide an appropriate set of functions that will be enable users to carry out all their tasks in the wat the want them to?
Learnability	Is it possible for the user to work out how the user of the product by exploring the interface and the trying out certain actions? How hard will it be to learn the whole set of functions in this way?
Memorability	What kind of interface support have been provided to help users remember how to carry out tasks, especially for products and operations they use infrequently?

2.2.3 INVOLVING CHILDREN IN THE DESIGN PROCESS

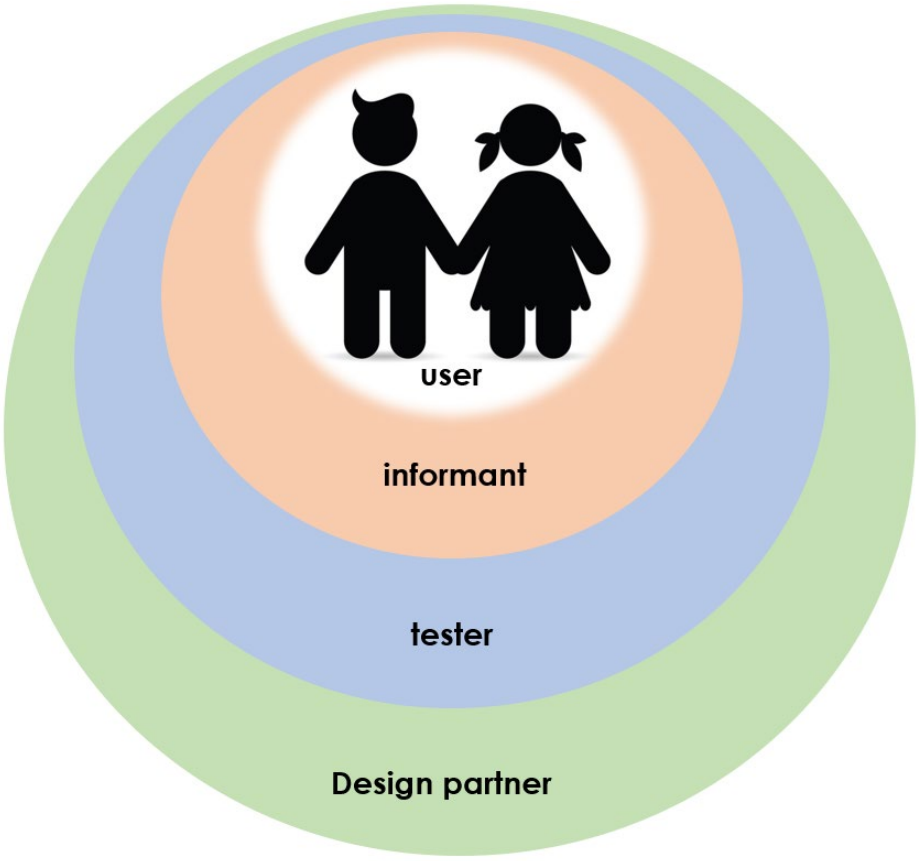


Figure 1 - The role of child in the design process. (Druin, 2002)

To use the design principles, usability goals, and to understand how children perceive technology, this research aimed to involve them in one or more activities in the design process. Allison Druin is one of the most notable experts with regards to CCI. Her research (Druin, 1999, 2002; Druin et al., 2001; Druin, Bederson, & Quinn, 2009; Fails, Guha, & Druin, 2013; Reuter & Druin, 2004) has been extensive and forgoing when it comes to involving children in the design process of technological systems. She has also had studies where she applies technology in libraries, but most importantly she involved the users in the process. *Figure 1* presents Druin's (2002) interpretation on how children can be involved in the design process as *users, testers, informants and design partners*.

When children are involved as users, their participation can be seen during the beginning and the end of the design process. This is very helpful for the designers to observe and assess how children interact and how this may affect the certain abilities from the users. Using this aspect alone may not be beneficial for the children at all since they

are not a part of the development. Hence, increasing the risk of the technology not useful to the needs of the child (Fails et al., 2013). Nevertheless, in the observation phase of this study, the interaction between the users and the librarians while choosing a book to read will give insights on the user requirements of the artefact.

Although technologies intended *for* children are tested *by* children will give the opportunity to catch unforeseen issues and find better solutions, this may only give them a limited opportunity to share their ideas and voice out their concerns. The role of children for the duration of this study will be as users, informants, and testers. The decision-making is remains with the designer and experts.

2.3 ETHICAL ASPECTS WHEN INVOLVING CHILDREN IN A RESEARCH STUDY

Children have been included more in the different stages of a design process as UX designers consider their competence and input in the field (Baxter, Courage, & Caine, 2015). However, no matter who the users are, ethical aspects must be taken into consideration. This is specially a concern when working with children in any research study. This study made all the necessary arrangements to ensure that all participants especially the children that are involved are well aware of their rights and are informed of what they are going to do and what is expected of them.

2.3.1 NONDISCLOSURE AGREEMENTS AND INFORMED CONSENTS

Children under the age of 18 cannot sign any documents without a present legal guardian. As researchers we are ethically obliged to inform the rights of the participants in any study. Therefore, non-disclosure agreements and informed consents must be presented to the participants. All participants including their parents must be informed of the following: presentation of the study, the purpose, what data is being collected, evaluation procedure, their right to terminate whenever they see it fit. According to Hansen (n.d.), giving children the right to know what data is being collected and how these data are being used make in many cases easier for them to support the study. Children are often curious to why their behavior and opinions are important. They may not fully grasp the situation that they are in this is why it is mainly the researchers have a responsibility in this matter. In this study consent will be solicited from parents.

2.3.2 INCENTIVES

Being open and transparent throughout the research is in itself an incentive for a child (Christensen, 2004). However, acknowledging that like any participating adult, children can also be compensated for their participation in a study. Several examples (Gibson, 2007) of incentives can be: reimbursements of travel expenses of the child participant and the guardian, offer a snack or meal if their they need to stay longer. Although Gibson states that (2007) financial reward may not in fact be a good incentive, a form of gift card in a shopping center or toy store should be considered as a good compromise and be an effective incentive for the young participants. A research study (Ruland, Starren, & Vatne, 2008) on co-designing a support system for and with young cancer patients between ages 9-12 years old, gave their participants a star on a notebook for every accomplished and a gift card for 500 NOK after the study in two months. Nevertheless, it would be best to discuss with the parents or guardians in advance to avoid any objections in the future.

2.3.3 UNDERSTANDING THE PARTICIPANTS LIMITED COGNITIVE ABILITY

When conducting research with children, there will be challenges in communication as they do not have the same cognitive ability as adults. They may find instructions and doing tasks challenging. This is why one must keep in mind the length of the study and the complexity of the task (Baxter et al., 2015). Several studies (Bekker, Beusmans, Keyson, & Lloyd, n.d.; Dindler, Eriksson, Sejer, Lykke-Olesen, & Ludvigsen, n.d.; Druin, 2002; Fails et al., 2013; Garzotto, 2008; Hourcade, 2008; Kelly, Mazzone, Horton, & Read, 2006) used techniques that had games and activities for data-gathering that engaged the young participant in the design process. These activities may, however, also be time-consuming and so for the duration of this research study may not be suitable.

Being open and transparent with the users throughout their involvement in the study is important. They have the right to say when something is unclear and as a researcher one must also be patient with them. They must be informed that the tasks are not a test and *they* are not being evaluated. Apart from the administrative duties, as the researcher we are responsible of leading the participants in the process.

2.4 UX IN RECOMMENDER SYSTEMS

A recommender system(RSs) is a collection of information filtering techniques which makes "recommendations" of items that can be of interests of for users. RSs is built around past and current user preferences, statistics, and inferred knowledge.

Physical libraries have a huge database of materials. Their large catalog can sometimes be overwhelming. Recommender systems are designed to help the users make better choices from large catalogs.(Knijnenburg, Willemsen, Gantner, Soncu, & Newell, 2012).

According to Knijnenburg et. al. (2012), "*a typical interaction proceeds as follows: First the users' preferences are elicited. Based on the collected preference data, the system tries to predict how much user would appreciate each of the available items in the catalog. Finally, the system presents the user those items that have the highest predicted value for the users. In some recommender systems this terminates this terminates the interaction, in other users continue to indicate their preferences and receive recommendation continually*".

An integrated view on the user experience of recommender systems can be obtained by means of user-centric development (Knijnenburg et al., 2012). It is important to look at the size and composition of the recommendation data sets and should depend on how the majority of user's preferences. The data sets are the choice situation that a user chooses in a recommender system. Studies (Eriksson & Lykke-Olesen, 2007; Knijnenburg et al., 2012; Milano et al., 2017; Vaz, Matos, Martins, & Calado, 2012) show the main challenge of creating optimal recommender systems are exactly how many recommendations should it provide: too few items restricts the users freedom to choose, but too many choices would can be overwhelming.

This research study will not develop a recommender system but explore and investigate how to create the user interface of the system that will enhance a child's experience when choosing a book from the catalog. Nevertheless, a presentation of the topic gave this research a brief overview of the literature on user experience in recommender systems.

CHAPTER 3

CHILD-COMPUTER INTERACTION FOR PUBLIC LIBRARIES

Bringing Together Interaction Design and Digital Literature Dissemination

This chapter explores the possible role of CCI for public libraries by bringing together the gap between interaction design and digital literature dissemination by designing an artefact for children that will help them choose a book to read. It will also present how ethnographic studies can discover user needs and how this was applied for this research. Then, a brief presentation of understanding how children read. It will also show how Bergen Public Library digitally disseminate books and presentation of other applications and relevant researches created for children with regarding digital dissemination. Lastly, digital literature dissemination is defined and a system visualization of the prototype "*Super Bibben*".

3.1 USER EXPERIENCE IN LIBRARIES

Public libraries are important institutions that houses both culture and literature. They host different types of interactions: social, entertainment, intellectual and the physical. In today's modern library, we also see the merging of technology. Libraries are no longer just limited to information retrieval, book finding and borrowing. As the advancement of technology continue, there is a need for public libraries to keep current.

In recent years, a new trend has emerged in the library community: application of User Experience when designing new artefacts/services/experiences. UX techniques and methods are being used by the public libraries to gain an overview of the its users and enhance their services. We explore ways in which digital technology can scaffold engagement with the library space and the physical books it houses (Wood et al., 2014)

Public libraries present a lucrative pool of data with regards to user behavior. Yet why has it taken a while to discover this? According to Priestner (2016) there are several reasons why UX in Public spaces and services have been so neglected for the past 10 years or more. First, Public libraries have been trying to keep up with the advancing

technology, and at the same time trying to prove relevance in an age where the value and purpose of the institution is constantly being challenge. We have probably heard of the rumor that "libraries are dying". This may have led to actually paying attention to the details and evolving experience of libraries. Second, even though libraries are actually a place where customer service is valued, most employees are not that trained to use UX methods and "think like the users" to mine valuable information. Last, there is an idea that technology will take over the physical library, when in fact, there should not be a competition rather should be seen as an integration to both worlds.

Library services may limit the potential of engaging children who surprisingly can be super users of the library. However, it is also observed that children of today are heavily influenced by the digital age may find the slow evolving library irrelevant. There is a risk of losing a whole generation if necessary, actions are not taken.

This study aims to design an application for the public library to help children choose a book to read without the assistance of a librarian. However, to create an artefact that will fulfill such requirements, one must first know how interaction is taken place in this particular setting.

3.2 ETHNOGRAPHIC STUDIES LIBRARIES

In recent years, ethnographic studies has been conducted in the library (Priestner & Borg, 2016) to have a better understanding of what the users need and want. It is a qualitative research on individuals or target users in a natural setting in which they are participating. Two ethnographic methods were used: contextual inquiry and interviews. Ethical aspects were also explored because children participated in the study.

Since this study involves designing a digital solution for the physical dissemination of books at the library, specifically for the children's department, the goal of conducting a User Experience (UX) research to identify the behavior of the target group in a specific context, the interaction between the stakeholders and the target group and how these interactions can be used to define the user requirements of the artefact.

3.2.1 CONTEXTUAL INQUIRY

This study involves an artefact being created, so when product development is involved, it can be an advantage to also interact with the users and not just observe them from a distance. So, by combining these two elements, we have what is called Contextual Inquiry (CI). There are four main parts of contextual inquiry (Baxter, Courage, & Caine, 2015): First, the *context* in which one being present at the user's environment in order to understand the context of his or her action. Second, developing a "master-apprentice" relationship through a *partnership* and by immersing oneself to the actions of the participants. Third, is interpretation as not all observations can be interpreted correctly by the observer. Follow-up clarification is needed so that assumptions and conclusions can be verified. Lastly is to develop an observation guide to maintain focus on the areas of concern.

To establish the user requirements for the prototype, mapping the relationship of a children's librarians book dissemination process to a child would give concrete input . This begins with an initial interview with the child librarian. At the start of the research, several contextual inquiries have been conducted with both the users visiting as a group from schools or public visits(e.g., Saturday visits and random visits throughout the week) when they come in children's department. More about the observation phase is presented in Chapter 5.

3.3 UNDERSTANDING CHILDREN'S BOOK BROWSING AND INFORMATION SEEKING/RETRIEVAL ACTIVITIES AT THE LIBRARY

One of the research objectives of this thesis is to identify the process when children choose books to read as well as how librarians guide them. Literary reading is an important activity for individuals and can be a long-term commitment. This makes book choice an important task for book lovers and public library users (Vaz, Matos, Martins, & Calado, 2012). Already towards the beginning of this millennium, several claims by educators have been made to there is a need to develop a child strategy in selection and information retrieval to enhance their reading skills and level (Carter, 2000; Hunt, 1996-1997; Krashen, 1993, Reuter & Druin, 2004).

A study by Raqi & Zainab (2008) in Malaysia observed children between ages 7-12 years old in two libraries to gain a better understanding of how children use a library to seek information, in order to study the information seeking patterns of children while they are the public library. They had two stages in the observation phase: first they observed the children while they were browsing the shelves and then they had a semi-structured interview with them to collect more data. The data collected was then mapped to get an overview of the interactions.

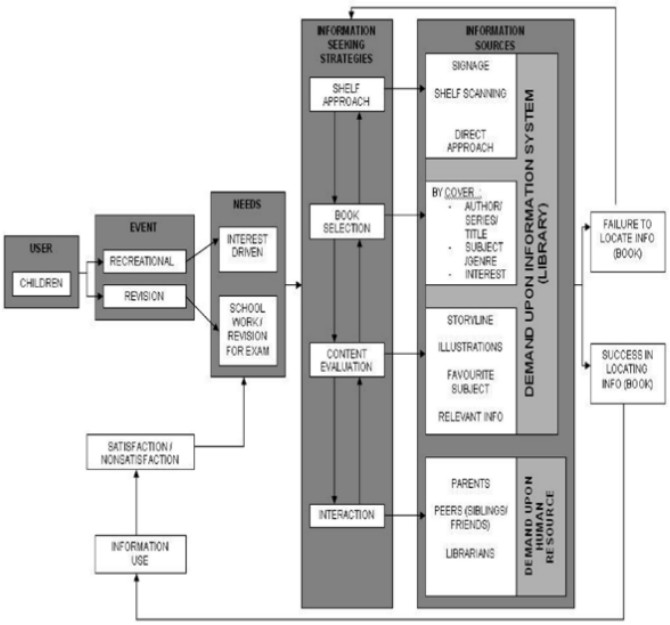


Figure 2 -Screenshot of interaction on the observation phase of Raqi and Zainab's observation study(2008)

Figure 2 presents the overview of the information seeking patterns of the users in the study conducted. The results should gave 3 consistent findings: 1) browsing was a method used to find books but with the following book criteria: author or series popularity, book by genres, the physical composition of the book (aesthetics, thickness, overall attributes); 2) the selection of books was based on the summary of the books (by reading the back cover), illustrations (cover design, fonts and pictures inside the books). The most interesting finding was that children also browsed and searched for books in a non-linear nature. Although the majority of the participants indicated no challenges in choosing and locating the book, there were a few that experiences confusion and were overwhelmed by the large collections. This suggested that children would prefer visual cues that would support them in their search. Based on the study, this research study adapted and used the observation method to understand

the service rendered by the children librarians to the young users, se chapter 5 for more details.

3.4 DIGITAL LITERATURE DISSEMINATION

Digital literature dissemination in a public library is the process of conveying physical literature such as books in many forms of literary genre to between a librarian and a library user. A librarian is a professional that is in-charge of organizing, cataloguing, collecting and preserving literary collections at a library. Mainly a public library has physical collections but technological advancement in the field has also opened wider digital services such as electronic books, audio books, and electronic new papers.

There is no concrete definition of "digital literature dissemination" found in the literature review and therefore this research attempts to define it as such: "*Digital Literature Dissemination is the formalization of the processes for conveying all types of literature, both digital and physical in such way that users have direct control to information through a digital system without the presence of a physical librarian*."

3.4.1 DIGITAL LITERATURE DISSEMINATION IN BERGEN PUBLIC LIBRARY

Bergen Public Library is where the designed artefact was tested. The observation phase was conducted in this library at the children's department. This library offers a few digital services such as electronic books and audiobooks[6], e-newspaper and articles[7], audio books, online learning platforms[8] for immigrants, and a platform for podcasts[9] and videos[10]. This section will present two digital literature dissemination tools that Bergen Public Library uses at the moment: *Bibliofil* and Digital shelves.

[6] https://bergenbibliotek.no/e-bibliotek/e-boker
[7] https://bergenbibliotek.no/e-bibliotek/digitale-aviser-paa-biblioteket-og-heime
[8] https://www.verdensbiblioteket.no/
[9] https://bergenbibliotek.no/e-bibliotek/bobcast
[10] https://bergenbibliotek.no/e-bibliotek/tv

Bibliofil[11]

Bergen Public Library currently uses a database called *Bibliofil* (see *Figure 3*). *Bibliofil* is a web-based library catalogue system that helps both users and the librarians look search and retrieve books and other media available in the library. The system is also available as a mobile application. All users have a library account that can be opened that the user is registered as a user of the library. In the user's dashboard they can: see the overview of books that they borrow and ready to pick-up; make a lists of what books they want to read in the future; make reservations; search for books, and check its availability; and, send messages to the librarians. Desktops computers with this platform is available at the library so that users can independently search and retrieve materials that they wish to borrow. The computers are placed in the adult sections of the library.

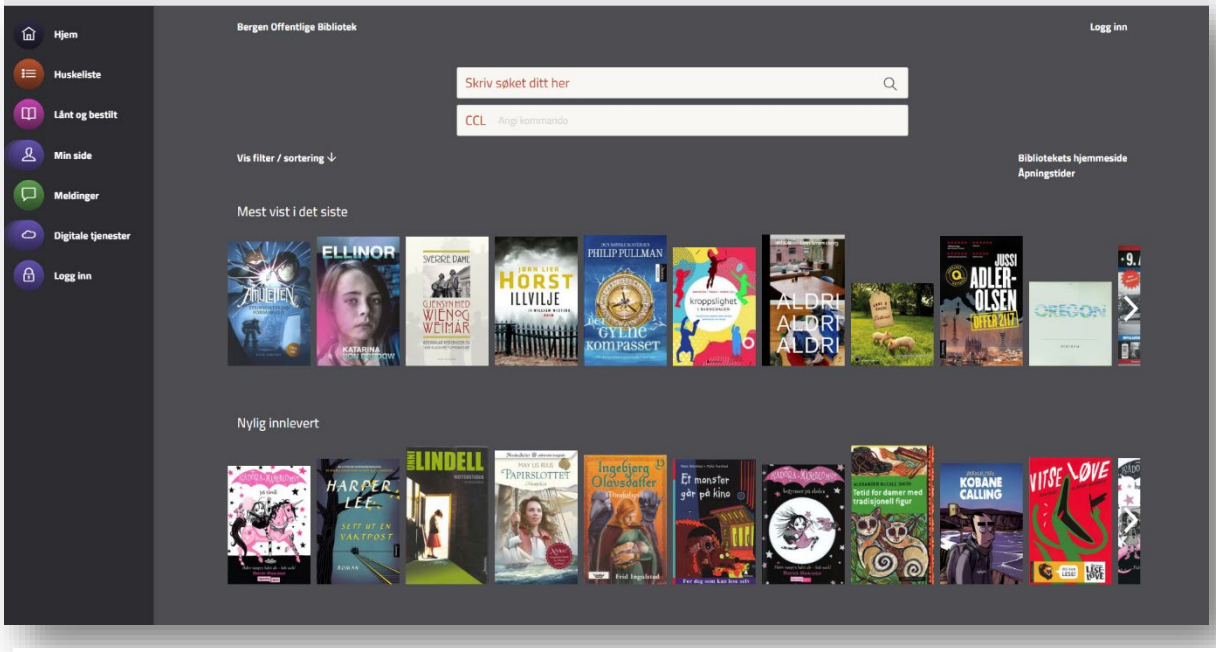


Figure 3 - Bibliofil search database with basic book recommendation.

[11] https://www.bibsyst.no/produkter/bibliofil/m2int.php

Digital shelves[12]

Digital Shelves (in Norwegian *Digitale Hyller*) is an interactive screen that allows users to view "digital exhibition" of books and other literary media at the library. *Figure 4* shows how a Digital shelf is set-up at Bergen Public Library.

Figure 4 – A digital shelf at the Bergen Public Library

The exhibitions are pre-defined by the digital administrator of the library. These can be one or more "themes" that are available in the library's collection. Themes can be *new books, crime and fiction, book suggestions from the librarians, Christmas books, new cartoons etc*. The user can click on the themes and all the suggested books are shown on the screen. The users can then click on the desired book cover, read a summary and see if it available in the main or affiliate libraries. It also possible to re-serve and loan the books with an extra module but this is not implanted in Bergen Public Library. The library has two digital shelves: one at the children's department and at another one located at one of the affiliate libraries.

[12] https://www.bibsyst.no/produkter/selvbetjening/digitalehyller.php

Initial thoughts and evaluation

Both Bibliofil and Digital shelves are examples of systems that define digital literature dissemination. Although both systems have the criteria that the limitation in its functionality hinders it from giving optimal service to the intended target group. The basic functionalities of searching and retrieving are easier for adults but as they are perceived differently by children. Thus, these systems may be useful to an extent before children will need an assistance of an actual librarian.

Bibliofil currently provides basic recommendation sets such as which literature are most borrowed and delivered. Yet, navigating through the system in a child perspective would limit it to one scenario when looking for a book to read. Children are limited in only finding specific titles or "key words" through the search function. The system could provide more suggestions book to read just like what children' librarians offer and provide better solutions in situations where the user does not which and what books to read.

On the other hand, *Digital Shelves* provides better options for children, given that predefined themes are programmed in the systems. Although the user interface allows children to interact as if they were asking a librarian. It still lacks the ability for children to explore other genres and search specific titles. This system does not have recommendations sets that may give the young readers ideas on what to read.

The user experience of a library is a complex interplay of physical environment, library services, resources and technology. It is still evolving, and empirical studies are still needed. Applying UX methods can help libraries adapt to changing user needs and tame this complexity by focusing on solutions rather than problems. Bergen Public Library has always been a front-runner when it comes to innovation for library and information science services. Although there are limitations in the functionality in the current digital literature dissemination services, this also opens room for further explorations, improvements and further developments. The current solutions offered are still limited in literature dissemination that it cannot fully cater to needs of the younger users of the library. This research study aimed to explore and investigate such.

3.5 EXAMPLES OF OTHER APPLICATION WITH DIGITAL DISSEMINATION

There were several studies (Detken et al., 2009; Detken & Schrader, n.d.; Eriksson & Lykke-Olesen, 2007; Milano et al., 2017; Wood et al., 2014; Wu, Liu, Chiu, & Chen, 2019)that have made digital dissemination for children. Milano (2017) states that such research serves as bridge to the barrier between children, methods in recommender systems, and providing a child-friendly paradigm. It is not new to use recommender systems in digital libraries (Huang, Chung, Ong, & Chen, 2002). This research study looked at some of these applications that made digital literature dissemination with children as users. Most of the applications found combined other external technology such as Augmented Reality (AR)and tangibles.

RABBIT (Pera, 2010) is a tool that was developed by automating reading advisory process provided in public libraries to make book recommendation for K-12 readers. The tool make makes recommendations that are similar in contents, topics, and literary elements that may be interesting to the target group. There is no independent user interface available and it is added in bookmarking sites which provide suitable reading selections.

MISRec App (Milano et al., 2017) investigates enhancing children's experience in recommender system. It investigates how user experience from children are very different from adults. The hypothetical application recommends movies by letting the user put a tangible object and the system matches the preferences expressed by the child.

Augmented Reality Navigation App[13] (Wu et al., 2019) helps children to find books and give children a better user experience in the library. One of the aims of the study is to understand information seeking activities between children and create book recommendations that would enhance self-learning. They created categories of the different icons to represent different genres found in the library. They developed an AR interface that would aid children in looking for books that enabled them to explore

[13] This paper was discovered later in the process of the study but was considered relevant for this study because it shared similar elements

different scenarios. The users use the app to navigate around the library independently. *Figure 5* shows screenshots of the application and how it is used around the library.

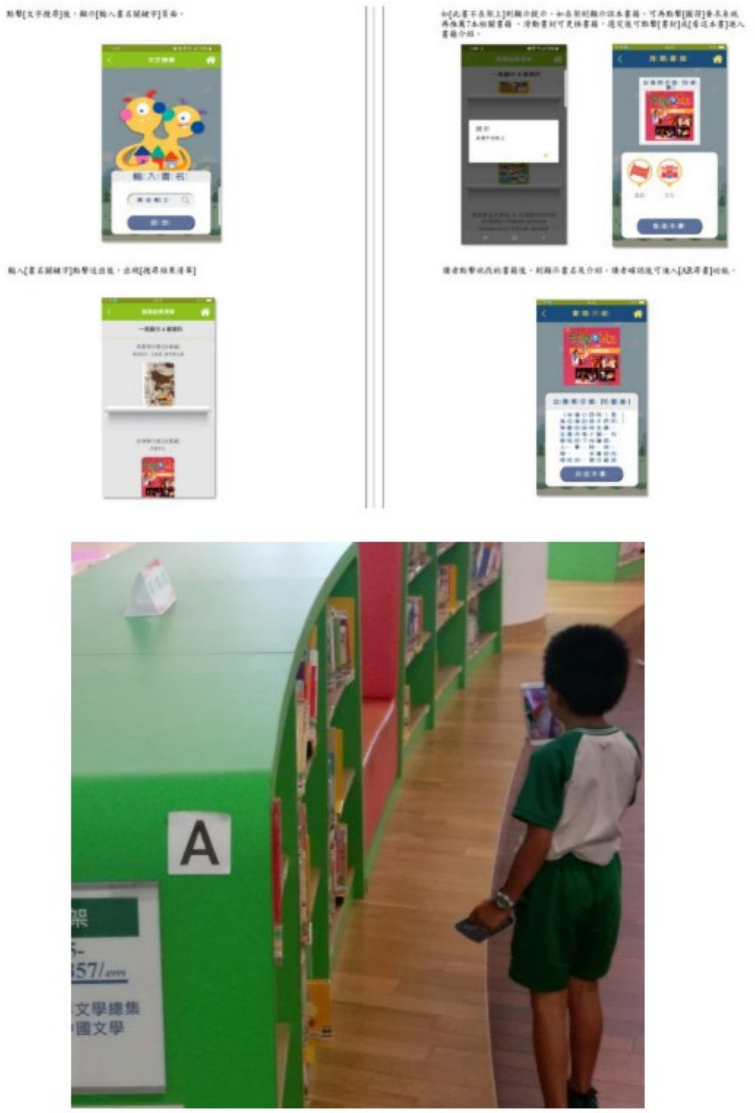


Figure 5 - Screenshot of AR navigation app and environment setting by Wu *(2019)*

3.6 SYSTEM VISUALIZATION AND PHYSICAL SET-UP FOR *"SUPER BIBBEN"*

Having explored the literature surrounding user experience in libraries, methods that have been used to enhance user experience in public libraries, as well as looking at the different possibilities of digital literature dissemination for children, this research study created a framework that would show how digital literature dissemination can be applied in the public library for children. Although that this research study focused on designing the user interface of the application, *Figure 6* shows how the prototype in mind should work. The user(s) interacts with the application, then when the users have made their information choices, the recommender system analyses the user(s) choices and the result used to search the database to find suitable books. Last, it checks the availability of the book and the results are sent back to the for the user to pick up in the shelves.

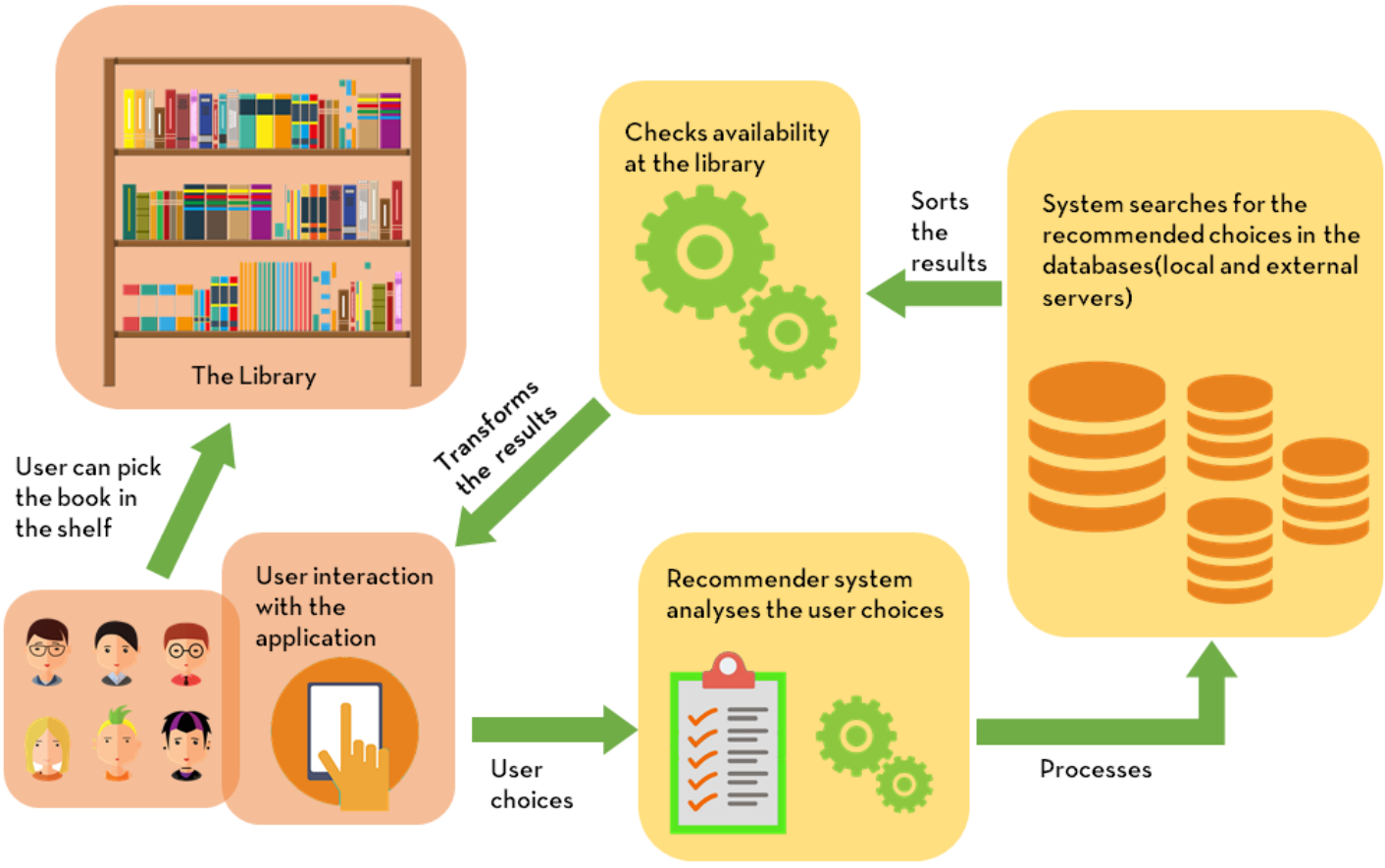


Figure 6 - Visualization of how a fully functional *Super Bibben - eBarnebibliotekaren* should work

Like the *Digital Shelf*, the application created was intended to supplement library services provided by librarians. Since the target group are pre-adolescent children, the application would be placed in the children's department. This would allow users to use it independently and without assistance from an adult.

CHAPTER 4

RESEARCH METHODOLOGY

This chapter describes the research design method that was used for this research presenting in detail Design and Creation Research, its processes and the data. There are five process steps and in the description of each step, methods and tools that were used during the study are presented.

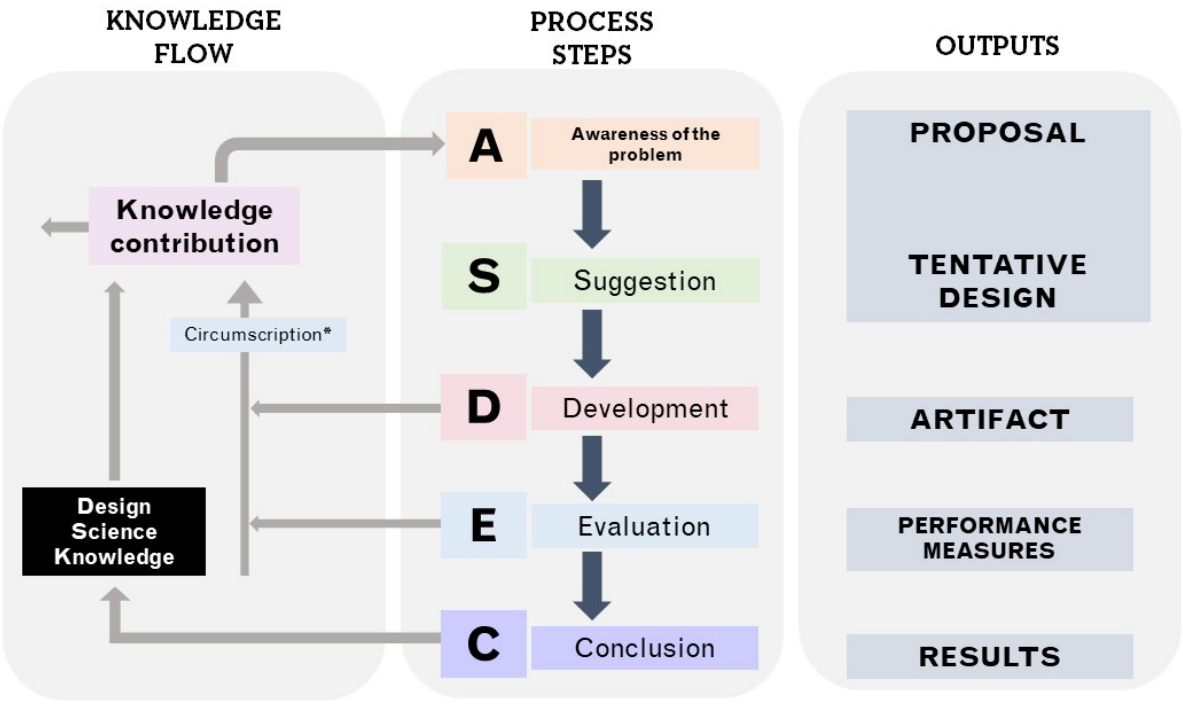


Figure 8 - Design and Creation Method according to Hevner & Chatterjee (2015)

4.1 DESIGN AND CREATION RESEARCH

According to Oates (2006) "*A researcher following a design and creation research strategy could offer a construct, model, method or instantiation as a contribution to the knowledge*" (p. 111). This research strategy can be applied when an IT application is a desired goal or a recommendation. The IT application can play three different roles: as the main focus; as a vehicle for something else; and, as a tangible end-product that is part of the development process. The Design and Creation Research Strategy composes of 5 process: *awareness; suggestion; development; evaluation;* and, *conclusion*. Design and Create is an iterative process and is a problem-solving approach (Oates, 2006). *Figure 7* is an illustration of the Design and Creation Method

(otherwise also known as Design Science Research) and the processes and *Figure 8* shows a visualization of how this research study was carried out .

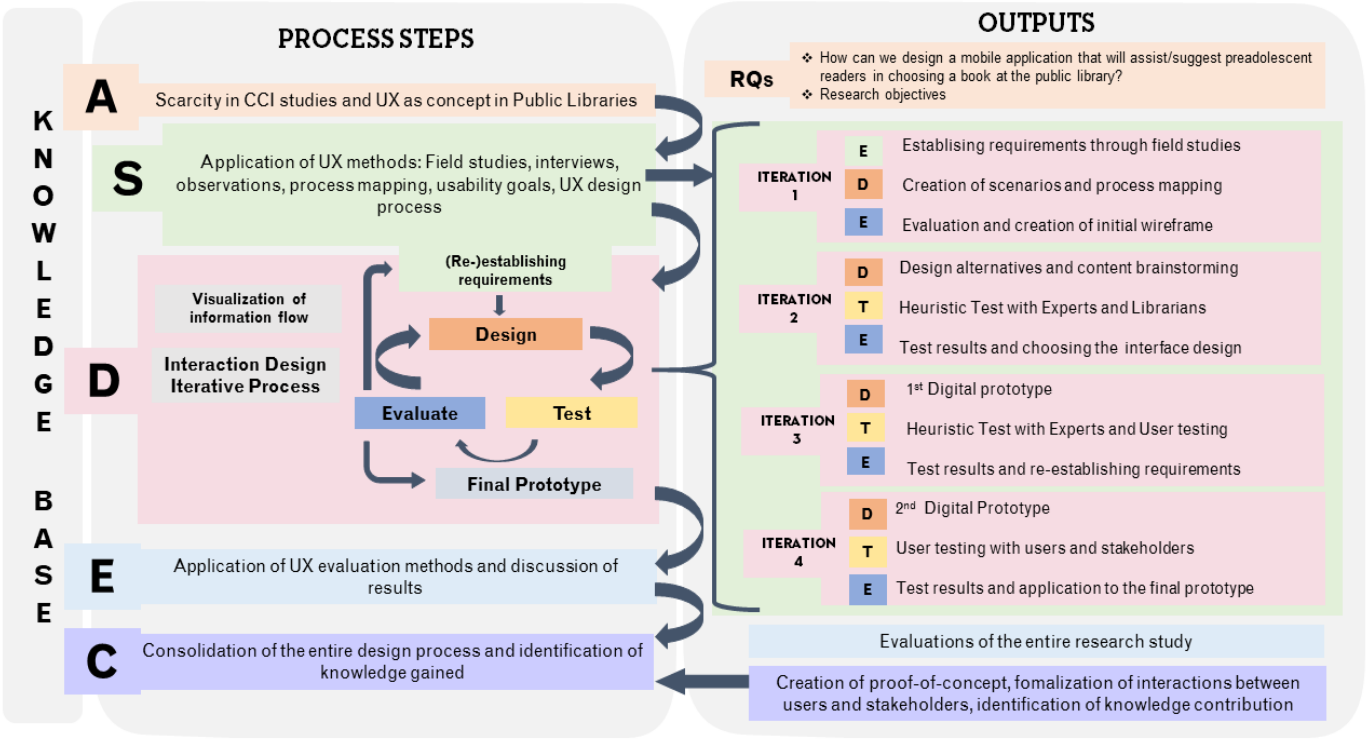


Figure 9 - Visualization of the how the research study was carried out (a larger version is found in Appendix J)

4.1.1 AWARENESS OF THE PROBLEM

By Awareness, means "articulating and recognizing the problem" (Oates, 2006, p. 112). Challenges and problems can be identified through review of literature where the authors of similar fields justify and identify the need to expand and explore the different fields of research surrounding the topic. This can be a new discovery of a different discipline or a need for something within certain ethnographic groups pertaining to a discovery of a new technology or field of research (Oates, 2006).

In initial findings of the literature review, recall Chapter 2, reveals that there is a need for more empirical studies for Child-Computer Interaction (CCI). It has been stated that knowledge contributions of this research will be the investigation of CCI in public libraries and the application of interaction design principles towards creating an artefact for the target group.

Due to the diversity and the vastness of users in "children" that needs to be covered, this poses a challenge. The advancement of technology can change a user's perspective can vary. Creating basic research on the interaction between computers

and children, has not been attractive in the HCI / CCI community (Hourcade, 2008). Such research does not yield immediate results and further studies of the methods are often discontinued. As technology changes over time, the preferences of children and the way interfaces are perceived also changes. Nevertheless, research for children and how they behave around technology still needs to be studied.

As mentioned in the Introduction, Bergen Public Library has had digital literature communication and dissemination a subject of several pilot projects. There is a need for traditional public libraries to investigate better and innovative solution to both integrate the physical and digital aspects of the library. Although there are existing digital services already cater to the general public, these current interactive solutions that Bergen Public Library offers limits the needs in making better suggestions and aiding the younger users to making challenging decisions. This means that these user groups are dependent on a librarian to be present when they need help in suggesting books to read. This limits the potential of young users to expand their reading interest independently.

Together with the child's evolving perspective towards technology and the merging of both the physical and digital aspects of the library, this thesis aims to fill in a gap in the knowledge base in the CCI field by using different UX methods and tools in designing a prototype of a possible system that would help children choose a book to read.

4.1.2 SUGGESTION

The Suggestion step is where the tentative ideas on how to solve the problem discovered in the Awareness step (Oates, 2006) are identified.

Since the topic of interest in this research revolves around Child-Computer Interaction (CCI) and designing an interactive solution for young users a literature review was conducted (see Chapter 2 for results). It was discovered that there were gaps and challenges with regards to CCI research and there is a need for a digital literature dissemination app for children. Hourcade (2008) argues that there are three areas of research that has not been addressed: developing empirically grounded guidelines; demonstrating that such research yields positive results; and, empowering disadvantage children. Having mentioned these challenges, it was also revealed methods have been created to understand the processes of interaction such as carrying out

ethnographic studies and involving children in the design process. This however, also opened issues with regards to the ethical aspects when conducting research with children.

The findings also opened three important elements. First, the researcher conducted an ethnographic research, to be able to understand the process of how the traditional way literature dissemination is between a librarian and a user. This user experience research helped identify the requirements that both users need to establish communication amongst them. This was done by observing the user in the environment of the interaction. In this phase, four scenarios were discovered (Chapter 5). Second, through an iterative design process by using interaction design life cycle led to design alternatives and designing a "proof-of-concept" based on the data collected and the design alternatives . The aim of the mobile application is to engage children in choosing fiction books to read and to learn the different fiction genres of the children's department. Last, this also opened an opportunity to study user involvement of children in the design process through focus groups and user testing.

Project Management

For the project organization of this master thesis, Kanban methodology was used. Kanban is a lean-agile method that allows one to perform tasks effectively and keep tract of the things that need to be done (Kang & Yoon, 2015). When several methods and processes are incorporated to one another in this research, there is a need for this agile method that helped organize the tasks needed to accomplish, yet it requires very few elements be maintain. Kanban can be as simple as three lists - to do, doing and done.

Prototyping tools

Once the initial requirements of the artefact were established and design alternatives have been evaluated, design activities are the next step of the design process. Prototype is "*one's manifestation of a design that allows stakeholders to interact with it and to explore its suitability*" (Sharp et al., 2007, p. 386). There are two main types of prototyping methods: *low-fidelity* and *high-fidelity*. Low-fidelity prototypes usually do not resemble the final product, but quick and inexpensive way to develop and easily modifiable. High-fidelity prototypes on the other hand, looks like the final product and provides more functionality. Although it may be an advantage to have a high-fidelity prototype, it can be time-consuming to develop, expensive and requires more

maintenance. In the end, the point of prototyping is to be able to quickly test and evaluate aspects of a prototype (Sharp et al., 2007). For this research study, low fidelity to semi-fidelity prototyping were chosen for prototyping. There are several tools that can be used during low fidelity prototyping and these are reviews here.

Storyboarding and Sketching

Storyboarding is a low-fidelity prototype that allows designers to see how tasks can be accomplished when using the product. It can also give a quick illustration of the interaction processes between product, users, and stakeholders. Figure 11 shows a diagram of how the literature dissemination takes place between a librarians and young users.

Sketching is a hand-drawn prototype that is a representation of the product. Sketches were use in the brainstorming sessions of this research to get an overview the system may and was also used to create design alternatives.

Adobe XD

Adobe XD is a user experience design and prototyping tool. The advantage of having this tool is that plug-ins may be installed and convert designs in *Adobe Illustrator* which can then convert the designs into Hypertext Mark-up Language (HTML). It makes it easier for designers to collaborate with developers. This research used Adobe XD to create the digital prototype for the 3rd and 4th iterations. Although there were other prototyping tools that were considered such as Balsamiq, Proto.io and JustinMind Prototyper, Adobe XD was chosen because it was user-friendly, and elements were easier to merge with the other Adobe packages.

Photoshop

Photoshop is an image and photo editing tool. The digital prototype used icons and visualizations to represent the functions. The advantage of using this tool is having experience with it and one can make multiple edits without any challenges.

Colourbox

Colourbox is a website that holds royalty-free photos, images, video and vectors. It was used for the icons and illustrations for the prototype. The advantage of using *Colourbox* was it made it easier to find standard icons that designers can use to create the prototype. It was also used to find suitable icons to represent the genres that made it easier for the target group to understand. Some of the vectors and images were purchased.

This research explored and investigated the designing of a mobile application that can help suggest books to read by looking at the child-friendly interfaces in recommender systems. This led to an ethnographic field study, sketching of different design alternatives, brainstorming the right terms of genres and several iterations for the digital prototype. Due to constraints in time and schedule, the lack of resources, and the complexity of using the catalogue system of Bergen Public Library for creating a child-friendly recommender system, there were limitations in creating a fully functional and high-fidelity prototype during the duration of this research. Nevertheless, the investigation of the designs and user involvement are valuable input for future development should the opportunity present itself.

4.1.3 DEVELOPMENT

In the Development step, "*the tentative design is where ideas are implemented*" (Oates, 2006, p. 112) as a result from the suggestion step. This study developed a prototype that help children understand fiction genres and aid them to choose a book to read.

Four (4) iterations were accomplished and focused on the user interface of the artefact. Each iteration will go through an a design process (see *Figure* 9) that is derived from the interaction design life cycle (Sharp et al., 2007). This involves 4 important activities: establishing the requirements; designing or prototyping; testing; and evaluation.

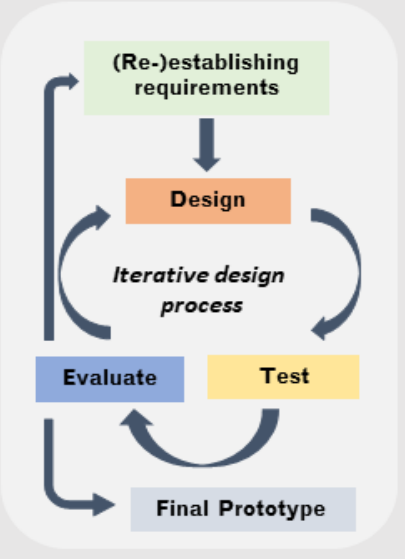


Figure 10 - Illustration of an interaction design life cycle

Iteration 1: From Research to Design

The first iteration was the observation phase which consisted of the following activities: a field study where the interaction between the librarian and the users were observed; semi-interviews with some of the participants and librarians; meeting with the domain expert, and, the discovery of scenarios. The first iteration basically overlaps the planning and preparation phase. The objective of this iteration was to investigate the basic functionality, content, visual and navigational design of the system in mind. The discovery of the scenarios created a basis for the design alternatives.

Iteration 2: From Mapping Interactions to Design Alternatives

In the second iteration design alternatives of the user interface were created by using sketching and paper prototyping. In addition, a brainstorming session with the librarians was conducted to organize the terms of the genres. A meeting with the UX expert was conducted to ensure that the terms used in the application was user appropriate. A conceptual design of the prototype was created with the initial functional and non-functional requirements established. The designs were then evaluated by a usability expert.

Iteration 3 and 4: From Paper to Digital prototype

The third and fourth iteration consisted of designing a digital prototype with the actual functionalities of the application. Both iterations explored the feasibility the interface of the recommender system of the prototype with the goal of making the system suitable to children as users. The result of the digital prototypes had both user and heuristic tests. Each test was evaluated while requirements were re-examined and re-established (2nd, 3rd, and 4th iterations are presented in Chapter 5 and 6)

4.1.4 EVALUATION

The Evaluation step examines the artefact developed and assesses the viability and worth from the expectations (Oates, 2006). To examine the usability of the artefact created in this research, there were several evaluation momentums: pre-evaluation of the research environment; the observation phase in the first iteration; heuristics; and, usability test in the final iteration.

Pre-evaluation of the research environment

Since there was no concrete concept in mind to begin with and children are involved in the research, rigorous planning and preparations were needed. Initial preparations were needed to structure the background information that both the researcher will

need for the sessions and development of the artifact. Three important factors examined during the pre-evaluation of the research environment were:

(1) data collected from the library statistics – this helped determine where to set the limits in terms of genre grouping and which age group were the suitable candidates for this study
(2) semi-interview with the domain experts which were the children librarians – this gave a better understanding to how genres are grouped and how books are presented to the general public
(3) conducting user research of the users while in the library– this determined which type of situations the target group were when they came to the public library (e.g. target group is together with an adult, alone, with a class, or with friends) and which situation was suitable for the research

Observation Phase

The use of contextual inquiry in the field and summarizing the data collected into personas and scenarios was considered during the observation phase. Observation in general can help designers understand the user's context, tasks and goals (Sharp et al., 2007). In addition to semi-structured interviews and questionnaires, the observation phase gave answers that filled in nuances and details of how literature dissemination occurred. The structure of this observation study involved 3 elements: the users' basic information (age and gender), how they use the library (e.g. to read, to play games, to do homework etc. and how they find books that they read by asking the librarian, independently, with a friend, etc.) In this stage, no sensitive information was compromised the user's anonymity was preserved while data were being collected. Personas were initially considered in this study because it could give a better understanding of the users. *Personas* are fictive descriptions of user the product (Sharp et al., 2007). However, data collected from this phase was sufficient and feasible to create the scenarios that represented the interaction of the librarian and users. *Scenarios* are fictive situations that describes how the users use and interactive with certain services or product (Sharp et al., 2007). These became the basis of the researchers understanding of the target group.

When results of the observation began to show patterns of certain scenarios, brainstorming sessions were conducted with domain experts. The aim of this sessions was to

interpret the scenarios, create an initial overview of the functionality, explore the context and look at the possible navigation and visual and content design of the application. This also opened a possibility a collaboration and exchange of ideas between the preadolescent users and the researcher. However, due to the time constraints, it was decided that the input from the domain experts were enough to create initial interface of the session.

Usability Testing

The goal of the usability test is to see whether the intended product can be used by the intended target group by performing task that was designed for (Sharp, Rogers, and Preece 2007). The method involved pre-defined tasks. For this research, user test was performed on the third and fourth iteration. The study was presented, and pre-defined tasks were created for the user to follow. The role of the researcher was to record the findings gathered from this test and evaluate the results.

Since this thesis involves user-centered designs, it was the responsibility of the researcher to be prepared and get to know the users, especially when there are children involved and before any collaboration should take place (Cairns & Cox, 2008; Krueger & Casey, 2015; MacKenzie, 2012; Sharp, Rogers, & Preece, 2007). For example, in the Bluebells project, (Kelly et al. 2006) the design process had 3 stages, before play, during play and after the play. "Before play" meant *factfinding* for the adults. This would include requirements, technical specifications and an initial contribution to how the product might look (Kelly et al. 2006).

Due to the underlying scope and limitations of this research study, however, implementing a full program for collaboration that has games and play in the user test would be time-consuming and the data collected would not be enough to give a thorough evaluation of the prototype.

For this research, semi-structured interviews, cognitive walkthroughs and user-friendly questionnaires were implemented. Semi-structured interviews are a combination of structured and unstructured that have open and closed questions. The process of this type of interview is that the interviewer has prepared pre-planned questions but also ask open questions or "paraphrases" the questions that may suggests an answer. According to Rogers (2007), children tend to behave in such a way that they may prefer concrete questions that lead into a form of an opinion without introducing any form of bias and would make the participant feel that their opinions are heard. For the

questionnaires, a set of "smileys" were used to represent their feelings of how they felt. To engage children in expressing their opinion on certain questions of the user tests, may require them to rely on images rather than written instructions.

Figure 10 presents how a user test was presented to the participants providing the answer with a *Smiley-o-meter gauge* (see Appendix C). A Smiley-o-meter is a child-friendly Likert-scale. Likert-scale is used for measuring opinions and are used for measuring user satisfaction (Sharp et al., 2007)

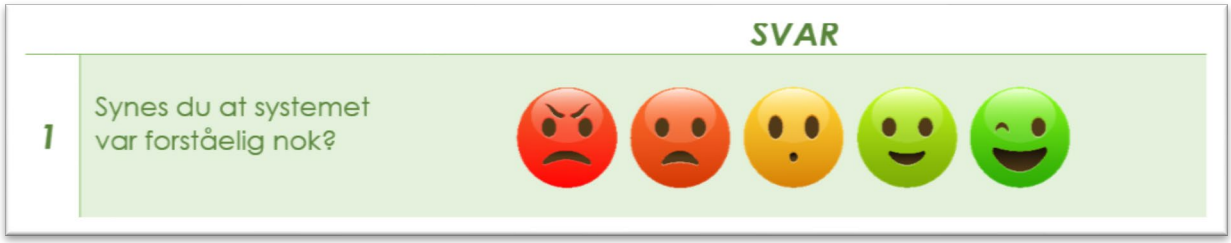


Figure 11 - Questions with a Smiley-o-meter

To make the user test more interesting for the children, prototype walkthroughs were implemented. Walkthroughs is a method that allows the user to perform certain tasks while using the prototype and interviewing them before and after using the prototype (Fails et al., 2013). This method gives children the role of being an informant than being a direct design partner in the study.

Heuristic Evaluations

Heuristics evaluation is a usability inspection developed my Nielsen et. al (Sharp, Rogers, and Preece 2007). *Table 3* shows the summary of the guidelines that were used to evaluate user interface elements. The artefact was tested and evaluate by experts with competence in UX. The experts that tested the prototypes where presented with the Nielsen Heuristics that served as the guideline for the test and evaluation phases of this study. The experts were presented of the initial findings and an initial walkthrough of the app. Semi-structured interviews were also given to the librarians so that relevant information and opinions would be forthcoming. Appendix F shows that the question asked for user test questionnaires and evaluation had usability goals and heuristics with the experts.

Table 3 - Nielsen's 10 Usability Heuristic

Nielsen's Usability Heuristics	
Visibility of system status	Recognition rather than recall
Match between system and the real world	Flexibility and efficiency of use
User Control and Freedom	Aesthetic and minimalist design
Consistency and Standards	Helps users recognize, diagnose and recover the errors
Error Prevention	Help and documentation

4.1.5 CONCLUSION

Oates (2006) states that in the conclusion step is "*where all the results of the design process are consolidated*" (Oates, 2006, p. 112). The creation of the artefact and the results from tests will determine the conclusion this research. Before the conclusion, a chapter on discussing the results was presented. This chapter answers the research questions and research objectives. It will also reflect on the decision-making process, the scope and the limitations that occurred while conducting the study. *Table 4* presents a brief summary of this master thesis. In conclusion, the summary of the entire research study will be presented, the contribution that it made to the knowledge base, further implementations on the prototype, and further research on the field.

4.2 DATA COLLECTION

This section presents which participants were chosen, the data that was collected on each iteration and the ethical decisions that were made during the research. *Table 5* presents an overview of type, methods, motives and results of the data that was collected.

Iteration 1: Ethnographic study

In the observation phase, data was collected to understand the interaction and process of literature dissemination between a librarian and a user. After each interaction, a follow-up interview with the librarian was done. This is to ensure that the notes on the observation would be as accurate as possible. The data was analyzed and were organized into scenarios that mapped the process of literature dissemination. Finally, based on the initial findings, basic requirements could be formulated.

Table 4 - Summary of the Design and Creation process of this research study

PROCESS	THESIS	Knowledge Contribution field
Awareness of the problem	How can we design a mobile application that will assist preadolescent readers in choosing a book at the public library?	
	- Current search database at the Bergen Public Library is not child-friendly - Literature dissemination for children is only possible in the presence of a librarian with a specialization - The lack of librarians in the field of children's literature makes it a challenge for children to get assistance	- CCI is not a very attractive study to the HCI community - There is still a need for child involvement and participation in the field - Children perceive the use of children technology differently than adults - Emerging technologies suggest the need of integrating the physical and digital in public libraries - "Interaction design in Public libraries" or UXlibs is a developing new concept in the field of Library and Information Sciences
Suggestion	Initial assumption: create an artefact	
	Goals and objectives: - To help children independently choose a book they will read - To understand the literature dissemination process between children and librarians - To observe and map the interactions found in the field study - To visualize and map the process of interaction between librarian and child user - To design a child-user friendly recommender system	Goals and objectives: - To investigate the application of HCI techniques to CCI - To identify Interaction Design process, methods techniques that can be useful for the younger user group - To observe the interaction of children in a specific environment through Ethnographic studies

	- Brainstorm with librarians as stakeholders	interviews, observations and mapping interaction - Create evaluation goals for artefact
Development (iterative)	- Establishing functional and non-functional requirements based on the results of the process map. - Designing design alternatives - Prototyping the interface - Expert heuristic testing - Interface testing with the users	- Visualizing tentative information architecture of literature dissemination - Application of Interaction Design process and design tools for prototyping and testing
Evaluation (iterative)	- Evaluating final design alternative - (Re-)evaluations of prototypes	- Application of Interaction design evaluation methods
Conclusion	Result discussion and answering the research question and revisiting of the research objectives through the creation of a user tested and evaluated prototype. Future enhancements for the artefact	-Further studies on Digital Literature Dissemination through the formalization of the interaction between librarians and users -Opens future studies on user experience research in public libraries.

Iteration 2 – Workshops and expert meetings

The observation phase resulted into formalizing literature dissemination scenarios. To make efficient design alternatives, a workshop was organized with the domain experts with the following objectives:

1. To establish correct terms and groupings of the literature genres,
2. To use proper terms for the questions that children will be asked in the prototype
3. To discuss the design elements that best represent the librarian's method of suggesting books to the children

The result of workshop yielded the initial wireframes, design alternatives, groupings of functions, basic design elements for the prototype. Finally, through evaluations of the design alternatives with the UX experts, the iterations concluded the first initial design for the user interface of the user prototype.

Table 5 - Summary of the data collected in iterations

PHASE		DATA	METHOD	MOTIVE	RESULT
Iteration 1	Observation phase	-Librarians interaction with the users -Methods use to disseminate books to its users	-Observation -Follow-up interview (appendix E)	Establishing initial requirements for the prototype	The discovery of scenarios and mapping the process. (*figure 11*)
Iteration 2	Workshop	Librarians competence prior to literature dissemination	Brainstorming	Establishing correct terms and groupings of literature genres	Design Alternatives Wireframes
		Experts opinions on designing the artefact	Semi-structured interview	Establishing the design elements of the prototypes	
Iteration 3	Heuristic test	Experts opinions on the current design and representation of elements regarding literature disseminations (librarians)	Interview with questionnaires	Evaluation and redesign of the prototype Organizing the necessary elements	1st Digital prototype
	User test	Users attitude, experience and opinion of the prototype	Walkthroughs, observation and questionnaires		
Iteration 4	Heuristic test	Experts opinions on the latest revisions to the changes and representation of elements regarding literature disseminations (librarians)	Semi-structured interviews with repeated questions from the last iteration	Evaluation of the prototype elements and the "digital literature dissemination" aspects of the prototype	2nd Digital prototype
	User test	Users attitude, experience and opinion of the prototype	Walkthroughs, observation and questionnaires	Re-designing the prototype and elements that is suitable for the target users.	

Iteration 3 and 4 – Prototyping

Each iteration has a user test and heuristic test. Before the user test, heuristic test and evaluations were made with the domain experts. This served as grounds for qualitative analysis for the study and to determine that the design elements followed the heuristic guidelines. Ensuring that the domain and structure of the prototype was fitted the definition of "digital literature dissemination.

The data collected from the user tests was to gain insights from the users, observe their attitude, share their experience and opinion on the structure and usability of the prototype. The data was then evaluated and was used as grounds for organizing (reorganizing for the 2nd iteration) the design and structure elements of the prototype. The participants were presented of the prototype and explained of the walkthroughs.

4.2.1 RESEARCH PARTICIPANTS

Users

The participants of this study were preadolescent children between 9-12 years old. In this phase of the study, relevant data from 40 pre-adolescent children were collected. The participating children came to the library during school visits (*klassebesøk*) in smaller groups and on Saturdays. For the data to be relevant, the following criteria had to be met during the observation phase:

1. The child must be preadolescent (*mellomtrinnet ages 9-12 years old*)
2. The child must directly and independently ask the librarian for assistance in choosing a book
3. There must be a concrete conclusion to each inquiry

During the user test, 5 participants were recruited to participate. They were contacted through Bergen Public Library's mailing lists and Code clubs. They were pre-adolescents. Ethnic background, gender, reading and digital proficiency were not criteria. The guardians of the parents were informed of the study and signed a consent form. It was important to get non-bias answers from the children by presenting the study to them. A total of 3 boys, and 2 girls participated in the user tests during iterations 3-4.

Domain Experts

The experts where needed to give qualitative feedback and evaluation on the design alternatives and prototype.

There were four experts involved in the research study: Rosaline Barendregt - an expert in Human-Computer Interaction, User Experience methodologies and Game design ; Inger Urdal a digital consultant for Bergen Public Library with extensive competence in pedagogy and learning; Ingrid Ytre-Arne – a children's librarian with competence in literature for child and young adults and child pedagogy, and another librarian with pedagogy background who wished to be anonymous for this study.

4.2.2 ETHICAL CONSIDERATIONS IN THIS STUDY

The literature survey revealed some ethical aspects that must be taken into consideration, especially when involving children in a research study. Below are the measures that were made to ensure that the privacy and safety of the participants are met.

Informed Consent with non-disclosure agreements

All participants signed informed consents with non-disclosure agreements (Appendix E) by their guardian or parent prior to the research study. All activities the participants were a part of were presented to all involved. Librarians and experts were also given the option to sign consents. Only one of the librarians wished to sign the form and remain anonymous for the duration of the study.

There was an adjusted approach to the observation phase. The initial plan was to ask all participants of this phase for consent, however, to preserve the quality of the data while the participants were performing, only the Librarians were interviewed in the observation phase. Nevertheless, for the class visits, an email was sent to the teachers to inform them research activities were being conducted during their visits in the library. They were assured that the children would not be interviewed. There will be several photos that will be taken but these were sent to them for approval before the research is allowed to use the material. Last, a sign was placed at the librarian's desk that informed everyone that went into the Children's department during this phase.

Incentives

All participants of the user tests received a gift card worth 100 NOK at the end of their participation. They were also offered snacks and refreshments during the user testing sessions.

Understanding the participants limited cognitive ability

An important issue during the observation phase of the study was to understand the non-verbal languages of the participants. Some data were challenging to interpret as the researcher did not have the psychological background competence of understanding all the participants actions and decision-making process.

This also proved to be an issue during the user test, and it was important to emphasize to the young participants:

1. there are no right or wrong answers during the sessions
2. they are not being tested but the usability and functionality of the interface
3. the interface is limited, and certain functions are not available
4. they will be guided throughout the sessions on what to do
5. whenever they feel uncomfortable, they may terminate their participation

It was important that during the tests, that the researcher was open and transparent throughout the study.

Regulations and Research environment agreement

In the early stages of the study, it was still uncertain what type of data collected from all iteration of the research study. To ensure the quality and integrity, the research study was officially registered and approved by the Norwegian Center for Research Data (NSD). The approval is attached in Appendix D.

In addition, a research agreement was made between this research study and the institution where it took place. A detailed and signed agreement is attached in Appendix A.

CHAPTER 5

ITERATION 1: MAPPING INTERACTIONS - FROM RESEARCH TO DESIGN

This chapter presents the first iteration of the study and is aimed to establish the initial user requirements for the prototype. In order to design an application that helps children to choose books to read, one must first understand how the interaction between a librarian and young readers takes place today at physical libraries. The objectives of this iteration were:

- Conduct a semi-structured interview with the librarian to establish the user history
- Observe the interaction between librarians and the children during one-on-one advisory
- Conduct semi-structured interviews to understand the elements that is needed when advising children with books
- Analyze and investigate the data collected and map the process involved in literature dissemination. Discover patterns and scenarios.
- Establish the initial functional and non-functional requirements of the prototype

5.1 SEMI-STRUCTURED INTERVIEW WITH THE LIBRARIAN

Prior to the semi structured interview was conducted with the librarians to establish any background information on literature dissemination in the library and which requirements children have when choosing a book to read. The librarian also presented a library statistic datasheet (see appendix G) of all the books that was borrowed by pre-adolescent library users in 2018. This was to get an overview of what type books are usually read by this user group.

5.1.1 BACKGROUND GUIDELINES AND PREFERENCES BETWEEN THE LIBRARIAN AND THE PRE-ADOLESCENT READER

Before any suggestions were made, the librarian

- The child's reading proficiency
- The child's general preferences
- Prior statistics from other library borrowers

While the young library users also had book preferences such as:

- Thickness of the book
- Visual content – book cover, pictures and texts in the book
- General interests (e.g. horses, football, ballet, vampires etc.)

These guidelines and preferences determined the direction of librarian's suggestion of literature to the enquiring child.

5.2 OBSERVATION STUDY

1

2

3

4

Figure 12 - Observation set-up at Bergen Public Library: 1) Librarian at the desk; 2)Sign on the desk announcing that field research is ongoing, 3)Observation field 4)Observers set-up

5.2.1 SET-UP

Observation is a data gathering technique that help designers understand the users environment, tasks and contexts (Sharp et al., 2007). *Table 6* represents a framework structure of where and how the observation study took place. *Figure 12* illustrates how the observations took place in the children's department of Bergen Public Library since the target group usually comes into this place during class and normal public visits. All observation took place in the early stages of the study over a period of 6 months. The majority of participants were children of pre-adolescent age, but during the public visits there were a large number of adults in the children's department as well. A sign (Appendix B) was placed on the desk of librarian and the observer sat at the back of the librarian's desks. The observer took notes with a pre-defined observation guide (Appendix C).

Table 6 - Framework structure for the observation study

Observation space	Children's department, Bergen Public Library
Actors involved	Children visiting the library(class visits and public visits), Librarian
General Activities at the observation space	Information seeking and retrieval, book borrowing and returns, other library services
Acts	Children – book inquiry Librarian - literature advisory
Time	3-7 minutes per interaction
Goals	Note down the process of literature dissemination between the children and the librarian

Figure 13 shows the observation guide that was used during the observation phase. The process during the observation was as follows:

- The preadolescent user comes to the librarian's desk to ask anything regarding books to read.
- The interaction and the duration of the conversation is noted by the observer.
- After each interaction, the observer asks the librarian in-charge for any follow-up questions if the observers think that the interpretation of data is ambiguous.
- Each interaction must conclude by having the librarian offer a book before a new interaction may be noted.

Table 7 - Guide during the semi-structured interviews of the observation phase

Research Project	Digital Literature Dissemination for the Pre-adolescent Users of the Public Library
Objective of this phase	To understand and map the interaction between the librarian and pre-adolescent user during literature dissemination and the decision making of choosing a book to read
Description of the setting	During the observation phase, the observer(also the researcher of this project) will observe the actions that are done before, during and after the process of literature dissemination. The observer will not speak during the observation period. The observer may ask questions only after the period is finished. This to avoid any confusions in the process. After the questions, the observer will have follow-up questions that is suitable for the situation (see the example questions below). Situation may vary and therefore one must be open for slight changes in the observation notes. All participants will be informed that the area is being observed and will sign a consent while participating.
What will happen to the data collected?	The data collected in this process will be used to determine the process of literature dissemination between a children's librarian and a pre-adolescent user. The data will be mapped and will be one of the criteria for establishing the requirements

5.2.2 RESULTS

There were 5 observation periods including 3 class visits and 2 public visits. The duration of observations varied from 30 minutes to 2 hours with participants between 3 – 60 years old. There was always a librarian present during the observation period. A total of 150 visitors were observed and 40 of the participants met the criteria for the scope of the research study. Table 8 presents the details of the observation data.

Table 8 - Summary of the data collected during the observation phase

	Duration of observation	Age group of the participants being observed	No. of visitors observed	No. of librarian present	Average time for each one-on-one advisory(with interviews with the librarian)	No. of valid data collected
			Total: 150			**Total: 40**
Class visit	45 minutes	9-10 yrs. old	23	1	5 min.	8
Class visit	1 hour	10-11 yrs. old	24	1	5-10 min.	5
Public visit (Saturday)	2 hours	6 - 60 yrs. old	48	2	10 - 15 minutes	15
Class visit	30 minutes	11 – 12 yrs. old	20	1	5 minutes	7
Public visit (Sunday)	45 minutes	3 - 45 yrs. old	35	1	5-10 minutes	5

Validating the data

The children's department was open to the public during the observation period and therefore anyone could come and ask the librarian a question. The current location of the children's department allows visitors from all ages to ask not only about books, but also about other library services (where the toilet is, newspapers, adult sections, returns, borrowing of books, picking up of reservations, etc.). The participants during the class visits were more specific than the public visits. With public visits most of the visitors come as a small group or as a family. Criteria for including the data was based on:

- The child must be preadolescent (*mellomtrinnet, ages 9-12 years old*).
- The child must directly and independently ask the librarian for assistance in choosing a book.
- There must be a concrete conclusion to each inquiry

A detailed description about the participants is found in Chapter 4.

5.2.3 EVALUATION

Scenarios

During the observation – each recommendation went through three levels - Each scenario may go through 3 levels before a book is given as shown in *Figure 13*

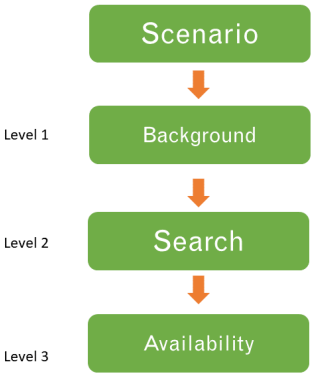


Figure 13 - Process levels from Book Inquiry to Receiving a book

Apart from the guidelines and preferences by the involving parties of the observation phase, the data also produced scenarios that occurred frequently. The scenarios depict the interaction between the librarian and the user.

Background

When a child asks for a book to read, depending on the scenario, the librarian establishes background information regarding reading preferences such as genres of interest (e.g., vampires, horses, etc.), prior books that have been read, types of literature genres (e.g., crime and mystery, sci-fi etc.), and general interest (e.g., sowing, dancing, etc.).

Search

Having established the background, the librarian may already have a specific title in mind. However, if this is not the case, the librarian may suggest a book based on Statistics and prior reading experiences (e.g., book that the librarian has read or books that have been presented in the librarians meeting).

Availability

The final level of the process is checking for its availability. If the book is not available, then the librarian reserves the book or goes back to the search to find another available book. Last, if the book is available, the librarian will go together with the reader to the shelf to pick up the book.

The observation phase discovered 4 scenarios:

"I have a specific title to a book"

This was the easiest and most common scenario, the child asking the librarian already knew the title of the book they want to read. The book may have been suggested by the school or book club as homework or assignment, a friend, or in another way. The librarian easily searches for the book in the database and checks its availability.

"I have read this book; do you have something similar?"

This scenario is for children that read more often. Young readers often stick to a literature genre that they enjoy. Nevertheless, the librarian would still explicitly ask about the genre of interest, the type of literature genre and the reading proficiency of the user. When this is established, the librarian searches the database and checks availability.

"I have a theme or a specific genre that I wish to read"

This scenario mostly occurred during the class visits. Class visits are often themed based and specific genres such as religion, history, or poetry are part of a school curriculum. Nevertheless, the librarian would still ask about the reading proficiency and confirm the literature genre. If there is a specific title of which the librarian is aware, a search on the database is sufficient. Otherwise, the librarian may refer to book statistics and past reading experiences before checking for availability.

"I don't know what to read"

The most challenging scenario discovered was when a young reader did not know what to read. This usually occurred during the public visits and the interaction for each situation was between 7-15 minutes. Children would come directly to the librarian desk asking for a book to read. In some situations, the librarians would suggest a book based on book statistics of most borrowed books on the children's department. However, this did not always entice children because they had their preferences such as general interest, visual content, and thickness of the books. In this case the librarian must further investigate and explore together with the child by establishing a thorough background of reading preferences: genre of interest, reading history, reading frequency and proficiency, type of literature genre and general interests. Based on the librarian's competency and reading experience, she may come up with a title and searches the database. On rare occasions when the librarians do not have an idea, he/she refers to a colleague for suggestions.

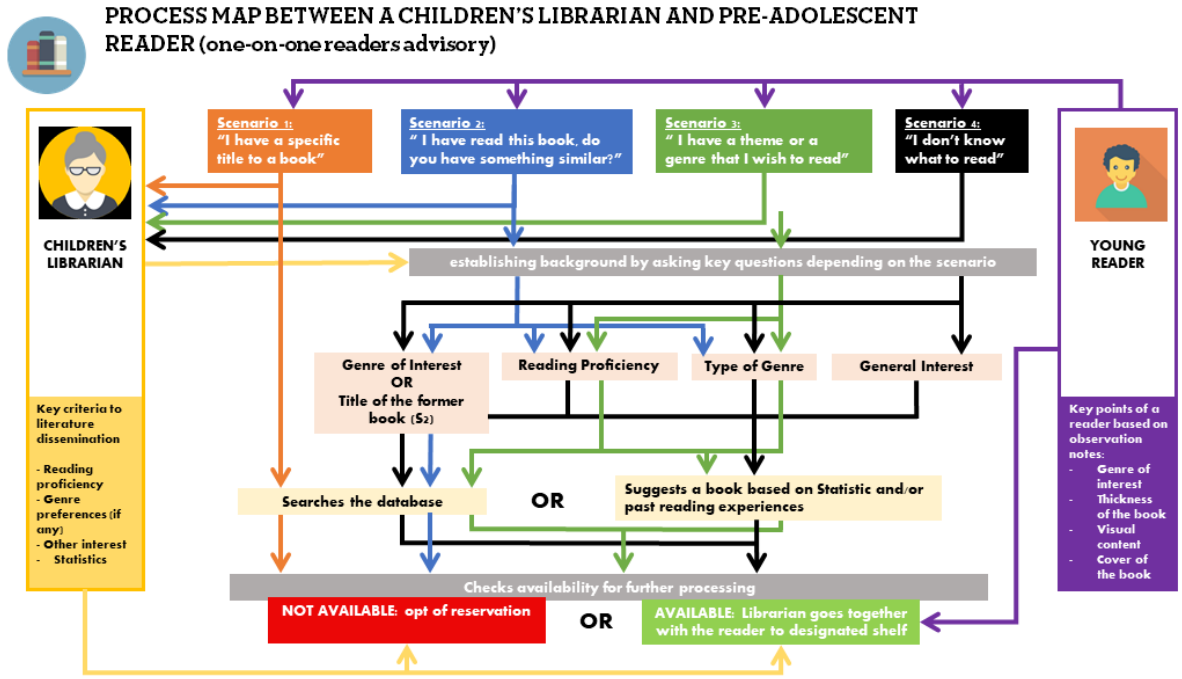


Figure 14 - Task flow chart of interaction between librarian and young user

A successful interaction with this scenario is when several books can be offered; they are available for borrowing, and the child can independently choose a desired book. Figure 14 (see Appendix J for a larger version) shows a flow chart of this interaction between a young user and the librarian.

5.3 ESTABLISHING USER REQUIREMENTS

The first iteration created data that initiated the bases for the user requirements for the prototype. According to Preece (2007), the term requirements is "a statement about an intended product that specifies what it should do or how it should perform". This is an iterative process and must be re-visited in every iteration. Together with the user principles and usability goals, this iteration helped establish the functional and non-functional requirements of the prototyped. Functional requirements specify what the artefact should do, while non-functional requirements are the "look and feel", usability, and performance of it (Sharp et al., 2007).

5.3.1 SET-UP FUNCTIONAL REQUIREMENTS

Based on the first iteration, the initial requirements for the artefact in mind should be able to:

- Search the database for specific titles
- Explore the different type of literature genres that exists in the library
- See which books librarians would suggests for reading
- See books that have similar genres and preferences
- Choose their personal preferences that would help them find books to read
- Get recommendations of books that they can read.
- Check whether the book they intend to read is available
- Show the where the book is located
- Rate the book that is being suggested

5.3.2 SET-UP NON-FUNCTIONAL REQUIREMENTS

The non-functional requirements are that the artifact should be:

- Easy to learn and understand for a child
- Have child-friendly aesthetics
- Require fewer tasks to perform
- Give immediate feedbacks when needed
- Have understandable visual content with proper icon representations

5.3.3 PRE-DEFINED REQUIREMENTS

Although the pre-defined requirements were not implemented in this research study, these elements are still important for the artefact should it be developed further:

- Internet connection for the application to connect to the catalogue database
- A well establish recommender system with child-friendly algorithms
- Stand-alone tablet at the library that would be present at all times especially when librarians were not present
- System language in Norwegian

CHAPTER 6

PROTOTYPE DEVELOPMENT

This chapter presents iterations 2, 3, and 4, which present three different stages of the prototype development.

Iteration 2 includes the creation of design alternatives, initial wireframing, and brainstorming activities about how to properly represent the functions and icons of the prototype.

The 3rd iteration aimed to transform the paper prototype into a digital prototype and refine the functions of the prototype through user- and heuristic tests. This formed the basis for the design of the final prototype.

The 4th and last iteration presents the final, clickable, prototype. To finish things off, this final prototype was also evaluated through a user- and heuristic test.

Going through these three stages aimed to refine the user experience children have when using this digital application that suggest books for them to read.

6.1 ITERATION 2 - DESIGN ALTERNATIVES

Having established the initial user requirements in Chapter 5, Iteration 2 applied those requirements in designing the initial prototype through paper sketches. Low-fidelity prototyping such as using pen and paper is an effective way of creating designs together with the experts, because it is fast and easy to adjust on the go. Paper wireframes were created to explore how the scenarios would be represented when suggesting a book to read. A workshop was conducted with the experts to brainstorm and discuss on design choices and functionality, how literature genres should be grouped and how to properly represent icons.

The objectives of this iteration were to:

- Place structure on the user interface
- Create the design alternatives for the digital prototype
- Create wireframes that describe the process of suggesting books to the user
- Select proper image/icon representations of the literary genres.
- Decide which functions would be relevant and appropriate for the prototype

- Set-up limitations for the digital prototype
- Evaluate and choose which design alternative is best suited for the digital prototype by testing it with the experts
- Re-evaluate the initial user requirements for the prototype

6.1.1 KNOWLEDGE ACQUISITION FROM THE EXPERTS

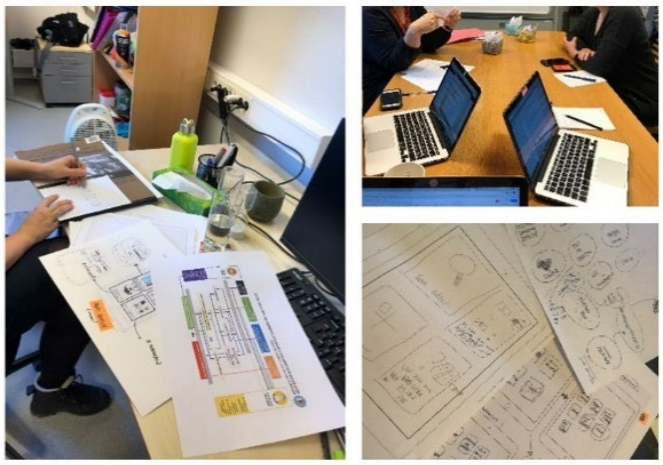


Figure 15 - workshop with librarians and UX expert in the early stages of the prototype development to discuss the prototype concept and design alternatives.

As shown in Figure 15, 2 workshops were conducted with the librarians and a UX expert to discuss the conceptual designs of the prototype. The workshops started with a brief introduction of the research, its research objectives, purpose of the workshops, and presentation of results during the observation phase. This gave the experts an idea of the type of data that was collected and provided an initial overview of how the intended application would be used in the library.

First, the UX expert provided input on how the scenarios could be represented digitally while at the same time considering the usability goals and design principles that should be considered when designing for children as presented and discussed in the Literature Review in Chapter 2. The user requirements are reviewed and evaluated to see if it appropriates all points matched the target group's needs. Each scenario would represent a function in the prototype.

Then, the librarians provided their expertise in identifying which literary genres were relevant for children and how to categorize them so that it would be understandable for the intended user group. Eleven main categories were presented as children literature genres at Bergen Public Library:

- Picture books (*Bildebøker*)
- Poetry and Verse (*Dikt og Rim*)
- Plays (*Skuespill*)
- Folklore (*Eventyr*)
- Science Fiction (*Sci-fi*)
- Realistic Fiction (*Realistiskefortellinger*)
- Historical Fiction (*Historiskefortellinger*)
- Biography (*Biografi*)
- Comic book (*Tegneserier*)
- Non-fiction (*Faktabøker*)

While the experts presented their knowledge on both library science and UX, sketches of the designs were drawn in pen and paper. Their feedback and the results from the first observation phase were used as a starting point to develop the conceptual designs for the prototype.

Setting the scope and limitations of the digital prototype

Even though other media can be borrowed at the library, this research study aims to design an application that would help suggests books for reading. Thus, in the workshop the genres discussed were only those that related to physical books. There were two challenges discovered in this activity: 1) grouping the literary genres, and 2) icon and image representation of the functions and genres. To effectively show the main objective of this research study, limitations were set to the number of literary genres that would be presented in the prototype. This would help a child reduce cognitive load while interacting with the product.

Grouping the Literary Genres

Non-fiction, Historical, and Biography genres were not included in the conceptual design as they have rigorous sub-categories, especially for non-fiction. However, these categories can also relate to other categories as well, for example: a book on animals and humans can also be both non-fiction and fiction as well.

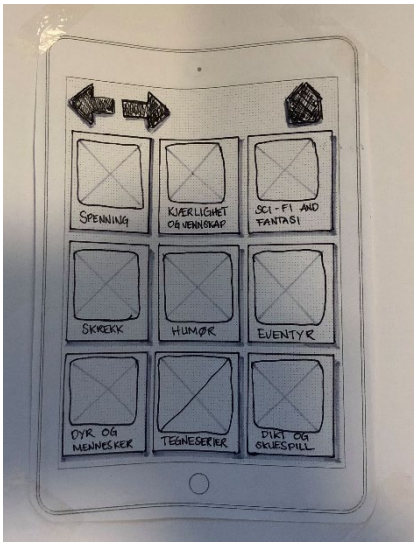


Figure 16 - Initial groupings of the literary genre at the workshop

The library has non-fiction literature divided into themes and uses a Dewey-Decimal[14] classification system for the catalogue organization. However, Bergen Public Library has some exceptions with regards to their literature organization and categorization, because for example Folklore (*Eventyr*) is categorized in the non-fiction section and has an assigned Dewey classification number, while other fiction books are organized according to reading level and theme:

- Picture Books (*Bildebøker*) – books for toddlers and nursery ages
- Small Children (*Småbarn*) – books that adults can read for non-reading children or children that has just started learning to read
- Pre-adolescent (*Mellomtrinn*) – books read by pre-adolescent readers and categorized according to theme (Horses, Horror, Fantasy and General Fiction). Here the librarians discuss that the application should have more themes that would help children find the books.

Nevertheless, books from all three reading levels were still being suggested by the librarian because reading proficiency still varied among pre-adolescent readers.

The discussion with the librarians showed that most of the themes of the target group can be divided into 9 categories (in no particular order) as shown were *Figure 16*: Crime and Suspense (*Krim og Spenning*), Romance and Friendship (*Kjærlighet og Vennskap*), Science Fiction and Fantasy (*Sci-Fi og Fantasy*), Horror (*Skrekk*), Comedy (*Humør*), Adventure/Folklore (*Eventyr*), Fictionbooks on Animals and People (*Dyr og Mennesker*), Comic Books (*Tegneserier*), and Poetry and Play (*Dikt og Skuespill*). This

[14] https://www.britannica.com/science/Dewey-Decimal-Classification

was an initial grouping of the literary genres and still needed user testing and expert's evaluation (heuristic test) when the digital prototype was developed.

Icon and Image Representations

Another challenge that was discussed with experts during the workshop were proper representation of the genres and themes through icons and images in the prototype. Colourbox (see section 4.1.2) was used as a tool for quickly finding icon representations for the prototype. Several icons were presented to the experts to help choose the proper representations of the literary genres. For example, Colourbox had several representations of "Horror" and it was a challenge to choose which the icon was appropriate and understandable to a child. Several questions were raised regarding the representations of icons and images:

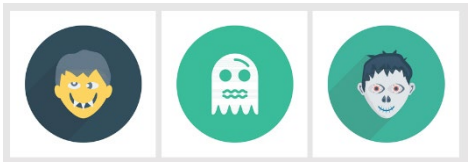


Figure 17 Choosing the proper icon that represents "Horror" for the prototype

- Will the children understand the metaphors of the genres?
- Will the icons influence how children perceive usability the application?
- Will the image representation influence the way their preferences of books that they could read?

6.1.2 DESIGN ALTERNATIVES

The four possible scenarios that were discovered during the observation phase were used as a starting point for the design alternatives. These 4 scenarios were:

- "I have a specific title to a book"
- "I have read this book ; do you have something similar?"
- "I have a theme or a specific genre that I wish to read"
- "I don't know what to read"

Since the users are children, usability goals and principles were used as guidelines while designing the alternatives. Both design alternatives present the main page of the prototype. Both design alternatives present the main page of the prototype, see figures 18 and 19.

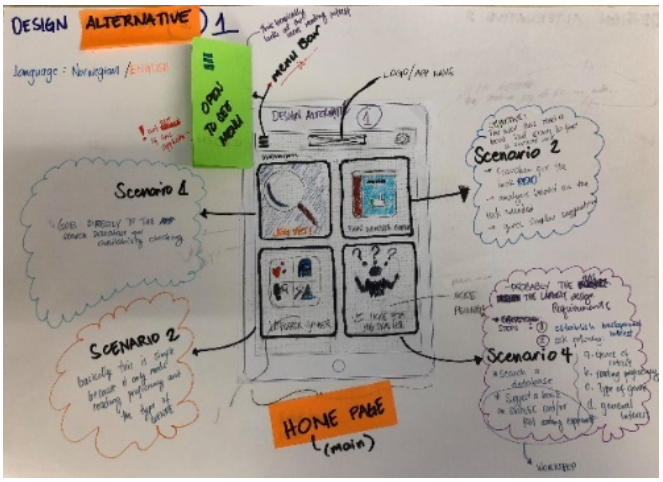


Figure 18 - Design Alternative 1

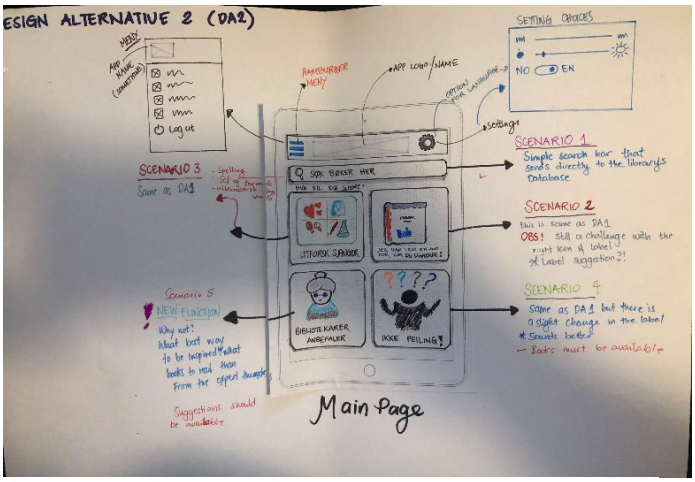


Figure 19 - Design alternative 2

In the first design alternative, see Figure 18, shows 4 main functions:

Search *(Jeg vet!)*
The users directly search known titles. This is represented by a magnifying glass as an indication to the user that this is where one can look for books.

Discover Genre *(Utforsk Sjanger)*
Users could explore the different types of genres that they can read. Four icons were used to represent 4 of the 9 literary themes (Romance, Horror, Crime, Fantasy). Clicking this icon would lead the user to learning about the different genres and corresponding book suggestions. It is intended that the each literary has a set of books ready for suggestion when clicked.

Something Similar *(Jeg har lest noe jeg liker, finnes det noes om ligner)*
This function represents the scenario where users have read a book and would like to read something similar. It connects to the recommender system through a set of questions before it will give results of book suggestions.

HELP!I don't know what to read! *(Hjelp!, jeg vet ikke hva jeg skal lese!)*
Represents the final and most challenging scenario where the users do not know what to read. This scenario connects to the recommender system by answering a set of questions.

Design Alternative 2 (*Figure 19*), is almost similar to the first one but presents a new function:

Librarian Suggests *(Bibliotekaren Anbefaler)*
This function quickly presents pre-defined books that children librarians' suggestion.

The inspiration behind the last function was observe during the observation phase. It was noted that Librarians would suggests books based from passed experience and library statistics.

The *Search* function was made into a search bar instead of having as one of the four main function, but it is still visible located as it is still a relevant scenario. Several terms were also shortened in these alternatives to make them more appropriate language of the user.

6.1.3 WIREFRAME SKETCHES OF DIGITAL LITERATURE DISSEMINATION

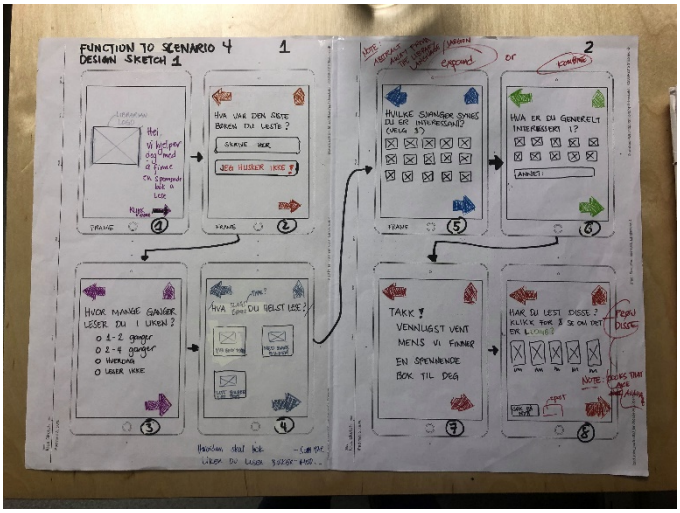


Figure 20 - Wireframing the process of finding out what book is suited for the user

In this activity, sketches were created to depict the process of asking the users questions and establishing what book a user might be interested in reading. When the users click on the "*Something Similar*" or "*I don't know what to read*" button, the user is directed to a set of questions. The questions in a full functioning application would be collected and processed through a recommender system, and then be sent to a database to check the book's availability in the physical library. The questions are based on the questions that were asked by the librarians to the users during the observation phase. As shown in Figure 20, five interface frames represent questions that establishes the users' reading proficiency and preferences:

"What was the last book that you read?"

The user has an option of writing the last book that they read or by clicking the "I do not know" button when he or she does not remember or know which book they last read. They then move to the next question.

Figure 21- wireframe "What was the last book that you read?"

"How often do you read in a week?"

This question establishes the frequency of reading and therefore establishes the reading proficiency as well. A user that reads often is assumed to read more books with texts and pages.

Figure 22 - wireframe "How often do you read in a week?"

"What type of book would you like to read?"

The question refers to whether the reader would like to read books with just texts, just pictures, or a combination of both. This is a follow-up question to the previous questions because not all "super" readers like pure texts in their books. Librarians explained that some of the children book in the pre-adolescent books found at the library are in series. For example, the comic book series entitled "Amuletten - Steinvokteren" has both texts and pictures in the 8 books. According to local library's statistics (see Appendix G), it was one of the most borrowed books by children in 2018.

Figure 23 - wireframe "What type of book would you like to read?

"Which literary genres do you think are interesting?"

The last two questions should narrow down the choices for the children and enable an overview of which books are suitable. The user can choose one of nine themes that they find interesting before moving on to the final question.

Figure 24 - wireframe "Which literary genres do you think are interesting?"

"What are your general interests?"

The user must write in this section their general interests: football, drawing, science etc. Apart from the literary genre, the books would be match with keywords that was entered. For example, if the user's types in football – then books with football and the literary genre would narrow down the choices.

Figure 25 - wireframe "What are your general interests?"

Each question provides the user with choices of answers and the each answer represents the direction of the books that will be suggested. When the results return books that are available at the library they will be shown and the user may pick the book up from the shelf. Note that these questions are suggestions to how the reccommender system should ask a child. The questions were results from the observation phase and assessements are based on the librarians judgement. The purpose of these questions is to apply user experience in a reccommeder system. How this will affect the results when this is implemented is yet to be explored.

6.1.5 EVALUATION FROM THE EXPERTS

The experts were generally favorable of creating an application that would make suggestions of books for children to read. All initial functionality of the suggested prototype was based on the expert's encounter with the user from the scenarios to the questionnaires. They found that an application such suggested in this research study would be useful in situations where librarians are not present to assist the children, or

when they are pre-occupied with assisting other borrowers. It was concluded that by integrating the design alternatives the first digital prototype can be developed. More about the evaluation of the design alternatives will be discussed in Chapter 7 Results and Discussions.

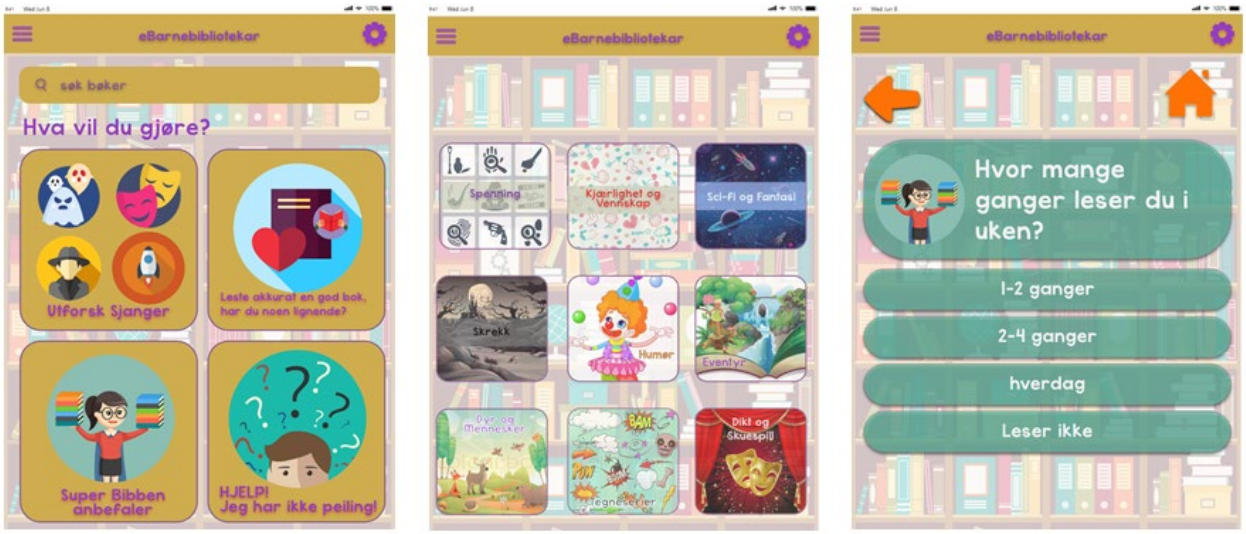
6.2 ITERATION 3 - FROM SKETCHES TO DIGITAL PROTOTYPE

The first two iterations of this research study were a rigorous creative process for establishing the user requirements of the prototype. This section presents the process of designing the first digital prototype. It explores the feasibility of using the application in the intended setting. Mock-ups were designed in Adobe XD, and user tests with the target group were performed as well as heuristic tests with the experts. The usability test allowed the user to interact with the prototype and test the functionality. The results from the test were analyzed and evaluated. The data was used to make the necessary adjustments on the final prototype.

The objectives for this iteration were:

- Design the mock-ups of the prototype
- Apply clickable functions that will present interactivity for the users
- Conduct usability testing and heuristic test
- Analyze the results
- Re-visit and re-establish the user requirements for the final prototype

6.2.1 DESIGNING THE DIGITAL PROTOTYPING



1) Main page

2) Representation of the literary themes

3) Example of the questions asked

Figure 26 – Screenshots of the 1st Digital Prototype

The paper sketches made in the 2nd iteration was transformed into a digital clickable prototype. The prototype was designed for an iPad interface and were mounted at the librarian's desks or next to the librarian's desks using a portable stand with lock[15].

The prototype begins with the main page as shown in Figure 26-1. The drop-down menu is located on the upper left side and the settings menu on the upper right side. During the development phase no particular function was assigned to the menus, but they served as a placeholder for the future developments. Below the menus is the *Search* bar that allows the users to search for books they already know. The user is asking what they want to do (*Hva vil du gjøre?*) and they have 4 buttons they can from: Discover literature genres (*Utforsk Sjanger*), Something Similar (*Leste akkurat en god bok, har du noe lignende?*), Librarian suggests (*Super Bibben Anbefaler*), or HELP! I don't know what to read (*HJELP! Jeg har ikke peiling!*). A description of each button can be found in sub-section 6.1.2 "*Design Alternatives*"

When the user clicks on the "*Utforsk Sjanger*" button, they are directed to another window that shows 9 literary themes, as shown in Figure 26.2. The user can choose

[15] Tablet stands are often used at the public libraries for games and information dissemination. An example of the stand would look like: https://www.shopsign.dk/shop/kabel-til-ipad-2601p.html (accessed 01.11.2019).

from the themes and they will be directed to the results window with books that they can pick up from the shelves and read.

The buttons "*Something Similar*"" and "*HELP! I do not know what to read!*" lead to a set of questions that the user needs to answer. Figure 26.3 shows an example of what a question looks like and which choices the users have. After going through the questions and the choices by the recommender system, the results are sent the database to check its availability then gives the user a book choice (see section 3.6). Questions asked of the user by the prototype, and the details can be read in sub-section 6.1.3. "*Wireframe Sketches of Digital Literature Dissemination*".

With the exemption of searches for specific books, Figure 27, shows an example of how books are suggested. This research study did not implement a recommender system, but rather just the interface design of an application that will use a recommender algorithm to suggest books for children to read. Mock-ups were created to mimic how book suggestions should appear, see Figure 27-1. After a user answers the questions the results will show books that the system suggests and only books that are available in the physical library are visible in the application.

Figure 27-1 presents examples of book suggestions when the reader answered questions regarding Comedy or Humor Books and having both texts and pictures. If the user has read the books that they see, then then can click "*Jeg har lest denne*" signaling to the system that the book has already been read. In addition, if the user has already read all books they may either: click "*Jeg har lest disse – prøv på nytt*", which indicates that they have read all the books and would like to refresh the system and get new suggestions, OR click "*Søk på Nytt*", which results in another round of questions.

When the user has decided which book, they want to read they click on the book to see where the book is located. The application shows the location of the book using the library mapping system[16] and the user can pick the book from the shelf. Extra information as to where the book is exactly located will be shown on the screen as seen in Figure 27-2. Finally, the user may click on the orange "*Home*" icon to go back to the landing screen and the user may choose to borrow the book or read it in the area.

[16] https://wagnerguide.com/c/bergen/bergenlibrary

1) Example of book suggestions when the choices refer to Comedy books

2) Location of were the book is located

Figure 27 - Book suggestions

Design Elements of Super Bibben

The user requirements that were gathered from the observation phase, workshops, and the design alternatives, lead to creation of the digital prototype. Child-friendly design principles that were discussed in the literature survey were incorporated throughout the design process.

Figure 28 - Clear feedback for the users

For example, the number of functions was limited to avoid cognitive load for users. The buttons were of appropriate sizes and were visible for the users. The aim is that the users would naturally know what to do when they encounter the application at the library. Lively and vivid colors that are pleasing to the eye were chosen to engage the users in interaction. Cartoon-like icons and image representation were used to give the child-like "look and feel" for the application. The main intention was to make the application as inviting as possible for the user. Clear directions such as the home button and arrows were placed in the user interface that signal children

what options they have. Buttons and images had shadows to indicate to the user that they are clickables. Notification of further actions, as shown in Figure 23, are as clear as possible so as to aid the user to make stress-free decisions while using the application. Users were also informed when the system was processing.

The typographic content of the user interface refers to how the texts are presented in the application (Sharp et al., 2007). The question formulations were child-friendly and as short as possible to reduce cognitive load and to not require assistance from anyone. The tone of the language used in the application was based on how librarians talk to children when they are helping them.

6.2.2 HEURISTIC EVALUATION

Three experts participated in the heuristic evaluation of the first prototype. The purpose of this activity was to ensure the quality assurance of the prototype making sure that it followed the heuristic guidelines. Meetings with the expert were held separately. A brief presentation of the domain experts that participated in this research study can be found in Chapter 4 sub-section "Research Participants". A consent form for their participation was presented and all experts participated without hesitation.

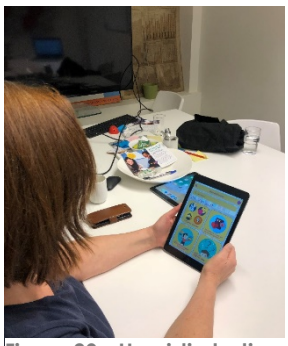


Figure 29 - Heuristic testing with one of the experts

Each meeting had the following activities: 1) an update of the research study was given, and it was explained what was done so far with the prototype. 2) the experts were given an iPad and were given 5-10 minutes to navigate through the prototype, and 3) a semi-structured interview was conducted (see Appendix I).

6.2.3 USABILITY TESTS

User tests were implemented to see how the intended user group would interact with the prototype. Five participants were recruited through the library's mailing lists. The ages of the children were from 10-13, with no particular criteria to ethnic background, gender, reading and digital proficiency to avoid bias in the data collection. However, it was emphasized that the user should know how to use a tablet and can use the library.

All participants and their guardians came at the same time but were tested separately. A room at the Bergen Public Library was reserved for the briefing and as waiting room. First the research study was briefly presented to them, including what was expected from the participants as testers, and the incentives they would get after participating. Then, the information letter with the consent form was handed out and the guardians were given time to read the form and sign the letter.

Each participant was taken to the children's department for the test. The guardians were requested to sit on the sideline and not interfere during the test. Each user used 15-20 minutes. First, we went through the user test guide (Appendix I). The participants were informed of the limitations of the prototype and it was explained that it was not a fully functioning prototype. Then, the participants were presented the prototype on an iPad, and we proceeded with the walkthrough of the 4 tasks. These tasks were explained as "make believe tasks" so that the user knew what was going to happen in the test. After each completed task, a book recommendation follows, they were then told to try locate and pick up the book from the bookshelf. The tasks were as follows (translated from Norwegian):

Task 1 - You want to read a book entitled "The diary of a Wimpy Kid"
This was a straightforward task. The participants were expected to go directly to the search bar, type the key words and get the results.

Task 2 - You do not know what you want to read but you do read a lot in your free time. Find a book that is suitable. You wish to read a book that is with mystery and crime.
The purpose of this task was to encourage the participants to use the "*Hjelp! Jeg har ikke peiling!*" function. They would then answer the questions, choose the genre in mind, and type in their general interests. Here mistakes can be expected, but this would also test the feedback and warning elements of the prototype

Task 3 - You talked with a librarian in the weekend, but you do not remember which book she suggested. How would you find it again?
The task invites the user to explore the prototype, but the easiest path is to click on the "*Super Bibben Anbefaler*" function. In this button the participants are able to see what books librarians have suggested that children should read.

Task 4 - You have not read about Sci-Fi before and do not know what it is all about.
In this task, the participants were expected to click "Utforsk Sjanger" and then click on "*Sci-fi og Fantasy*" before getting results of the book.

The user test was expected to be flexible and there was a situation where additional tasks were requested. After all the tasks were completed, a semi-structured interview was conducted using the pre-defined guide questions, see Appendix I.

Results
Almost all participants managed to follow the walkthrough in the prototype, but most of them had trouble locating the books in the shelves. The participants answered using a Smiley-o-meter (see section 4.4.3 *"Usability Testing" and Appendix I for the questionnaire), but follow-up questions were also asked when the smileys they chose were neutral (middle smiley). A summary of the results is presented in Table 8.*

All the participants managed *Task 1* and *Task 4*, easily. Tasks 2 and 3, however, took longer to accomplish than expected. Two participants chose "Utforsk Sjanger" to accomplish *Task 3 but* discovered the "Super Bibben Anbefaler" when they returned and started again. One participant had difficulty accomplishing Task 2.

There was one function that did not have a task in this user test. "Something similar", which was suppose help a user find a book similar to past books they have read. However, 2 of the participants were given a task to explore this function since they accomplished the first 4 tasks more effectively than the others. Both of the participants liked how this function presented, although they commented that they would rather use the "Utforsk Sjanger function because it was faster".

All participants answered that they would use the application if it existed in the library, but 2 of 5 said that they would also ask the librarian if she was present in the library. Everybody thought that the application was "cool". The majority liked the design, the icons, and the typography content. The language that was used was easy for them to understand and was easy to learn. One commented (translated from Norwegian) that "it is amazing how an app can actually help find a book that I like to read without talking to a librarian". Four of 5 thought that the system was intuitive, however, one of the participants thought it was difficult when the task 2 was being accomplished. There was some confusion with which function was suitable to use.

Although the majority though that it was not challenging to use the prototype, one participant experience challenges using it. The participant was having trouble understanding one particular literary theme: "*Dyr og Mennesker*" and meant that it was confusing.

Everyone clearly understood the questions that were being asked of them. One suggested some design changes in the book suggestion interface. Instead of having the sentence "*Jeg har lest disse*" (I have read these) there should be two buttons a check and a cross: the cross would indicated that the user is not interested in the book, and the check indicate that the book is selected and its location would be shown.

Table 9 Summary of results of the user test from 5 participants for the first iteration

Question	Results	
	Smiley-o-meter	*Comments*
Was the application understandable enough?		"It was easy to use!"
		"I was not sure how to do on of the tasks in the application"
Was it easy to perform given tasks in the application?		
		- "when I had to do tasks nr. 2 I was unsure where to start"
		- I got confused with choosing which was the right button to do one of the tasks
Was there anything in the application that was challenging	- "none that I can think of" - The application was ok to use - I thought that doing task number 2 was confusing	
Is there anything that anything that you think was boring or fun the application ?	- It like playing a game! - It was a little challenging to explore the genres	
If the application actually existed in the library, would you use the it if the librarian was not present? Would you use the application even if the librarian was present? Why? Why not?		- Yes!
		- " I am not sure; I like talking to people". The librarian would understand what I want."
Do you understand how the icons/image representations?		- "Super Bibben icon was cool!"
		- I did not understand the Animals and People *(dyr and menneske)* genre - Is Animals and People *(dyr and menneske)* about friendship with animal and man? Like dog's bestfriend?
Where the questions in the application easy to understand?		
Other Comments	- Maybe instead of using the "I have read these"(Jeg har lest disse) it should be check and a cross. Check for books that I want to read and the cross if I have read the book.	

User interface

All experts liked the app name "Super Bibben" for the app and even suggested that it should be called "Super Bibben – eBarnebibliotekar". This would give a clearer definition of what the application is all about. Overall impressions were generally positive

and design choices were favorable. The experts praised how the results from the observation phase and workshops transformed into the digital prototype. In addition, the experts commented that that the application was very intuitive to use. Nevertheless, the prototype needed adjustments with regards to design and suggestions were given:

- Remove the icons (drop-down menu and settings) above the application, as they have no purpose for this research study. This would minimize the amount of error that the user can perform while using the protype.
- Make the start screen understandable so that the users would understand what the app is all about. Instead of having the landing screen as the first interface that the users interact, have another screen to begin with a brief explanation of what the app is for and what it can offer the user.
- The background on the main page is too much, but it looks good in the questionnaires
- Clickables should look different when clicked to notify the users that a choice has been made

In one of the questions users were asked whether they wanted books with just text. One of the experts suggested that this should be taken away as the books with just pictures – "Bare Bilder" - are meant for younger children. Another suggested to add "Comic books (Tegneserier)" as an alternative since the local library statistic (Appendix G) show that children like to read in this literary format.

Evaluating the typographic content of the prototype

In addition to evaluating the user interface of the prototype, the experts also revisited the typographic content that was used in the prototype. In general, the experts were in favor of the language that was used. Nevertheless, some revisions were made to improve the quality of the interaction between the application and the user.

It was suggested the users be asked their age as this would narrow down the results of appropriate books for the user. In addition, there were a few spelling and grammatical errors that were discovered and that need to be corrected. Some of the questions asked in the application were revised to make it more colloquial for the users.

6.3 ITERATION 4 - FINAL PROTOTYPE

This section presents the iteration that produces the final prototype. The design process in this iteration is the result of the user test and heuristic evaluation carried out in the 3rd iteration . The first 3 iterations have been a rigorous creative process and this iteration applies the necessary design adjustments for the final prototype.

These were the objective for this iteration:

- Assess the feedback that was collected from the user test and heuristic evaluation
- Re-design the final prototype
- Conduct a user test and heuristic evaluation
- Evaluate the final prototype and its usability goals with the experts

6.3.1 DESIGNING THE FINAL PROTOTYPE

In designing the final prototype, see figure 30, the feedback from the user test and heuristic evaluation from iteration 3 was used to improve and adjust the final prototype. Time constraints on this research, however, hindered making rigorous design decisions in this final iteration. Thus, 5 design elements were prioritized in designing the final prototype. These are described below with descriptions of how the feedback was used.

Welcome screen *(see Figure 30-1)*: One feedback suggested by experts was that there should be a welcome screen before entering the application. A splash screen was developed and placed at the beginning of the prototype. This could enhance the user experience of the product and allows the user to be informed that the application is loading. Even if this prototype was not fully functional, small implementations of user experience such as splash screens was still an important design aspect of the development.

1) Welcome screen

2) Main screen

3) New Question

3) Book Suggestion

Figure 30 - Screenshot from the final digital prototype

Landing Screen *(Figure 30-2):* Design experts expressed their opinions regarding the design of the main screen of the first digital prototype. The background was making the main functions of the main screen look "wild". In the final prototype, the background of the main screen was replaced with a lighter shade. In addition, some colors in the prototype were changed to enhance the child-friendly "look and feel" of the application.

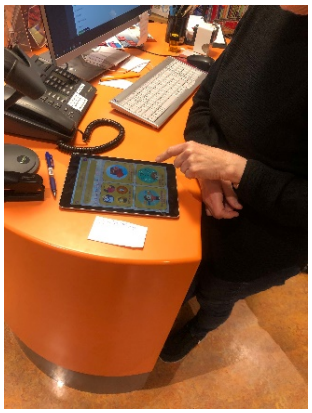
Additional questions *(Figure 30-3):* To gather better data about the user and make effective book suggestions, questions such as age and book thickness/total number of pages were added. This is to help in narrowing down the search and giving better and more specific book suggestions.

Interactive functions *(Figure 30-4):* One participant in the user study wished to have more interactivity in the application. Interactivity such as putting shadows on the buttons to signal the user that it is clickable was added. Also, effects were added to the buttons: when the user clicks the button, the button darkens to indicate that it has been chosen. Changes in the how the user chose the book was implemented. Users could set an (x) on a book that they have read and check (✓) if the they want to read this book. Users can also rate the books that they have read.

Typographic Content: There were no huge design changes, but rather improvement in the language and use of words that are understandable to children. The application was created in Norwegian and thorough spelling and grammar check of all the typographic content was inspected while designing the final prototype. Some of the questions and feedback sentences were shortened.

6.3.2 FINAL EVALUATION WITH EXPERTS

There was not much discussion with regards to design elements at the final evaluation with the experts as most of the design challenges were already addressed during the semi-structured interviews, workshops, and heuristic evaluations from the previous iterations. A short repetition of the heuristic test that was conducted in the previous iteration was held with the expert librarians on the final prototype.



The experts were satisfied with the corrections made in the typographic content. While the expert librarians are very interested in implementing a fully functional application, they were more interested in how much interaction the user would get from the application. This is discussed in Chapter 7.

Figure 31 - Heuristic evaluations with the experts

6.3.3 USER TESTING THE FINAL PROTOTYPE

The set-up for the user test for this iteration was similar to the user test in 3rd iteration so that qualitative data could be collected. The test was also to show the feasibility of the application. However, due to scheduling conflicts with the participants, only 2 participants were available for the final user test; these are 2 of the same participants that were involved in the first user test. This led to inconclusive results, and is discussed in Chapter 7. Nevertheless, there were still relevant data that was collected from this activity.

These 2 participants prior to the last user tests were presented with the update of the research study and then we proceeded with the user test. Performing the tasks was much faster and effective for this iteration than the previous iteration. The participants were already familiar with the prototype and could easily navigate.

Both participants thought that the prototype was better organized than last time. They did not make any comments about the added splash screens. One of the participants commented that the it was more interactive with him than the last user test, and the colors looked livelier.

CHAPTER 7

RESULTS AND DISCUSSIONS

The purpose of this Design and Creation research study was to design a mobile application that will assist preadolescent readers in choosing books at the public library. Furthermore, this research aimed to define the concept Digital Literature Dissemination in Public libraries. This chapter discusses the results and answers the research question:

How can we design a mobile application that will assist preadolescent readers in choosing a book at the public library?

In order to help answer the main research question, the following research objectives were established:

1. Identify the process and techniques of suggesting/choosing books for children at the Public Library
2. Design a mobile application that will assist pre-adolescent readers in choosing a book
3. Design the interface based on data collected
4. Test the artefact with the target group and the experts
5. Apply User Experience (UX) methods in physical spaces such as libraries

This chapter discusses and reflects on the key methods that were used in the design iterations, the results that were discovered. The study provided new insights into the relationships between Child-computer interaction, User Experience in Public libraries, and Digital Literature Dissemination which resulted into creating an application that will help children choose a book to read. Finally, the limitations of this research are discussed.

A literature review was conducted and revealed the following research challenges when working with children: 1) further studies and explorations are still needed in child-computer interaction; 2) usability goals and design principles for children are different from adults; 3) there are ethical issues when involving children in the design process; and, 4) there is a scarcity of literature about digital literature dissemination. The results of this review suggested that an application that suggests pre-adolescents' books to

read is a contribution to the knowledge base. This research designs such an application, *Super Bibben – eBarnebibliotaker*.

7.1 OBSERVATION PHASE

In line with the literature review on Contextual Inquiry, field studies were conducted to study the interaction pre-adolescent users had the public library. Semi-structured interviews were conducted with the librarians to gain background information regarding literature dissemination in the public library. While previous research Raqi & Zainab (2008) focused on observing strategies of how children choose books to read to understand their information seeking process, these results demonstrate that such data can also create patterns of scenarios that can be used to design a digital prototype. It was surprising that from the interviews with the librarians, no clear indications could be made on the scenarios that were discovered. This analysis only confirms that conducting observations studies with the target group is an important research method. The data that was collected from the field studies generated initial user requirements for the prototype. Most importantly, the data contributes a clearer understanding of how the interaction between librarians and users occur in a physical library, which is an important element towards defining digital literature dissemination.

7.2 DESIGN ALTERNATIVES AND PROTOTYPING

Chapter 6 presents the prototype development of the research study. In this chapter design alternatives were created from an analysis of the data collected in the observation phase of the study. Since this research is a creating a user-centered application, collaborations with the librarians–for their competence in the Literature Disseminations–and UX-experts–who provide insights and perspective towards User Experience–was essential. Most importantly, designing the application would have been very limited if the pre-adolescent users could not be a part of the research study, indirectly as participants being observed and directly (as these participants in the user test). Their participations gave meaningful insights and helped shaped designs of the prototype. The results of these collaborations build on Druin's evidences (see section 2.2.3 "*Involving Children in the Design Process*") on the benefits of involving children in the design process of technological systems.

In the 2nd iteration a workshop was conducted with the domain experts where they explored the conceptual design of the prototype. The workshop conducted with the experts provided the qualitative data for designing the application; including the language content, icon and image representations of the literary genres, as well as the transforming the "interactions" into questions that the application will ask the users when they are searching for a book.

During this iteration, sketching in pen and paper was used to create low-fidelity prototypes. The results build on existing research (Sharp et al., 2007) that low-fidelity prototyping is quick and inexpensive method, and it allowed the experts and designer to see immediate designs of the prototype and make heuristic evaluation in a short-term research as this.

In the 3rd and 4th iterations digital prototypes were created in *Adobe XD*. This tool helped transform the sketches made in the previous iteration, into better representations of the concept, and enabled visualization of the functionalities. Digital prototypes allowed the users to experience the "look and feel" of the prototype without us having to use so much time on the internal functionalities.

Since the research study had time constraints Colourbox, a website that allows designers to download online icons and image representations, was used during the development of the digital prototype and proved to be an innovative decision since it provided the research study additional design possibilities and choices. Nevertheless, there were some challenges in choosing the right icons for specific literary genres as presented in Section 6.1.1. "Icon and Image Representations".

Further studies should consider that perhaps the intended user group could have been involved in choosing the proper representation and according to their own interpretations. This, however, would require a much larger data collection as preferences would vary, and was not possible due to the time constraints on the research. Due to the lack of data collected, the results cannot confirm whether the design decisions made during the workshop would have any effect on using the application.

The methodological choices made for this research study were constrained by the limitations of a designing a non-functional prototype. It was beyond the scope of this study to implement the back end and create the recommender system for the prototype. The result might have suggested that fully implementing the application would

have allowed more accurate results in a user test, however, based on the findings of similar study mentioned in section 3.5, a hypothetical application such as this should be sufficient to prove the validity of data collected. This research study implemented the use of the prototype through walkthroughs, which allows user to perform tasks that mimics a fully functional system. This builds on existing evidence (Sharp et al., 2007) that this type of method would still allow users to note problematic features before the protype is developed.

7.3 INVOLVING CHILDREN IN THE DESIGN PROCESS

This research designed an application that would help preadolescents choose a book to read. Children were involved in two phases of this study: during the observation phase, and the user testing.

7.3.1 OBSERVING

The data that was collected during the field studies came from two groups: class visits and public visits. A total of 150 participants were observed and of these the data of 40 participants was included. While the data collected from the class visits were more accurate because they belong to specific group (belonging to a school and a grade), the reliability from the data collected during the public visits was impacted by wider age range of users that visited children's department. Even if the data collected gave meaningful insights, it still required filtering, which was time-consuming. Further studies should consider that it is optimal and more efficient to collect data using specific groups such as class visits if time is factor in the research study.

Otherwise, a larger pool of participants such as public visits can also generate unexpected, yet very relevant data for the study. It would be interesting for future studies in the field to see which data "public visits" groups generate when they use the prototype.

7.3.2 USER TESTING

User tests were an important part of the research because they revealed the challenges and limitations of designs in the prototype. The data collected from the user tests were essential for evaluating the designs and re-defining the requirements for further development. The results indicate that most children found the app useful and intuitive. At both user tests it was unanticipated that one of the participants has

Dyslexia, which is a form of learning disability. Yet in spite of this cognitive barrier, the youth completed the task without problems. Though this information is not enough to confirm a concrete analysis, it showed promise on the feasibility of the application for other user groups.

Two user tests were conducted during this research. Five participants participated in the first user test and 2 of these participants returned for the last user tests. The initial plan was for both user tests to have 5 participants, but due to scheduling conflicts and time constraints this proved not possible. The availability of enough participants should be considered when conducting user tests in short-term research in the future.

The overall analysis of the data collected from this research confirms that user tests with children would require more resources and time. Collecting enough data in a research study such as this can be challenging. Nevertheless, certain methods can still be implemented to ensure that children as user testers would understand what is expected of them. It was important for the participants to feel that there were no right or wrong answers in the user tests. Child-friendly user tests methods were implemented during the user tests. Likert scales were transformed into "Smiley-o-meters", which helped the participants express their opinions about the application. This research study demonstrates the importance of understanding that children's cognitive ability in perceiving things is different from an adult. Unexpected issues were experienced while the users were performing the tasks in the user studies. Some experienced walkthroughs and "mock-ups" proved to be difficult as they were limited to exploring the application by pre-defined tasks. The data suggests the majority had challenges in performing tasks 2 and 3.

The study also revealed that the application alone would not be enough for a child to search books on the shelfs independently. The results indicate that most of the participants had challenges in locating the books in the library shelves. The interactive map that was integrated in the application was too complex for the users. The results might suggest that it may be enough to just adjust the interactive map into a much child friendly map, however, based on the findings of similar studies conducted (see section 3.5), it is more plausible to implement external measures in the library. This can be as easy as color coding the bookshelves or as complex as integrating augmented reality in prototype. The results provide a new insight into the relationship between the digital and physical aspects of the Public library.

7.3.3 ETHICAL CHALLENGES

It can be a challenge to look at all the angles of ethics in a social research (Hansen, n.d.), and throughout the entire study, unforeseeable and unanticipated challenges were experienced while working with children.

To preserve the integrity of the results and hinder bias in the study, the observer did not approach the participants for follow-up questions in the open observation. During the observation, however, there were situations where the data was not reliable. The observer observing behind the librarians had trouble hearing some of the conversation between the librarian and the child as they talked very low and there were other people in the library. In addition, there were times when the age of the participant was questionable for the observer. Thus, the reliability of some of the data collected may be impacted by the factors mentioned above. One of the challenges of collecting qualitative data is that the researcher participation and perception might have influenced on the results.

Most of the back-ground information of the target group were analyzed from library statics and semi-structured interviews with the librarians, and this proved to be sufficient for the study. Nevertheless, the results observation phase resulted into the discovery of the scenarios.

During the user tests, children were offered incentives for their participation in the research. Though generally it did not affect most of the participants, the results contradict the claims of Gibson (2007) that incentives are beneficial. At one user test, bias was observed when incentives were mentioned. After the users received information of the incentives, participant showed very little interest in interacting with the prototype and had very little reflection (e.g. comments were "Everything was great with the app!" even if they had trouble fulfilling tasks) on the questions being asked after the user test. Future studies should consider limiting the information on incentives before the study and just present it first to the guardian instead.

A letter of consent was presented to guardian on the day of the user test. They were given enough time to read and understand the study. The guardians signed the consent then the study proceeded. The guardians were assured that at any point of the study they can choose to have their child withdraw from the study. A month prior to

the submission of this thesis, one of the guardians sent a request to withdraw identifiable information such as pictures of their child. This was not an issue because the pictures were for documentation only, and the important aspect of the user tests were the feedback, but this also raises questions to what extent does "having the right to withdraw at *any time*" have on the impact of the research study.

7.4 DIGITAL LITERATURE DISSEMINATION

While there exist projects[2345], library services (see section 3.4) and studies (see section 3.5)on Digital Literature Dissemination that have created applications for the library, they have not explicitly defined the process.

This research study defines Digital Literature Dissemination as:

Digital Literature Dissemination is the formalization of the processes for conveying all types of literature, both digital and physical, in such way that users have direct access to information through a digital system without the presence of a physical librarian.

By creating the digital prototype and testing its feasibility, this research provides new insights in the concept of digital literature dissemination.

7.5 REVISITING THE DESIGN PRINCIPLES AND USABILITY GOALS

This research study presented literature regarding design principles and usability when designing interfaces for children. Throughout the study, these design elements were met while creating the "Super Bibben".

Visibility: The application presents itself clearly and was designed with clear with child-friendly icons, image representations, and vivid colors. The functionalities are presented in a strongly visual manner that reduces cognitive load for the user.

Feedback: The communication between the user and the application is precise and it gives immediate feedback on the actions that the users need to perform. When the user wishes to return to the main page or back a previous page, clear icon representations help the user perform the next step the application.

Constraints: To limit cognitive load, the application has limited actions by limiting the number of functions in the application. For this research the literary genres were clustered in a way that it limits individual functions without compromising the interaction.

Consistency: Super Bibben limits the causes of a "trial and error" method for a user by implementing consistent functions in the application. When the users are in the process of choosing a book to read, the system is designed so that the user understands that the tasks requires a process of answering questions before revealing the suggestions. The typographical content of the application allows for easily understand the concept of the application.

Affordance The inspiration behind Super Bibben is based on the interaction between the user and the librarian. The application is designed in such a way that it visually mimics the way a librarian would render service to a child. The functionalities and questions use child-friendly language.

In addition to the Design principles, usability goals were also covered in guide questions (Sharp et al., 2007) to ensure that user experience elements were present in the application. This section discusses the results from the user tests.

Effectivity	***Is the product capable of allowing people to learn, carry out their efficiently, access the information that they need?***

The results of the user tests demonstrated that Super Bibben was intuitive and easy to use. Although results indicated some challenges in carrying out the pre-defined tasks, the majority of the users were able use the product efficiently. The functionalities were visually presented.

Efficiency	**Once users have learned how to use the products to carry out their tasks, can they sustain a high level of productivity?**

Those who participated in both user tests, found that the tasks were easier the second time and results showed faster completion of the pre-defined tasks.

The results indicate that goals of effectivity and efficiency are not just limited to completing the tasks faster especially when the users are children. In line with Paget's the-

ory (Read et al., 2011) that children of the same age still have different cognitive abilities. These goals are accomplished when a child can finish the tasks, regardless of time, easily and intuitively.

Safety	**What range of errors that are possible using the product and what measures are to permit users to recover easily from them?**

There were situations where participants in the user test did the task differently than expected. When a user wants to read a particular literary genre, there are two known ways to do this. Either the user clicks on the "Discover Genre" (*Utforsk Sjanger*) function or the user may just say that click "Something Similar" (*Jeg har lest en god bok, har du noe lignende?*). In any function that the user chooses they may at any time cancel by either going back (clicking the left side arrow) or by clicking the home icon. This allows the user easily to start again.

Utility	**Does the product provide an appropriate set of functions that will be enable users to carry out all their tasks in the wat the want them to?**

The prototype that was developed is not fully functional, therefore, this question addresses only the interface elements of the prototype. The pre-defined tasks given during the user tests indicated that the participants could use all the given functions to perform them. The functions are organized in way that the user would generally know which functions to use.

Learnability	**Is it possible for the user to work out how the use of the product by exploring the interface and the trying out certain actions? How hard will it be to learn the whole set of functions in this way?**

The results of the user tests suggest that the majority of the participants understood how the application works. However, the user test was conducted in a control setting. They were presented the application beforehand and they knew that they were going to perform pre-defined tasks. Although the data suggested that they could, the product is easy to learn. The reliability of the results is limited by the fact that the participants have established the idea of how the application should work. Further studies are needed to confirm the learnability of this application. It would be interesting for future studies to see how this application would work during public visits.

Memorability	**What kind of interface support have been provided to help users remember how to carry out tasks, especially for products and operations they use infrequently?**

The consistency of how the functions are presented in the application allows the user to easily remember how to use it. This research study had two user tests. According to the results of the 2nd user tests, the participants knew how to use the application without any challenges. Having said that, there were only two users that tested the final prototype, and this limits the reliability of whether the interface is easy to remember. Further studies need to consider having more participants in the user test to get reliable results.

7.6 HEURISTIC EVALUATIONS WITH THE EXPERTS

Experts participated throughout the entire design process in this research study. Semi-structured interviews were conducted in all 4 iterations. The purpose of the interviews was to ensure that the quality of the design choices made by this research match a level of User Experience Standard. For evaluating the designs, Nielsen's Heuristic design guidelines (Chapter 4.4 "Heuristic Evaluations") were used. The results indicated that the prototype followed the guidelines. All experts had positive experience with the prototype. The data collected contributes a clearer understanding of how a Digital Literature Dissemination app should be designed. However, the methodological choices were constrained by not being able to get any quantitative data (e.g., how long it takes to get through getting through the task or using a Likert-Scale to measure the feelings). Semi-structured interviews were based on the researcher's interpretations and can be subjective to some bias. Nevertheless, the data still gave meaningful insights by showing the feasibility of the application.

7.7 ANSWERING THE RESEARCH QUESTION

How can we design a mobile application that will assist preadolescent readers in choosing a book at the public library?

The prototype Super Bibben is an example of how we can design a mobile application that will assist preadolescent readers in choosing a book at the public library. This is accomplished by first establishing the possible scenarios of literature dissemination between a librarian and a library user. Through cooperation with the library, the designer, experts, and librarians should go through design objectives to map down the process of interaction between the librarians. The scenarios can then be transformed into a digital prototype whilst incorporating the necessary design elements such as child-friendly language, content, and icon and image representations. In specific, the icons should accurately represent the literature genres and the interactions with *Super Bibben – eBarnebibliotekar* should represent talking with a real-life librarian.

CHAPTER 8

CONCLUSION AND FUTURE WORKS

The Design and Creation research study defined digital literature dissemination as the process of conveying literature to a user, whether in physical or digital format, through an information system without the presence of an expert (e.g. a librarian). To explore what digital literature dissemination means in a public library, this study developed a digital prototype that would help a pre-adolescent user choose a book to read in a public library. Moreover, the motivation of this study revolved around Child-computer Interaction (CCI), User Experience (UX) in public libraries applying user experience methods in child-friendly recommender systems.

To answer the research question and investigate the research objective of this study, a literature review was conducted which led to the discovery that there is a lack of empirical studies in the field CCI and UX in Public Library is a still a young concept that opens possibilities for further research in the field. Findings in the literature review with regards to involving children in the design process; child-friendly design principles, UX methods and usability goals; and ethical considerations when involving minors in research study were basis for the development of the prototype. The development process of this study had 4 design iteration.

In the first iteration, field studies were conducted to observed how librarian convey literature with preadolescent users in public library. A semi-structured interview was conducted with children librarians to establish an overview of information that was used during literature dissemination. The observation phase discovered re-occurring scenarios that became the initial user requirements of the prototype.

The second iteration took the results from the first iteration to conceptualize designs for the prototype. In addition, workshops with librarians and UX experts were organized to collect qualitative data with regards to the domain of the prototype. To make the prototype mimic the interaction between the user and the librarian, language content was discussed in this iteration. Through paper sketching, design alternatives and wireframes of the interaction. The result of workshop was choosing a design the initial design of the prototype.

The third and fourth iteration revolved around creating the digital prototype. Usability tests with pre-adolescent users and heuristic test with the experts were conducted. The rigorous creative process of the all four-iteration resulted into creating the final prototype.

The results from the test generated positive feedback as well as interest in future developments for the prototype. Nevertheless, there were still a lot to improve and issues to be resolved with regards to making design choices and ethical considerations when involving minors in a research study.

8.1 RESEARCH CONTRIBUTIONS

The research that was done in this Master Thesis presents the following research contribution to the knowledge base in the field of Child-Computer Interaction and User experience in Public libraries:

- Offers a framework of formalization in the way librarians interact with children when suggesting a book to read
- By creating a digital prototype based on the data that was collected
- Offers new insights on how studies can be conducted with children in public spaces and the underlying challenges in entails.

Lastly this research study, introduces the concept regarding digital literature dissemination by which opens possibilities for Public libraries can further its cause in the integration the physical and digital elements as whole.

8.2 FUTURE WORKS

Although it is just a digital prototype, "Super Bibben" has gained positive feedbacks among the librarians in Bergen Public Library. The study has been presented and the library have shown interest in the concept. Future intentions of applying for funding at the National Library of Norway have been discussed with regards to creating it into a fully functional application.

Nevertheless, there are still design and technical elements that need to be developed and improved. Additional workshops with the librarians should be conducted to expand the number literary genres in the prototype. This would include non-fiction, historical literature and biography. Usability tests with more participants should be conducted to get more feedback.

It would be interesting to look at the icon and image representation of the apps and recreate them to better suit the libraries requirements. It would be exciting to see how the character "Super Bibben" would be represented in the application.

Further studies are needed on implementing a functional child-friendly recommender system that can connect to the libraries database. BibSys, the libraries Database provider could look into a collaboration in implementing upgraded recommender system for its information systems as whole. This prototype should be given access the database's API.

It would be very interesting to see if the application might be implemented in bigger touch screens like "Digital Shelf" to enhance User Experience. In addition, look into applying tangible and/or Augmented Reality (AR) elements to the application.

This research study has also opened into further research. It opens possibility of looking at Digital Literature Dissemination in other special user groups such as library users with learning disabilities like dyslexia or for older user groups that are not exposed to technology that much.

This could also be a basis for using similar methods and techniques to create the same prototype such as countries that use lesser technology or expanding the application for the general public.

Lastly, this research could look more into methods and techniques of designing with children in public spaces at the same time assessing the ethical boundaries of their participation.

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APPENDICES

APPENDIX A – RESEARCH AGREEMENT WITH THE RESEARCH ENVIRONMENT

See next page.

Research Agreement

between

Jay Gwendolyn Poltakova

and

Bergen Public Library

BACKGROUND

A. *Jay Gwendolyn Poltakova* is a master student of Information Science at the University of Bergen, Institute of Media and Information Sciences at the Faculty of Social Sciences.

B. Throughout this agreement, the master student may be referred to as: master student, observer, user tester or evaluator.

C. The student's tentative title for the master thesis – "Designing an interactive mobile application for pre-adolescent users of the Public Library"

D. The student's aim for the master thesis is to create an artefact that will assist pre-adolescent children in choosing a book to read.

E. The thesis has the following research objectives:
   1. To identify the process and techniques of suggesting/choosing books for children at the Public Library
   2. To design a mobile application that will assist pre-adolescent readers in choosing a book
   3. To design the application based on data collected
   4. To design and test the artefact with the participants
   5. Apply user experience methods in physical spaces such as libraries

F. The student is currently employed as a digital consultant for the children´s department Bergen Public Library.

G. The Public library is an arena for field research and opens a possibility for the students to collect data.

NOW, THEREFORE, in consideration of the premises and mutual covenants herein contained, the Parties agree as follows:

TERMS AND CONDITIONS

It is hereby agreed as follows:

A. The period of this agreement is valid form **January 05, 2017** until **6 months** after the student has delivered the final draft of the master thesis

B. As the student is currently employed at Bergen Public Library, the student shall only collect data relevant to the master thesis.

C. Bergen Public Library has been presented and made aware of that the research study conducted by the master student is registered at the Norwegians Centre for Research Data (NSD). See attachment.

D. These are the following field studies method agreed between the Bergen Public Library and the master student:

   a. The master student may conduct meetings and brainstorming sessions with the employees of the Library. However, the sessions must interfere during office hours. Department heads for both parties must be informed when and where the sessions will take place.

   b. During the observation period

      i. the observer shall ***NOT*** be involved during the process of literature advisory between the child.
      ii. Follow-up questions only regarding the observation may be asked by the observer to both the users and the children's librarians *after* the literature advisory is completed.
      iii. A sign shall be placed at the service desk so that the public is informed of the ongoing participation. See attachment (in Norwegian).
      iv. The public may anytime approach the observer and inquire further information.
      v. The observer can present the observation notes and template. See attachment for the template.

   c. During the interview and user test period
      i. All participants (especially underaged participants) of the user test/interview of this research study must sign a letter of consent with an information letter, before participating the user test and/or interview. See attachment for the information letter and letter of consent (in Norwegian).

ii. In the written consent the participants will be informed of the following:
    1. What the user test/interview is for
    2. What type of data are being collected by the research study
    3. The duration of the interview/test/study
    4. Compensation offered for participating the study
    5. The right to withdraw from the study at any time
    6. A guarantee that that no personal information will be disclosed and,
    7. All data collected are confidential and will only be publish in master thesis and research articles (if any).

E. Both parties reserve the right to terminate the agreement at any time.

F. At the end of the research study and upon final delivery of the Master Thesis, Bergen Public Library may request a copy of the thesis.

IN WITNESS WHEREOF, the Parties have executed this Research Agreement as of the dates set forth below.

for Sverre Helge Bolstad
Margrete Rasmussen

Sverre Helge Bolstad,
Department Head,
Technology and Learning
Bergen Public Library

Leikny Haga Indergaard
Library Director
Bergen Public Library

Date: 3rd January 2017

Jay Gwendolyn Poltakova
Master Student
Institute of Media and
Information Sciences
Faculty of Social Sciences
University of Bergen

Date: 3rd January 2017

APPENDIX B – NOTICE OF OBSERVATION FOR THE CHILDREN´S DEPARTMENT

FORSKNINGSARBEID PÅGÅR

Området er en del av forskningsarbeidet. Dine bevegelser og holdninger kan bli observert. Dersom det blir bilder eller opptak vil observervatøren spørre deg på forhånd. Dere vil få informasjonsskriv og mulighet for å delta ved et samtykke. Dere vil få mulighet for å reservere dersom dere vil ikke være med. Om du er 18 år eller mindre uten foresatte med, skal observatøren ikke ta bilder eller opptak.

Forskningsarbeidet er en del av en masteroppgave om digital litteraturformidling for mellomtrinnsbarn.

Har du spørsmål ta kontakt skranken.

APPENDIX C – INTERVIEW GUIDE DURING THE OBSERVATION PHASE

Interview guide for the observation phase

Research Project	**Digital Literature Dissemination for the Pre-adolescent Users of the Public Library**
Objective of this phase	**To understand and map the interaction between the librarian and pre-adolescent user during literature dissemination and the decision making of choosing a book to read**
Description of the setting	**During the observation phase, the observer(also the researcher of this project) will observe the actions that are done before, during and after the process of literature dissemination. The observer will not speak during the observation period. The observer may ask questions only after the period is finished. This to avoid any confusions in the process. After the questions, the observer will have follow-up questions that is suitable for the situation (see the example questions below). Situation may vary and therefore one must be open for slight changes in the observation notes. All participants will be informed that the area is being observed and will sign a consent while participating.**
What will happen to the data collected?	**The data collected in this process will be used to determine the process of literature dissemination between a children's librarian and a pre-adolescent user. The data will be mapped and will be one of the criteria for establishing the requirements**

Examples of follow-up questions for the Child librarian's as participants

- **How do you establish the criteria for each user?**
- **Which questions do they usually ask?**
- **Does the book cover influence the use of the book?**
- **What are often reactions/feedback do you get from the users?**
- **Is the user satisfied with the book that they got?**
- **What challenges are there?**

Examples of follow-up questions for the Pre-adolescent users as participants:

- **Were you satisfied with the book that you got?**
- **What challenges are there when you are choosing a book to read?**
- **What were you thinking when the librarian was suggesting this (the observer presents the title)?**

APPENDIX D – LETTER FROM THE NORWEGIAN CENTER FOR RESEARCH DATA (NSD)

See next page.

NSD NORSK SENTER FOR FORSKNINGSDATA

NSD sin vurdering

Prosjekttittel

Digital Literature Dissemination for the Pre-adolescent Users of the Public Library

Referansenummer

655385

Registrert

11.09.2018 av Jay Gwendolyn Mixon Poltakova - Jay.Poltakova@student.uib.no

Behandlingsansvarlig institusjon

Universitetet i Bergen / Det samfunnsvitenskapelige fakultet / Institutt for informasjons- og medievitenskap

Prosjektansvarlig (vitenskapelig ansatt/veileder eller stipendiat)

Barbara Wasson, barbara.wasson@uib.no, tlf: 91141297

Type prosjekt

Studentprosjekt, masterstudium

Kontaktinformasjon, student

Jay Poltakova, jpo003@uib.no, tlf: 45122405

Prosjektperiode

01.09.2018 - 31.12.2019

Status

24.01.2019 - Vurdert

Vurdering (2)

24.01.2019 - Vurdert

NSD har vurdert endringen registrert 24.01.2019.

Det er vår vurdering at behandlingen av personopplysninger i prosjektet vil være i samsvar med personvernlovgivningen så fremt den gjennomføres i tråd med det som er dokumentert i meldeskjemaet med vedlegg den 24.01.2019. Behandlingen kan fortsette.

OPPFØLGING AV PROSJEKTET
NSD vil følge opp ved planlagt avslutning for å avklare om behandlingen av personopplysningene er avsluttet.

Lykke til med prosjektet!

Kontaktperson hos NSD: Karin Lillevold
Tlf. Personverntjenester: 55 58 21 17 (tast 1)

22.01.2019 - Vurdert

Our assessment is that the processing of personal data in this project will comply with data protection legislation, presupposing that it is carried out in accordance with the information given in the Notification Form and attachments, dated 18.01.2019, as well as dialogue with NSD. Everything is in place for the processing to begin.

NOTIFY CHANGES
If you intend to make changes to the processing of personal data in this project it may be necessary to notify NSD. This is done by updating the Notification Form. On our website we explain which changes must be notified. Wait until you receive an answer from us before you carry out the changes.

TYPE OF DATA AND DURATION

The project will be processing general categories of personal data until 01.06.2019.

LEGAL BASIS
The project will gain consent from data subjects to process their personal data. We find that consent will meet the necessary requirements under art. 4 (11) and 7, in that it will be a freely given, specific, informed and unambiguous statement or action, which will be documented and can be withdrawn. The legal basis for processing personal data is therefore consent given by the data subject, cf. the General Data Protection Regulation art. 6.1 a).

PRINCIPLES RELATING TO PROCESSING PERSONAL DATA
NSD finds that the planned processing of personal data will be in accordance with the principles under the General Data Protection Regulation regarding:

- lawfulness, fairness and transparency (art. 5.1 a), in that data subjects will receive sufficient information about the processing and will give their consent
- purpose limitation (art. 5.1 b), in that personal data will be collected for specified, explicit and legitimate purposes, and will not be processed for new, incompatible purposes
- data minimisation (art. 5.1 c), in that only personal data which are adequate, relevant and necessary for the purpose of the project will be processed
- storage limitation (art. 5.1 e), in that personal data will not be stored for longer than is necessary to fulfil the project's purpose

THE RIGHTS OF DATA SUBJECTS
Data subjects will have the following rights in this project: transparency (art. 12), information (art. 13), access (art. 15), rectification (art. 16), erasure (art. 17), restriction of processing (art. 18), notification (art. 19), data portability (art. 20).

NSD finds that the information that will be given to data subjects about the processing of their personal will meet the legal requirements for form and content, cf. art. 12.1 and art. 13.

We remind you that if a data subject contacts you about their rights, the data controller has a duty to reply within a month.

FOLLOW YOUR INSTITUTION'S GUIDELINES
NSD presupposes that the project will meet the requirements of accuracy (art. 5.1 d), integrity and confidentiality (art. 5.1 f) and security (art. 32) when processing personal data.

To ensure that these requirements are met you must follow your institution's internal guidelines and/or consult with your institution (i.e. the institution responsible for the project).

FOLLOW-UP OF THE PROJECT
NSD will follow up the progress of the project underway and at the planned end date in order to determine whether the processing of personal data has been concluded.

Good luck with the project!

Contact person at NSD:
Data Protection Services for Research: +47 55 58 21 17 (press 1)

APPENDIX E - INFORMATION LETTER AND LETTER OF CONSENT

See next page.

Informasjonsbrev for forskningsprosjekt:

Digital litteraturformidling for barn og unge ved Bergen offentlige bibliotek

Dette er en forespørsel om deltakelse i et forskningsprosjekt hvor hovedformålet er å ***designe en mobilapplikasjon for bibliotekets unge brukere***. I dette brevet vil vi gi deg informasjon om formålet med prosjektet og hva din deltakelse vil innebære

Formålet med prosjektet

Dette forskningsprosjektet er en del av en masteroppgave innen informasjonsvitenskap. Masteroppgaven undersøke følgende:

- Prosesser og teknikker for å foreslå/velge bøker for barn og unge ved Bergen offentlige bibliotek.
- Teknikker knyttet til brukeropplevelse som kan benyttes på offentlige områder slik som offentlige bibliotek.
- Design og test av en mobilapplikasjon som basert på innsamlede data, vil hjelpe unge lesere til å velge en passende bok.

Hvem er ansvarlig for forskningsprosjektet?

Institutt for informasjons- og medievitenskap og *Centre for the Science of Learning and Technology*, begge ved Universitetet i Bergen, er ansvarlig for prosjektet. Prosjektet gjennomføres i samarbeid med Barnebiblioteket og Avdeling for teknologi og læring ved Bergen Offentlige Bibliotek.

Hvorfor blir du/din barn bedt om å delta?

For bibliotekarer:

Et av prosjektets mål er å kunne identifisere teknikker og prosesser som bibliotekarer bruker når de formidler bokvalg til barn og unge. Du ble valgt til å delta i studien fordi du har kunnskap og erfaringer med bokformidling. Din kompetanse på feltet er nødvendig for å kunne validere behovene.

For foreldre og foresatte:

Mobilapplikasjonen som er utformet i denne undersøkelsen, gjelder for barn og unge som er brukere av biblioteket. Forskningen i prosjektet dreier seg om å skape et interaktiv verktøy for barn og unge og anvendelsen av interaksjonsdesign-prinsipper i dette. Barn og unges innspill til definisjonen av deres brukeropplevelse er viktig for å skape et mer optimalt og brukertilpasset mobilprogram. Du er kontaktet gjennom barnets lærer, for å be om frivillig deltakelse i prosjektet.

Centre for the Science of Learning and Technology, University of Bergen
Vektergården, Christies gate 13
5015, Bergen, Norway
slate.uib.no *@slateresearch*

Hva innebærer deltakelse for deg?

Deltakelsen i dette forskningsprosjektet er todelt. Første fase involverer deltakere i observasjonsfasen av studien, og den andre fasen innebærer deltakelse i brukertesting/evaluering. Hver deltaker kan delta i en eller begge faser av prosjektet.

For bibliotekarer:

Hvis du velger å delta i dette prosjektet, deltar du i følgende:

- interaksjon med barn som blir observert og hvor det blir tatt notater
- et 30 minutters intervju med lydopptak og transkribering
- brukertesting av prototypen (som ekspert innen bibliotekvitenskap)

For foreldre/foresatte for de unge deltakere:

Hvis du velger å la barnet ditt delta i dette prosjektet, vil det innebære at det deltar i ett eller flere av følgende:

- observasjoner – hvor samspillet mellom ditt barn og bibliotekaren vil bli observert og notater vil bli tatt
- brukertesting av prototypen

Som en del av brukertestingen, kan barnet bli bedt om å delta i et kort (ca. 20 minutters) intervju (med lydopptak og transkribering/utskriving). Etter at intervjuet er transkribert, vil lydfilen bli slettet. Om ønskelig kan foreldre/foresatte få tilsendt intervjuspørsmålene på forhånd.

Deltakelse er frivillig

Deltakelse i prosjektet er frivillig. Hvis du velger å delta, kan du til enhver tid trekke tilbake samtykket ditt uten å oppgi grunn. All informasjon om deg vil da bli gjort anonym. Det vil ikke være noen negative konsekvenser for deg hvis du velger å ikke delta eller du senere bestemmer deg for å trekke deg fra prosjektet.

Ditt personvern

Ingen personlige data (for eksempel navn, adresse, personnummer) blir registrert i denne studien. Det er mulig vi vil be om tillatelse til å ta et bilde av deltakerne. Hvis tillatelse gis, vil både ansiktet og evt. kjennetegn bli gjort uskarpe og ingen navn er i bruk. Vi behandler dine personopplysninger konfidensielt og i samsvar med lovgiving rundt datasikkerhet (Forskrift om informasjonssikkerhet og Personopplysningsloven).

Hva skjer med personlige data ved slutten av forskningsprosjektet?

Prosjektet er planlagt å slutte 01.06.2019. Alle personopplysninger (hvis noen) vil bli ødelagt på slutten av prosjektet. Eventuelle data som brukes i avhandlingen og påfølgende publikasjoner vil bli anonymisert.

Dine rettigheter

Så lenge du kan identifiseres i de innsamlede dataene, har du rett til:

- få tilgang til personopplysningene som behandles om deg
- be om at dine personlige data blir slettet
- be om at feil i personlige data om deg er korrigert / utbedret
- å motta en kopi av dine personlige data (dataportabilitet)
- sende klage til databeskyttelsesansvarlig eller Datatilsynet om behandling av dine personopplysninger

Hva gir oss rett til å behandle dine personlige data?

Vi behandler dine personlige data basert på ditt samtykke. Vennligst se vedlagt samtykkeskjema.

Basert på en avtale med Institutt for informasjons- og medievitenskap ved Det samfunnsvitenskapelige fakultet ved Universitetet i Bergen, har NSD - Nasjonalt senter for forskningsdata AS vurdert at behandling av personopplysninger i dette prosjektet er i samsvar med lovgivning om datasikkerhet.

Hvor kan jeg finne ut mer?

Hvis du har spørsmål om prosjektet, eller dine rettigheter, kontakt:

- Jay Gwendolyn Poltakova (forsker) via e-post: jpo003@uib.no eller på telefon +47 45 12 24 05
- Professor Barbara Wasson (veileder). via e-post: Barbara.Wasson@uib.noCentre for the Science of Learning and Technology (SLATE), Universitetet i Bergen
- Nasjonalt senter for forskningsdata AS (NSD), via e-post: (personverntjenester@nsd.no) eller på telefon: 55 58 21 17. Referansekode til prosjektet: 655385

Samtykkeskjema

Jeg har mottatt og forstått informasjonen om prosjektet:

Digital Literature Dissemination for the Pre-adolescent Users of the Public Library
(Digital litteraturformidling for barn og unge ved Bergen offentlige bibliotek)

og jeg har hatt mulighet til å stille spørsmål.

Bibliotekarer: (vennligst kryss av for alle valg du gir ditt samtykke for):

- ☐ Jeg gir mitt samtykke til å delta i *observasjonsfasen* og i *oppfølgingsintervjuene*.
- ☐ Jeg gir mitt samtykke i å delta i prosjektets *brukertesfase* og i *oppfølgingsintervjuene*.
- ☐ Jeg gir mitt samtykke i å bli *fotografert.*

Foreldre/foresatte for de unge deltakere: (vennligst kryss av for alle valg du gir ditt samtykke for):

- ☐ Jeg gir mitt samtykke i at mitt barn kan delta i *observasjonsfasen* av studien.
- ☐ Jeg gir mitt samtykke i at mitt barn kan delta i *brukertesting* og i *oppfølgingsintervjuene*.
- ☐ Jeg gir mitt samtykke i at mitt barn kan bli fotografert, gitt at de personlige dataene bli **anonymiserte** (sladdete ansikt og karaktertrekk) og brukes i prosjektrapporten og de tilhørende publikasjonene.

…… ……
Navn av deltaker

…… ……

Sted, Dato

……
Underskrift (**foreldre/foresatte for de unge deltakere**)

Centre for the Science of Learning and Technology, University of Bergen
Vektergården, Christies gate 13
5015, Bergen, Norway
slate.uib.no @slateresearch

APPENDIX F - HEURISTIC TEST GUIDE WITH THE EXPERTS

Heuristic interview with the experts

Research Project	**Digital Literature Dissemination for the Pre-adolescent Users of the Public Library**
Objective of this phase	To provide feedback from the experts. The experts have knowledge and competence in evaluating interactive prototypes. Librarians are also invited to participate an expert in the test to evaluate the interaction of book advisory.
Presentation of the prototype	The digital prototype will be presented through a tablet. The expert may browse around the prototype. The procedure of how the prototype works will be explained and give a brief description of the objectives of the prototype and where and when it is intended to use. The librarians may be given some task to test the usability.
What will happen to the data collected?	The data collected will be analyzed and used for the next iteration as an improvement to the previous version of the prototype.

Example tasks/walkthroughs (if necessary)

- Pretend that you are 10 years old:
    - do not know what to read. You would like to find a book. You like mysteries and solving crimes.
    - Your friend read a book and you would like to read it too
    - You would like to know what librarians would suggest read.

Questions for the librarians

1. Would you have asked the same questions as the proposed system?
2. Do you think that a child would understand the questions?
3. Would you have suggested the same books based on the results?
4. Are the questions enough to establish a result?
5. Would you say that the genres were properly divided?

Questions for the expert

1. Is the level of interaction between the system and the user enough to establish engagement with the users?
2. What can you say about the functionality of the prototype?
3. What can you say about the organization of the prototype?

Questions for both

1. Do the Icons properly represent the genres?
2. Are there any addition or tips?

APPENDIX G - LIBRARY STATISTICS OF BORROWED BOOKS FROM 2018

See next page.

Utlånsstatistikk for Bergen Off. Bibliotek

- Utvalg begrenset til:
  - Omfatter titler i søkebegrepet "lf=1 og bn=j og ff=l"
  - Tidsbegrenset til perioden 01/01/2018 - 01/01/2019
  - Lånere i kategorien : b
  - Type : Utlån (Inkl. forny. og fjernlån)
- Presentasjon gruppert på:
  - År
  - Tittel
  - Genre
  - Låners alder
- Presentasjon sortert på antall.

Hvis rapporten ikke kommer opp innen 10 minutter, trykk her for forklaring.

Nummer	År	Tittel	Genre	Alder	Antall
1	2018	Steinvokterens forbannelse	fantastiske fortellinger	9	78
2	2018	Steinvokterens forbannelse	fantastiske fortellinger	10	64
3	2018	Lunda på rideskole	Fortelling	7	58
3	2018	Steinvokteren	fantastiske fortellinger	10	58
5	2018	Flukten fra Lucien	fantastiske fortellinger	9	56
6	2018	Gutta i trehuset med 91 etasjer : sitter barnevakt i en baguett	humoristiske fortellinger	10	54
6	2018	Operasjon Mumie	kriminalfortellinger	8	54
8	2018	Det hemmelige rådet	fantastiske fortellinger	9	53
8	2018	Steinvokteren	fantastiske fortellinger	9	53
10	2018	Lars er lol	Romaner	9	52
11	2018	Den store hemmeligheten	Grafiske romaner	9	51
11	2018	Gutta i trehuset med 13 etasjer	humoristiske fortellinger	9	51
13	2018	Byen bak skyene	fantastiske fortellinger	9	50
13	2018	Det hemmelige rådet	fantastiske fortellinger	10	50
13	2018	Sceneskrekk	humoristiske fortellinger	10	50
16	2018	Det hemmelige rådet	fantastiske fortellinger	8	49
16	2018	Ismaskinen		7	49
16	2018	Kaja og Stine og sjokoladetyvene	Spenning	7	49
16	2018	Steinvokteren	fantastiske fortellinger	8	49
20	2018	Kaptein Super-Truse og de drittleie doene	fantastiske fortellinger	8	48
21	2018	Alveprinsen	Fantastisk	9	47
21	2018	Flukten fra Lucien	fantastiske fortellinger	8	47
21	2018	Ildfuglen	Tegneserier	9	47
21	2018	Operasjon Bronseplass	kriminalfortellinger	8	47
21	2018	Ulvegutten	Fortelling	7	47
25				**Totalt**	**1311**

APPENDIX I - TEST GUIDE FOR THE USERS

User test guide for the users

Research Project	**Digital Literature Dissemination for the Pre-adolescent Users of the Public Library**
Objective of this phase	To provide direct feedback about the usability of the system with the intended users.
Description of the setting and establishing the participants	User testing will happen at the children's department. Children have been pre-screened with criteria that is intended for the user. Guardians are contacted and will have to sign a consent before the child can participate. The test normally takes 20 minutes per participants and each participant will receive a gift card for participating in the user test.
What will happen to the data collected?	The data will be analyzed and discussed with the experts to make the necessary adjustments for the next iteration and version of the prototyped.

Criteria

The participant of this test must be of the following:

- Pre-adolescent: 9 – 12 years old
- Does not need to love reading but can read
- Knows how to use a mobile phone(clicking, navigating)
- Has been to the public library before

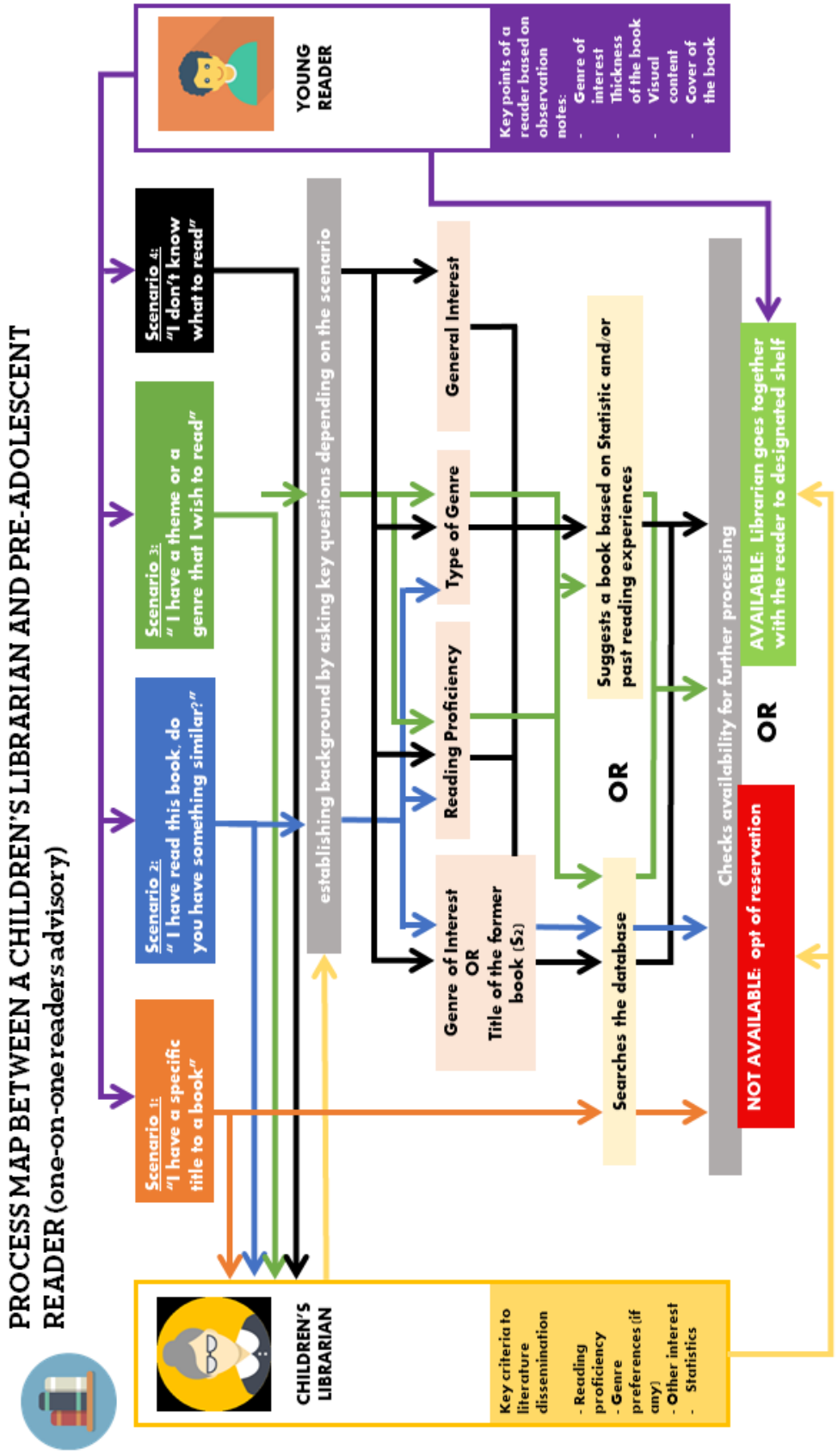
Task (in Norwegian)

1. Du vil lese den første boken av den «En Pingles Dagbok»
2. Du vet ikke hva du skal lese og du leser mye tekst på boken. Finn en bok som passer. Du ønsker å lese en bok med mysterier og krim
3. Du snakket med en bibliotekar i helgen men husker ikke de bøkene hun anbefalte. Finn fram de igjen.
4. Du har aldri lest om Sci-Fi men vet ikke hva det handler om.

Spørsmål

		SVAR
1	Synes du at systemet var forståelig nok?	
2	Var det lett å gjøre oppgavene med systemet?	
3	Var det noe i systemteme som var utfordrende?	
4	Er du noe du synes var kjedelig eller gøy is systemet?	
5	Hvis systemet faktisk finnes på biblioteket, Ville du ha brukt appen hvis bibliotekaren var ikke til stedet? Ville du ha brukt den istedenfor å spørre bibliotekaren? Hvorfor? Hvorfor ikke?	
6	Forstår du ikonenen/bildene?	
7	Var spørsmålene lett å forstå?	
	ANDRE KOMMENTERAR	

APPENDIX H - PROCESS MAP OF THE ONE-ON-ONE BOOK ADVISORY



APPENDIX J - VISUALIZATION OF THE RESEARCH STUDY