UNIVERSITY OF OSLO
Department of informatics

Making Sense of Ambiguity – designing for user experience in the Gokstad boat exhibition

Master thesis

60 credits

Sven Magne Bakken

14. November 2008

Abstract

In recent years, there has been an increased interest in how people actually experience their interactions with digital technology, and more research is now addressing issues going beyond the instrumental. This approach to understanding digital technology is often referred to as *user experience*.

In this thesis, I take the perspective of user experience, and investigate how ambiguity can be used as a resource for making the user start a reflective activity. In order to do this, a review of theories and concepts in the emerging field of user experience is conducted. The use of ambiguity as a resource for design is discussed, and a set of concepts for addressing user experience is presented. My main understanding of user experience is derived from John McCarthy and Peter Wright's framework for understanding technology as experience (McCarthy and Wright 2004). They see user experience as a situated, creative process of making sense.

The empirical data is derived from my participation in an experimental research project conducted at the University of Oslo. In this project, an exhibition mediating the process of reconstructing an old Viking boat was designed and implemented. The project's main aim was to explore the potential of using digital technology as a mean to communicate cultural heritage to young people. At the end of the design process, a group of teenagers was invited to the exhibition, and their behaviours and use of technology was thoroughly studied.

I investigated both the design and use of the exhibition. My findings make evident how the exhibition used ambiguity in order to make the visitors start a reflective activity, and point out two main categories of situations where the teenagers expressed uncertainty and doubt. Moreover, I use what McCarthy and Wright call the six processes of sense making and their underlying pragmatic philosophy in order to further deepen our understanding of how ambiguity can used as a resource for design.

Acknowledgements

I would like to thank my supervisor Jo Herstad. Thank you Jo, for your kindness, engagement, and insight. I have greatly appreciated our conversations.

Thank you Dagny Stuedahl, for letting me in on the Gokstad boat project and for your advices along the way. Thank you Christina Mörtberg, for your generous contributions to this thesis.

Thanks to my collaborators on the Gokstad boat project, Ine Fahle and Morten Vøyvik. Thanks also to all of you who worked on the implementation of the exhibition, and those of you who helped arranging the experiments.

I would also like to thank the administration at the Department of Informatics, University of Oslo, and in particular Kaja Elisabeth Mosserud Haavardsholm, for helping me out more than once. Thanks to Berit Strange and her excellent team at the Informatics Library. Keep up the good work! Thanks also to fellow students at the Department of Informatics.

Finally, thank you friends and family who have been there for me. I feel honoured and privileged to have you around. Special thanks goes to the following people who have generously contributed with their time and efforts in order to help me finish my thesis:

Ragnhild and Anne. Thank you so much! It has been so nice to see you again. Kirsten, thank you for your enthusiasm, your warm hugs, and your good advice. Torfinn and Kristin, thanks for your reviews. Big thank you also to others that in various ways have contributed to the work in this thesis.

Oslo, November 2008, Sven Magne Bakken

Table of contents

1 Introduction

> It is a truism that computers are becoming faster and more powerful all the time. They play an ever larger role in our lives, giving us access to more and more information, being incorporated into more and more of our devices, and creating whole new forms of interaction and activity that we would never otherwise have imagined. From desktop computer to laptops to personal digital assistants, not to mention bank teller machines, microwave ovens, cellular phones, and ticket machines, we encounter computers in all aspects of everyday life. (Paul Dourish 2001: 1)

The field of working with the relationship between people and computer technology is known as human-computer interaction (HCI). Traditionally, research within this area has focused on how digital technology can be used for supporting people in the context of work. Technology has been regarded as a tool, and great effort has been invested to assure that people can use it in an effective and effortless manner (Forlizzi and Battarbee 2004).

During the last two decades, more attention has been paid to how people *actually experience* their interactions with technology. In opposition to the traditional focus on efficiency and ease of use, this research is addressing questions going beyond the instrumental (Hassenzhal and Tractinscy 2006). It is addressing qualitative aspects of use, such as fun, pride, pleasure, intimacy and joy. Theories and concepts dealing with these issues are often referred to as *user experience*. Research within this area is thriving to understand, define, and quantify these facets of people's interactions with technology (Law, Hvannberg and Hassenzahl 2006).

One reason for this shift towards emphasizing how people experience their encounters with technology can be found in the technological development of the computer, leading to new possibilities for services. From being a scarce resource typically used in a work place environment, the computer has become inexpensive and is today in widespread use. An important factor for the popularity of the computer is the development of the desktop computer and the internet, which have taken the computer out of the offices and laboratories, and into the homes.

In addition to the success of the personal computer, there has been a development towards ubiquity (Weiser 1991). Today, the computer is embedded in a range of devices, such as cameras, cars, mobile phones and watches. It is becoming a part of people's everyday lives, pervading not only work, but also leisure and social life.

As seeing interaction with technology in terms of experience is relatively new, the field of user experience does not have well developed methods and techniques. There is still no coherent definition and the term «user experience» is associated with a range of meanings (Forlizzi and Battarbee 2004).

In this thesis, I investigate the concept of user experience, and how we can *design for* user experience. I make use of a set of concepts in order to analyse the design and use of an exhibition mediating the process of reconstructing an old Viking boat. An important concern in this thesis, is how ambiguity can be used in order to make the user start a reflective activity.

1.1 The Gokstad boat exhibition

The Gokstad boat exhibition was a result of an experimental research project Stuedahl, Gokstadbåtprosjektet 2008) conducted at the University of Oslo. I was a member of the group responsible for designing the exhibition. The design group consisted of three master students in the areas of media, digital media, and informatics, and the leader of the project, postdoc Dagny Stuedahl. The exhibition made use of both traditional media and digital technology in order to mediate the process of reconstructing the third Gokstad boat.

In 2004, ethnologist Terje Planke and boat builder Svein Erik Øya started the work of reconstructing the third Gokstad boat. The reconstruction was accomplished by first translating the remaining fragments onto paper, followed by building a small paper model. Based on the paper model, a full-scale wooden model was built.

The remaining fragments from an excavation do not give all the answers regarding the shape and look of the original boat; they must be seen as sources to be interpreted during the process of reconstruction. Many of the fragments from the third Gokstad boat were deformed, and some were missing. They could not simply be 'puzzled' together. The fragments had to be interpreted in relation to a series of other factors, such as other findings from the period, historical sources, and the practical knowledge of boat building and sailing. How the boat finally turned out, was a result from a series of choices that Planke and Øya made during the process of reconstruction.

When the boat is finally displayed in a museum, the uncertainties, and the choices made during the process of reconstruction are no longer seen; the boat is presented as an exact copy of the third Gokstad boat. What does this tell us about history and the way it is communicated in museums? What does it tell us about science, and what we regard as «truth» in general? The exhibition aimed to address these questions by communicating the uncertainties inherent in the process of reconstructing the third Gokstad boat. By doing this, the exhibition wanted to address a more general problem; how do we understand the past?

The exhibition made extensive use of digital technology. There were mobile phones, blogs, a projector screen, and a context-aware system tracking the visitor's whereabouts in the exhibition space. The visitors were encouraged to contribute to the exhibition by recording and sending short video clips to a system that would display them on a projector screen. There were also blogs that the visitors could use in order to document their experiences at the exhibition.

1.2 Ambiguity as a resource for design?

An important aspect of the design of the Gokstad boat exhibition was a deliberate use of ambiguity. The designers wanted the visitors to experience *uncertainty* and *doubt*, and in this way, start a reflective activity related to the issues addressed by

the exhibition. An important question for the design team was how digital technology could be utilized in this regard.

A deliberate use of ambiguity in the design of digital technology is quite new. In an environment where usefulness and usability have been seen as «[…] the twin goals of HCI research and development» (Helander, Landauer and Prabhu 1997, 21), ambiguity has hardly been regarded as anything by a problem. As more research is addressing user experience, this is about to change. In recent years, several articles have explored the concept of ambiguity. An essential contribution came from William Gaver, Jacob Beaver and Steve Benford, who claimed that a reflected use of ambiguity can enhance both the user experience, and the learning outcome (Gaver, Beaver and Benford 2003, April 5-10).

In this thesis I explore how ambiguity can be used as a resource for design. I do this by investigating the case of the Gokstad boat exhibition. My focal point is how the exhibition was designed in order to make the visitors start a reflective activity, and how the visitors used digital technology during their visit at the exhibition. My main understanding of user experience in this thesis will be derived from a framework for seeing technology as experience proposed by John McCarthy and Peter Wright (McCarthy and Wright 2004). I will make use of what they call the six processes of sense making, which can be seen as a way of understanding and addressing different aspects of user experience. McCarthy and Wright's work is based upon pragmatic philosophy, which sees experience as a situated and creative process of *making sense*. The next section introduces the problem definition and the research questions addressed in this thesis.

1.3 Research questions

This thesis is concerned with user experience, and how we can *design for* user experience. My focus is on how ambiguity can be used as a resource for design.

Problem definition:

> How can ambiguity be used in order to make the user start a reflective activity?

In order to look at the problem area, three research questions concerning the case of the Gokstad boat exhibition will be explored and discussed.

The first research question addresses the design of the Gokstad boat exhibition. The designers wanted to make the visitors experience uncertainty and doubt, and in this way, start a reflective activity directed towards the issues raised by the exhibition. This research question aims to bring forth how ambiguity was used in this regard. The first research question is:

1. *How was ambiguity used in order to make the visitors experience uncertainty and doubt?*

The second research question is concerned with the exhibition during use. It aims to illuminate the situations in which the visitors expressed uncertainty and doubt. An important issue is to look at the consequences of these situations. Did these situations make the visitors start some kind of reflective activity, or did they solely make them confused? The second research question is:

2. *In what situations did the visitors express uncertainty and doubt?*

The third research question aims to further explore our understanding of ambiguity as a resource for design. This is done by applying McCarthy and Wright six processes of sense making to the case of the exhibition. An important aspect of answering this research question is to bring forth the various aspects of user experience, and how they relate to ambiguous design. The third research question is:

3. *How do the six processes of sense making apply to the case of the Gokstad boat exhibition?*

In order to answer the three research questions, I will make use of concepts of user experience, empirical material describing the design of the Gokstad boat exhibition, and findings from observations during use. The method of research will be thoroughly described in chapter 2.

1.4 Limitations

When designing for user experience in an exhibition, many facets needs to be consider; literature from a range of fields such as interior design, media and communication, science of education, and exhibition design are all relevant. Even though all of them may be valuable sources when addressing user experience in the case of the exhibition, none of them will be at the centre of my investigation. This thesis is concerned with the relationship between people and digital technology, and my focus will be on user experience of the technology utilized in the exhibition. My work is done within the field of informatics, and my scope of interest is limited to the area of human-computer interaction.

An important aspect of the Gokstad boat exhibition was the use of digital technology. There were mobile phones, blogs, a projector screen, and a context-aware system. There is much literature addressing mobile phones, blogs and context-aware technologies. I will not account for this literature here, as my discussion will be set on a higher level of abstraction, regarding experience of digital technology in general. However, the various technologies involved in the exhibition will be presented in a later chapter.

The exhibition made use of traditional media and exhibits such as models and displays. Not every element of the exhibition will be thoroughly described in this thesis; nor every aspect of the technology involved. The description of the various elements will be selective, and be aimed at bringing forth facets that are seen as

important for the analysis in this thesis. In some cases, this makes it necessary to describe the design of the exhibition in a very detailed fashion, while in others, elements are discussed solely on a conceptual level. My aim will be to illuminate those aspects that are seen as important from the perspective of *user experience*.

I will not discuss the ethical problems related to the design of the Gokstad boat exhibition, nor will I discuss questions regarding the visitors' privacy protection. These are both important and necessary concerns when designing digital technology, but none of them will be considered in this thesis.

1.5 Translations

The Gokstad boat exhibition was conducted at the University of Oslo. The teenagers that participated in the experiments were Norwegian, and all material used in the exhibition, such as posters and video clips from the reconstruction of third Gokstad boat, were in Norwegian. When I refer to the material of the Gokstad boat exhibition, or to statements from any of the participants, these are my translations.

1.6 Chapter overview

This section is a reader's guide to the thesis. It offers an outline of the main topics addressed in each of the eight chapters.

Chapter 1 - Introduction
The introduction explains the motivation and background for my work, and formulates three research questions that will be explored and discussed in the subsequent chapters.

Chapter 2 - Method
The second chapter describes the research strategy and the research methods applied in this thesis, and my involvement in the group responsible for designing

the exhibition. My research strategy has been that of a case study. In order to collect data from the case of the Gokstad boat exhibition, my main methods have been participant observations and a group interview. My main contribution to the design group was finding appropriate theoretical concepts to comprehend and design for user experience in the Gokstad boat exhibition.

Chapter 3 - HCI and User experience

This chapter presents the field of human-computer interaction from the perspective of design. Three main directions within the field as proposed by Anders Kluge (2005) are described: task-efficient design, participatory design, and interaction design. Concepts and theories of user experience are then addressed. A selection of theories and concepts proposed during the last two decades is presented. Finally, this chapter discusses how a focus on user experience has implications for our way of understanding and evaluating digital technology.

Chapter 4 - Tools for analysis

This chapter introduces the concepts used for analysing the case of the Gokstad boat exhibition. I first introduce McCarthy and Wright's (McCarthy and Wright 2004) six processes of sense making and their underlying pragmatic philosophy. Then I present the use quality of ambiguity, and discuss how this concept can be exploited in order to design for experiences such as uncertainty and doubt, and for making the user start a reflective activity.

Chapter 5 - The case study

This part introduces the case of the Gokstad boat exhibition. The exhibition made extensive use of digital technology. Mobile phones, blogs, and a context aware system were mixed with traditional media in order to mediate the uncertainties in the process of reconstructing the third Gokstad boat. This chapter describes the technology, the exhibits, and the main design concepts underlying the exhibition.

Chapter 6 - Empirical findings

The empirical findings are collected from observations conducted in the Gokstad boat exhibition. A group of teenagers was invited to the exhibition, and their activities and use of technology was thoroughly studied and documented. This chapter presents the empirical findings and the procedures in the observations.

Chapter 7 - Making sense of ambiguity

This chapter analyses the case of the Gokstad boat exhibition using the concepts introduced in chapter 4. It aims to answer the three research questions formulated in the introduction.

Chapter 8 - Conclusions

The final chapter presents the conclusions from the conducted research. I found that the exhibition made use of ambiguity in two main ways: the use of fragmented information, and the use of contradictory information. I analysed the situations in which the visitors expressed uncertainty and doubt, and found that they could be categorized into two broad groups, according to the activities they initiated. The first group of situations led the visitors to focus on technology, or technology use, while the second group of situations led to a variety of reflective activities concerned with the issues raised in the exhibition. Moreover, I applying McCarthy and Wright's six processes of sense making, and their underlying pragmatic philosophy to the case of the exhibition, and this resulted in a more nuanced view on how ambiguity can used to make the user start a reflective activity.

At the end of chapter 8, directions for further work are given. The Gokstad boat exhibition made use of ambiguous information in order to make the visitors start reflective activities concerned with the process of reconstructing the third Gokstad boat. I see great potential of also using ambiguity in other applications, and by using other techniques, than those applied in the case of the Gokstad boat exhibition.

2 Method

The work in this thesis is based on qualitative research using a case study as the approach. I analysed the case of the Gokstad boat exhibition, both in terms of how it was designed, and how it was used. The research methods employed involved a literature review, observations, a group interview, and data analysis. In addition, I drew upon experiences from my participation in the design group.

2.1 Literature review

In order to find appropriate concepts and techniques for addressing user experience in the case of the Gokstad boat exhibition, an extensive review of literature in the field of human-computer interaction was conducted. My starting point for finding relevant literature on the topic of user experience, was two recent articles, both summarizing concepts and theories in this rather new field of study (Forlizzi and Battarbee 2004; Hassenzhal and Tractinscy 2006). These articles both offer a good introduction to literature of user experience, and they led me to other relevant articles and books. Some of the literature I have been reading during the work with this thesis has not been relevant for my research questions. It has however helped me towards a better understanding of various perspectives on user experience, and led me to other interesting articles and books.

Other sources for finding relevant literature have been searches on Google Scholar[1], and several databases such as ACM Digital Library[2] and IEEE Xplore[3]. I have also benefited from advice on relevant literature given by my supervisors.

[1] http://scholar.google.no/

[2] http://portal.acm.org/

[3] http://ieeexplore.ieee.org/

2.2 Case study

My research approach in this thesis is that of a case study. According to Keith Punch (2005), a case study should make use of whatever methods seem appropriate in order to develop as full an understanding as possible:

> The basic idea is that one case (or perhaps a small number of cases) will be studied in detail, using whatever methods seem appropriate. While there may be a variety of specific purposes and research questions, the general objective is to develop as full an understanding of the case as possible. We may be interested only in this case, or we may have in mind not just this case we are studying, but others like it. (Punch 2005: 144)

Punch (2005) argues that the case study is especially valuable in situations where our knowledge is shallow, fragmentary, incomplete or non-existent. This was the case for the issues addressed in this thesis. Research in the area of user experience is relatively new within the HCI community, and there is a lack of empirical material (Hassenzhal and Tractinscy 2006).

Punch emphasizes the importance of preserving and understanding the wholeness of the case. He argues that this makes the case study a research strategy:

> In keeping with other approaches in qualitative research, the case study aims to understand the case in depth, and in its natural setting, recognizing its complexity and its context. It also has a holistic focus, aiming to preserve and understand the wholeness and unity of the case. Therefore the case study is more a research strategy than a method. (Punch 2005: 144)

I make use of data describing the implementation of the exhibition, and empirical material collected in observations during use. I use this material in order to analyse the exhibition seen as a whole. By analysing the case using concepts of user experience, I seek to understand and present a holistic account for the case of the Gokstad boat exhibition.

The data collected for this thesis may be seen as two distinct data sets. The first set of data is concerned with how the exhibition was implemented. It describes the main exhibits, the technology involved, and the design concepts underlying the exhibition as a whole. These data are derived from a study of the implemented exhibition, but also from discussions with members of the design team. I also conducted an interview with the leader of the project, Dagny Stuedahl (Interview 2007). A description of the exhibition and its underlying design principles is presented in chapter 5.

A second set of data consists of empirical findings from observations during use. On February 14, 2008, groups of children and teenagers were invited to the Gokstad boat exhibition, and their behaviour and use of technology was thoroughly studied and documented. At the end of these visits, group interviews were conducted. Overall, there were three sessions. The first two sessions were carried out with children approximately ten years old. I did not participate in these sessions, but rather focused on the last session where a group of teenagers visited the exhibition.

This group consisted of eight participants: six girls and two boys. They were all approximately 14 years old, and were classmates from a local school. All participants took part on a voluntary basis. At the end of the session there was conducted a group interview where the teenagers were asked about their experiences of being at the exhibition. The whole session lasted for approximately one hour.

All but two of the teenagers participating in the Gokstad boat exhibition had also been part of a pre-study conducted at the Viking ship museum in Oslo during the summer of 2007. In this study, the participants used mobile phones for taking pictures and recording short video clips. The material was then transmitted to computers, temporary placed in the museum, and the teenagers documented their visit to the museum using blogs similar to those utilized in the Gokstad boat

exhibition. I did not participate on the pre-study, but this project is described in the master thesis of Ine Fahle (2008).

The procedures for the observations, and the empirical findings, are presented in chapter 6. During the observations, data was collected using participants observation, video recordings, and a group interview. These techniques are presented and discussed in the next section.

2.3 Data collection

There is a variety of methods for collecting data, which can be used individually or in a combination. David Silverman (2005) identifies four main methods for collecting qualitative data: ethnographies, audio- and video-recordings, interviews, and text analysis.

2.3.1 Participant observation

Observations can be done in several ways and for several reasons. They can be used throughout the design process both as an input to design and for evaluation. Users can be observed in controlled conditions or in a natural environment. Jenny Preece, Yvonne Rogers and Helen Sharp (2002) say that depending on the type of study, the observers may be onlookers, participant observers, or ethnographers. The roles taken by the observer brings a certain philosophy and practice that influences what data is collected, how data collection is done, and how the data is analysed and reported.

The degree of immersion adopted by the observer can be seen to vary along an insider-outsider spectrum (Preece, Rogers and Sharp 2002). While the outsider is merely passively observing the situation, the insider observes from inside a group. She becomes a member of the group and must learn the social conventions, protocols, dress codes, language, non-verbal communication, et cetera.

In the case of the Gokstad boat exhibition, the degree of immersion was somewhere in between these two extremes. Our method was participant observation. In this approach, the evaluators participate with the users in order to learn what they are doing, how they do it, and why (Preece, Rogers and Sharp 2002). As observers in the Gokstad boat exhibition, we took an active role. We talked with the teenagers, guided them, and helped them with technical problems that arose during the experiment.

2.3.2 Video recordings

Another method we used for gathering data during the session was the use of video recordings. Preece, Rogers, and Sharp (2002) state that the use of video has the advantage of capturing both visual and audio data, but add that there are also a number of disadvantages.

The first problem is that the use of camera can be intrusive. In the Gokstad boat project, most of the teenagers did not seem to take much notice of the use of the camera. One of the cameras followed three girls through most of the exhibition. These girls seemed very comfortable. The other teenagers, now and then, looked into the camera, or took notice of it in other ways.

Another problem addressed by Preece, Rogers, and Sharp, is that the use of camera tends to focus the attention on what is seen through the lens, making it easy to miss things that go on outside the camera view. In the exhibition, video recording was only one out of several techniques for collecting data. We were a large team and video recordings and photos were done by professionals working at Intermedia. In this way, we could collect data using the camera without missing other important aspects of the session.

The last problem discussed by Preece, Rogers, and Sharp is how the work of analysing the data tends to be time-consuming. They say, however, that this is the

case when transcribing on a detailed level. Usually this is not necessary, as focus is often on particular episodes. This was the case for the work in this thesis.

There were, however, several advantages related to using camera for collecting data in the exhibition. First, it offered a rich source of data. One of the cameras followed three girls most of the session, and this was my main source of data during the data analysis. The fact that we had professionals to do the recordings was invaluable: the quality of the recordings was excellent, and we could as observers concentrate on observing and talking with the teenagers. Finally, the digitalized video recordings were easy to distribute among the researchers, and could easily be analysed on an ordinary computer.

Two cameras were used during the session with the teenagers. One camera was placed in the corner of the room for the entire experiment, capturing most of the room. A second camera followed a set of participants through the whole session. In addition to the use of video cameras, many still photos were taken during the experiments.

2.3.3 Qualitative group interview

The third method for collecting data during the experiment was the use of qualitative group interview. At the end of the session, an unstructured group interview was conducted. The goal was to get feedback from the teenagers on what they felt about the exhibition and their activities. The interview was conducted by the leader of the project, Dagny Stuedahl. It lasted for about 25 minutes and was documented by video camera.

2.4 Data analysis

The methods for collecting data generated empirical material in the form of video recordings and pictures. When analysing audio- and video-material a common approach is to transcribe the data according to a set of transcription rules. Preece,

Rogers, and Sharp (2002) state that transcribing on a detailed level is very time consuming, but that it is usually not necessary, since the evaluators often focus on particular episodes and use the material in order to achieve contextual information and reference. This was the case for this thesis. I transcribed the recordings, but only the parts relevant for the objectives of this thesis.

In my analysis, I make use of concepts proposed by McCarthy and Wright (2004), and by Löwgren and Stolterman (2004). None of these concepts is formulated as design rules or heuristics; rather they offer concepts and understandings that can be used for discussing design in the case of the exhibition. Yvonne Rogers (2003) calls this kind of theory formative. It provides a lingua franca, a set of easy-to-use concepts, for discussing design. This implies that there is no strict way of applying these theoretical concepts to a particular design. It is necessary for the designer to use her experience and abilities in order to apply the concepts to a particular case.

The formative nature of the theories used in this thesis meant that, to a large degree, I had to evaluate which features of the design that related to the various concepts. In addition to the data generated during the observations, I made use of my experiences from the observations, and from discussions with the design team.

2.5 Generalizability

The research strategy for this thesis is a case study. A case study can be studied for its own sake, but may also be studied with other, similar cases in mind. This raises the question of generalizability. How can findings from the case of the Gokstad boat exhibition be of value in other cases? How can the work in this thesis inform research and design of user experience in other applications and systems?

Punch (2005) argues that findings from a properly conducted case study are valuable in terms of generalizability. He sees three main ways that a case study can be a valuable contribution.

1. The first is what we can learn from the particular case. The case may be unusual, unique, or not yet understood. In these cases, building an in-depth understanding of the particular case is valuable in its own right.

2. In a new or persistently problematic research area, only the in-depth insight provided by the case study can provide the necessary understanding into different aspects of the object of research. Punch sees the act of discovering important features, developing an understanding of them, and conceptualizing them for further study, as often best achieved by the use of a case study.

3. Thirdly, the case study can successfully be used in combination with other research approaches. It can, for example, be used to give directions for an upcoming survey.

The Gokstad boat exhibition mostly relates to the second of these situations. Research in the area of user experience is new and problematic, and the use of a case study makes it possible to build an in-depth understanding of the particular case of the Gokstad boat exhibition.

This view of seeing a thorough study of single case as a basis for generalization is supported by Bent Flyvbjerg:

> One can often generalize on the basis of a single case, and the case study may be central to scientific development via generalization as supplement or alternative to other methods. But formal generalization is overvalued as a source of scientific development, whereas «the force of example» is underestimated. (Flyvbjerg 2006: 228)

A much-used way of conceptualizing findings in order to inform further research and design in the HCI is the use of prescriptive design rules or principles. This is exemplified by Donald Norman's principles for good design (Norman 1988), or Ben Shneiderman's «golden rules» for interface design (Shneiderman 1987).

However, when dealing with such a complex phenomena as user experience, these kinds of rules seems too reductive. In the branch of HCI often referred to as Interaction design, this is admitted. Here, emphasis is on formative theory and more weight is put on developing knowledge and understanding in the individual designer. In order to build a better understanding of user experience, Löwgren and Stolterman (2004) advocate an approach based on a thorough study and discussion of design:

> In view of the inherent difficulties of objectively measuring the interesting qualities of digital artifacts, we advocate an approach based on *articulation*. This is to say that we view a designer's knowledge of product quality as an ongoing debate, a conversation with other designers and design theorists, as well as with design situations and the stakeholders involved in them. Statements are made in this debate through the main vehicles of design and reflection. A digital artifact or a design concept can be seen as a statement about desirable product quality. Likewise for written or spoken analysis, where a core quality of a certain artifact genre or class of use situations is identified. (Löwgren and Stolterman 2004: 102)

Löwgren and Stolterman emphasize that statements about a product's qualities are never to be generalized in the sense of a straightforward application to a new situation. There is a significant amount of work involved in understanding the statement, and to access its relevance to the situation at hand. This process is, however, made easier if the one making the statement provides an account of the reasoning behind the argument, and its possible scope and consequences.

In this thesis, I describe the case of the Gokstad boat exhibition, and discuss it from the perspective of user experience. These findings can be used to inform further research and design, but following Löwgren and Stolterman, this cannot be done without an adaptation to the particular situation at hand.

2.6 The design process

During the work with this thesis, I was a member of the design group responsible for designing and implementing the Gokstad boat exhibition. This section describes my involvement in the group, and my contributions to their work.

My first contribution was presenting a way of understanding and discussing user experience in case of the exhibition. When I first attended the design meetings, I realized that we had no formalized way of talking about experience. The whole concept is quite elusive, and when discussing how the visitors might experience the exhibition, the arguments turned out rather vague and subjective. There seemed to be a need for a mutual way of understanding and addressing experience in the case of the exhibition. This observation led me to introduce a conceptual framework for understanding experience of technology[4]. This kind of framework is a way of understanding user experience, and offers a terminology for discussing different aspects of user experience. This process made the members of the design group more aware of different aspects of experience, and helped us to start thinking and talking about experience in a more nuanced and coherent way.

My second contribution was concerned with introducing concepts and techniques aimed at designing for uncertainty and doubt, and for forging reflective activities. In order to start a process of thinking about these issues, I introduced several relevant design concepts[5]. This process sparked a discussion on how these concepts could be used for mediating the uncertainties in the process of reconstructing the third Gokstad boat.

In addition to these theoretical contributions, I occasionally participated in discussions regarding alternative design solutions for the exhibition. My role in the design group was as a adviser and as a partner for discussions, and I had no

[4] Technology as experience (McCarthy and Wright 2004).

[5] Slow technology (Hallnäs and Redström 2000), Ambiguity as a resource for design (Gaver, Beaver and Benford 2003, April 5-10).

responsibility for the design. I did not participate in the group meetings from middle of December 2007, until the experiments with the teenagers that was conducted on the 14 of February, 2008. Most of the work of implementing the exhibition was conducted by professionals working at Intermedia, University of Oslo, and I did not participate in this process.

3 HCI and User experience

This chapter introduces the field of human-computer interaction and its historical origins. Kluge (2005) recognizes three main directions within the community: task-efficient design, participatory design and interaction design. As a basis for further discussion, I will present these directions. I then turn to theories and concepts explicitly addressing user experience. I introduce a series of concepts and theories dealing with user experience, and discuss what quality of use refers to in this perspective. Finally, I discuss how a focus on user experience has implications for design and evaluation of digital technology.

3.1 The field of HCI

> Human-computer interaction (or HCI) is, put simply, the study of people, computer technology and the ways these influence each other. (Alan Dix 1993: xiii)

The field of working with the relationship between people and digital technology is known as human-computer interaction (HCI). It is a multi-disciplinary field drawing on knowledge and expertise from a range of disciplines.

Historically[6], the field grew from collaboration between computer scientists and cognitive scientists. The main understanding of interaction was of a single user sitting in front of a machine. This approach was also valid in a work context. Here, the computer was seen as a tool; a useful remedy to help maximize efficiency and throughput.

Another strand of research goes back to systematic study of human performance in factories, with emphasis on human tasks. This approach aimed to improve labour productivity. The Second World War was a motivation for studying the interactions between machines and people, as there was a continuous need to produce more

[6] The part sketching the historical origins of HCI is based on Alan Dix (1993).

efficient weapon systems. This led to an increased interest in the area among researchers, eventually leading to formation of the research area of ergonomics. Traditionally, ergonomics have been concerned with the physical characteristics of machines and systems, and how these affect user performance. Another field concerned with people and machines is known as human factors. Here, the field of ergonomics is incorporated with more cognitive issues. These two terms are often used interchangeably, with the term ergonomics being preferred in Europe and human factors in North America. Both fields are concerned with human performance in context of a system, whether mechanical, manual or computerized. As the computer became more widespread, an increasingly number of researchers started to focus on the relationship between people and computers.

Today, HCI is a multi-disciplinary field with a range of approaches to design. Kluge (2005) sees three main directions within the field: task-efficient design, participatory design, and interaction design. His principal criterion for differentiating the directions is their goals for design, and what he calls their spaces of interaction (Kluge 2005). I will now introduce the three directions as a basis for further discussion. This introduction is not meant to be exhaustive. I will not attempt to describe the range of concepts and techniques developed and used within the different directions, but rather attempt to bring forth the essence in their ways of approaching design.

3.1.1 Task-efficient design

Task-efficient design emphasizes efficiency and ease of use, and may be seen as the traditional approach to design within HCI. In this approach, the focus has been on task- and work-related usability.

According to the ISO 9241-11 standard (ISO 1998), usability is seen to have three main factors: e*ffectiveness,efficiency* and *satisfaction*.

The first factor, effectiveness, is the accuracy and completeness with which users achieve certain goals. The second factor, efficiency, is the relation between the accuracy and completeness with which users achieve certain goals, while satisfaction is the users' comfort with, and positive attitude towards, the use of the system.

A common way of addressing design in the branch of task-efficient design is by the use of prescriptive design rules or principles. These are developed to aid the designer when developing different parts of a system. They are based on knowledge accumulated through scientific studies and the work of practitioners, and are often formulated as rules or goals (Preece, Rogers and Sharp 2002). One example of such a rule is formulated by Norman (1988). He lists several principles for good design: visibility, feedback, constraints, mapping and affordance. Another influential example is Shneiderman's «golden rules» for interface design (Shneiderman 1987). Among other things, he encourages the designer to strive for consistency, enable frequent users to use shortcuts, and reduce short-term memory load (Shneiderman 1987: 60).

Another important concept within task-efficient design is the task, and techniques commonly known as task analysis. Task analysis is a generic term for a range of techniques (Preece and Rogers 1994). Jenny Preece and Yvonne Rogers say that task analysis are aimed at «… eliciting descriptions of what people do, representing those descriptions, predicting difficulties and evaluating systems against usability or functional requirements» or they are concerned with «… predicting performance, measuring system complexity, measuring learnability or the transfer of knowledge between systems» (Preece and Rogers 1994: 410).

In task analysis, an activity is divided into a set of tasks that have to be performed in order to accomplish some kind of goal. For example, if someone wants to write a letter using a text editor, this activity can be divided into several tasks. First, the program must be started, then a new document must be opened and text entered. Finally, the document must be saved and eventually printed. By dividing the

activity of writing a letter into several tasks, we are able to see in what order the different tasks must be done, and what they are. We may divide a task into a set of subtasks, and in this way get a hierarchical structure. This kind of analysis is called a hierarchical task analysis.

3.1.2 Participatory design

An alternative direction within the HCI is the Scandinavian tradition in systems development. This approach, started out in the late 60s, has and does not have its ancestry in the HCI. More generally, the Scandinavian tradition is known as participatory design. Kluge (2005) says that there is a difference between participatory design and the Scandinavian tradition in systems development, but he treats them as one.

The Scandinavian tradition takes on a broader scope than the focus on task- and work-related usability emphasized in the task-efficient tradition. It sees design as a process, and user involvement throughout the process of design is important for the quality of the result. According to Pelle Ehn, participatory design is seen as a process of mutual learning, where both designers and users learn from each other (Ehn 1989). In contrast to the branch of task-efficient design, participatory design emphasizes the context of use. In order to understand how technology is actually used, social science oriented methods are employed in order to obtain valid data.

The Scandinavian tradition sees it as a goal to empower the users, both in terms of the situation of use, but also in a political sense. One early example is Kirsten Nygaard's collaboration with the Norwegian Metal Workers' Union in the 70s. This pioneer project had clear political position, and intended to facilitate work-life democracy (McCarthy and Wright 2004). In the years that followed, numerous projects were carried out; many of these were in collaboration with trade unions and had political ideals concerning work-life democracy. Löwgren and Stolterman (2004) see these early design projects from the 70s as stronger on political levels than on design methods, as they were primarily found in negotiations, legislations,

and regulations. However, further research and development in the 1980s and 1990s has resulted in a stronger theoretical grounding, as well as methods and techniques for the practical work of participatory design. An important contributor to a more contemporary view of participatory design in Scandinavia is Pelle Ehn (1989).

3.1.3 Interaction design

The third direction within HCI is interaction design. More than the other two approaches, interaction design is seen as a design discipline. Gillian Crampton Smith and Philip Tabor see interaction design as «... more art than science» (Crampton Smith and Tabor 1996: 56).

In this approach there is to a larger extent focus on the aesthetical aspects of digital technology. Kluge sees the main goal of interaction design to be designing for user experience: «… a main goal of interaction design is to unite aesthetical aspects with functional aspects to create a user experience» (Kluge 2005: 29). This notion of user experience is also central for Jenny Preece, Yvonne Rogers and Helen Sharp:

> By interaction design, we mean *designing interactive products to support people in their everyday and working lives*. In particular, it is about creating user experiences that enhance and extend the way people work, communicate and interact. (Preece, Rogers and Sharp 2002: 6, emphasis in original)

In interaction design, the development of a sense of quality and a language for use-oriented qualities are essential for the design ability (Löwgren and Stolterman 2004). This is in contrast to the approach taken in task-efficient design, where the designer largely is guided by predictive models, prescriptive design rules, and heuristics.

I have now introduced three main directions within the HCI community: task-efficient design, participatory design, and interaction design. These three directions all have different perspectives on how to design digital technology. The work in

this thesis is closest to that of interaction design; my focus is on how people *experience* their interactions with technology. The rest of this chapter will be devoted to theories and concepts explicitly addressing user experience.

3.2 User experience

User experience is a relatively new field of study. Traditionally, research within HCI has been concerned with designing digital technology for the context of work, and focus has been on efficiency and ease of use. Theories and concepts of user experience take on a wider perspective, and some of them aim to design for what Terry Winograd foretold in his 1996 book *Bringing design to software*:

> Designing for the full range of human experience may well be the theme for the next generation of discourse about software design.. (Winograd, Bennet, et al. 1996: xix)

Marc Hassenzhal and Naom Tractinsky (2006) describe how the ideas in user experience evolved from programmatic in the 90s, trying to convince the HCI community to take issues beyond the instrumental more seriously, to gradually becoming more conceptual in the new millennium. These conceptual contributions aimed to establish a common view on what experience of technology might be.

In their attempt to obtain a better understanding of the experience of technology, researchers and practitioners have adopted concepts from several areas of research. Ideas from as different fields as cognitive psychology (Norman 2004), poetry (Dix 2003), philosophy (McCarthy and Wright 2004), theatre (Laurel 1993), architecture (Kapor 1996) and film (Wright, McCarthy and Meekison 2003), are used for better understanding the concepts of user experience. This great variety of approaches means that there is no mutual understanding or agreement of what user experience essentially is, and the term «user experience» is associated with a range of meanings (Forlizzi and Battarbee 2004).

Hassenzhal and Tractinsky (2006) see three major perspectives in the literature on user experience. One addresses human needs beyond the instrumental, another emphasizes the affective and emotional aspects of interaction, while a third is dealing with the nature of experience. Each of these three perspectives contributes to our understanding of users' experiences with digital technology. They all share some ideas and arguments, but according to Hassenzhal and Tractinsky, none of them fully captures user experience.

An alternative way of grouping the literature on user experience is offered by Jodi Forlizzi and Katja Battarbee (Forlizzi and Battarbee 2004). They divide the different approaches into three branches, depending on their way of focusing on the relationship between people and technology. Theories and concepts in their first category are trying to understand experience from the perspective of the user. Approaches in the second category understand experience as it relates to the product, while in the last category, user experience is understood through the interaction between the product and the user. Forlizzi and Battarbee see this last way of understanding experience as the most valuable approach.

I will now present a series of theories and concepts addressing user experience. This presentation is not meant to be exhaustive, but aims to display some of the variety of approaches to user experience proposed within the HCI community during the last two decades.

3.2.1 Models and theories of user experience

In an early attempt to define user experience, Lauralee Alben (1996) formulates eight criteria to be met by a successful interaction design, leading to quality user experiences. Taken together, the criteria are meant to raise one key question: How does effective interaction design provide people with a successful and satisfying experience? Alben emphasizes the need for understanding the users, an effective design process, and a real need for the product. The product should be learnable, usable and appropriate, and offer aesthetically pleasing and sensually satisfying use.

The designer needs to consider whether mutability is appropriate or not: does the design allow the product to change and evolve for new, perhaps unforeseen, uses? Finally she must assure that the product is manageable, meaning that the artefact needs to support the entire context of use. In Alben's view, use must be understood in a broader sense that merely functionality. She addresses the importance of helping users manage needs such as installation, training, maintenance, cost and supplies, both in an individual and organizational sense.

Nathan Shedroff, a practitioner in the area of information and interface design, gives a practical contribution to the field of user experience. In his book *Experience design 1* (Shedroff 2001) he argues that great experiences can be deliberate, and that they are based upon principles that have been proven. He sees superior experiences as having a number of elements that are knowable and reproducible, making them designable.

This notion of experience as a set of reproducible elements is also seen in the work of Alan Dix (2003). Drawing on work from poetry, graphic design and music, he analyses an experience by deconstructing it into what he sees as essential to the experience. He then translates and reconstructs the experience in another medium. Dix says that deconstruction of instances and analysis to form abstractions is the essence of science, and that construction of new artefacts by the synthesis of these abstractions in a new context is the essence of design. He argues that these concepts can be applied in experience as in other domains.

Pieter Desmet (2003) investigates our emotional responses to products. He classifies emotions into five classes of what he calls product emotions: instrumental, aesthetic, social, surprise, and interest emotions. The five types of product emotions cover different emotional responses towards products. Even though they do not cover all possible emotional responses, they illustrate that products have different layers of emotional meaning and make us aware of the emotions elicited by a certain kind of design.

In the classification scheme offered by Forlizzi and Battarbee, different approaches to user experience are divided into three different branches. They are either user-centred, product-centred, or centred on the relationship between product and user. Norman's three-layer model for understanding user experience (Norman 2004) is an example of the second category. Norman argues that attractive things work better, and analyses experience of technology using three levels of design: visceral, behavioural and reflective. Based on a psychological study of emotion, he suggests that there are three different layers in the human brain, each controlling different parts of our behaviour. He maps these levels onto different product characteristics, showing how different aspects of design affect our experience of technology.

In opposition to Norman, Marc Hassenzahl (2003) understands experience from the perspective of the user. He provides a theoretical model for describing people's goals and actions when interacting with a product or system. He defines key elements of user experience and their functional relations, such as the subjective nature of experience, how the user perceive a product, and emotional responses to products in different situations. Hassenzahl´s model focuses on the user and explicitly links product attributes with needs and values.

The third category offered by Forlizzi and Battarbee, where user experience is understood in the relationship between product and user, is exemplified by McCarthy and Wright's framework for seeing technology as experience (McCarthy and Wright 2004). They use concepts from pragmatic philosophy to understand interaction with technology, and see experience of technology as a construction made by the individual in a process of sense making. Their framework addresses both the qualities in the immediate experience, and what experience means to us in a wider perspective; in terms of how we see ourselves and the world as a whole. Their work has a conceptual character, offering a way of understanding experience of technology. I make use their six processes of sense making for addressing different aspects of user experience in the case of the Gokstad boat exhibition. The next chapter will thoroughly describe these concepts and their underlying pragmatic philosophy.

Forlizzi and Batterbee (2004) argue that because a team of multidisciplinary experts often conducts the process of design, a framework for understanding experience must not rely on the point of view of a single discipline, but provide a common design-oriented frame of reference for all the relevant actors involved. They propose a framework for understanding experience, differentiating between «experience», «an experience» and a «co-experience». Experience is seen as a constant stream of «self talk» when interacting with a product or system, an example of this is the use of an instant messaging system. «An experience» can be articulated and named, and have a finite start and end. A «co-experience» is creating meaning and emotion together with others through product use. One example of this category is interacting with others at a museum exhibit.

The different approaches to user experience introduced in this section take different perspectives on what user experience is, but they all have one thing in common; they see the traditional interpretation of interaction with technology as limiting, and try to expand the understanding of what interaction with technology is, and what it might be. Mark Blythe and Peter Wright explain:

> A number of theoretical frameworks for understanding user experience have been developed in the last five years. While there are differences in these approaches they all attempt to move away from the narrow focus on usability towards more holistic accounts of experience with technology. (Blythe and Wright 2007: 65)

An important aspect of this extended understanding of what interaction with technology is, and what it might be, is to formulate qualities of use going beyond those defined by usability. In the next section, I discuss what such qualities are, and how they are addressed.

3.2.2 Quality of use

The different approaches to human-computer-interaction emphasize different criteria when evaluating a system. In the domain of task-efficient design there is emphasis on evaluating a design on criteria that can be objectively measured and

addressed. Jakob Nielsen (1993) sees usability as having five attributes: *learnability*, *efficiency*, *memorability*, *errors* and *subjective satisfaction*.

In many respects, these are all valuable criteria for evaluating a product. However, it is also quite clear that this approach leaves out important aspects of use, both in terms of the context of use, and how the user experiences her interaction with technology. Stefan Holmlid reflects upon the concept of usability's limited domains of use:

> The practical and functional aspects are the stronghold of usability, but when it comes to the social, the aesthetic, the symbolic *et cetera*, usability is not sufficient. And when using products all those are of great importance. Thus, usability shows low performance when trying to deal with other applications than work-oriented artifacts. (Holmlid 2002: 13)

Within interaction design there is, in contrast to the branch of task-efficient design, less emphasis on usability, and more focus on user experience and the subjective satisfaction of using digital technology. Löwgren and Stolterman represent the direction of interaction design. They argue that a product's quality is far more than what can be objectively measured, and warn against relying on these qualities alone:

> A designer is never allowed to skip the question of product qualities by using the argument that nobody knows how these qualities can be measured. (Löwgren and Stolterman 2004: 101)

Löwgren and Stolterman see digital technology as a design material with certain qualities of use. They describe eighteen use qualities of digital technology, but emphasize that their proposal is not exhaustive. Among their use qualities are seductivity, playability, technical performance, and elegance. Some use qualities can be identified and perhaps measured, such as technical performance and structural features. However, most use qualities that are of interest for the designer, at least from the perspective of interaction design, are not measurable in a strict scientific sense. Löwgren and Stolterman point out that both researchers and

designers have attempted to create means for measuring such qualities, but these are merely used for facilitating the process of design and deployment. They state that «… there are no commonly agreed upon approaches for handling the more difficult aspects of digital artefact qualities» (Löwgren and Stolterman 2004: 101).

3.3 From usability to user experience

I have now introduced several theories and concepts of user experience. They take different approaches, but they all aim to move beyond the limitations of usability, and address a wider concern. These theories and concepts can be seen to represent a change of perspective, going from usability to user experience. According to Kluge, this change is a major one:

> The move from designing for usability to designing for user experience is a significant one. The activity of use is not something that can be measured in laboratories according to metrics. Rather it is a personal interpretive experience of making meaning, which takes into account the context of use, previous knowledge, and use situation in general. (Kluge 2005, 30)

What does such a change of perspective mean for the design and evaluation of digital technology? And what are the scope of these new concepts and theories? This section discusses some of the implications of going from a focus on usability, to a focus on user experience.

3.3.1 From invisibility to visibility

An important paradigm within the field of human-computer interaction is known as ubiquities computing (Weiser 1991). It was developed by Mark Weiser and his colleges at Xerox PARC in the late 1980s, and was a program for how to make computers an integral, invisible part of people's lives. According to Dourish (2001), this way of understanding digital technology has been very influential on a range of different research areas.

Kluge (2005) explains how the notion of invisibility is central within the branch of task-efficient design. One of the research fields advocating the invisible computer is known as information appliances (Norman 1998). An example of this kind of attitude towards digital technology is illustrated by Norman, as he reflects upon the choice of title for his book, *The invisible computer*:

> Now it is *The Invisible Computer*, because that is the end result, hiding the computer, hiding the technology so that it disappears from sight, disappears from consciousness, letting us concentrate upon activities, upon learning, doing our jobs, and enjoying ourselves. (Norman 1998: viii-ix)

This notion of invisibility is, however, troublesome from the perspective of user experience. It is hard to imagine how to experience the invisible computer. We may experience what it does for us, the task, the activities, but that is something different then experiencing the computer *per se*. This is recognized by Dourish:

> The design perspective seeks to find a new level of engagement between system and user. It reflects an attempt to make interaction engaging and marks a transition from thinking about the user «interface» to thinking about the user «experience». But you cannot be engaged with something that essentially isn't there. Invisibility is not engaging; invisibility does not communicate. (Dourish 2001: 202)

This section has discussed how changing perspective from usability to user experience, challenges a prevailing understanding of digital technology from the perspective of task-efficient design, namely that the computer should be invisible. The next section discusses the scope of the new concepts and theories of user experience.

3.3.2 From work to leisure?

I have introduced several approaches to user experience. Many of these were addressing qualitative aspects of use, such as fun, pride, pleasure, intimacy and joy. An important contribution to research on user experience is a collection of articles unified under the name *Funology* (Blythe 2003). Does this mean that research on

user experience should be aimed at understanding and designing digital technology offering fun and play, in opposition to work-related, more «serious» applications? Some see user experience this way. This view is illustrated in a recent article by Jan Stage. It is concerned with the evaluation of user experience:

> User experience is being used to denote what a user goes through while using a computerized system. The concept has gained momentum as a means to distinguish new types of applications such as games and entertainment software from more traditional work-related applications. (Stage 2006: 146)

According to this view, digital technology is seen to have two domains of use: work and play. Is changing perspective from usability to user experience a shift from understanding digital technology in the context of work, to understanding it in the context of leisure? Are the two perspectives just different ways of understanding problems arising in separate domains, usability addressing work activities and user experience addressing leisure activities?

In the introduction, I sketched out the development of the computer. From being a scarce resource limited to the work place, it has developed towards ubiquity and is now penetrating both work and social life. Many of these digital artefacts, such as the personal computer and the mobile phone, are not used solely during work or leisure. They are a part of our everyday lives, and cannot be characterized as either a tool or a toy. Bill Gaver and Heather Martin recognize this and address the need for alternative values:

> Suggestions for how digital technologies might be employed in everyday settings tend to represent a narrow range of cultural possibilities, reinforcing a simple dichotomy between work and play. Many devices import values from the workplace into the home, emphasising the requirements of «domestic work» by allowing chores to be done more efficiently or productively. Others emphasise the desirability of taking «time off», allowing people to play unproductive games or access new forms of broadcast media. Other values seem rarely to be addressed at all. (Gaver and Martin 2000)

It is a legitimate goal to design digital technology aimed at entertainment and fun, just as it is legitimate to design applications and artefacts aimed at heightening productivity in the work place. However, much of today's digital technology cannot be understood in this dualistic way. Just as people's lives are not divided into two activities, work and play, digital technology is not used in two distinct domains. Seeing user experience solely as a perspective to understand and design for entertainment and fun seems to reinforce an unnatural dichotomy of computer use. In addition, this view restricts valuable ideas of user experience to be applied in other domains.

In this thesis, I make use of the six processes of sense making proposed by McCarthy and Wright (2004) for addressing user experience in the case of the Gokstad boat exhibition. McCarthy and Wright do not see the concept of user experience as value laden. For them, user experience is simply the felt emotional quality resulting from our encounters with digital technology. In this way, the user experience can be joyful, captivating, and fun, but it can also be stressful, frustrating, or boring. This way of understanding the concept of user experience is more in line with how we interpret experience in everyday language. Particular qualitative aspects of the user experience resulting from our interactions with technology, such as fun, interest, or doubt, are, in this context, better seen as different qualities of use.

3.3.3 Evaluating user experience

In the traditional, task-efficient, approach to system development, there are several methods and techniques for evaluating a system. However, most of these evaluation techniques are designed for use at the level of the task, and do not seem adequate when it comes to evaluating how people experience their interactions with technology. Joseph Kaye and Alex Taylor (2006) say that most techniques for measuring usability can be conducted in a laboratory setting. This way of measuring usability takes the form of an experiment, reflecting a Popperian view of science – in which one seeks to determine a hypothesis based on results derived

from an experiment. In this scheme, the hypothesis implies that the evaluation is closely defined. The results take a form easily compared to criteria defined in advance. For example, during the design of a system, one criterion may be that a user should not make more than three errors during completion of a certain task. If user-testing shows an average of more than three errors, the system has failed and must be redesigned. However, when coming to evaluating how users' *experience* technology, the criteria we are to evaluate are no longer obvious, making it hard to find a good method for evaluation.

Another problem arising when trying to evaluate user experience is caused by the sheer complexity of the phenomena. Human experience is many-faceted and rich. There is obviously a danger in using techniques trying to reduce and quantify user experience in order to make it 'measurable'. Doing so, we are in danger of missing what we wanted to measure in the first place, namely user experience in all its colour, value and meaning. Kaye and Taylor suggest that the HCI community must learn from other fields that have spent much time trying to understand and characterize experience, namely the humanities, arts and social sciences. This approach «... embraces and encourages multiple, simultaneous, partial, overlapping, ambiguous and sometimes contradictory representations of multiple stakeholders' experiences» (Kaye and Taylor 2006: 1).

Kaye and Taylor point to the difficulties of characterizing human experience in an adequate way, and suggest that researchers and designers should turn to the humanities, arts and social sciences. A problem with this kind of approach is pointed out by McCarthy and Wright (2004). They argue that there has been a tendency to adopt weak versions of social-theoretical positions in order to inform research and design, and refers to this as *tourist theorizing*. They claim that when we introduce concepts originating from the social sciences to the field of HCI, there is a danger of reducing these theories and concepts to something that no longer represents human experience in an adequate way. There seems to be a tension between the complexity of the phenomena and the need to make it simple enough to inform research and design.

For the case of the Gokstad boat exhibition, I make use of concepts that build upon theories originating in the art and humanities. They offer a rich way of understanding and discussing different aspects of user experience. I hope that these concepts can be used without reducing the complex phenomena of human experience to a set of empty stencils. The next chapter introduces the philosophical stance of pragmatism, and the concepts used for analysing the exhibition.

4 Tools for analysis

This chapter presents the concepts that I use in order to analyse the Gokstad boat exhibition. They take different perspectives on user experience. The first offers a way of understanding and addressing various aspects of user experience, while the other offers a way of designing for a particular quality of use.

My main understanding of user experience in this thesis is McCarthy and Wright's six processes of sense making, and their underlying philosophy of pragmatism (McCarthy and Wright 2004). The six processes of sense making have a conceptual nature. They offer a way of understanding and characterizing user experience. However, they do not offer a way of designing for particular qualities of use. In order to address experiences such as uncertainty and doubt, I utilize the use quality of ambiguity as described by Löwgren and Stolterman (2004).

Before introducing McCarthy and Wright's six processes of sense making, there is need for a short introduction to the philosophical foundations of their work. Their view on experience is in line with that of pragmatism, which has a strong commitment to life as felt by the individual. Pragmatism is forward-looking and sees experience as something creative, open and relational.

The next section gives a short introduction to the philosophical movement of pragmatism, and to two philosophers strongly influencing the work of McCarthy and Wright: John Dewey and Michail Bakhtin. This short survey is not meant to be exhaustive. My aim is to illuminate thoughts and attitudes important for the work of McCarthy and Wright, and for the objective of this thesis.

4.1 The philosophical stance of pragmatism

The philosophical movement of pragmatism originated in USA in the late 1800s. It is a practical, consequential philosophy with a strong commitment to life as experienced. In opposition to many other philosophical directions, which are

grounded in the theory of knowledge or subjective states, pragmatism starts with experience. It is committed to a holistic, relational worldview, and is concerned with imagining and enriching as much as understanding. The aim it sets itself is to improve things.

John Dewey (1859-1952) was an American philosopher, psychologist and educational reformer. He is recognized as one of the founders of the philosophical school of pragmatism, and his thoughts have been greatly influential around the world. Dewey's understanding of experience is, according to McCarthy and Wright:

> … the irreducible totality of people acting, sensing, thinking, feeling, and meaning-making in a setting, including their perception and sensation of their own actions. (McCarthy and Wright 2004: 54)

Dewey makes a distinction between experience and what he calls aesthetic experiences. Aesthetic experiences are seen to be «... refined forms of everyday, prosaic experience in which the relationship between the person (or people) and the object of experience is particularly satisfying and creative» (McCarthy and Wright 2004: 18). In aesthetic experiences, there is no difference between means and ends, and the process of experiencing is just as important as the outcome. Even though aesthetic experiences may seem to be far from ordinary experiences, Dewey seeks to restore the continuity between the two. He uses aesthetic experience as a tool for seeing ordinary experiences in all its colour, value and meaning.

Michail Michailovich Bakhtin (1895-1975) was a Russian philosopher and literary critic. His main contribution to the work of McCarthy and Wright, is his thoughts on the relationship between experience and sense making. For Bakhtin, experience and the meaning we make of it is never known *a priori*, but is constructed along the way. McCarthy and Wright explain how meaning is made dialogically in the tension between self and other:

> I make sense of my self only in terms of how I relate to others and to my own history of selves – the way I was and the way I would like to be. (McCarthy and Wright 2004: 18)

Bakhtin sees the process of meaning making as creatively bringing together different perspectives and thereby forging understanding. He calls this *creative understanding* (McCarthy and Wright 2004: 18).

Creativity is essential for Bakhtin. He is committed to what is called unfinalizability. Here, the concern for surprisingness, potentiality, freedom, and creativity are important. Bakhtin's view on the world is that it is open and free; everything is still in the future. McCarthy and Wright note that Bakhtin points out what we tend to miss in the world because we have already finalized it in our minds:

> We tend to close our minds to the potentiality of the physical, biological, and social world, having already decided what everything is. (McCarthy and Wright 2004: 70)

In the same way that Dewey seeks to restore the continuity between ordinary and aesthetics experiences, Bakhtin tells us that by the use of imagination and creativity, ordinary experiences can become extraordinary. Bakhtin's understanding of experience as a dialogical process of making sense is essential for the six processes of sense making, which are presented in the next section.

4.2 The six processes of sense making

An experience, as McCarthy and Wright see it, is not ready made; it is a construction (McCarthy and Wright 2004: 105). We actively construct our experiences through a process of sense making. This process of sense making is not restricted to our physical interactions with technology, but goes on before, during, and after interaction:

> As creative, dialogical, meaning-making creatures, we bring as much to any experience as a designer, a film-maker, or a friend brings. We make something of what they give, we make it in dialogue with them and with others, and we do it at the time, before, and afterwards. (McCarthy and Wright 2004: 105).

In order to address user experience, McCarthy and Wright describe six processes of sense making; *anticipating*, *connecting*, *interpreting*, *reflecting*, *appropriating* and *recounting*. Even though they describe experience as six different processes, they emphasize that this is only done to make the complex phenomena of experience analytically accessible. The six processes are essentially one, single, process of making sense, and are best understood as six different, but intertwined aspects of experience. I will now present each of the six processes.

1. *Anticipating.* Going into an experience, we bring along expectations, prejudices and knowledge, guiding us when making sense of the situation in a certain way. In this way, what happens before an incident can be seen as part of the experience. Normally we think of anticipation as something prior to an experience, but there are also anticipations building up during an experience (McCarthy and Wright 2004: 124-125).

2. *Connecting.* When we encounter a situation, connecting is the first impact the experience has on our senses. The material components of the situation have an impact on us before we can make any sense of them intellectually; this impact generate some kind of response pre-linguistically. This process can be seen as a kind of gut-reaction (McCarthy and Wright 2004: 125).

3. *Interpreting.* Interpreting is seen as the process of making sense of an experience as it unfolds. What is happening, and what is likely to happen next? At this point, we may sense a thrill of excitement for not being in

control of the situation, or anxiety for not knowing what to do (McCarthy and Wright 2004: 125-126).

4. *Reflecting.* The process of reflecting is seen to be going on both during an experience and afterwards. We are making a judgment of the experience as it unfolds and are placing a value on it. We are trying to make sense of the situation in terms of both causal and emotional aspects. A causal aspect can be evaluating the situation, trying to decide our next action. From an emotional aspect, we may evaluate and ask ourselves if we are getting any emotional fulfilment, or how we feel about being in the situation at the time. After the experience has run its course to completion, we may reflect on what happened and try to relate the experience to other experiences (McCarthy and Wright 2004: 126).

5. *Appropriating.* An important part of making sense of an experience is relating it to our own history and current worldview. During appropriating, we think of an experience, trying to understand it, shaping it to fit our senses of selves, and who we want to be. Some experiences have the potential to change how we see ourselves and the world in general. Other experiences just pass us by, and do not contribute to our senses of selves (McCarthy and Wright 2004: 126-127).

6. *Recounting.* How we see our experiences may change when talking to others. We share our experiences and this might change the way we see them. By sharing our experiences, they appear in the context of other experiences and the society as a whole, changing how we see them and what they mean to us (McCarthy and Wright 2004: 127).

The six processes of sense making and their underlying pragmatic philosophy offer a way of understanding user experience. They do not see user experience as a

process restricted to our physical interactions with technology. User experience is seen as a process of making sense that is going on before, during, and after technology-use. It is a creative process, bringing together different perspectives, including how we see ourselves and the world at large.

The six processes of sense making offers an open and relational approach to user experience, and paves the way for a range of concerns that can be addressed by design, many of them going far beyond the purely instrumental. In addition to providing an understanding of user experience, the six processes give us a way of characterizing and addressing different aspects of user experience. However, they do not give advice on how to design for certain qualities of use. In order to address the question of how ambiguity can be used when designing for user experience, we need advice of a more practical character. This can be found in the use quality of ambiguity.

4.3 The use quality of ambiguity

Löwgren and Stolterman saw digital technology to have different qualities of use. They proposed several groups of use qualities, where one was concerned with the user's creation of meaning in relation to the digital artefact. In this group they describe the use quality of ambiguity.

Gaver, Beaver and Benford (2003, April 5-10) explore the nature of ambiguity. They argue that the process of making an ambiguous situation comprehensible can be pleasurable, and can lead to a deeper and more profound understanding of the artefact:

> By impelling people to interpret situations for themselves, it encourages them to start grappling conceptually with systems and their contexts, and thus to establish deeper and more personal relations with the meanings offered by those systems. (Gaver, Beaver and Benford, 2003, April 5-10)

Using examples from contemporary arts and design practice, they distinguish between three broad classes of ambiguity according to where uncertainty is located in the relationship linking person and artefact. The three classes are ambiguity of information, ambiguity of context, and ambiguity of relationship.

4.3.1 Ambiguity of information

Ambiguity of information impels people to question for themselves the truth of the situation. It is the most relevant for the case of the Gokstad boat exhibition, as the designers of the exhibition wanted the visitors to question the reliability of the various sources that Terje Planke and Svein Erik Øya used for interpreting the fragments of the third Gokstad boat.

Gaver, Beaver and Benford give several bits of advice for how to enhance the ambiguity of information: use imprecise representations to emphasize uncertainty; expose inconsistency to create a space for interpretation; and over-interpret data to encourage speculations.

As an example of ambiguity of information, Gaver, Beaver, and Benford refer to the arts, particularly Leonardo da Vinci's Mona Lisa. This painting is famous for Mona Lisa's ambivalent smile: it is hard to tell the expression on her face. To create this famous smile, Da Vinci applied a technique called «sfumato» on the area around her lips. In this technique, the definition, or focus, of the painting is reduced. It creates a blurred expression, and opens up for personal interpretations: «With insufficient information to go on, the viewer has to bring that smile into focus in their mind» (Gaver, Beaver and Benford, 2003, April 5-10).

This kind of ambiguity can also be seen in the work of Lars Hallnäs and Johan Redström (2000). They see the need for emphasizing other aspects than the concepts of usability when designing digital technology, and propose a design philosophy for developing «… technology aimed at reflection and moments of mental rest rather than efficiency in performance» (Hallnäs and Redström 2000: 1).

The key issue in what they call a design philosophy for slow technology is the use of deliberate slowness in learning, understanding, and in augmenting presence, and in this way give people time to think and reflect. Their work makes use of several types of ambiguity; the following example has an element of ambiguity of information.

Hallnäs and Redström describe what they call the slow doorbell. The slow doorbell plays short fragments of a very long melody each time the doorbell button is pushed. To fully understand the doorbell by its behaviour, the user must stop and reflect each time it rings, and the melody can only be grasped over time. In this case, it is the absent of information that impels the user to actively make sense of the song as a whole.

Both examples in this section render easy interpretation impossible. They create situations in which the user is forced to participate in order to make some kind of meaning, and opens up a space for personal interpretation.

4.3.2 Ambiguity of context

The second category of ambiguity offered by Gaver, Beaver and Benford is addressing technological genres. It aims to make the user open up in order to make sense of a system in a new way:

> Blocking the interpretation of a product or system in terms of an established discourse creates ambiguity of context. This is useful in spurring people to approach a particular system with an open mind, and more generally to question the assumptions they have about technological genres. (Gaver, Beaver and Benford 2003, April 5-10)

Ambiguity of context does not necessarily arise because a design is unclear, but because it can be understood in variety of contexts in different ways. Gaver, Beaver and Benford give an example of how mothers with small children have been observed to use the variety of ring tones on mobile phones in other ways than those thought of by the designers. These mums have been observed to set their mobile

phones ringing and then hand them over to their whining children. Even though the mobile phone itself is not ambiguous, these mothers make sense of it in a new way when they hear their babies crying. This is not simply an unexpected use of the mobile phone, it is a transformation of a mobile phone into a new kind of baby rattle.

Gaver, Beaver and Benford say that the user's ability to interpret a product in different ways should be recognized and encouraged by the designer. They offer three tips when designing for ambiguity of context: block expected functionality to comment on familiar products; add incongruous functions to breach existing genres; and implicate incompatible contexts to disrupt preconceptions. (Gaver, Beaver and Benford 2003, April 5-10).

Stefan Holmlid (2002) discusses how surprise and confusion can initiate exploration and learning. He has studied the use of digital technology in a traditional context of work, and found that neither surprise, nor confusion, should be seen as errors, but rather as natural parts of a problem-solving activity. This activity might involve exploration of action possibilities or even a reconsideration of the initial problem. Gaver, Beaver and Benford suggests to block expected functionality in order to comment on familiar products. The work of Holmlid indicates that this sort of ambiguity can also be used as a way to make the user explore the product, and in the same process learn about its functionality.

4.3.3 Ambiguity of relationship

The last category of ambiguity is directed toward the individual, and is aimed at creating awareness and self-reflection in the user. It encourages us to reflect upon our relationships with technology and on the social and cultural values they hold:

> Ambiguity of relationship creates the condition for a deeply personal projection of imagination and values onto a design. This can allow products and systems to become psychological mirrors for people, allowing them to

> try on new identities or to question their values and activities. (Gaver, Beaver and Benford 2003, April 5-10)

In this group, three tricks are suggested: offer unaccustomed roles to encourage imagination; point out things without explaining why; and introduce disturbing side-effects to question responsibility (Gaver, Beaver and Benford 2003, April 5-10).

Examples of ambiguity of relationship are found in the work of Anthony Dunne and Fiona Raby. They introduce a concept called design noir, which deals with «… rich and complex human pleasure» (Dunne and Raby 2001: 6).

An example of a noir product is the Truth phone, which combines a voice stress analyser with a telephone. It is used as an ordinary telephone, but it also has additional functionality. The voice stress analyser indicates whether the person in the other end of the line is telling the truth or not. Dunne and Raby explain how this kind of artefact opens up a conceptual space where interactivity challenges and expands our current experiences of using everyday electronic objects:

> Imagine speaking to your mother or a lover while the truth phone suggests they are lying. The user becomes a protagonist and the designer becomes a co-author of the experience, the product creates dilemmas rather than resolving them. By using the phone, the owner explores boundaries between himself and the paranoid user suggested by the product, entering into a psychological adventure. (Dunne and Raby 2001: 46)

Design noir explores and question the way digital technology influences our lives, and illuminates sensual, aesthetical, and even metaphysical potentials of digital artefacts. Dunne and Raby are not using design solely to meet some kind of predefined need, but they also use it as a comment and critique. Dunne labels this design strategy «critical design» (Dunne 2006).

Löwgren and Stolterman (2004) offer a very similar concept. What they call the use quality of parafunctionality is aimed at creating a heightened sense of distance.

Such objects are conceptually hard to assimilate into one's view of reality. This is a rather powerful concept. Löwgren and Stolterman indicate the revolutionary potential for this kind of design: «Acknowledging its usability or usefulness, is hence also to discover new ways of seeing the world» (Löwgren and Stolterman 2004: 131).

As an example of the use quality of parafunctionality, they describe the Intolerant Object by the French surrealist Phillipe Ramette. In this artefact, a lens focuses sunlight directly onto the top of the user's head, with possible fatal consequences. This object is obviously not intended for use; its strength lies in the reflective process that it starts when one imagines using it. This can also be said about the Truth phone described by Dunne and Raby. There is however a difference. The first is an art object, while the latter is a real product produced by the Counter Spy shop (Dunne and Raby 2001: 46).

Some might dispute that the qualities discussed in this section are valid concerns for the designer, and argue that artists had better address them. Löwgren and Stolterman do not see it in this way. They argue that these concepts are valuable as they addresses the assumptions we normally take for granted when coming to digital technology and the role it play in our lives. They claim that this kind of critical thinking is just as important when designing systems to support office work as it is in the arts.

All of the approaches discussed in the last sections are based on the user's creation of meaning in relation to the artefact. They make it hard for the user to interpret the situation at hand, and force her to participate in order to make some sort of meaning out of what she experiences. Using her previous knowledge, the information available, but also her sense of self, she needs to actively *make sense* of the situation. This act of bringing together different perspectives in order to make meaning is what Bakhtin calls creative understanding. For him, this is ultimately a creative process, forging understanding (McCarthy and Wright 2004, 18).

There is an obvious relation between the six process of sense making and the use quality of ambiguity. They are building upon the same foundations, namely the process of *making sense*. I see them as complementary perspectives; the six processes of sense making and their underlying pragmatic philosophy offer a way of understanding and addressing different aspects of user experience, while the use quality of ambiguity gives us a way of addressing and designing for a specific quality of use.

The concepts discussed in this chapter will be my main source for understanding and addressing user experience in the case of the Gokstad boat exhibition. The next chapter gives a thorough description of the case study.

5 The case study

This chapter describes the case of the Gokstad boat exhibition. I first introduce the history of the third Gokstad boat, and explain the motivation and aims for the project. I then describe its main features, it underlying design concepts, and the digital technology involved in the project. Finally, there is a collection of pictures from the exhibition.

5.1 Background

The Gokstad ship is a Viking ship from the late 9th century. It was found in 1880 at the Gokstad farm in Sandefjord, and is one of the largest archaeological findings from Viking times in Norway. In 1930, the ship was reconstructed, and it is currently at display in the Viking ship museum in Oslo.

Along with the Gokstad ship, three smaller boats were found. They were cut into pieces, packed flat, and then buried together with the ship, probably as a part of a ritual. Two of the smaller boats were reconstructed at the same time as the Gokstad ship, and are today displayed along with the main ship at the Viking ship museum. The last of the three boats was however never reconstructed. It consists of over 200 fragments and has, until recently, been locked away in the museum's storeroom.

Figure 1 Fragments from the third Gokstad boat

What can these fragments tell us about the original boat? How did it look? How did the Vikings think and work when they built the boat more than a thousand years ago? These were some of the questions ethnologist Terje Planke wanted to answer when, in 2004, he started the work of reconstructing of the third Gokstad boat.

The process of reconstructing the boat was documented by the use of video, audio and photography. This was done according to the standards for documenting research using video logging, and the outcomes were categorized according to archiving and standards of documentation. When using such standards, the resulting video material is regarded as empirical data from the research conducted. The Gokstad boat exhibition made use of parts of this video material, along with several models, pictures, and other artefacts from the reconstruction.

5.2 The RENAME project

The Gokstad boat project was part of the RENAME (Research-Narrative-Mediation) project which was lead by Dagny Stuedahl. It aimed to foster digital excellence in cultural heritage communication (Stuedahl, Rename 2008), and explored the potential of using digital media as a means to engage young people in cultural heritage and history communication.

5.3 Target audience

The target audience for the exhibition was children and youth in the age from 10 to 14 years old. The exhibition was suitable for educational purposes. At the end of the design process, three groups of children and teenagers were invited from a local school. Their behaviour and use of digital technology was thoroughly documented.

5.4 Main themes and features

The exhibition made use of traditional media and digital technology in order to communicate the process of reconstructing the third Gokstad boat. By mediating

the uncertainties in the process of reconstruction, the exhibition aimed to make the visitors question what we know about history in general. In this way, the exhibition was not solely about the process of reconstructing the third Gokstad boat, it also addressed how history is created, and the validity of history as presented in museums. This was reflected in the title of the exhibition: «The Gokstad boat project: How do we understand the past?».

The exhibition had three main themes: *fragments*, *model*, and *boat building*. Each theme described a part of the process of reconstructing the third Gokstad boat. In the exhibition space, the three themes were presented through the use of traditional exhibits such as installations, displays, and by the use of digital technology.

An important feature in the exhibition was the use of the visitors' personal mobile phones and a location-aware system tracking the visitors' whereabouts in the exhibition space. The three main themes were located in physically distinct zones. These zones also had their digital counterparts. When a visitor entered a zone, she could accept to receive short video sequences on her mobile phone. If she for example walked into the zone dealing with the theme *boat building*, she could agree to receive a short video where Terje Planke discusses various problems that he and Svein Erik Øya met during the reconstruction. These video clips were derived from Terje Planke's video documentation of the process of reconstructing the boat.

The context-aware system tracked the visitors' whereabouts in the exhibition space, and created a digital, or what Dunne (2006) calls hertzian, space. Moving around in this hertzian space, the mobile phones acted as media that enabled the visitors to interact with the digital parts of the exhibition.

On displays in each of the three zones were questions related to problems that Terje Planke met during the process of reconstructing the third Gokstad boat. One example is the question in the theme fragments: «You are trying to put the pieces of the boat together, but one of them does not seem to fit in. What do you do?» These questions were answered by sending some kind of information to the system, in the

form of text, pictures, or short video clips, recorded using the mobile phones. The answers from the visitors were then projected onto a large screen placed in the exhibition space, available for everyone to see.

Thus, an important aspect of the exhibition was the visitors' generation of their own content, which, in this way, contributed to the exhibition. All digital content that were sent to the system could also be found on computers that were placed in the exhibition space. Using these computers the visitors could publish their content on personal blogs that were established in advance.

5.5 Design concepts

The exhibition's main conceptual idea was based on three activities or design concepts. During their visit at the exhibition, the visitors were seen to be involved in these three main activities: *collecting*, *reflecting* and *sharing*.

5.5.1 Collecting

Using their mobile phones, the visitors collected information in the form of pictures and short videos. This information was stored on the mobile phones and could later be shared in various ways. The activity of collecting was not restricted to gathering digital content this way; the visitors also collected information that was not saved on a digital format. They read texts, and looked at various pictures and exhibits in the exhibition space.

5.5.2 Reflecting

The design concept of reflecting is related to the main aim for the exhibition. The design team wanted the visitors to engage in, and learn about, the process of reconstructing the third Gokstad boat, but also about the uncertainties inherent in knowledge production about the past in general. The exhibition explored how the use of digital technology could help stimulate and support reflective activities directed towards these issues.

5.5.3 Sharing

The design concept of sharing is closely connected to the term ‘user generated content’ and what is known as web 2.0. Using social media, the visitors were encouraged to share their experiences of the exhibition and, in this way, contribute to the content. This was done by sending text, pictures and short videos to the system, which then projected them onto a large screen for everyone to see. The activity of sharing was also reflected in the act of publishing information on the personal blogs.

5.6 Digital technology

The exhibition made extensive use of digital technology. There were mobile phones, computers, a projector screen, and a context-aware system tracking the visitors’ location in the exhibition space. This section shortly describes the various digital technologies used in the exhibition.

5.6.1 BLIP system

The exhibition used a BLIP (Bluetooth Local Infotainment Point) system for tracking the visitors’ physical locations in the exhibition space. The system establishes a wireless local area network, which users can access via their Bluetooth-enabled devices. The BLIP system has limited communication range. Typically, it makes use of several communication nodes, each having a communication range less than ten meters. When a Bluetooth-enabled device enters within the range of a node, communication can occur in both directions.

In the exhibition, four such nodes were used. The first node was solely used for registration and was placed in a hall outside the exhibition space. Each of the three remaining nodes were placed in one of the three zones. One node in the theme fragments; another in the theme models, while the last node was placed in the theme boat building.

5.6.2 Mobile phones

Mobile phones are seen to be a personal medium. The visitors used their private mobile phones for interacting with the digital parts of the exhibition. They were used for receiving short video clips, and for taking pictures and recording short video clips that could be uploaded to the system.

5.6.3 Projector screen

A projector and a large screen were used for displaying the content that the visitors produced during their stay at the exhibition. Their contributions were then projected onto the screen along with the sender's name, and information about which zone it had been sent from. When the various contributions were received by the system, they were put at the end of a queue. After a contribution had been displayed, it ended up back at the end of the queue. In this way, they could be shown several times during the exhibition.

5.6.4 Blogs

There were several computers placed in the exhibition space. They were used for accessing personal blogs that were established for each of the visitors. A blog is seen as part of social media. It is a website, usually maintained by an individual, which has regular entries of commentary, descriptions of events, or other material such as graphics and videos. An important feature of blogs is the ability for the readers to leave comments in an interactive format. In the case of the exhibition, the social qualities of blogs were used for stimulating discussions and for sharing information. The blogs were also available on the internet, and could be accessed after the exhibition had run its course.

5.6.5 Webpage

The personal blogs resided on a webpage presenting the Gokstad boat exhibition. The design of this page will not be further discussed.

5.7 Traditional exhibits

In addition to the digital content that was sent to the visitor's mobile phones, each of the three zones had traditional displays and exhibits.

5.7.1 Displays

Each theme had a large display with text and pictures describing the according process of reconstructing the third Gokstad boat. Each of these displays had a question that the visitors were encouraged to answer, using their mobile phones.

5.7.2 Exhibits

The exhibits were representations of tools, materials and fragments from the excavations. Two models used during the process of reconstruction, and a full-size replica of the bow of the third Gokstad boat, were on display.

5.8 The exhibition space

The exhibition was arranged in the basement at Intermedia, University of Oslo, in a rectangular room measuring approximately sixty square meters. A part of the hall outside the room was used for registration, and for introducing the exhibition before the visitors entered the exhibition space.

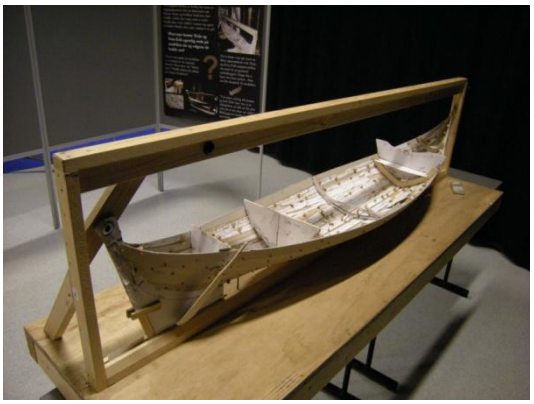

Figure 2 A model

Figure 3 A close up of a model

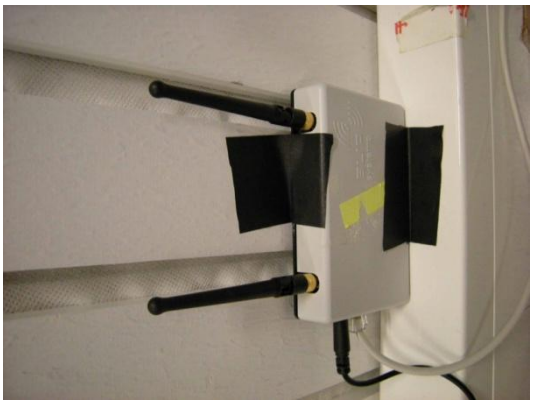

Figure 4 A Blip node

Figure 5 Overview over the exhibition space

Figure 6 The projector screen

Figure 7 A full size replica of the bow

6 Empirical findings

This chapter presents the empirical findings from a session where a group of teenagers visited the Gokstad boat exhibition. First, the procedures for the session are described, and then the findings from the observations and the group interview are presented.

6.1 Procedures

On their arrival at the University, the participants were given a short introduction to Gokstad boat exhibition by the leader of the project, Dagny Stuedahl. The teenagers had explained to them the main features of the exhibition, such as the use of mobile phones, blogs, and the context-aware system. Stuedahl also talked about the background and the motivation for the project, and explained how the uncertainties in the process of reconstructing the third Gokstad boat affected the shape and look of the final boat.

Those of the participants who had suitable mobile phones used these during their stay at the exhibition. The rest of the participants borrowed mobile phones from the project.

There were several observers present during the experiment, and their roles in the project were explained for the participants. The teenagers were told that they should feel free to ask the observers questions whenever they felt that it was necessary.

The group interview was conducted at the end of the session. All the participants were gathered in the exhibition space, and were asked several questions about their experiences of being at the exhibition. The interview was lead by Dagny Stuedahl.

6.2 Observations

The participants were not led directly into the exhibition space. Before entering the exhibition, they had to stop in the first zone for registration. Each of the teenagers received a text message that they had to reply to in order to register in the system.

The task of sending text messages using Bluetooth communication is different from sending text messages over the ordinary telephone system. The message must be written into what is called a note, and then sent to a receiver chosen among several active Bluetooth devices. Most of the participants were not used to sending text messages in this way. Several of them were confused by the list of receivers, and some of them sent their messages to each other, rather than to the system. With some guidance from the observers, most of the teenagers figured out how to do it.

Figure 8 The teenagers are about to enter the exhibition.

At this point many of the teenagers expressed uncertainty, doubt, and confusion. Here is a short excerpt from the conversations going on in the hall outside the exhibition space:

The teenagers are about to send their first text messages to the system. A girl utters with a resigned tone in her voice:

«I don’t understand it!»

Another girl is staring into the display of her mobile phone, apparently struggling to send the message:

«What do I do? There… no. Ops!»

After a bit back and forth, and some help from an observer, she sends the message and is ready to enter the exhibition space. These kinds of problems were also observed later in the session.

When the participants were successfully registered in the system, they were allowed to enter the exhibition space. They now spread out into the room and started to read the various posters and look at the exhibits. Immediately after they have entered the exhibition space, a girl utters:

«Where are we supposed go?»

She then goes over to two of her friends who are occupied reading one of the displays. She stops behind them and asks:

«What are we to do here?»

When the teenagers entered one of the three BLIP zones in the exhibition space, they started to receive text messages on their mobile phones. At this point, some of the participants expressed confusion. They did not understand why they suddenly started to receive messages.

In order to download a video clip, the participants had to confirm a text message. This was misunderstood by many of the participants. Some of them read the

message, but failed to understand that they had to confirm it in order to receive a video clip. In these cases, the observers helped the participants and explained to them what to do. This problem was only observed at the start of the session.

One problem with the BLIP system was the low bandwidth. In some cases, it took more than a minute to download a video clip. Most of the participants did not understand why this was so, and this technological insufficiency caused minor confusion and frustration. Some of the teenagers were told that the transmission speed would increase if they went closer to the transmitters. This resulted in several creative attempts to reduce the waiting time. One girl was observed lying on the floor, holding her mobile phone as close as possible to a Bluetooth transmitter. Another girl simply left her mobile phone by one of the transmitters, and then returned to pick it up later on.

Not all of the teenagers waited passively for the video clips to download. Some of them found it natural to do other activities while waiting. Some started discussions, while others read posters while waiting for the download to complete.

Many videos and pictures were sent to the system. A result of this was that it often took several minutes from when a contribution was sent until it finally appeared on the projector screen. Some of the teenagers were impatient to see their video clips on the screen. One girl asked an observer when her contribution would appear, and why it took so long.

There were several problems related to the use of mobile phones. Activities such as recording videos, playing video clips, and sending messages, turned out to be a challenge for some of participants. However, after some guidance, most of them figured out how to do it. Often the teenagers solved these kinds of problems on their own. They gathered in small groups and discussed how to send text messages, how to choose the right transmitter, or how to record a video, and so on.

Some of the mobile phones did not work as intended. Some of the participants received neither text messages nor videos, and some of the teenagers did not manage to display the video clips. The participants did, however, solve most of these problems one way or the other. If a mobile phone did not work as intended, the owner joined in with another participant, or borrowed a mobile phone from someone else. One example of this on-the-spot problem-solving was a girl that could not manage to record a video using her mobile phone: she did not think of this as a major problem, and decided to take a picture instead. Another example is a girl that was about to record a video. Unfortunately, it turned out that her mobile phone would not allow her to record a video clip of the length that she had planned. She elegantly solved this problem by making several small videos clips, and then sent them to the system as series of «episodes».

The three girls that were foot-tracked by a camera mostly collaborated on their activities. Their focus was on answering the questions in each of the three zones. Often they recorded a video in order to answers the questions. These videos took the form of an interview. Typically, one of them read the question on the poster, while the other two discussed the issue, and gave their opinions on the matter. The three girls did not only interview each other, but also asked other participants for their opinions. This way of answering the questions by conducting an interview, soon became popular among the participants.

In the zone dealing with the theme of fragments, a large group of girls was observed to answer the question in this way. One girl was recording and interviewing, while four others were in front of the camera. The girls with the camera started the interview by reading out aloud the question on the poster. The other girls discussed the issue, and each of them was asked to give an answers. Finally, also the girl with the camera gave her opinion.

In the first zone, the three girls that were foot-tracked by a camera, spent considerable time reading the posters and looking at the exhibits. They downloaded the video clip and discussed for some minutes before they started to make a video.

As they moved on to the second zone, they did not use that much time on the exhibits, but were more interested in receiving the video clips and making their own contributions right away.

This kind of behaviour was observed among many of the participants. At the beginning of the session, much attention was paid to the various exhibits and to the activity of collecting information using the mobile phones. The teenagers went from theme to theme, and were busy looking at the posters and the exhibits. As time went by, more attention was oriented towards the projector screen. The participants now formed small groups where they discussed and commented on the various contributions that were displayed on the screen.

There were different reactions to the contributions displayed on the screen. Some of the participants laughed and pointed to the screen when they saw themselves on a picture or in a video clip. Others seemed a little embarrassed. In one situation, two girls watched a video clip that was displayed the screen:

One of the girls appears in a video clip that has been displayed on the screen several times. The video clip now appears one more time. The girl says with a grim look on her face:

> «Ahh, it's irritating!»

The other girl then turns to one of the observers and says:

> «Can we delete? Can we remove it [the video clip]?»

In another situation, two girls are waiting for their video clip to appear on the screen. When a contribution that had already been shown several times reappears, one of the girls says, slightly resigned:

> «Ahh, there it [the particular video clip] is again!»

As the contributions from the participants were shown many times, some of them seemed to lose their value; some of the contributions that were very popular at first, did not cause that much attention after a number of repetitions.

After approximately 30 minutes, the interest in the exhibits started to cease. Most of the teenagers now gathered in groups in front of the projector screen. They were talking together, and commenting on the various contributions. Some of them where showing each other content that they had collected and stored on their mobile phones. Up until this point there had been little attention paid to the media centre. Stuedahl now directed some of the participants towards the computers. She sat down and showed some of the teenagers how to use the blogs.

Several of the girls now gathered around one of the computers. At this point, some of them discovered that the content that they had sent to the system also were to be found on the computers. Some found their video clips on the computers, and started to display them to the others.

Figure 9 A group of girls gathering around a computer

Some of the participants created posts in their personal blogs, and, after a while, they started to read each other's posts aloud. These activities were mostly done in

collaboration. Even though the participants' focus now was on the computers, they were still aware of the projector screen. Now and then, they turned towards the screen. In particular, this seemed to happen when they heard an interesting or unfamiliar sound coming from the loudspeakers. Sometimes, when a new contribution appeared on the projector screen, some of the teenagers stopped whatever they were doing, and turned to the screen to watch.

At this point, the session was getting towards the end, and most of the participants had begun to lose their interest in the exhibition. They started to discuss personal matters and one of the girls was observed to be logged onto Facebook. Stuedahl now stated that the exhibition was over, and asked everyone to gather for the group interview.

6.3 Group interview

Stuedahl started the interview by saying that she wanted to interview the teenagers in order to understand what they had learnt about Planke's project, and how they felt about being at the exhibition. The teenagers were asked what they thought about this exhibition compared to the pre-study where they had participated the previous summer. Most of them seemed excited about the use of technology. A girl said it was «better this time», more «technological» as she put it. Another said that it was «more fun».

The teenagers seemed especially fond of the projector screen. One of the girls excitingly proclaimed:

> «We appeared on a large screen!»

Stuedahl now turned to questions aimed at obtaining a better understanding of how the teenagers understood the conceptual design of the exhibition, and what they learned about Terje Planke's project. Some said that they experienced the video clips as being too long, and some admitted that they had cut them short because

they were, in the end, boring. A girl explained that she did not have time to see all of them, and that she sometimes stopped in the middle of a clip. She felt that she did not have the time to see them all. She argued that there should have been something indicating the length of video clips. In her opinion, a timeline similar to those founds in various media players would have been helpful. This is how she put it:

> «When I didn't know it's [the video clip] length, I just couldn't keep on watching and watching and watching...»

Some of the participant, who used the mobile phones provided by the project, said that they found it troublesome to use an unfamiliar mobile phone. A boy said that he found it stressful to answer the questions using the mobile phone. A girl agreed, and suggested that the exhibition should use larger screens. Others proposed the use of touch sensitive screens. Some said that they would rather have a computer with web camera to answer the questions. A boy rejected this proposal, and said that this would prevent him from taking the pictures that he wanted to. The group interview ended in a discussion on how to overcome this problem.

7 Making sense of ambiguity

This chapter aims to answer the three research questions formulated in the introduction. Using the six processes of sense making and their underlying pragmatic philosophy, and the use quality of ambiguity, I analyse the design of the Gokstad boat exhibition and the empirical material resulting from the observations.

7.1 Designing a space for reflection

One of the main aims of the exhibition was to mediate the uncertainties in the process of reconstructing the third Gokstad boat. The designers wanted the visitors to experience uncertainty and doubt and, in this way, start a reflective activity that could help them understand the issues raised by the exhibition. The first research question formulated in the introduction addressed how ambiguity was used in this regard:

1. *How was ambiguity used in order to make the visitors experience uncertainty and doubt?*

The following two sections aim to answer this question. I found two main uses of ambiguity; the first section discusses how the exhibition made use of fragmented information, while the second addresses the use of contradictory information.

7.1.1 Fragmented information

As an example of using ambiguity as a resource for design, I introduced the concept of slow technology, a «… technology aimed at reflection and moments of mental rest rather than efficiency in performance» (Hallnäs and Redström 2000, 1). Hallnäs and Redström described what they called the slow doorbell, which chopped a melody into smaller fragments, forcing the user to actively *make sense* of it as a whole.

This kind of fragmentation of information was essential in the Gokstad boat exhibition. No chronological story was offered; pieces of information had to be gathered using the mobile phones, and by looking at installations, pictures and text. When the visitors entered one of the three zones in the exhibition space, they received short video clips on their mobile phones. These video clips did not tell a whole story; rather they offered pieces of information that had to be interpreted in relation to the exhibits, text and pictures in the zone in which they were received. In the same way that the users of the slow doorbell had to *make sense* of pieces of music in order to grasp the melody, the visitors needed to *make sense* of pieces of information in order to get an understanding of the exhibition seen as a whole.

However, in the case of the exhibition, the fragmented information and how they related were much more complicated than those offered by the slow doorbell. Hallnäs and Redström describe how the slow doorbell was designed for reflection using two key parameters: *time* and *presence* (Hallnäs and Redström 2000: 166). In the Gokstad boat exhibition there was also a third parameter, the notion of *space*. The short video clips that the visitors received on their mobile phones were linked to one of the three themes in the exhibition. The various themes were presented in separate areas in the exhibition space, and the visitors needed to make sense of the video clips in the context in which they were received.

The qualities of digital technology were important in this design; the BLIP technology was used in order to distribute the video clips to the visitors based on their whereabouts in the exhibition space, and the mobile phones were used to display the content.

7.1.2 Contradictory information

The fragmented information encouraged the visitors to be active consumers of information. They received only pieces of a story, meaning that they needed to make an effort in order to make sense of the exhibition as a whole. Each fragment

had to be evaluated and interpreted in relation to each other, and in relation to the exhibition seen as such.

To further add to the complexity, the exhibition made use of inconsistent and partly contradictory information. The Gokstad boat exhibition was not mediating a single story; the various pieces of information were partly contradictory, and could be interpreted in a variety of ways. The visitors were not offered one, single, story. Rather they were offered a multiplicity of stories, and had to make use of their knowledge and creativity in order to make sense of a story on their own.

Gaver, Beaver and Benford give several pieces of advice for how to enhance the ambiguity of information. One of them is to «[e]xpose inconsistency to create a space of interpretation» (Gaver, Beaver and Benford 2003, April 5-10). In the exhibition, this was done by emphasizing two main sources of knowledge: scientific knowledge, represented by the scientist Terje Planke, and knowledge based on experience and practical know-how represented by a traditional boat builder. In each of the three themes, the visitors were explicitly confronted with diverging and partly contradictory information through a series of questions that they were encouraged to answer, using their mobile phones.

One example is the question in the theme *model*:

> «You show your model to a boat builder from Sogn. Based on his knowledge of boat building he says that your model cannot be correct. How do you go on with the process of reconstruction?»

Another example is from the theme *fragments*:

> «You are trying to put the pieces and fragments of the boat together, but one of them does not seem to fit in. What do you do?»

These questions were not mediated through digital technology; they were printed on conventional posters and placed in each of the three zones in the exhibition space. Digital technology did, however, play an important role as a tool for starting and supporting a reflective activity. The questions were answered by sending in text, pictures, or short video recordings using the mobile phones.

This section has been concerned with how ambiguity was used in order to design for uncertainty and doubt in the exhibition. The next section addresses the empirical material resulting from the observations, and examines in which situations the visitors of the Gokstad boat exhibition expressed uncertainty and doubt.

7.2 Observations of uncertainty and doubt

The second research question formulated in the introduction was concerned with bringing forth situations in which the visitors expressed uncertainty and doubt. An important concern answering this question is to gain a better understanding of how uncertainty and doubt affected the visitor's behaviour: in which situations did the use of ambiguity make the visitors start a reflective activity directed towards the issues addressed by the exhibition? The second research question was:

> 2. *In what situations did the visitors express uncertainty and doubt?*

There were many observations from the Gokstad boat exhibition where the visitors expressed uncertainty and doubt. I found two broad categories of situations. The situations were categorized based on the activities that they initiated:

- Design-centred situations
- Technology-centred situations

In the design-centred situations, the teenager's uncertainty and doubt led to an activity concerned with the issues raised by the exhibition. This could be observed as discussions, someone reading a poster, or other activities directed towards the issues addressed by the Gokstad boat exhibition. The name *design-centred* indicates that the behaviour of the users was in line with the overall aim for the design. In this case, the aim was to make the visitors engage in, and possibly learn about, the reconstruction of the third Gokstad boat.

In the technology-centred situations, the teenager's uncertainty and doubt led to an activity solely concerned with technology, or technology use. In these situations, the visitors could not *make sense* of technology; they did not know what to do, how to do it, or to figure out what to do next. The activities initiated in these situations did not seem to help the visitors to better understand the process of reconstructing the third Gokstad boat.

These categories are not absolute, nor are they mutually exclusive. There were situations were uncertainty and doubt led to a behaviour that was partly design-centred, and partly technology-centred. I will return to an example of such a situation later in the text. In the following, I will describe a series of observations that naturally belong in at least one of these two categories of situations.

7.2.1 Design-centred situations

The situations described in this section are those categorized as design-centred. In these situations, the teenagers expressed uncertainty and doubt, and started an activity directed towards the issues raised by the Gokstad boat exhibition.

A typical reflective activity in these situations are discussions going on amongst the participants. One example is a discussion that took place in the part of the exhibition dealing with the theme of model:

Three girls have just downloaded a video clip, and they are now watching it together. In the video clip, Terje Planke describes the process of making the model. He explains that many of the pieces from the third Gokstad boat were damaged and deformed and that it was often hard to tell their original shape. When the video clip is over, the girls turn to the posters to read. After a few second, one of the girls starts to read aloud a question from one of the posters:

> «How sure could Terje and Sven Erik be of their model and the choices they had made?»

One of the other girls responds:

> «Not much. Not 100 percent.»

The girl reading the poster says:

> «No, it could not be 100 percent. Because it was not accurate. They had to make guesses about the pieces that were missing.»

The other girl seems to agree, but she is still confused:

> «But I still don't get it!»

In this situation, digital technology is used to send the teenagers a piece of information that relates to the exhibits and posters in the area they are received. This situation may have to be interpreted as it is a result of the use of fragmented information. The girls have just seen a video clip describing the process of making the model, and they then turn to the poster where they are confronted with a question. They are obviously trying to make sense of the information, and it seems that they are trying to relate the information from the video clip to what they have just read on the poster.

In a second situation, digital technology is also involved, but it is not used to mediate information; rather, it is used as a tool for helping the teenagers to start and maintain a reflective activity:

Five girls read the question poster in the theme fragments, and decide to make an interview in order to answer the question. One of the girls is recording the video, and she takes on the role of interviewer. The following is an excerpt from her «interview»:

The four girls gather in front of the camera, and wait for the interview to begin. The girl with the camera now starts the recording, and says in a loud, theatrical voice:

> «And the question is: you are trying to put the pieces of the boat together, but one of them does not seem to fit in. What do you do?»

She then starts to interviews the four girls one by one. The first girl does not seem to know what to say:

> «I would have filled the empty spaces, I think. I would probably have put something there. And then I would have… maybe tried to… tried to…»

At this point, she is interrupted by the other girls, who start to discuss with each other. One of them says:

> «It is one thing that I don't understand; what is it that does not fit in? What is it that we can fit in? And what are we supposed to do?»

This girl is clearly confused. When asked, she tells the interviewer that she does not understand the question:

> «I don’t understand the question. I think I am a bit stupid. I cannot answer this question.»

The «microphone» is now handed to one of the other girls:

> «I would have tightened the holes using planks. And maybe applied some plastelina in the fractures.»

The last of the girls agrees, she would also have tried to tighten the holes:

> «I would have tightened them.»

The interview ends with a final comment from the girl that interviewed the others. She turns the camera towards herself and says:

> «And I… would have found another way to put the pieces together!»

This situation was one of several where the teenagers interviewed each other. In these situations, digital technology did not play the role as a mediator of information. It was however an important tool for starting the activities, and for supporting them along the way. The fact that the girls were in front of a camera, and that it would later be projected onto the screen, seems to have been an incitement to the whole situation. It is hard to imagine this kind of creativity and engagement if the mobile phones had not been involved.

The situation may be interpreted as it is the result of the use of contradictory information; the girls were confronted with a question that they tried to answer. To various degrees, they made use of their previous knowledge, information gathered in the exhibition, and their creativity, in order to *make sense* of the situation at hand.

An interesting element in this situation is that it is partly design-centred, and partly technology-centred. The girls were very aware of the technology involved. They were clearly posing in front of the camera, and some of them spoke in theatrical voices. In this situation, the awareness of technology did not seem to diminish their attention to the issues raised by the exhibition.

A third example in the category of design-centred situations is more explicitly related to technology use. In this situation, there seems to be a relationship between a usability problem, and a design-centred behaviour:

Three girls gather in the zone dealing with the models. Each of them has a mobile phone, and they are chatting together. One of them receives a text message where she is asked to confirm in order to receive a video clip. The girl confirms, and the video clip starts to download. She stares impatiently at the display, waiting for the download to complete. After a few seconds, she says:

> «This [time to download the clip] is taking a long time!»

Another girl, standing next to her, points to the poster and says:

> «It means that we must read this [poster], so we have something to do in the meantime.»

All three girls now turn to the poster and start to read. After a little while, the video clip finally downloads, and they watch it together.

In this situation, a usability problem surprisingly enough seemed to become an incitement to a reflective activity. The girls did not passively wait for the video clip to download, rather, they started a reflective activity of reading and learning about the exhibition. This kind of «slowness in use» is similar to that advocated by Hallnäs and Redström (2000).

It should be mentioned that even if these situations were observed, there were also many examples of participants that did not use the long download time to such productive purposes. In these situations, the slowness inherent in the system was merely seen as a problem. One such situation is described in the next section, which deals with technology-centred situations.

7.2.2 Technology-centred situations

The observations described in this section refer to what I have called technology-centred situations. In these situations, the teenager's uncertainty and doubt was followed by an activity concerned with technology, or technology use. In these situations, the teenagers could not *make sense* of technology. They did not know what to do, how to do it, or to figure out what to do next.

Most of the situations observed in the Gokstad boat exhibition were in this category, and many of them are concerned with problems related to sending or receiving messages using Bluetooth technology. The first example is intended to illustrate this general problem. It describes a situation where two girls are about to upload a video clip to the system:

One of the girls is in charge of the mobile phone while the other one is observing her actions. The girl with the mobile phone starts the procedure of uploading the video recording to the system. This is not necessarily an easy task. One has to find the correct receiver among several on a list, and then send the file with the video recording as an attachment. The girl with the mobile phone does not seem to have made any progress, and the other girl who is observing her says:

> «Well, you must push send!»

The girl with the mobile phone responds:

> «Yes, but then we will have to…»

The other one now interrupts her, saying with a loud voice:

«No! What are you doing?!»

She now leans over, and looks closely at the display. After a little back and forth, the girl with the mobile phone now to be on track. She is executing a series of commands on her mobile phone, as well as saying them out load:

«Send… Via Bluetooth… Start…»

At this point, her friend interrupts her again. This time screaming:

«No no no! Not Start!»

It turns out that the girl with the mobile phone had attempted to upload the message to the wrong receiver. The message should have been uploaded to the Bluetooth transmitter called *Model*, but the girl chose another one named *Start*. There is a short discussion, before the girl with the mobile phone finally succeeds in starting the transmission. She now lies down on the floor, and crawls under a table where the Bluetooth transmitter is located. She holds her mobile phone as close as possible to the transmitter in order to increase the transmission speed, and stays there for approximately 20 seconds.

A second example describes a problem of using a mobile phone. In this situation, a girl has decided to make a video recording of another participant. She is getting ready to shoot, and chooses the video mode on a menu on her mobile phone. She is pushing the button while she is saying the command out load:

«Video…»

Suddenly, a problem arises. She utters:

«Hello! What is happening?»

She now starts fumbling with her mobile phone. After a few seconds, she lowers it, and stares into the display:

«System error?»

It turns out that she cannot make a video recording as planned, but she elegantly solves this problem by taking a picture instead.

In the situations described in this section, the teenagers cannot *make sense* of technology. The girl with the video clip has problems with uploading it to the system, while the girl with the camera is not able to make a video recording of her friend. Both of them start to focus on the technology at hand, and their behaviour is what I have called technology-centred.

These situations are very similar to those that Winograd and Flores (1987) call *breakdown* situations. In these situations, the user becomes aware of technology. Technology does not work as expected, and therefore becomes «visible» for the user. From the perspective of task-efficient design, these situations are not wanted. This is related to the assumption about the «invisible computer». These kinds of situations are synonymous with usability problems.

In the previous section, I discussed how a usability problem seemed to cause design-centred behaviour for some of the participants; the slowness inherent in the BLIP system made some of the participants start a reflective activity directed toward the issues raised by the exhibition. It is worth noting that also in the situations discussed in this section, there were reflective activities going on. They were however not directed towards the issues raised by the exhibition; rather they were directed towards technology, or technology use. They were what I have called technology-centred. The girl who wanted her video clip to upload faster to the system, lay down on the floor and held her mobile phone as close as possible to the transmitter. The girl with the camera who could not make sense of how to record the video responded by taking a picture instead. Both of these situations are

excellent examples of reflective activities. These girls used both their knowledge and creativity in order to *make sense* of the situation at hand. Unfortunately, their energy was directed toward solving technological problems, *not* towards understanding the issues raised by the Gokstad boat exhibition.

These findings do, however, indicate another interesting use of ambiguity in the design of digital technology; namely the use of ambiguity as a mean to make the user explore and learn about the artefact itself. In such designs, the aim might be to increase the user's understanding of technology, or technology use. This can be seen as technology-centred *design*. In this kind of design, ambiguity can be used to make the user explore the functionality of the artefact, or its personal relations to digital technology. Holmlid (2004) addressed how surprise and confusion could be used to enhance an understanding of the artefact, while Gaver, Beaver and Benford (2003) discussed how ambiguity of relationship had the potential to make the user question her current understanding of digital technology and what they mean to her.

7.3 Making sense of the exhibition

The third research question formulated in the introduction was aimed at illuminating different aspects of user experience in the case of the Gokstad boat exhibition.

> 3. *How do the six processes of sense making apply to the case of the Gokstad boat exhibition?*

In this section, I analyse the case of the exhibition using the six processes of sense making as described by McCarthy and Wright (2004). I will illuminate different aspects of user experience in the case of the exhibition, and discuss how this insight can be of value when ambiguity is used as a mean to make the user start a reflective activity.

7.3.1 Anticipating – It was more fun this time!

When the teenagers during the group interview were asked how they felt about the Gokstad boat exhibition in relation to the pre-study conducted the preceding summer, they said that it was better this time, more «technological» as a girl said.

This experience of the pre-study obviously affected the teenagers anticipations for what to expect in the Gokstad boat exhibition. Also the pre-study made use of digital technology. The teenagers took pictures with their mobile phones and published them on a blog. But the Gokstad boat exhibition was even «better», and «more fun». The teenagers «… appeared on a big projector screen!».

How the teenagers made sense of the experience at the Gokstad boat exhibition was coloured by their anticipations building up as a result from their participation at the pre-study, but also other concerns, such as their experiences of other museums, or their attitudes towards school and their classmates.

For the use quality of ambiguity, the process of anticipating is important. I described several techniques that made actively use of ambiguity, and all of them were to some extent violating the users' expectations. McCarthy and Wright see the tension between anticipations and how they are eventually met as important for experience: «It is the relation between our continually revised anticipations and actuality that creates the space for experience» (McCarthy and Wright 2004: 124).

The Gokstad boat exhibition made use of digital technology in a new way. The visitors' mobile phones were used as media for interacting with the digital parts of the exhibition. This refers to what Gaver, Beaver and Benford call ambiguity of context. Did this kind of ambiguity make the visitors more eager to use their mobile phones, and in this way explore and learn about the exhibition?

It was not only the use of the mobile phones that was different, the projector screen and the context-aware system made the whole exhibition more «technological» than an average museum.

Anticipations are not solely building up *prior* to an episode or situation; they are also active *during* an experience or interaction with technology. The way anticipations are building up during our interactions with technology, and how they are eventually met, shapes the overall experience. McCarthy and Wright see this interplay as an ongoing dialogue between people and technology involved in an interaction.

The dialogue between anticipations and actualities is not restricted to a single experience or interaction; it also connects one experience to another. Using an artefact once give us certain anticipations for how to use it the next time, as we are trying to make sense of the interaction using our prior knowledge and experience. In this way the process of anticipating also points forward in time. This refers to how the teenagers' experiences at the Gokstad boat exhibition may be causing anticipations for similar, future events. It is interesting how the teenagers' experiences of using the mobile phone as a medium for interacting with the Gokstad boat exhibition, might change their anticipations for how to use it in other contexts.

7.3.2 Connecting – What can I do here?

When the teenagers entered the exhibition space for the first time, a girl looked around in the large room and immediately uttered:

> «Where are we supposed go?»

She then saw two of her friends, who were occupied in reading a display. She went over to them and asked:

«What are we to do here?»

In the Gokstad boat exhibition, the exhibits were scattered around in a single room, the atmosphere was open and ambiguous. No signs or clues indicated where the visitors were supposed to go. The girl's first response was uncertainty and confusion.

Her way of making sense of the situation relates to the process of connecting, which is seen as the first impact an experience has on our senses. It refers to the immediate, pre-linguistic understanding of the situation at hand. We encounter technology, and immediately make sense of what it is, or what it can do. For this process of sense making, features such as types, colours and sounds are important.

An understanding of the process of connecting can be a resource when designing for ambiguity. Connecting refers to of how the material components of the situation have an impact on us before we can make any sense of them intellectually. This can be used as a mean when designing for ambiguity of context. We can play upon the user's biased understanding of different genres of digital technology. A rather unfortunate example of this kind of is described by McCarthy, Wright and Meekeson (2003). They explain how people might make sense of the process of connecting when arriving at a particular site on the internet: «[a]n immediate impression of one frequently visited web-site is of redness and flesh tones which immediately gives an impression of sleaziness, yet on another closer inspection it is a quite respectable e-commerce site» (Wright, McCarthy and Meekison 2003: 49).

It is worth noting that the process of connecting refers to something that is not easily articulated or understood, but that still is important for the user experience. An interesting aspect in the case of the Gokstad boat exhibition is how the teenagers felt about coming to the exhibition. Did they get a sense of being at an exhibition, or did they feel like they were still at school? Or maybe an amalgam of the two? Did a feeling of being at a «technological» museum make them more willing to explore the exhibition?

7.3.3 Interpreting – The two edged sword of usability

The observations made evident that there were many usability problems in the design of the Gokstad boat exhibition. Most of the situations where the teenagers expressed uncertainty and doubt were caused by usability problems, and most of these situations resulted in an attention to technology, or technology use. Typical for these situations are comments like «What do I do?» or «I don't understand it!». In these cases, the teenagers could not make sense of the process of interpreting, which has to do with our practical understanding of technology during use. What is happening, and what is likely to happen next?

Most of these situations were related to sending and receiving messages using the Bluetooth technology. The unreasonably long transmission time for the video clips is one example of a usability problem, the difficulties related to finding and choosing the right receiver among a list of active devices, another. The use of Bluetooth technology was unfamiliar for most of the teenagers and it caused much uncertainty and confusion. In addition to these obstacles, there were also technical problems, such as mobile phones that could not find the Bluetooth transmitters, or mobile phones that did not support the file format sent to them by the system.

McCarty and Wright emphasize how the process of interpreting is a result of our anticipations. How we interpret a situation is changing over time as a result of our experiences during interaction with technology: «On the basis of our interpretation falling short of our anticipation, we may reflect on our anticipation and alter it to be more in line with our interpretation.» (McCarthy and Wright 2004: 125). This was clearly seen in the exhibition. As the teenagers gained more experience using the technology, the number of situations where they expressed uncertainty and doubt decreased. This was partly because they gradually learnt how to use the technology, but also because they changed their anticipations for how things were supposed to work. When they realized that the download time for the video clips actually were that long, they did not express uncertainty and doubt, but they may have felt bored or resigned.

None of the problems described in this section were foreseen or designed for, and it is obvious that they had an impact on the user experience. This can be illustrated by the girl who crept under the table in order to increase the transmission speed while uploading a video clip to the system. What was her user experience like in this situation?

Figure 10 A girl uploading her video clip to the system.

Usability and ease of use are traditionally important qualities of digital technology. However, when designing for user experience, they are not necessarily that important. Qualities such as inconsistency and ambiguous information, that are seen as problematic from the perspective of task-efficient design, may give a sense of thrill and excitement, or a sense of anxiety of not knowing what to do. When designing for user experience, these qualities may be just as important as ease of use.

The findings from the Gokstad boat exhibition point toward the difficulties related to designing for user experience, and to the rather unsettled relationship between usability and user experience. When we are designing for user experience, usability seems to become a two-edged sword. In some situations, usability and ease of use

is crucial for the user experience. In other situations, ignoring the rules of usability is necessary in order to obtain a certain quality of use.

7.3.4 Reflecting – Why are things going so slow?

There were situations were a usability problem started a reflective activity directed towards the issues raised by the Gokstad boat exhibition. In these situations, the teenagers seemed to be reflecting on what was happening, or how they felt about the situation. One example is the situation where a girl for the first time downloaded a video clip to her mobile phone. After a few seconds of waiting, she said:

> «This [time to download the clip] is taking a long time!»

In this case, the girl clearly made a judgment of the situation. In her opinion, the video clip downloaded too slowly. This corresponds to McCarthy and Wright's process of reflecting. This process is going on at the same time as interpreting, but we are not trying to make sense of what to do, rather we try to make sense of what the experience means, or how we feel about it.

Another girl who was observing the situation was also trying to make sense of why things were going so slowly. Her creative conclusion was that the slowness meant that the girls should read the poster while waiting for the video clip to download. As an answer to her friend's complaint, she pointed to the display and said:

> «It means that we must read this [poster], so we have something to do in the meantime.»

In this case, what I have called a design-centred situation started because of a usability problem. Instead of passively waiting for the download to complete, the girls started a reflective activity of reading and learning about the exhibition.

This kind of reaction to the slowness inherent in technology was by no mean obvious – most of the teenagers reacted in similar situations by focusing on technology, or technology use. One example of this is the girl who crept under the table in order to upload her video clip to the system. Even though she did not literarily say so, she probably thought that things were going a bit slow. Interestingly enough, the girl pointing to the poster, and the girl lying under the table, were the same person. In both situations, she made use of her creativity in order to make sense of the situation at hand. In the first situation, her efforts led to an activity concerned with the issues raised by the exhibition, in the latter, to a focus on technology.

I found two main uses of ambiguity in the design of the Gokstad boat exhibition: The use of fragmented information, and the use of contradictory information. In both cases, the design made the visitors actively make sense of the information at hand. They had to ask themselves why the information was contradictory, and how they could solve Planke's problems. This refers to the process of reflecting.

One example from the exhibition is the situation where the four girls were interviewed by a fifth girl who also recorded the event using her mobile phone. She confronted the others with a question from the theme fragments:

> «And the question is: you are trying to put the pieces of the boat together, but one of them does not seem to fit in. What do you do?»

There were several answers, one of the girls responded:

> «I would have tightened the holes using planks. And maybe applied some plastelina in the fractures.»

In this situation, the girls had to make use of the fragmented and partly contradictory information offered by the exhibition, but also their previous knowledge and a good portion of creativity, in order to make sense of the situation

at hand. Plastelina that the girl refers to is a modelling clay that would probably be excellent for tightening holes in a boat. This is of course not the «right» answer, but it is an example of how the use of ambiguity of information started a creative process of making sense.

7.3.5 Appropriating – Making sense and making self

An important feature in the Gokstad boat exhibition was the use of digital technology, and it seemed popular among the teenagers. In particular, the use of the projector screen was appreciated. A girl stated, excitedly, «We appeared on a large projector screen!». Do these findings indicate that the use of digital technology in the Gokstad boat exhibition made it easier for the teenagers to relate to the exhibition?

McCarthy and Wright argue that an important part of making sense of an experience is relating it to our own history and personal worldview. During the process of appropriating, we are thinking of an experience, trying to understand it, shaping it to fit our sense of self, and who we want to be. In this way, we are making the experience our own. The experience may change us, or how we see the world in general, but it may also be just another ordinary experience.

An incitement for using personal and social media in the Gokstad boat exhibition was an assumption that these technologies would make it more compelling for young people to learn about cultural heritage. The mobile phones and the blogs were seen as technologies to which the teenagers could relate. Did the use of mobile phones and blogs help the teenagers to relate to the past in a positive and engaging way? Moreover, did the use of ambiguity contribute to make this happen?

In the section dealing with the process of anticipating, I discussed how the extensive use of digital technology made the Gokstad boat exhibition a different kind of museum, and how the unusual way of using the mobile phone refers to an ambiguity of context. Did the use of the mobile phone in this way, change the

teenagers' understanding of what a mobile phone is, or what it might be? And more important for the RENAME project as such, did this way of using the mobile phone, change the teenagers' understanding of the museum, or their attitudes towards culture heritage in general?

What Gaver, Beaver and Benford called ambiguity of relationship was aimed at creating awareness and self-reflection in the user (Gaver, Beaver and Benford 2003, April 5-10). These designs are addressing and challenging people's sense of self. Löwgren and Stolterman say that acknowledging the usefulness of a parafunctional design is, at the same time, to «… discover new ways of seeing the world» (Löwgren and Stolterman 2004: 131). Parafunctional objects such as the Truth phone makes it hard to make sense of the process of appropriating. By solely imaging how to use this artefact, the user must necessarily confront herself with who she is, and who she wants to be.

The process of appropriating is difficult to address. Still, from the perspective of user experience, how people make sense of the process of appropriating is an important concern for design.

7.3.6 Recounting – Let's talk about it!

Many of the situations where the teenagers expressed uncertainty and doubt led to discussions. Often these situations were initiated by fragmented or contradictory information. A central element was the use of digital technology – for initiating discussions, but also for supporting them once started. The situations where the teenagers interviewed each other could hardly be imagined without ambiguous information, or the mobile phones used as a video recorder. In these situations, the use of digital technology was an important element in the teenagers' involvement in the issues raised by the exhibition. In particular, the use of the mobile phones as a video recorder seemed to engage the teenagers.

Figur 11 Four girls posing in front of the camera

An interesting finding was that these situations were both design-centred and technology-centred. This was seen very clearly in the situation with the girl who took the role as an interviewer and challenged four others with a question concerning the fragments. The girls spoke in theatrical voices and were clearly posing in front of the camera. In this situation, the girls were very aware of technology. Still, they were deeply engaged in solving Planke's problem of putting the fragments together. This is pointing towards a positive relation between an awareness of technology, and engagement in the issues raised by the exhibition. In this situation, the technology was highly visible, but it did not prevent the teenagers from engaging in the exhibition.

The process of recounting was also concerned with technology, and technology use. The teenagers occasionally gathered in groups where they discussed and solved their technological problems. These discussions were mostly initiated by some kind of usability problem, like how to download a video clip, or how to send a message. Also in these situations, the teenagers proved themselves as creative sense makers, but, unfortunately, it did not help them to gain a better understanding of the process of reconstructing the third Gokstad boat.

The findings make evident that the process of recounting was a natural and effective way for the teenagers to make sense of an ambiguous situation. In the Gokstad boat exhibition, recounting was mostly done orally, while digital technology was an important means for starting and supporting the process. The qualities of the digital material are, however, well suited to explicitly supporting the process of recounting. Wikis, blogs, and mobile phones, are all excellent examples of how digital technology can be used in this regard.

The main aim for using ambiguity in the design of the Gokstad boat exhibition was to make the visitors experience uncertainty and doubt, and in this way start some kind of reflective activity. The findings from the observations indicate that when ambiguity is used for this purpose, a vital concern may also be to motivate and support the reflective activities once started.

8 Conclusions

In this thesis, I have explored the case of the Gokstad boat exhibition, and addressed how ambiguity can be used to make the user start a reflective activity. In the introduction, I formulated three research questions. I will now revisit each of them, and present my most important findings.

The first research question was concerned with how the Gokstad boat exhibition made use of ambiguity in order to make the visitors experience uncertainty and doubt:

1. *How was ambiguity used in order to make the visitors experience uncertainty and doubt?*

I found two main uses of ambiguity in the case of the Gokstad boat exhibition: the use of fragmented information, and the use of contradictory information. The aim of both forms of ambiguity was to give a space for reflection, where the user had to bring together different perspectives in a creative way in order to *make sense* of the situation at hand.

In the case of the fragmented information, the visitors received pieces of information that had to be interpreted in relation to each other, and to the exhibition seen as such. The dealings with contradictory information made it possible for the visitors to interpret the content of the exhibition in a variety of ways. It opened up a space for reflection, where the visitors actively had to make sense of a story on their own.

The second research question's aim was to bring forth the situations in which the visitors expressed uncertainty and doubt:

2. *In what situations did the visitors express uncertainty and doubt?*

Based on the empirical material gathered during the observations, I found two broad categories of situations that made the visitors express uncertainty and doubt:

- Design-centred situations
- Technology-centred situations

The design-centred situations refer to observations where the teenagers' uncertainty and doubt led to some kind of reflective activity related to the issues given in the exhibition. The technology-centred situations refer to situations where uncertainty and doubt solely led to an awareness towards technology, or technology use.

Most of the findings were categorized as technology-centred, and these situations were, overall, a result of some kind of usability problem. There were, however, also observations of design-centred situations which seemed to arise from usability problems.

The last research question was aimed at further elaborating on the use of ambiguity as a resource for design. I wanted to use McCarthy and Wright's six processes of sense making in order to illuminate the various aspects of user experience that needs to be considered when ambiguity is used as a means to make the user start a reflective activity. The third research question was:

3. *How do the six processes of sense making apply to the case of the Gokstad boat exhibition?*

To answer this question I related each of the six processes of sense making to the design of the Gokstad boat exhibition, and to the empirical findings collected during the observations and the group interview.

This activity illuminated a diversity of concerns that are all valid from the perspective of user experience. It brought forth a range of aspects that affected how the teenagers made sense of their experiences in the exhibition.

The six processes of sense making and their underlying pragmatic philosophy shed light on how user experience is something personal and situated. How the teenagers *made sense* of their interactions with technology was coloured by their previous experiences and knowledge, how they perceived themselves and the situation they were in, but also their hopes and dreams for the future.

The findings made evident that the most natural and effective way that the teenagers made sense of the ambiguous situations they encountered in the exhibition was by oral discussion. I found that in these situations digital technology was important for supporting and motivating these activities.

The empirical findings from the Gokstad boat exhibition showed that usability is a valid and important concern; also from the perspective of user experience. It is, however, difficult to know when to obey the rules of usability, and when to ignore them. When designing for user experience, there is a need to balance the utility of ambiguity against the utility of usability and ease of use. How this can be solved is not obvious.

This is pointing towards a general problem: designing for user experience is complex. The case of the Gokstad boat exhibition showed that there is a range of concerns that must be balanced against each other, and many of these will necessarily vary from case to case.

When designing for user experience, there is a need for a nuanced view on how a system should, or can, be interpreted. Not only in terms of how it should be used, or what it can do, but also in terms of how it makes sense for the individual. These kinds of concerns cannot be captured in a set of heuristics or design guidelines.

This does not, however, mean that design knowledge cannot be expressed or cultivated. In the method chapter, I described how Löwgren and Stolterman advocate an approach based on «articulation». They see a designer's knowledge of product qualities as an ongoing debate, and argue that statements can be given in the form of a design concept or, likewise, a «... written or spoken analysis, where a core quality of a certain artifact genre or class of use situations is identified.» (Löwgren and Stolterman 2004: 102).

The case of the Gokstad boat exhibition was an experimental design project exploring the use of digital technology in an exhibition setting. This thesis has reported on the design and use of the exhibition. I have illuminated the case from the perspective of user experience, and have discussed how the exhibition made use of ambiguity in order to design for uncertainty and doubt. In this regard, this thesis must be seen as a statement in the debate described by Löwgren and Stolterman. I hope it can make a small contribution, and in this way help to enrich, and possibly expand, the language of design.

8.1 Further research

The Gokstad boat exhibition made use of ambiguity in two main ways: by offering fragmented information, and by offering them contradictory information. This kind of ambiguity is what Gaver, Beaver and Benford (2003, April 5-10) call ambiguity of information. There are, however, alternatives. In this thesis, I have introduced several other ways of using ambiguity as a resource when designing for user experience. The findings from the Gokstad boat exhibition also indicate that other forms of ambiguity can be used with a positive effect; the slowness inherent in the BLIP system offered «extra time» that some of the participants used for reflective or productive activities. Further experimentation and empirical investigations into the use of different kinds of ambiguity will contribute to a better understanding of how such concepts can be of value for design.

My understanding of user experience in this thesis is adopted from McCarthy and Wright (2004). I made use of the six processes of sense making and their underlying pragmatic philosophy. The six processes can be seen as a conceptual way of understanding and addressing different aspects of user experience. They provide a conceptual understanding of user experience, but they do not give advice on how to design for certain qualities of use. In order to address the qualities of use sought for in the case of the exhibition, I utilized what Löwgren and Stolterman (2004) call the use quality of ambiguity. I found that the combination of the six processes of sense making and the use quality of ambiguity was a powerful way of addressing user experience in the case of the Gokstad boat exhibition.

It comes across as fruitful to combine these two sets of concepts, using a conceptual framework for understanding user experience in general, and then apply a certain quality of use. It would be interesting to apply this methodology to other applications, aimed at offering other qualities of use than that those strived for in the exhibition. For example, in order to address user experience in the case of an internet bank, the six processes of sense making could be combined with use qualities forging a sense of *stability, security*, and *trust*. In a different application, the six processes may be combined with other use qualities, forging other qualities of use. As the six processes of sense making apply on user experience in general, they can also be used to better understand the various use qualities, and possibly help characterize them in a more nuanced way. This was the case for the use quality of ambiguity.

This thesis has addressed how digital technology can be used in order to design for user experience, and my object of study has been the Gokstad boat exhibition. What I have not discussed is how the act of introducing digital technology into an exhibition necessarily alters the experience of going there. If we *choose* to introduce digital technology into a museum environment, we also *choose* to suppress some of the qualities offered by a traditional exhibition. These qualities are not easily articulated, and they are not necessarily recognized before they are gone. As researchers and designers, we cannot only be aware of what digital

technology can *do*, in terms of forging a particular user experience, we also need to reflect on how introducing such technology is apt to *change* the existing experience. How digital technology shapes existing practices is addressed by Löwgren and Stolterman (2004). They see this as a use quality inherent in the digital material:

> It is not difficult for the designer to change user's social action spaces. Any change in the man-made environment, any new artifact, brings with it some kind of change in the social action space. The hard part is to predict the outcomes; the future social activities around the new artifact. (Löwgren and Stolterman 2004: 106)

This notion of the social action space points towards the need for addressing the broader implications of designing digital technology. My focus in this thesis has been on the experience of digital technology on an individual level. Given the apparently endless technological development of digital technology, there is an increasingly need to look at *social*, *cultural* and *ethical consequences* of computers and computer use. This development urges designers and researchers to hail a pluralism of approaches to human-computer interaction, some going beyond the perspective taken in this thesis.

9 Literature

Alben, L. (1996). Quality of experience: Defining the criteria for effective interaction design.

Blythe, M. (2003). *Funology : from usability to enjoyment.* Dordrecht: Kluwer Academic Publishers.

Blythe, M., and Wright, P. (2007). User Experience Research as an Inter-discipline: Towards a UX Manifesto. *Towards a UX Manifesto* (pp. 65-70). Lancaster, UK: COST294-MAUSE affiliated workshop.

Crampton Smith, G., and Tabor, P. (1996). The role of the artist-designer. In T. B. Winograd, *Bringing design to software* (pp. 37-57). Reading, Mass: Addison-Wesley.

Desmet, P. (2003). From Disgust to Desire: How products Elicit Emotions. Hekkert, McDonagh, van Erp (Eds).

Dix, A. (2003). Deconstructing Experience - pulling crackers apart. In M. A. Blyth, *Funology: From Usability to Enjoyment* (pp. 165-177). Dordrecht: Kluwer Academic Publishers.

Dix, A. (1993). *Human-computer interaction* . New York: Prentice-Hall.

Dourish, P. (2001). *Where the action is : the foundations of embodied interaction.* Cambridge, Mass.: MIT Press.

Dunne, A. (2006). *Hertzian Tales: Electronic products, aesthetic experience and critical design.* Cambridge, Mass.: MIT Press.

Dunne, A., and Raby, F. (2001). *Design noir: The secret life of electronic objects.* London Basel: August Birkhäuser.

Ehn, P. (1989). *Work-oriented design of computer artifacts, 2nd edition.* Stockholm: Arbetslivscentrum.

Fahle, I. (2008). *User created content as aid in the creative process. Master thesis.* Oslo: University of Oslo, Department of informatics.

Flyvbjerg, B. (2006). Five misunderstanding about case study research. *Qualitative inquiry , 12* (2), 219-245.

Forlizzi, J., and Battarbee, K. (2004). Understanding Experience in Interactive Systems. *DIS2004, August 1-4.* Cambridge, Massachusetts, USA: ACM.

Gaver, B., and Martin, H. (2000). Alternatives: Exploring information appliances through conceptual design proposals. *CHI '2000* , 209-216.

Gaver, W., Beaver, J., and Benford, S. (2003, April 5-10). Ambiguity as a resource for design. *Human Factors in Computing Systems (CHI '03 Proceedings)* (pp. 233-240). Ft. Lauderdale, Florida, USA: ACM.

Hallnäs, L., and Redström, J. (2000). Slow Technology: Designing for reflection. In J. Redström, *Designing everyday computational things, doctoral thesis Göteborg University* (pp. 161-191). Göteborg: Göteborg University.

Hassenzhal, M., and Tractinscy, N. (2006). User experience - a research agenda. *Behaviour and Information Technology , 25* (2), 91-97.

Hassezahl, M. (2003). The thing and I: Understanding the relationship between user and product. In M. A. Blyth, *Funology: From Usability to Enjoyment* (pp. 31-42). Dordrecht: Kluwer Academic Publishers.

Helander, M. G., Landauer, T. K., and Prabhu, P. V. (1997). *Handbook of Human-Computer Interaction, 2nd completely revised edition.* Amsterdam: Elsevier.

Holmlid, S. (2002). *Adapting user: Towards a theory of use quality, doctoral thesis Linköping University.* Linköping: Department of Computer and Information Science, Linköpings universitet.

ISO. (1998, January 1). *ISO 9241-11:1998.* Retrieved November 13, 2008, from ISO 9241-11:1998: http://www.iso.org/

Kapor, M. (1996). A software design manifesto. In T. B. Winograd, *Bringing design to software* (pp. 2-9). Reading, Mass.: Addison-Wesley.

Kaye, J., and Taylor, A. (2006). What Does Science Know about Experience? Alternatives Approaches to Evaluating User Experience. *UX WS NordiCHI'06: COST294-MAUSE,* (pp. 16-21).

Kluge, A. (2005). *Progressive interaction design for the metamedium : an investigation into interactive meaning-making. Doctoral dissertation.*

Oslo: Department of Informatics, Faculty of Mathematics and Natural Sciences, University of Oslo Unipub.

Laurel, B. (1993). *Computers as theatre.* Reading, Mass.: Addison-Wesley.

Law, E., Hvannberg, E., and Hassenzahl, M. (2006). Foreword UX WS NordICHI'06. *UX WS NordICHI'06: COST294-MAUSE* (pp. iii-v). Oslo: Nordichi.

Löwgren, J., and Stolterman, E. (2004). *Thoughtful interaction design : a design perspective on information technology.* Cambridge, Massachuetts, USA: MIT Press.

McCarthy, J., and Wright, P. (2004). *Technology as experience.* Cambridge, Massachusetts, USA: MIT Press.

Nielsen, J. (1993). *Usability engineering.* Boston, Mass.: Academic Press.

Norman, D. (2004). *Emotional design : why we love (or hate) everyday things.* New York: Basic Books.

Norman, D. (1988). *The design of everyday things.* New York: Basic Books.

Norman, D. (1998). *The invisible computer : why good products can fail, the personal computer is so complex, and information appliances are the solution.* Cambridge, Mass.: MIT Press.

Preece, J., and Rogers, Y. (1994). *Human-computer interaction.* Wokingham: Addison-Wesley.

Preece, J., Rogers, Y., and Sharp, H. (2002). *Interaction Design: beyond human-computer interaction, 2nd edition.* New York: Wiley.

Punch, K. (2005). *Introduction to social research: quantitative and qualitative approaches* (2nd edition ed.). London: Sage publ.

Rogers, Y. (2003). New theoretical approaches for human-computer interaction. *Annual review of Information Science and Technology , 38* (1), 87-143.

Shedroff, N. (2001). *Experience design 1.* Indianapolis: New Riders.

Shneiderman, B. (1987). *Designing the user interface: Strategies for effective human-computer interaction.* Reading, Mass. : Addison-Wesley.

Silverman, D. (2005). *Doing qualitative research : a practical handbook.* London: Sage.

Stage, J. (2006). Defining and Measuring User Experience: Are they two sides of the same coin? *UX WS NordiCHI'06: COST294-MAUSE*.

Stuedahl, D. (2008, October 25). *Gokstadbåtprosjektet*. Retrieved October 25, 2008, from http://www.intermedia.uio.no/display/gokstad/Gokstadbatprosjektet

Stuedahl, D. (2008, October 31). *Rename*. Retrieved October 31, 2008, from http://imweb.uio.no/rename/

Stuedahl, D., interview by S. Bakken. *Interview* (November 5, 2007).

Weiser, M. (1991, September). The computer for the 21st century. *Scientific American* , pp. 94-104.

Winograd, T., and F., F. (1987). *Understanding computers and cognition : a new foundation for design.* Reading, Mass. : Addison Wesley.

Winograd, T., Bennet, J., De Young, L., and Hartfield, B. (1996). *Bringing design to software*. Reading, Mass.: Addison Wesley.

Wright, P., McCarthy, J., and Meekison, L. (2003). Making sense of experience. In M. Blythe, *Funology: From Usability to Enjoyment* (pp. 43-53). Dordrech: Kluwer Academic Publishers.