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Design-inclusive UX research: design as a part of doing user experience research

Arnold P.O.S. Vermeeren^{a*}, Virpi Roto^b and Kaisa Väänänen^c

^aDepartment of Industrial Design, Delft University of Technology, Delft, The Netherlands; ^bSchool of Arts, Design and Architecture, Aalto University, Helsinki, Finland; ^cHuman-Centered Technology (IHTE), Tampere University of Technology, Tampere, Finland

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Since the third wave in human–computer interaction (HCI), research on user experience (UX) has gained momentum within the HCI community. The focus has shifted from systematic usability requirements and measures towards guidance on designing for experiences. This is a big change, since design has traditionally not played a large role in HCI research. Yet, the literature addressing this shift in focus is very limited. We believe that the field of UX research can learn from a field where design and experiential aspects have always been important: design research. In this article, we discuss why design is needed in UX research and how research that includes design as a part of research can support and advance UX design practice. We do this by investigating types of design-inclusive UX research and by learning from real-life cases of UX-related design research. We report the results of an interview study with 41 researchers in three academic research units where design research meets UX research. Based on our interview findings, and building on existing literature, we describe the different roles design can play in research projects. We also report how design research results can inform designing for experience methodologically or by providing new knowledge on UX. The results are presented in a structured palette that can help UX researchers reflect and focus more on design in their research projects, thereby tackling experience design challenges in their own research.

Keywords: UX research; design-inclusive research; research through design; research for design

1. Introduction

Traditionally, research in the field of human–computer interaction (HCI) has had its main focus on developing approaches, methods, techniques, and tools for user-centred design. As Cockton (2012) points out, the role of design in user-centred design has been much smaller than that of understanding users and evaluating the designs. HCI research has studied users and the usage of interactive systems, and evaluated usability of the designs. The actual creation of products, the design activity, has played a minor role in HCI research. However, as the focus of HCI has moved towards user experience (UX), a better understanding is needed of what creates a good experience, and more effort is needed in investigating emotional, rather than only utilitarian, aspects of designing interactive products. Designing for emotions or experiences is a different kind of challenge from designing for usability, since avoiding and fixing usability problems are tasks aimed at avoiding negative consequences of using a product or system use, while designing for UX requires looking for design opportunities that may affect people's emotions in a positive way. This requires more empathy and design skills from the designer, and creates new challenges also for research, since UX researchers will also need to expand their scope from analytical studies to creative and generative studies.

The role of design has thus become more important for HCI research, especially for UX research, and the issue of how to integrate design activities into UX research has become more and more relevant.

In this article, we address this issue by reaching out to design research (including Interaction Design research), where there is much experience in integrating design in research. There have been several laudable attempts in the Interaction Design research community to increase the knowledge of the HCI community on design research (e.g. Fallman 2003; Zimmerman, Forlizzi, and Evenson 2007; Zimmerman, Stolterman, and Forlizzi 2010; Wiberg 2013), for example, by introducing various design research approaches. Presenting these approaches was an important step forward. In our study we go one step further and offer a structured overview, or *palette*, of the field of design-inclusive UX research that further details general approaches that were found in the literature. We do this by learning from projects of design researchers who wanted to improve UX design practice by integrating design in their research. We formulated two research questions for developing such a structured palette:

RQ1: Why can it be useful to include the act of designing in UX research; specifically, what are the roles that design activities can play in UX research?

*Corresponding author. Email: a.p.o.s.vermeeren@tudelft.nl

RQ2: How can UX research that includes the act of designing, as a part of the research advance UX design practice; specifically, what outcomes can it produce for advancing UX design practice?

In our research, we first studied the literature for frameworks describing design research relative to our research questions and then interviewed UX design researchers on (1) how they combine research, design, and UX in their research; (2) what kinds of research results they produce; and (3) the role design¹ plays in their research projects.

1.1. Concepts and scope

When reaching out to another research field, there are typically different interpretations of the terminology, so before proceeding, we will clarify the key terms. In a 2010 Dagstuhl seminar, 34 UX researchers and practitioners agreed on the following formulation for experience and UX:

The notion of experience is inherent to our existence as people. Experience in general covers everything personally encountered, undergone, or lived through. User experience differs from experiences in a general sense, in that it explicitly refers to the experience(s) derived from encountering systems, where ‘encountering’ can be interpreted as using, interacting with, or being confronted passively, and where ‘system’ is used to denote products, services, and artifacts – separately or combined in one form or another – that a person can interact with through a user interface. (Roto et al. 2011, 6)

In our study, we have adopted the above view on what UX entails as the starting point, because it corresponds to our understanding of the scope of UX research. However, naturally, our interviewees may have had a different understanding of these terms, and we did not stimulate them to adopt the above perspective.

The concept of UX is so widely used that UX research is sometimes considered equal to HCI research. In our view, UX research always relates to people’s subjective feelings, whereas HCI research does not necessarily do so (e.g. the focus can also be more on objective usability aspects or on development of interactive technologies). Although our focus was on studying UX aspects in design

research, our present article may be of interest to all HCI researchers wanting to include design in their research.

We define *UX research* as research in which there is a focus on advancing the field of UX design, for example, research studying the phenomenon of UX (such as research on how experiences are formed or what people may experience, expect to experience, or have experienced), finding the means (materials, technologies, etc.) for designing systems that enable particular UXs, or studies investigating and developing UX design and assessment methods (cf. Roto et al. 2011, 5). Borrowing the terminology from, for example, Frayling (1993) or Zimmerman, Stolterman, and Forlizzi (2010) we could call this *Research for (UX) Design*. We will use the term *design-inclusive UX research* to refer to UX research where design activities form an integral part of the research, that is, design as a part of, and contributing to UX research. Thus, again borrowing from Frayling (1993) and Zimmerman, Stolterman, and Forlizzi (2010) we could also call this *Research through Design for UX Design (RtD for UXD)*. Figure 1 shows the scope of our research, which is design-inclusive UX research.

As the outcome of the research, we aim to provide a structured palette of design-inclusive UX research elements for researchers who conduct or consider to conduct such research, and that helps them reflect on ways in which design can contribute to their (intended) research projects (RQ1) as well as informs them about the types of outcomes that can be produced through such research (RQ2). The metaphor of a palette implies that the researchers and research managers can pick research elements from a set of research element descriptions (like artists picking colours from a painter’s palette), and ‘mix and match’ those elements when they want to include design activities in their UX research.

We want to note that we are not studying the work of *designers* in this article, but rather the work of *design researchers*, that is, we do research on design research. With this focus, we hope to advance the research field of design-inclusive UX research by structuring much of the already ongoing research in this field.

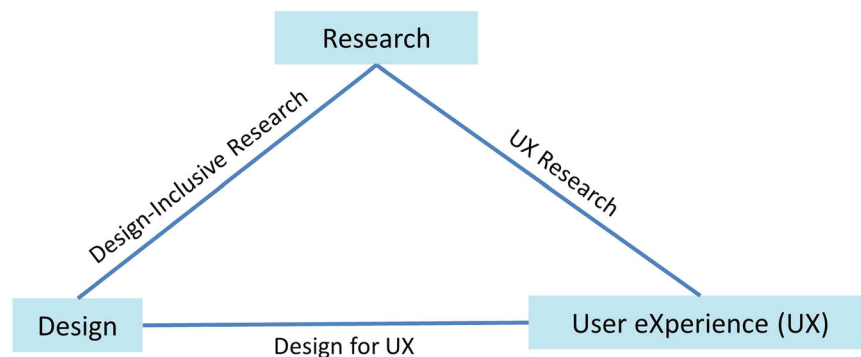


Figure 1. Design-inclusive UX research is design-inclusive research in which the word *design* should be interpreted as UX design, and in which *research* should be interpreted as research contributing to the field of UX design.

2. Related research about design-inclusive research

In this section, we analyse literature related to our research questions and our search for a structured palette of design-inclusive UX research. There is a good amount of literature that has analysed the different types of design research, but we are now primarily interested in the differences between the design research types regarding the role of design in research and the type of research outcome in those cases where design has been used as a means of research.

We focus on types of research in which the act of designing contributes to, and is a part of the conducted research. We will refer to this as ‘Design-Inclusive Research’, a term we borrowed from Horvath (2008) who defines it as follows:

The most important feature of design-inclusive research is that it embeds “design” as a research means. ‘Design’ as a research means may be an artefact, process, entity, phenomenon and knowledge. The goal of inclusion is to create new opportunities for generating new knowledge, which cannot be derived otherwise (Horvath 2008, 77).

Similarly, Stappers (2007, 87) states that ‘the designing act of creating prototypes is in itself a potential generator of knowledge (if only its insights do not “disappear” into the prototype, but are fed back into the disciplinary and cross-disciplinary platforms that can fit these insights into the growth of theory)’.

In this article we use the term ‘design-inclusive UX research’ (instead of just ‘Design-Inclusive Research’) as an umbrella term for design-inclusive research that contributes to new knowledge for the field of *UX design*. In the literature, various frameworks can be found relating design to research, and we believe it is fruitful to study those for developing our structured overview of design-inclusive UX research approaches.

2.1. Design-inclusive research for science and technology development

Driver, Peralta, and Moultrie (2011) studied design contributions to scientific research and thereby give us some insights into the role of design in research projects (RQ2). They focused on ‘bringing in’ design expertise into a scientific environment and studying the kind of collaboration between scientists and designers that would occur. Based on a literature review, interviews, and case studies, they identified barriers and enablers for such collaboration as well as contributions of design to scientific research, such as: prototyping for quick testing of ideas, challenging scientists’ perceptions, assisting with communication and dissemination of research, and creating technology demonstrators. Note that although Driver et al.’s study deals with a form of design-inclusive research, the research mentioned is not aimed at advancing design practice (cf. RQ2); rather, it is design-inclusive research for science and technology development only. In the following sections this is different.

2.2. Research for, about/into and through design

In the field of Art and Design, Frayling (1993) introduced a categorisation of Research in Art and Design, derived from Herbert Read’s (1944) work on Education through Art. Frayling distinguishes Research *for* Art and Design, Research *into* Art and Design, and Research *through* Art and Design. Based on Frayling (1993), Zimmerman, Stolterman, and Forlizzi (2010) used a similar categorisation for the field of Interaction Design research: Research *for*, *about* and *through* Design.

According to Zimmerman, Stolterman, and Forlizzi (2010) Research *for* Design (RfD) represents a type of research that focuses on improving design practice and that may yield outcomes such as frameworks, philosophies, design recommendations, design methods, and design implications. Frayling (1993) is less clear in his definition. He refers to it as ‘research with a small “r” in the dictionary – what Picasso considered was the gathering of reference materials rather than research proper’. However, both Frayling (1993) and Zimmerman, Stolterman, and Forlizzi (2010) refer to RfD as research aimed at outcomes that feed into (art and) design practice.

Research about (or into) Design (RaD) focuses on understanding the human activity of design (Zimmerman, Stolterman, and Forlizzi 2010), or ‘its rules and procedures’ (Frayling 1993). Specifically, Zimmerman, Stolterman, and Forlizzi (2010) state that:

Theory on design grows naturally from research on the design process, creating knowledge about how and why people design. The goal of this type of theory is to move towards a unified understanding of the human activity of design, rather than to provide theories that help practitioners improve the practice of design. (313)

Zimmerman, Stolterman, and Forlizzi (2010) found examples of such research mentioned by designers, philosophers, rhetoricians, social scientists, and others. In RaD, designing may or may not be embedded as a means of research. For example, a form in which design is not embedded as a means of doing research is when it is solely the object of investigation (e.g. studying ongoing design projects, and not undertaking any design activities specifically for the research study).

According to Zimmerman, Forlizzi, and Evenson (2007), Research *through* Design (RtD) refers to the process of iterative and creative design where the created artefacts themselves are the outcome of the research. Zimmerman, Forlizzi, and Evenson (2007) state that in RtD, ‘design researchers focus on making the right thing; on artefacts intended to transform the world from the current state to a preferred state’ (497). In doing so, design researchers engage with what they call ‘wicked problems’ (Rittel and Webber 1973) – ‘problems that because of the conflicting perspectives of the stakeholders cannot be accurately modelled and cannot be addressed using

the reductionist approaches of science and engineering' (Zimmerman, Forlizzi, and Evenson 2007, 495) and that they have 'no "solutions" in the sense of definitive and objective answers' (Rittel and Webber 1973, 155). In Zimmerman, Forlizzi, and Evenson's (2007) interpretation of RtD, design researchers try to gain an understanding of the particular situation they will be designing for, by making prototypes, products, and models, that at the same time provide a concrete framing of the problem and a description of the proposed, preferred state. This interpretation of RtD is an example of what Stolterman and Wiberg (2010) call 'situation-driven design research', which involves a design process aimed at the creation of artefacts addressing 'real world' (societal, often 'wicked') problems. Although Zimmerman, Forlizzi, and Evenson (2007) borrowed the term RtD from Frayling (1993), Frayling seems to adopt a much broader view on what RtD could be. He mentions examples such as: materials research, development work and action research. However, he does not define RtD in an operational way. In 2010 Zimmerman, Stolterman, and Forlizzi (2010) also adopted a broader view on RtD, by defining it as 'a research approach that employs methods and processes from design practice as a legitimate method of inquiry', and as 'an approach that can lead to theory for design, and possibly to theory on design'. The term Design-Inclusive Research as we use it in this article can be seen as a synonym for RtD in its broader interpretation (cf. Frayling 1993; Zimmerman, Stolterman, and Forlizzi 2010).

In the literature we can find many design research approaches that Frayling (1993) and Zimmerman, Stolterman, and Forlizzi (2010) would and Zimmerman, Forlizzi, and Evenson (2007) would not see as RtD approaches. For example, Stolterman and Wiberg's (2010) concept-driven design research is 'an exploratory investigation of established theories with the overall aim of improving and widening the range of theory and knowledge' (102). The concept-driven approach produces knowledge primarily for the internal theoretical development of 'interaction' as an object of study. The resulting conceptual constructs and interaction theories can be used in interaction design and research. Thus, in contrast to the tightly focused interpretation of RtD as defined by Zimmerman, Forlizzi, and Evenson (2007) in which designs are created in response to and are expected to deal with 'wicked' or societal problems, in concept-driven design 'the actual design outcome, as a design that addresses real-world issues, is not necessarily important' (Stolterman and Wiberg 2010, 101). Another design approach that Frayling (1993) and Zimmerman, Stolterman, and Forlizzi (2010) would probably consider to be RtD and Zimmerman, Forlizzi, and Evenson (2007) would not, is Hoby and Löwgren's (2011) research-through-explorative-design approach, which leans on 'sketching with technology', experimentation in the sense of making and trying out prototypes in the lab and in the field,

and in which the goal of the experiments is to develop an understanding of the experiential qualities of the design materials. Yet another approach to design research would be Gaver et al.'s design for ludic engagement which aims 'to offer a new perspective on how technology might fit into our everyday lives' (Gaver et al. 2004, 899).

We conclude that Zimmerman, Stolterman, and Forlizzi (2010) and Frayling's (1993) categorisations relate to our research questions in the following way:

- (1) The definitions of RfD (Frayling 1993; Zimmerman, Stolterman, and Forlizzi's 2010) suggest that its *outcomes* are meant to feed into design practice (contributing either to a specific design project, or – more generally – to the field of design practice). With respect to the types of outcomes Zimmerman, Stolterman, and Forlizzi' (2010) provide an unstructured set of general examples, such as frameworks, philosophies, etc. One of the aims of our research is to study what types of outcomes can be expected or aimed for in Research for UX design (see research question 2 which is about outcomes).
- (2) For RaD, the definitions (Frayling 1993; Zimmerman, Stolterman, and Forlizzi 2010) only state that the outcomes *could* be useful to design practice, but that they do not necessarily *have* to be. In those cases where it informs design practice, RaD can be interpreted as a specific form of RfD. In our study, we focus on RfD (see research question 2), so we will only deal with RaD that can be seen as a specific form of RfD.
- (3) With respect to RtD, Zimmerman, Stolterman, and Forlizzi (2010) mainly states that the act of designing plays an integral role in the research, but leaves open what that role could be. Frayling (1993) is not very specific in how exactly he defines RtD, but his interpretation seems to be largely similar to Zimmerman, Stolterman, and Forlizzi (2010) definition when it comes to the role of design activities in research. The term Design-Inclusive Research we use in this publication can be interpreted as a synonym for Zimmerman, Stolterman, and Forlizzi's (2010) interpretation of RtD. However, to us, the term RtD seems to suggest that design is the *major* or the *most important* part of the research. For this reason we prefer to use the term *Design-Inclusive Research*: it clearly indicates that design is part of the research (it is a means to an end), but it leaves open to what extent design plays a role in the research. One of the aims of our research is to provide a structured overview of the possible roles design can play in design-inclusive UX research (or RtD for UX design).

In the above conclusions we already noted that we focus on RtD for (UX) Design (a form of RtDfD) and that in some cases also RaD can be interpreted as a specific form of RfD. Indeed, as Yee (2010) showed, in her overview of design PhD projects, Frayling's (1993) categories are not mutually exclusive: two of the projects Yee studied are at the same time RtD, RaD and RfD. We conclude that Frayling's distinction between RtD, RaD, and RfD can be helpful in analysing design-inclusive UX research projects, but cannot be expected to provide a framework for categorising such projects. Even though in this publication we will use the term design-inclusive UX research and discuss findings in terms of roles of design in the research as well as possible outcomes of the research, we will, in our explanations, also refer to Frayling's (1993) and Zimmerman, Stolterman, and Folizzi's (2010) terms, as these are well-known terms in design research.

2.3. Constructive design research

In their book on design research, Koskinen et al. (2011) introduce the term 'Constructive Design Research' for 'design research in which construction – be it product, system, space, or media – takes centre place and becomes the key means in constructing knowledge' (5). By analysing the construction of prototypes, scenarios, mock-ups, or detailed concept descriptions design researchers can generate new scientific knowledge. This definition comes close to Horvath's (2008) definition of design-inclusive research, which we see as a more comprehensive term. For example, design-inclusive research could also take the form of investigating ongoing 'design processes' (design as an object of study), without actively participating or intervening in the design activities. Such research would not be termed Constructive Design Research as no construction activities are undertaken specifically for the research. Koskinen et al. (2011) identify three design research programmes which they identify as 'lab, field and showroom', and trace them back to different research traditions. Although this may be a useful distinction in some cases, it does not directly relate to our intentions with respect to the structured overview we are searching for (i.e. our research questions). The book does provide a large number of inspirational examples of constructive design research projects in which design played various roles and which led to a large variety of different outcomes, but it does not provide a structured overview of these roles, nor of the types of outcomes that can be produced. In Frayling's (1993) terminology most of Koskinen et al.'s (2011) 'lab' and 'field' examples seem to be forms of a combination of RtD and RfD (i.e. RtDfD), whereas the 'showroom' examples seem to refer to RtD but not to RfD. For example, the most influential programme in 'showroom' research is critical design (Koskinen et al. 2011, 90), which is a form of RtD aimed at contributing to society rather than a form of RtDfD (and thus it is outside the scope of our study).

2.4. Conclusion of the related work

A number of overviews categorising types of design research have been discussed. The various design research approaches mentioned above provide a rich view on design in the context of research. However, we conclude that none of the overviews satisfied our needs of specifying the roles design can play in research, or the outcomes that can be expected from design-inclusive UX research. In the following section we describe interviews we conducted with design researchers for developing our own structured palette for design-inclusive UX research.

3. Methodology

To understand current approaches in integrating design and UX research, we planned a study with the aim of collecting information on such research cases. To be able to properly investigate the topics of our research questions, we chose thematic interviews (Astedt-Kurki and Heikkinen 1994) as the research method, and targeted at researchers who bring design, research, and UX together. We recruited the interviewees from three research units in Europe where design-inclusive UX research takes place, see Section 3.1. The topics in the interviews were broader than those in our research questions, as through the 1–2 hour interviews we wanted to gain a picture of the interviewees' research that was as holistic as possible. We wanted them to tell us the stories of their projects in much detail, so that we could get a deep understanding of the characteristics of the projects, and distil from their stories the answers to our research questions. In this article, we will present the key findings and some example research projects from our interviews.

3.1. The academic research units

Aalto University is a newly created university from the merger of three Finnish universities; Helsinki School of Economics, University of Art and Design Helsinki, and Helsinki University of Technology. What is now known as the School of Arts, Design and Architecture has given art and design education for over 138 years. In our study, we interviewed people from two departments, Design and Media. The main streams of research at the Department of Design are user-centred design, cultural design, and sustainable design research. The department has a strong tradition in participatory design. UX has belonged to the research focus since late 1990s.

The main concern of the faculty of Industrial Design Engineering at Delft University of Technology is to study, innovate, and improve the development of durable products and their related services for people, on the basis of the balanced interests of users, industry, society, and the environment. Its motto is: 'creating successful products people love to use'. Research in the faculty traditionally

has a strong focus on design. The aim of the faculty's UX research programme is to understand how people experience products and services, to be able to measure such experiences and to support designers in designing for them.

The Mobile Life Centre at Stockholm University is a VINNOVA² Centre of Excellence. The centre conducts consumer-oriented research on mobile and ubiquitous services spanning all areas from entertainment and socialisation to work and society. The centre joins forces with local research organisations and has partners from the IT and telecom industry, both in Sweden and internationally. Most of the research projects in the centre produce functional prototypes that can be taken to a field, to study them with the end users. Thus, design research at the Mobile Life Centre largely stems from various disciplines of Interaction Design (HCI).

In this article, we refer to the research units by the identifying part of the university name: Aalto, Delft, and Stockholm.

3.2. Interviews and interviewees

We conducted thematic interviews (Astedt-Kurki and Heikkinen 1994) with 41 design researchers and research managers at three research units: 16 interviewees at Aalto, 16 interviewees at Delft, and nine interviewees at Stockholm. The interviewees were chosen based on their research topics and expertise areas, which we wanted to be close to design in terms of dealing with experiences. Although not all researchers considered UX design to be their primary research topic, their research largely related to UX as we defined it in the Introduction. We interviewed researchers in different roles: research managers (6), researchers (26), and people who act in both roles (9).

Each interview took 1–2 hours and was conducted by a visiting researcher from another university. After clarifying some background information, the semi-structured interviews focused on three themes:

- research context (topic, goal, projects, and role in project team)
- researcher's relation to UX (interpretation of UX and the role of UX in research)
- research practices (project phases, user involvement, the role of design in the research, and research outcomes).

The three topics served to gain a deep understanding of the interviewees' projects. Each of the topics was addressed using various questions to provide various perspectives or entrances from which to start discussing the projects (see Table 1 for the main questions). For example, for getting an answer to research question 1 (about the roles of design in research), various questions were asked around the topic of the research practice (e.g. designer's

role in the team, relation between design and research in the project, character of the project, and project phases). This led to insights beyond strict answers to the research questions. In each interview all main themes were covered, even though it was not always possible to ask all questions due to time restrictions. Table 1 provides an overview of the answers to the interview questions, structured around the individual questions. This is presented as background information, illustrating the diversity of the projects.

3.2.1. Interviewees' backgrounds

To get a feel for the interviewees' backgrounds, we asked how they would position themselves in terms of research fields. We did that in two ways: in terms of publication venues and in terms of the communities the researchers feel they belong to.

The interviewees mainly publish in journals and conferences that have their origins in HCI (38 were mentioned; e.g. CHI, NordiCHI, and INTERACT) and Design (34 mentioned; e.g. DPPI, Design & Emotion, and Co-Design Journal). Another substantial category is 'conferences with their origin in Computer Science' (nine mentioned; e.g. Siggraph, and Pervasive Technologies). Other publication venues mentioned included areas such as Human Perception (4), Business (3), Psychology (2), and five others (all mentioned once).

Looking at the communities the interviewees feel they belong to, we can identify Design as the largest category (mentioned by all 41 interviewees), followed by Computer Science (17), HCI (14), and Behavioural and Social Sciences (13). Only two mentioned UX as their community. Other categories that were mentioned included Business (3), Theology and Philosophy (2), IT for Civil engineering (2), Cultural history (2), and six others that were mentioned only once.

3.2.2. Interviewees' views on UX

In addition to interviewing researchers on their backgrounds, we also asked them about their views on UX, instead of feeding them one interpretation of UX. We asked them an open, difficult question: 'What is UX?' The purpose of this question was to better understand the perspective from which interviewees answered the other questions, rather than as results related to our research questions. However, as the answers to this question proved to be rather interesting, we nevertheless decided to present them here.

Interviewees approached this question in different ways. Seven researchers described UX in relation to other disciplines or to usability. They noted that UX reaches a broader set of disciplines than traditional HCI, and that UX is not the same as usability.

A majority of interviewees (32) described some qualities that UX has, that is, what kind of phenomenon

Table 1. Result of initial processing of the individual interview questions, illustrating the diversity of projects and interviewees.

<p>1. What is UX, in your view? <i>(Interviewees' approaches to answering this question)</i></p> <p>A field of study (7) UX vs. other disciplines (3) UX vs. usability (4)</p> <p>A phenomenon (32) Conscious (5) Inside a person (7) Momentary (6) Long-term (3) Perceived quality (2) Situational (10) Other (2): richness, UX</p> <p>Practice (8) UX as central focus in design (2) UX as a tool towards another design target (2) Challenges in UX design (2) Other (3)</p> <p>Focus not on UX (10) Not interested in a product (5) Study practices, not UX (3) A different theoretical basis (2) Other (3)</p> <p>Terminology comments (7) Experience vs. UX (3) Dislikes 'user' (2) Complex term (2)</p>	<p>Interaction (5) Bodily interaction (4) Robots (1) Social aspects (6) Long-term impacts (5) (Engagement, Attachment, Change mindset, Values, Socio-technical changes) Sustainability (5) User interface (4) Management (3)</p>
<p>2. What is your research topic? What aspect of UX do you focus on?</p> <p>Experience (20) What is UX (4) UX formation process (3) Effect on behaviour (3) UX over time (2) Meaning and/or value (2) Other (3)</p> <p>Ways of designing (28) Method analysis (3) Method development (5) Approach development (7) Process (4) Designing for other cultures (3) Digital materials in design (2) Empathic design (2) Designer's thinking (2)</p> <p>Context design (5) Public places (4) Multisensory environment (1)</p>	<p>3. What was the research goal? Support designers (19) Theory (9) Change behaviour (6) Create better world (4) Wellbeing (4)</p> <p>4. What were the research outcomes? Approach (6) Tools (10) Design (10) Scientific knowledge (7)</p> <p>5. What is the designer's/design researcher's role in the research? Creating new designs (7) Method developer (6) Facilitator/expert (4) Building prototypes (3) Problem solver (2) Conversing with design materials (1) Contact to users (1) Focusing on experience (1)</p> <p>6. How do design and research relate in design research? Hands-on design as part of research: to learn by doing (7); to solve novel situational design problems and explore methods to do so (4); to create a design specifically to answer research questions (7). to coordinate activities (1)</p> <p>7. What is the character of a design research project? RtD (mostly situation-driven design) (18) Focus on building theory or frameworks (9); Pure research on design (not through design) (1)</p>

Notes: The numbers in brackets refer to number of times mentioned. Note that an interviewee might have mentioned more than one item.

UX is. They mentioned that UX is something conscious (not merely subconscious), perceived quality, inside a person, momentary and/or long-term, or situational. In these descriptions, we noticed a variety of different perspectives to UX, for example:

UX is a mental awareness of human product interaction. Experience is often on the conscious level and not on the unconscious level. (D10r)

We can explain experience just as bodily experience. It is hard to find an example of mind experience. (A8r)

Eight people approached the 'what is UX' question by describing its role in practice: UX was considered as either being the core of any design activity (2) or rather as something that helps to reach another design goal, such as changing behaviour (2). Two interviewees also mentioned that UX is difficult to work on due to its subjective and

complex nature. Other practice-related comments considered a UX research focus on designer's experience, user interface, or value.

Seven interviewees from Aalto and Stockholm wanted to make remarks about terminology. Three of them preferred the term 'experience' to 'user experience', and two others disliked the term 'user'. Two interviewees noted that the term is so complex that it is unlikely that it can ever be defined.

Ten interviewees explained why their main focus is not on UX: five of them said that UX is about interacting with a product, but that their research is not about a product. Three interviewees studied practices or behaviour rather than experience, and two simply said they come from a different theoretical basis and thus do not use the term UX. Other reasons included: focus on affordances rather than experiences, experiences rather than UX, or dislike of some connotations that UX has:

For me, UX has more the feel of usability on which you slap an experience component. We study experience more broadly. (S6r)

These last answers led us to conclude that for many researchers in these units UX is not the right term, and many would prefer to use plain 'experience' rather than 'user experience'.

3.2.3. Processing the interview data

The interviews were audio recorded, and notes were taken during the interview. Artefacts used in the interviews (documents, products, sketches made during the interview, etc.) were collected by the researchers, or pictures were taken of them. Each interviewer transcribed the interviews into a Word file, with pictures of artefacts added to the transcription. The person who transcribed the interviews manually marked statements that related to the topics of interest. For each interview session transcript, each statement was given a code identifying the interviewee and a unique number identifying the statement. The part of the code that identifies the interviewees (e.g. A1r, D5m, or S3mr) refers to the interviewees' affiliation (A = Aalto, D = Delft, S = Stockholm), identity (indicated by a running number), and the role of the interviewee (m: manager, r: researcher, and mr: manager/researcher). To this code a unique identifier was added per statement. Thus all statements were uniquely identifiable using codes such as: D4r-14 (Delft interviewee number 4, who is a researcher, statement 14). An Excel sheet was made with one worksheet per interview question. For example, a worksheet for 'role of the designer in the team', for 'view on UX', etc. The data were shared amongst the researchers using GoogleDocs, so they could collaboratively work on it. Statements from the transcriptions were then copy-pasted with their codes at appropriate places into the data sheet. Categories, subcategories and subsubcategories emerged by grouping similar statements through copy-paste actions in a collaborative

process with all three researchers, which involved several rounds of turn taking and of Skype meetings discussing the intermediate results. Table 1 provides an overview of the answers to the interview questions.

3.2.4. Analysis of the data

After processing all interview data as explained above, one researcher processed the statements against the two main research questions. Findings about the *role of design activities in research projects (RQ1)* were derived mainly from statements in response to question 5 (role of designer in the research), question 6 (relation between design and research, in design research) and question 7 (character of the design research project). Insights regarding our RQ2, *how the research outcomes support UX design work*, were collected mainly from the answers in response to questions 2 (research topic), 3 (research goal), and 4 (research outcomes). Note that the answers to our research questions did not result from the categorisation depicted in Table 1, but from the 'raw' individual statements in the Excel sheet (i.e. directly taken from the stories of research projects the interviewees told us). The statements were coded with emergent coding, focusing on the two research questions. One of the other researchers reviewed the resulting categorisation and disagreements were resolved through discussion among the three researchers. First, in Section 4, three example research projects will be discussed. Then, in Section 5 the results of our study (i.e. the answers to our research questions) will be presented in the form of a structured palette for design-inclusive UX research.

4. Example projects

Since our goal is to provide a better understanding on why and how to include design activities in UX research, we highlight three different examples of research projects from three different research units. The projects were described by interviewees and we show how they relate to our research questions in the end of each case description.

4.1. Designing an authentic experience of swimming through an old ship wreck: the Vrouw Maria project (A4mr)

The *Vrouw Maria* was an eighteenth-century Dutch vessel that sank in Finnish waters on its way to Saint Petersburg. An interactive, real-time, virtual reality simulation of the *Vrouw Maria* shipwreck has been created as part of an exhibition at the Maritime Museum of Finland (<http://sysrep.aalto.fi/vrouwmaria/>).

The research project was a collaborative design research project with many disciplines involved. For the interviewee, who was project leader, a crucial question was 'how to let visitors of the exhibition have an experience of



Figure 2. Users experiencing *Vrouw Maria* shipwreck through virtual reality simulation. Photographs by Lily Diaz, January 2012.

navigating and exploring the shipwreck, and which feels authentic to them'. Authenticity of experiencing simulations is a larger research theme the interviewee's research group is working on, and into which this project fits.

The research project took the form of a design project in which an actual installation was built, under the real-life constraints of a museum and of available technology. Real-life constraints included, for example, logistic constraints, such as 'the maximum time people can spend at the installation' (how can you achieve an authentic experience in seven minutes maximum, when a real dive to the ship wreck would take much longer?), and technological constraints, such as 'being able to recognise people's gestural intentions when they try to navigate through the virtual ship wreck' (e.g. making swimming movements would be a natural way of navigating, but these proved to differ too much across individuals. Hence simple gestural movements were designed for navigating, while still trying to induce an experience of authenticity).

An installation such as the one developed for this exhibition provides a future picture of how underwater places can be made accessible to a larger audience (e.g. in the context of UNESCO's theme Underwater Cultural Heritage: <http://www.unesco.org/new/en/culture/themes/underwater-cultural-heritage/>) (Figure 2).

The role of design in this example project was to create novel ways to improve the authenticity of the experience (RQ1). The research supports experience design by providing knowledge on experiences, specifically how knowledge of new technology, such as gesture recognition, affects the experience (RQ2).

4.2. Improving designer's skills to design for experience (D2r)

The Design for Usability project (<http://www.designforusability.org>) studies how designers can deal with usability issues, not as a separate thing, but as integrated in the

design process: how to design for situated use. In the project, D2r develops a design workshopping process and tries to find ways in which the designers can learn about situated use. She aims to get a picture of how designers design situations, and develop tools and techniques that would fit in that picture. She believes that designers need to study use through observation and experiencing rather than through reading theories, so she has focused on the different ways to observe situated use.

D2r has been conducting several half-day design workshops where she teaches the observation methods to design students and tries them out. She collects usage data by observation and by interviewing the students after the workshop. After the workshop, she analyses the data and changes the observation methods so that they better address situatedness and the experiential aspects of use. So far, the tools and techniques have gone through six iterations.

The role of design in this research example was to iteratively develop (generate and try out) new design methods, techniques and tools (RQ1). It supports experience design by producing new methods, tools, and techniques (RQ2).

4.3. Designing a biofeedback system to study how people reflect on their bodily experiences (S3mr)

In the Affective Health project (Ståhl, Höök, and Kosmack Vaara 2011), researchers studied people's reflections of their bodily reactions and experiences. A system measures pulse, movement, and arousal level through bio-sensors attached to one's body. It transfers the sensor data to the mobile device in real time, and then the person looks at his or her own data through patterns visualised on the mobile user interface (Figure 3).

The aim was to study everyday life, social life, and one's body in one. Rather than focusing on an accurate analysis of one's bio signals, the aim was to empower users



Figure 3. Affective Health system allows users to reflect on their life experiences based on their biosensor data. Source: Courtesy of Mobile Life Centre.

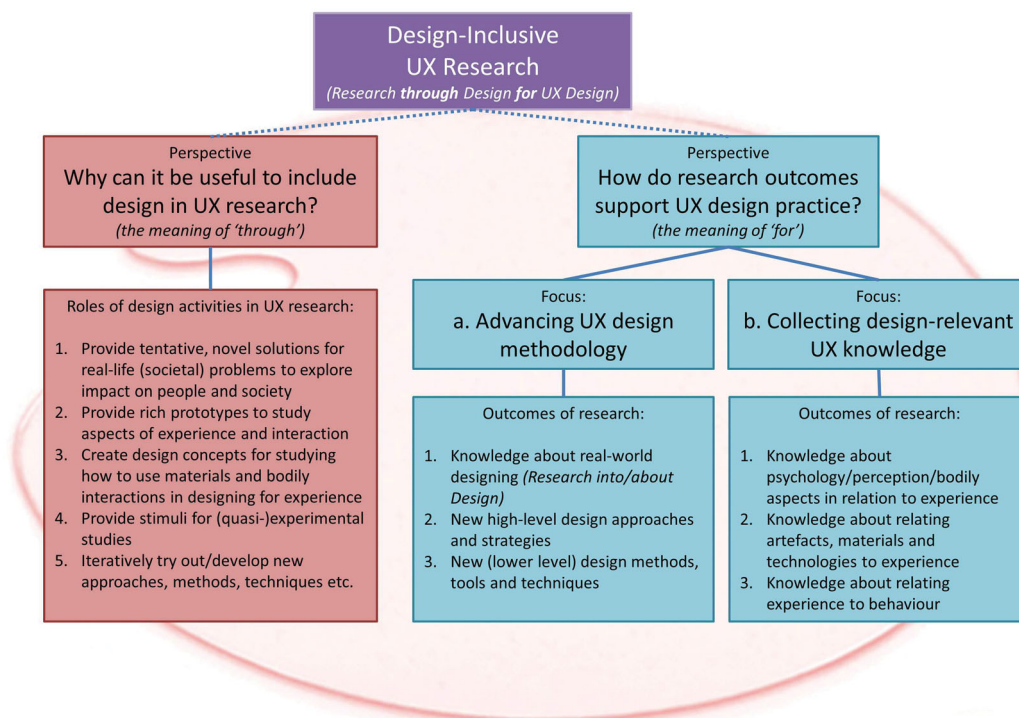


Figure 4. Structured palette for design-inclusive UX research. In this context we will refer to design-inclusive UX research, also as *RtD for UXD*. The palette is meant to help design researchers reflect on possible design research approaches by letting them combine elements from the two different perspectives. These two perspectives are seen in the two parts of the palette: the left-hand part focusing on the ‘through’ and the two right-hand parts focusing on the ‘for’ in RtD for UXD.

to make their own reflections and interpretations of their own biosensor data. People would then learn to understand their emotional and bodily reactions and experiences on a more meaningful level. New design qualities such as those related to the aims of familiarity, interpretative visualisation, and complementary modalities were employed in the design and evaluation of the system.

The role of design in the research example was to develop experiential design examples, enabling exploration of the bodily experiences and reflections (RQ1). It supports experience design by advancing an understanding

of how bodily aspects can be reflected with the novel visualisation in the mobile user interface (RQ2).

5. Structured palette for design-inclusive UX research

In this section, we present the answers to our two research questions in the form of what we metaphorically named a structured palette for design-inclusive UX research (Figure 4). We call it a palette because just like painters use their palettes to mix colours in creating a

Table 2. Roles that design can play in design research.

Why can it be useful to include design in UX research? Roles of design activities in UX research (<i>the meaning of 'through' in Research through UX Design</i>)	
1. Provide tentative, novel solutions for real-life (societal) problems, to explore impact on people and society	D1r, D6r A4mr, A6r, A13r, A14r
2. Provide rich prototypes to study aspects of experience and interaction	D13r, D14r A2r
3. Create design concepts for studying how to use materials and bodily interactions in designing for experience	S1r, S2r, S3mr, S4r, S5r, S6r, S7r, S8mr
4. Provide stimuli for (quasi-)experimental studies	D10r
5. Iteratively try out/develop new approaches, methods, techniques, etc.	D2r, D6r A7r, A11r, A12r, A13r

Note: Codes in the right-hand column represent individual interviewees.

painting, researchers can mix elements from this palette when developing a plan for their design-inclusive UX research projects. The palette provides elements that help a researcher reflect on why including design in the research may be a good idea, as well as on the possible research outcomes one can aim for. In Section 5.3, we will give an example of how the palette may be used. Tables 2 and 3 with their explanations provide a more detailed description of our results (i.e. the elements of the palette).

5.1. Why can it be useful to include design in UX research: roles of design activities in UX research

To address our first research question, Table 2 provides an overview of five roles design can play in UX research projects.³ In terms of Frayling's (1993) framework this concerns a further specification of the 'through' in Research through UX Design.

Provide tentative, novel solutions for existing real-life (societal) problems to explore the impact on people and society (1): design activities are being undertaken to tentatively come up with novel solutions for existing real-life problems, based on new perspectives to the problem, which may be taken from the start or may emerge during the design process itself. The resulting products or prototypes exemplify a possible new future, and can be used to explore the impact they may have on people and society. This category closely relates to the perspective on RtD as expressed in Zimmerman, Forlizzi, and Evenson (2007). Although in Zimmerman, Forlizzi, and Evenson's (2007) tightly focused interpretation of RtD this can be interpreted

Table 3. Different ways in which research can support experience design.

How do research outcomes support UX design practice? (<i>the meaning of 'for' in Research for UX design</i>)	
<i>a. Advancing UX design methodology</i>	
1. Knowledge about real-world designing (<i>research into/about design</i>)	D12r A5mr, A15r
2. New high-level approaches and strategies	D1r, D5 m, D6r A7r, A8r, A11r, A12r, A13r
3. New (lower level) methods, tools and techniques	D2r, D11mr, D16r A1r, A7r, A10r
<i>b. Collecting design-relevant UX knowledge</i>	
1. Knowledge about psychology/perception/bodily aspects in relation to experience	D4 m, D10r, D13r, D14r A14r S3mr, S6r, S7r
2. Knowledge about relating specific artefacts, materials and technologies to experience	A2r, A4mr, A6r S1r, S2r, S4r, S5r, S8mr
3. Knowledge about relating experience to behaviour	D3mr, D15r A3r, A17r

Note: Codes in the right-hand column represent individual interviewees.

as RtD done for society, rather than for Design, in our framework we assume that the research is also done as RfD (i.e. it also aims at one or more outcomes of the two types as described in the two right-hand parts of Figure 4 and in Table 3; e.g. outcome b3). In Stolterman and Wiberg's (2010) terminology this concerns situation-driven design research.

Examples: 'developing interventions on streets, that aim to make people think about their environment, and that bring participation and engagement' (A6r); 'designing solutions based on social practice theory, which help people manage their energy consumption, and implementing these solutions in "living labs"' (D6r); 'creating an experience for museum visitors which simulates swimming through a ship wreck, with a focus on making such an experience feel like an authentic experience'. (A4mr)

Provide rich prototypes to study aspects of experience and interactivity (2): design activities are undertaken to create variants of rich prototypes with the aim to systematically study aspects of interaction and experience with them. The resulting prototypes may look like products, but are not primarily intended to solve specific real-life problems or paint a picture of what the future could bring; rather, they are carefully crafted with the aim to embody and study specific aspects of interactivity or experiences. This category closely relates to Stolterman and Wiberg's (2010) concept-driven design research approach.

Examples: ‘my ambition is to create knowledge that helps all designers, not just those within a specific company, therefore I need the freedom to experiment with the design in a way that makes sense to my research questions about finding nuances in positive emotions’ (D14r); ‘developing moodboards and different ship design proposals for studying how to communicate sustainability qualities of ships in the very early design stages’. (A2r)

Create design concepts for investigating how to use materials and bodily interactions in designing for experience (3): This category focuses on exploring new design spaces for future interactions. Usually such projects start from new materials, new technologies, from applying known materials and technologies in new domains, or from designing novel ways of interacting with artefacts that are sensorially richer or more meaningful than conventional interactions. This category resembles most the ‘sketching with technology’ approach discussed by Hoby and Löwgren (2011).

Examples: ‘exploring in workshops what kind of aesthetics can be created when forms are made of stearin’ (S1r); ‘exploring through successive design projects how biofeedback can be used to provide data in such a way that to the users, it really feels as if they are watching themselves’ (S2r); ‘designing to explore what kind of experiences one can have when involving multiple parts of your body in interactions’. (S3r)

Provide stimuli for (quasi-) experimental studies (4): Designing stimuli representing specific product qualities, in a systematically controlled way, but decontextualised, for use in (quasi-) experimental settings in the lab. This category comes close to design-inclusive research done for science and technology development (see the research by Driver, Peralta, and Moultrie (2011) in Section 2.1). The difference is that in case of Driver et al.’s research the aim was not to apply the findings in a specific development programme or project, whereas in our example case the study was done to develop scientific knowledge in the context of a concrete programme for developing alarm systems. This makes our example a combination of RfD and design for science and technology development, whereas Driver’s study was conducted for science and technology development only. Of course, one could argue that all scientific findings at some point in time will be applied and that this makes the distinction between the two a distinction of *when* the outcomes will be applied, rather than *if* they will be applied. However, what matters here is that we identified a form of design for science and technology development with a relatively short time span of application and that can thus be interpreted as also being RfD. Therefore, it needs to be included in the palette.

Example: ‘designing sounds based on systematically varying sound parameters to learn about properties of sounds for functional sound feedback in alarm systems that do not annoy people’. (D10r)

Iteratively try out/develop new approaches, methods, techniques, etc. (5): Design for trying out and further

developing new approaches, strategies to design, or specific new methods, tools, workshop set-ups, techniques, etc.

Examples: ‘Observing designers in design workshops (and then improving the workshops), which are aimed at finding out ways in which actual product use can effectively be fed back into design process’ (D2r); ‘Doing and further developing design games with stakeholders, as a process of involving them in the design process’. (A11r)

5.2. How can research outcomes support UX design work?

Table 3 provides an overview of results relating to our second research question of how research outcomes can support UX-related design work.⁴ In terms of Frayling’s (1993) framework this concerns a further specification of the ‘for’ in Research for UX Design. We distinguished two main types of support: (1) *advancing design methodology* and (2) *collecting design-relevant UX knowledge*.

5.2.1. Focus on advancing UX design methodology

In this category of support, we distinguish between three types of design methodological outcomes.

Knowledge about real-world designing (a1): Learning about how design takes place in practice (in industry and institutes) by studying without much intervention what the current practice is, what barriers and enablers designers are confronted with, what perspectives to design are taken, etc. In Frayling’s (1993) terms, if done for advancing UX design methodology, this concerns Research into/about Design.

Examples: ‘what are, in real-world practice, barriers and enablers for doing user-centred design’ (D12r); ‘how does innovation of products occur in the real world’. (A15r)

New high-level design approaches and strategies (a2): Attempts to come up with new approaches or strategies that are on a more abstract level than individual methods or techniques. New perspectives are sought in which to ground the entire design or development project (or at least a substantial part of it). Concrete methods and tools can then be developed to be used within such new approaches.

Examples: ‘how can you design for connectedness of people, based on the principle of letting people self-organise this connectedness’ (D1r); ‘how can social practice theory be used in design’ (D6r); ‘trying to define what it means to be human, what ontology is used for that, in the views of design researchers, and from there: develop new methods and tools’ (A8r); ‘developing co-design approaches’. (A11r, A12r)

New (lower level) design methods, tools, and techniques (a3): Here the scope is usually that of methods, tools or techniques for dealing with specific design or evaluation questions/issues, for example, a specific generative or evaluative technique within an individual development/design phase.

Examples: ‘developing methods to evaluate experiences in the field’ (D16r); ‘developing an experience evaluation tool for the very early phases of product development’. (A10r)

5.2.2. Focus on collecting design-relevant UX knowledge

We distinguished three types of UX-related research based on the type of UX knowledge they intend to collect. These three categories focus on UX as a topic of research: characteristics of, preconditions for, triggers for, and pragmatic consequences of experiences.

Knowledge about psychology/perception/bodily aspects in relation to experience (b1): This category of projects focuses on understanding how experiences come about in humans, and on understanding psychological and perceptual aspects in relation to experience; so, experience as a human phenomenon. Similar to category 4 of Roles of Design Activities in UX Research, such research can also be interpreted as design for science and technology development. Again, however, in our case it concerns a focus on collecting knowledge for application in an embedding design programme.

Examples: ‘what should functional sound feedback be like so that it does not annoy people’ (D10r); ‘what does it take for people to feel stimulated to engage in cooperative learning’ (A17mr); ‘what kind of experiences can you have when multiple parts of your body are engaged in an interaction’. (S3r)

Knowledge about relating specific artefacts, materials, and technologies to experience (b2): This category focuses on ways of using design materials effectively and creatively for letting experiences emerge. The design materials are the primary starting point here.

Examples: ‘how can I make people engage with every day public places’ (A6r); ‘using unexpected materials (like stearin) to find out what kind of aesthetics/aesthetic experiences can be created with that’. (S1r)

Knowledge about relating experience to behaviour (b3): What role do or can experiences play in people’s behaviour? People may change their behaviour if they believe or feel that the change of behaviour will lead to a better experience. Designers may use that to their advantage to influence people’s behaviour (e.g. Persuasive Design).

Examples: ‘what kind of user experiences can trigger behaviour change in people’ (D15r); ‘what design strategies can I use in design to make people want to use their clothing longer’ (A3r); ‘how can I design spaces (e.g. in churches) in such a way that people will behave in a certain way’. (A17mr)

5.3. Illustration of how to apply the structured palette

We envision the palette to be primarily of use in planning and considering approaches for a new research project or in reflective stops⁵ within ongoing research projects. We

will illustrate its use with imagined examples, based on the *Vrouw Maria* research project (see Section 4.1).

In the *Vrouw Maria* project a Maritime Museum wanted to have an installation that can provide people with the experience of visiting an existing ship wreck at the bottom of the sea, through a virtual reality installation. As one of the general research themes for the involved research team was to study how simulations can evoke experiences that are felt as authentic, they treated the design of the installation in a way that we would call design-inclusive UX research. Thus, for the team the main design challenge was: ‘how can we provide visitors of the Maritime Museum with the experience of exploring a sunken ship wreck to which they do not have access in reality, but that still feels authentic to them’? In terms of research the main aim was to ‘learn about experiencing authenticity when experiencing simulations’. This was the ongoing research theme of the group.

In a real-life project, such as the *Vrouw Maria* project, designs can be used in different ways to address various sub-research questions that can help in trying to meet the main research challenge as best as possible. Our structured palette can facilitate structuring one’s thoughts and reflecting on possible approaches. Below we will describe a few examples illustrating how this can lead to different research approaches in terms of roles of design and types of answers to the main challenge.

The main challenge of ‘learning about experiencing authenticity when experiencing simulations’ suggests that in terms of the palette a logical starting point would be ‘b. Collecting design-relevant UX knowledge’ (Figure 4, right-hand block). However, as a real-life installation needed to be built for the museum, one can also imagine that one of the research interests could at the same time be to use the project as a case study for learning about how to develop novel installations in the real world (e.g. how to deal with conflicting interests and concerns of a variety of stakeholders in design). That would suggest another possible research opportunity, facilitating learning about the process of designing for experiences in general (i.e. Figure 4, a.: Advancing Design Methodology). In the next sections we will illustrate how the palette would help in further reflections on adopting such starting points.

5.3.1. Example: collecting design-relevant UX knowledge as a starting point

If the focus is on collecting design-relevant UX knowledge, there are at least three possible kinds of knowledge one could strive for to generate (see Figure 4, right-hand block). We will discuss two of them: (1) striving to generate knowledge with a focus on ‘psychology/perception/bodily aspects in relation to experience (Figure 4, b1)’ and (2) striving to generate knowledge with a focus on ‘relating artefacts, materials and technologies to experiences’ (Figure 4, b2).

A focus on psychology/perception/bodily aspects in relation to experience can lead to research questions, such as: ‘would it be necessary, for an authentic experience, that visitors make realistic swimming movements to simulate the underwater movements, or can they also use other gestures’? Inspired by part of the palette about the possible roles of design (Figure 4, left-hand block), one can then think of at least three ways in which design can be helpful in answering such a question:

- One can design stimuli for use in experimental settings to study bodily gestures and how those are experienced (Figure 4, design role 4). This usually means conducting a comparative study, with conditions differing in one or two precisely defined variables, based on some theoretical considerations. For example, condition 1 could be: *participants are free to use their whole body*, and condition 2 could be: *whole body movement is restricted; only arms can be moved*. In this case, the design part would consist of developing two interaction styles, for doing some abstracted, standardised navigational task, as well as designing the standardised, abstracted environment for the task. A set-up like this may be characterised as an experimental study (Kumar 2014).
- Another approach suggested by the palette would be to ‘develop prototypes specifically developed for testing assumptions about how people experience different ways of moving around under water’ (i.e. Figure 4, design role 2). In such an approach virtually moving around under water would not necessarily take place in the complex context of the ship wreck, but could, for example, be integrated in some simple computer game with different interactive ways of virtually moving around under water. Thus, the environment would be more rich and engaging than in the previous approach, but would not necessarily be a realistic simulation of a ship wreck. Such kind of prototypes can be considered similar to what in Lean UX would be called a Minimum Viable Product—the prototype that is minimally needed to test the riskiest assumptions behind a design proposal (e.g. Ries 2011). Like in the previous approach one can also think of a study with comparative settings, however without reducing the differences between the prototypes to a single variable, because the prototypes are holistically designed artefacts and changing one single aspect could make them unconvincing, thus spoiling the experience. Such a study design will usually not be that of a strict experimental study, but can have the character of a quasi-experimental study (Kumar 2014).
- A third approach related to this research question could be to involve users in generating underwater navigation gestures that feel natural to them. In

such a case one could think of generative sessions in which groups of users would, for example, brainstorm about possible gestures by performing those in response to specific tasks (e.g. how can you make underwater navigation movements when keeping your two hands palm-to-palm together?). See Väänänen-Vainio-Mattila, Olsson, and Laaksonen (2012) for an example of such a study, focusing on generating gestures in the context of social devices.

In some cases a design or research team may have come across some technology or material and want to explore to what extent the technology or material can provide a promising new experience. In such a case, a focus on ‘relating artefacts, materials and technologies to experiences’, inspired by the b-part of the palette (Collecting design-relevant UX knowledge), most likely leads to researchers considering research outcomes of type b2 (Figure 4: *Knowledge about relating artefacts, materials and technologies to experience*), rather than of type b1 (Figure 4: *Knowledge about psychology/perception/bodily aspects in relation to experience*). In the presented example, one can think of designs based on, for example, new motion sensors, or new feedback mechanisms, to explore to what extent those may lead to experiences that are perceived as authentic in relation to exploring a ship wreck. Such a study would perfectly fit design in the role of *creating design concepts for studying how to use materials and bodily interactions in designing for experiences* (Figure 4, role 3). Usually, the nature of studies in this category is very explorative, as researchers and designers are entering unknown areas in terms of interactions and experiences.

5.3.2. Example: a focus on advancing design methodology

One can imagine that apart from learning about what makes experiencing a simulation feel authentic, a project such as the *Vrouw Maria* also provides the opportunity to learn about design processes, because the design serves a real-world purpose. Thus, a possible sub focus of the research could be to ‘develop knowledge about real-world designing’ (Figure 4, a1). The approach of the research could then be to use design in the role of iteratively developing and trying out new approaches, methods, techniques, etc. (Figure 4, role 5), and the focus would be on systematically reflecting on and documenting the steps that are taken in that.

The above examples illustrate how the different elements of our structured palette can be used to systematically reflect on the focus a study can have, and to think through what consequences this could have as well as what opportunities this may provide in terms of the other

research elements represented by the palette, and the nature of the required studies.

6. Discussion and conclusions

It is paradoxical that in the past, research in HCI, with user-centred design as its mainstream approach, has hardly focused on the actual activity of design, but more on understanding users and evaluating designs (Cockton 2012). With the increased attention for UX design, HCI research has started to become more aware of the need to better attune its research to design activities. In the past, multiple attempts have been made to present an overview of design research approaches to HCI researchers (e.g. Fallman 2003; Zimmerman, Stolterman, and Forlizzi 2010). The study presented in this article aims to take another step in that direction.

Our aim was to provide a structured overview of design-inclusive UX research (or RtD for UXD) providing actionable knowledge, building upon the earlier work done in this field and further detailing it in terms of the various roles design can play in design-inclusive UX research as well as the kinds of UX-design-relevant knowledge this could produce. In detailing the 'through' in RtD we identified five different roles design activities can play in design-inclusive UX research projects (RQ 1). In detailing the 'for' of Research for UX Design, we identified two categories of ways in which design-inclusive Research outcomes can support UX design work (RQ 2): one focusing on advancing UX design methodology, the other focusing on producing *UX knowledge* that can be applied in design projects. Within each of the two we identified three types of outcomes (see Figure 4 for an overview). We metaphorically termed the overview a *structured palette* for design-inclusive UX research, referring to its intended purpose of providing combinable elements for new design-inclusive UX research projects.

We grounded our structured palette in findings from interviews with 41 design researchers in three design-oriented academic research units that have a tradition in carrying out design-inclusive Research. We aimed for variety, both in research units and interviewees backgrounds. Backgrounds of the research units covered a diverse set of design-related disciplines, including arts and media design, (industrial) design, and designing mobile and ubiquitous services. Interviewees considered themselves to be members of a diverse range of communities such as Design, Computer Science, HCI, and Behavioural and Social Sciences, and published in conferences and journals having their origin in the fields of HCI as well as of Design.

To reduce bias in interview data analysis due to the individual perspectives of us as interviewers, interviews were conducted by an interviewer from a research unit other than that of the interviewee, and the interview data were audio recorded, transcribed and collaboratively analysed in much detail, defining categories of findings in a

bottom up manner, in an extensive process involving many discussions until consensus was reached.

Our palette connects well to the related research reported in Section 2. In terms of Frayling's (1993) framework and following the findings of Yee (2010) who showed that Frayling's various categories can be combined in a study, we defined the scope of our research as *RtD for UXD*. The left-hand part of Figure 4 explains the ways in which research can be RtD, the two right-hand parts explain the ways in which research can be Research for UX Design. Any of the examples in our study can be described as a combination of the two. Frayling's (1993) RaD finds its place in outcomes category a1 (Figure 4, Knowledge about Real-World Designing), as a specific form of Research for UX Design. We acknowledge that there may also be RaD that is not Research for UX Design. However, as a consequence, such research is outside the scope of this study. The same is true for research similar to Driver, Peralta, and Moultrie (2011) research for science and technology development. In our study we only included research for science and technology development that can also be characterised as Research for UX Design (i.e. that is embedded in and contributes to some design-oriented research project or programme). Research termed situation-driven design research by Stolterman and Wiberg's (2010) (i.e. Zimmerman, Forlizzi, and Evenson (2007) narrow definition of RtD) can be recognised in role 1 (Figure 4: *Provide tentative, novel solutions for real-life, societal problems to explore impact on people and society*), but was only included as far as it was also Research for UX Design. Stolterman and Wiberg's (2010) concept-driven design research can be recognised in role 2 (Figure 4: *Provide rich prototypes to study aspects of experience and interaction*) and is usually combined with one of the outcomes of category b (Figure 4: *Collecting design-relevant UX knowledge*). Hoby and Löwgren's (2011) Research through Explorative Design (sketching with technology) bears similarities to role 3 (Figure 4: *Create design concepts for studying how to use materials and bodily interactions in designing for experience*). Koskinen et al.'s (2011) lab and field research is RtDfD (i.e. it falls within the scope of our research). Their distinction between lab and field does not directly relate to roles and outcomes, but it is a distinction on a different aspect. Koskinen et al.'s (2011) showroom research, however, is a form of RtD, but not RfD; for example, the most influential programme in it is critical design, which is not a form of RtD for UXD, and thus is outside the scope of this study.

In sum, our structured palette on the one hand provides an overview of possible roles design can play in research, and of research outcome types that may be produced by including design in the research project. In doing so it further details types of design research as found in the literature. It provides concrete research elements to reflect on, when setting up new research projects or in reflective stops

in ongoing research projects. It demonstrates the various ways in which design can be used and be useful in UX research projects.

6.1. Limitations and future work

Note that in the above examples we often discussed research in terms of *experience* rather than *user experience*. This is largely caused by the fact that in the interviews it became clear that many researchers preferred the term *experience* over *user experience* (e.g. because the term *user* seems to refer to instrumental use of products or systems, and many researchers preferred a more open term, not specifically referring to products or to instrumental use). Indeed, we had selected researchers of which we suspected they were involved in UX design research. However, as stated in Section 3 (*Methodology*) we were curious to discover other researchers' views on UX and do not see their preferences on using the term *experience* as a problem, because even though they preferred using the term *experience*, their interpretations mostly still fitted our very tolerant definition of UX which we used as our starting point (see Section 1: Introduction).

A question that may arise when reading about our study is whether interviewing design researchers of only these three academic units suffices when intending to come up with a comprehensive overview of research elements. We admit that based on these interviews we cannot guarantee an overview that covers all possible types of design-inclusive UX research, and we do not intend to claim that this is the case. Firstly, as indicated earlier, our research scope is RtD for UXD, thus excluding various types of design research found in the literature. This was a deliberate choice, given the academic units we used as cases. However, within that scope we believe that the varied background of the interviewees, as well as of the three academic institutes has led to a rather comprehensive overview in terms of views on possible roles of design and on types of UX knowledge. We managed to come up with an overview of approaches that incorporates the approaches we identified in the related research section, expanded it significantly, and structured it. Nevertheless, the concern that all three institutes are from northern Europe is legitimate, as traditionally northern Europe, especially the Scandinavian countries, has a very specific tradition in human-centred design. Thus, we would very much welcome attempts to further elaborate on and expand our structured palette based on research from other geographical areas, such as the USA or eastern Asia.

As UX researchers with a long-standing experience in HCI field, we noticed the trend of UX research focus moving from an analytical approach, towards design with its generative activities of creating various kinds of positive experiences. For UX researchers following this trend, it is utterly important to gain a deeper understanding of design research. Interaction design researchers have

already introduced different types of design research to HCI, and our research builds upon this work by showing ways to integrate design into UX research. However, the design activity around interactive technologies and UX in real-world practice may differ dramatically from much of the design activity studied so far by design researchers. RaD as a research type seems to be largely missing in the current UX research. This is why we call for more research on the process of UX design in practice, for example, how design decisions are made and how this leads to a final design. Furthermore, it would be interesting to expand the work to include the other types of research that have not been addressed separately, such as Research for science and technology development that is not RfD, as well as showroom design research, Gaver et al.'s (2004) ludic design and other forms of design research that can be considered having an impact on or stimulating discussion in society, but that is not RfD.

6.2. Conclusion

In this study, our goal was to deepen our understanding of why and how design can be used as a part of and contributing to UX research. We developed a structured palette of research elements to consider when selecting approaches for design-inclusive UX research projects. The palette is based on interviews with 41 researchers from varied backgrounds in three academic design-oriented institutes. We suggest this palette to be used by anyone intending to set up new design-inclusive UX research projects or for considering a change of approach in ongoing research, as a tool for reflecting on possible approaches to take: in terms of roles design activities can play in the research, as well as in terms of what design-relevant UX knowledge one could be after.

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Disclosure statement

No potential conflict of interest was reported by the authors.

Notes

1. Note that, for ease of reading, in this article the term 'design' is generally used as a verb; that is, it refers to the act of designing, rather than to 'a design' as the outcome of an act of designing.
2. VINNOVA is the Swedish governmental agency for innovation systems.

3. In Table 2, results from some interviewees are omitted. In those cases no design activities were carried out as part of the research, because: (1) the researcher selected (and sometimes adapted) design activities in ongoing (often: student) projects external to them; (2) the project was just starting, and had not yet arrived at a stage where design was included; (3) the researcher used products and prototypes that had resulted from other projects; or (4) the interviewee was manager of several projects (or a whole research group) around one topic. In such cases, approaches varied within the group, and individual sub-projects were not or hardly discussed, nor was the role of design in those projects.
4. In the table, results from some interviewees are omitted, either because these interviewees are research managers who do not do research themselves or because they are support staff who currently do not do (UX-related) research themselves.
5. Reflective stops can be seen as pauses in ongoing research projects, which are meant for looking at the project from a meta-level: to reflect on issues such as 'what have we done so far', 'what have we achieved', 'what is still to be done' and 'how to proceed'.

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