Inquiry when doing research and design: wearing two hats

Guri Verne, Tone Bratteteig [1],

[1] Department of Informatics, University of Oslo, Gaustadalleen 23B, 0373 Oslo, Norway
{guribv, tone}@ifi.uio.no

Abstract. Methods for data collection in research and design of digital technologies seem similar, but lead to different results. In this paper we suggest a conceptual framework for characterising, planning, evaluating, and reporting knowledge produced when doing research and design. We characterise research based on the three paradigms positivist, interpretive, and critical. We suggest three simple questions that can be used for characterising and reflecting on the possible underlying philosophical assumptions (paradigms) and methodologies: 1) who owns the problem, 2) whose meaning is represented, and 3) who delineates the fieldwork. These three questions help us address similarities and differences of research methodologies and the kind of knowledge produced. We discuss how this conceptual framework allows for clarity and flexibility in research design.

Keywords: Design research, digital design, research paradigms, research methodologies, research methods, design methods.

1   Introduction

This paper started as a discussion about how we do research when design of a digital artefact is an important part of the process. Research in user centered and participatory design includes a lot of research activities in order to understand what the users need and want, and sometimes it is hard to distinguish between research for knowledge that is necessary for building the design result and research for knowledge that goes beyond the result and is useful for other researchers. These types of knowledge production are possible to distinguish analytically, but our students (and sometimes we as well) find it difficult during research to have a good grip of what we are doing. The aim of this paper is therefore to offer a conceptually precise and still practical way of describing the research we do when designing an artefact is part of that process.

   In our efforts to be clear about our research, we have also looked into how design researchers describe their research. We have found a number of claims about what research means in design activities [20, 15, 22, 29, 4]. Some design researchers contrast design research with natural science, and discuss how design research is different [70, 4] like Gaver [22], who refers to theories "from Philosophy of Science to help reflect on the nature of design theory" [p. 937]. He starts with Popper's criterion of falsification as a way to ensure scientific quality, and then use Kuhn [38] to argue that falsification does not give an accurate description of scientific practice. Research through design is not falsifiable, he argues, and is therefore not scientific if we base our view on the Popperian criterion of falsification. Gaver is not alone, as many design researchers contrast design with a positivist understanding of research

(e.g., [4, 70]) where science is aimed at finding general truths, in contrast to design, which result in concepts, interpretations, values, and policies [4].

We find these references to natural science intriguing. As participatory design (PD) researchers our research involves understanding users where we use research methods for data gathering involving fieldwork, interviews and observations, both as methods for design and for research. Like Gaver and colleagues [22], we investigate the use context in which our design result will be part and use this knowledge in the design process. In contrast to Gaver, we find concepts from social science research more useful for describing our research – and we use social science research which is interpretive and critical rather than positivist to characterize the knowledge and knowledge production we do. These approaches are very different, and the differences intrigue us.

The search for knowledge in research can take many forms. We discuss if and how the different research approaches can be explained in terms of research paradigms and methodologies. Research can be characterized by the questions we ask and the methods we use to answer them. But when does designing something answer our questions – and what sort of questions can get answered by designing an artefact? In this paper, we suggest a conceptual framework for discussing, combining and selecting research methodologies as well as design methods and research methods. The paper is a result of our inquiry into the way we inquire and produce knowledge when we design as part of our research. Being clear about the methodological choices we have to make and identify the choices we have when doing design research is an important motivator for the paper.

The paper is organized as follows. We start with suggesting that researchers basically pose three types of questions: descriptive, normative and constructive. We then go deeper into these types of questions, and continue with discussing differences in the philosophical assumptions or paradigms positivist, interpretive, and critical that have consequences for how research is done. We categorize a set of research methodologies by the three types of research questions and the research methods that are common in these methodologies, including some forms of design research. We discuss what sort of knowledge design contributes to in research and what kind of design research can be carried out without designing. We argue that the analytical distinctions we make offer rigor and flexibility for how research projects can be designed and be of use when understanding knowledge production and inquiry in design research.

2 Research and Research Questions

Research is about producing knowledge. Basically, research involves 1) asking questions, 2) systematically gathering empirical data, 3) analysing and/or theorizing referring to the data, and 4) answering the questions (see e.g., [35, 47]. Research aims to provide answers and argumentation for the answers. Such accountability is achieved by being transparent with respect to the methodologies and methods used to go from the research question(s) to the answers (the four steps above).

Logically, research begins with a question: the Research Question (RQ). In principle, this question is the start of the research process, although in practice the RQ will be influenced and iterated upon as the research process goes on. The researcher often experiences interesting preliminary answers to slightly different questions during the research process – or may even experience that the original RQ is less researchable than a slightly revised version, and a new RQ takes over [69].

2.1   Types of research questions

The type of new knowledge produced depends on the kinds of questions asked and the paradigms, methodologies and methods used to answer the questions. Different kinds of research give different kinds of answers. We find it useful to distinguish between three main types of questions: 1) descriptive, 2) normative, and 3) constructive questions [35, 47]. These three types of questions require different research approaches, different kinds of data collection and provide different kinds of answers.

Descriptive questions open up for descriptions of conditions or situations, and typically aim to i) identify something, ii) document a phenomenon, iii) compare cases or iv) explain a phenomenon. A typical example of this kind of research is investigation of a work place to identify if and how people experience problems with existing IT systems. A classic example of iii) is given by Barley [1] describing two radiology departments using the same IT system in different ways with very different outcomes.

When asking **normative questions**, we ask about the values in a social situation and do not aim to be neutral. Normative questions typically describe variation (good and bad examples of something), comparing and contrasting examples of something similar with emphasis on the evaluation of the object of study.

In social science, evaluative ideas come from critical theorists such as Habermas [35: 53]. In order to evaluate something one needs a norm and normative arguments. The knowledge acquired from evaluating something can (logically) be used to suggest and discuss improvements to it. However, also answers to normative questions need to be presented with trustworthy documentation and clear and coherent argumentation. The suggestions for improvement have to be based on descriptive research as a basis for arguing that the suggestions are based on an understanding of the real world, and actually represent improvements.

Most social science research is descriptive rather than normative, but in informatics the aim is to provide alternative technical solutions, hence we need to include normative questions as a basis for posing constructive questions and suggest change.

When asking **constructive questions**, we continue from an evaluation to see how things can be different. Constructive questions can be i) what can X do to improve Y? ii) intervening in a situation, or iii) imagining (experimenting). Constructive questions are common in all design fields: designers know that a design could always be different or improved. Design includes evaluations [58, 60] and to evaluate something will often lead to suggestions for improvements.

Constructive questions like (i) problem solving and (ii) intervention are situated in contexts outside of the researcher's control, e.g., when an organization wants to solve a problem and the researcher sees this as an opportunity for investigating a particular research question. Imagining questions point to experiments that explore possibilities – in the lab or in the field. Imagining questions are common in the design fields where the explorations can concern both technical possibilities and possibilities grounded in the use context.

When working with constructive questions the researcher's role as a fieldworker is different from descriptive research approaches. We will argue that design research often concerns giving answers to constructive research questions.

2.2   Paradigms and Views on Knowledge

All research is based on some explicit or implicit paradigms, i.e., underlying philosophical assumptions about what constitutes valid research and which research methods are appropriate. In order to conduct or evaluate research, it is important to

recognize and make explicit these assumptions. In order to not be too detailed about the distinctions between paradigms, we have chosen three common paradigms: positivist, interpretive and critical as representatives of important differences for research in our field [48, 53, 27]. Expectations to what is a research result: the answers and the arguments for them, vary among these paradigms.

Positivist research is based on the assumption that reality is objectively given and can be described independently of the observer/researcher. Positivist research aims to uncover truths, and aims for objectivity as a prerequisite to find general truths. Positivist research requires validity (external and internal), repeatability, objectivity, and representativity, and aims to increase the predictive understanding of phenomena, testing a theory or a hypothesis. General truths can in principle only be found by refuting candidate claims (see, e.g., [73]).

Interpretive research is based on the assumption that access to reality can only come through social means such as language, consciousness and shared meaning. Interpretive research aims to understand phenomena through the meanings people give to them [48] through *inter-subjective* understanding, which is developed through the fieldwork that the researcher engages in.

In order for other researchers to make sense of and use the research results, it is important for interpretive researchers to be explicit about their positionality by stating clearly their background and the research set-up [42, 45]. The credibility and transferability (and dependability and confirmability) of the research [42, 45] are important for other researchers to evaluate the results. This often results in thick descriptions [68, 23] of phenomena studied in their home context. Engaging with the messiness of practical reality and understanding why many versions of events are produced and recited is a valuable contribution from ethnographic research [13: 14]. Research in design of IT – and in Participatory Design in particular – often include interpretive research like ethnographic studies [36].

Critical research sees the world as historically constituted, and as produced and reproduced by people. Critical research builds on interpretive research but adds social critique with the aim to uncover restrictive and alienating conditions that people may live under. In focus for critical researchers is to describe power: how and why things are as they are, often seeking emancipation for underprivileged groups that are subject to alienation and oppression. Some research in PD and design of IT follows principles for conducting critical research [49].

3   Answering Questions

How researchers go about answering the different kinds of questions can vary a lot. There is no common terminology for what constitutes a method or a methodology in the literature on use-oriented design of IT.

We distinguish between a method and a methodology [53] where a *methodology* is a way to find an answer to a RQ, a strategy of inquiry [16]. A research methodology

"is a strategy of inquiry which moves from the underlying philosophical assumptions to research design and data collection. The choice of research [methodology] influences the way in which the researcher collects data. Specific research [methodologies] also imply different skills, assumptions and research practices." [48].

A research *method* is a "recipe" for collecting data as a part of a methodology. Based on the data collected, the researcher develops an understanding of the topic that will be the basis for answering the RQ. In the following, we focus on qualitative research, as qualitative data is often collected in both descriptive and constructive research.

3.1 Collecting Qualitative Data

Qualitative research involves the use of qualitative data, such as interviews, documents, participant observation, and photographic material. Such data are also the basis in many IT design approaches. Collecting or analysing particular types of data, e.g., interviews and observations, can be part of a number of different methodologies and contribute to answering different types of RQs (descriptive or constructive) within different paradigms (positivist, interpretive or critical). The questions and paradigms will heavily influence how the interviews and observations are done, and how the resulting data are coded and analysed. The methodology and the question can result in different data and represent different bases for research answers.

An ethnographic view on data collection is given in Crang and Cook [13], who describe in detail how the researcher struggles to arrive at an inter-subjective understanding between the researcher and the respondents/ informants. The inter-subjective understanding opens up for each participant to bring whatever s/he wants into the conversation, and allows the researcher to *see* and *listen to* the informant or user from the user's perspective.

A very different perspective on data collection is given by Preece and colleagues [55], who state the importance of data collection for interaction design:

"data gathering is a central part of establishing requirements, and of evaluation. Within the requirements activity, the purpose of data gathering is to collect sufficient, accurate and relevant data so that a set of stable requirements can be produced, within evaluation, data gathering is needed in order to capture users' reactions and performance with a system or prototype" [55: 226].

Here data collection is instrumental, aimed at fulfilling a set of objectives for the designer's design work. The data collection is more limited and stands in contrast to the open ethnographic view in Crang and Cook [13]. Data gathering for requirement specification sees whatever is told through the designer's perspective about their function as a requirement.

Also the analysis of the data varies depending on the paradigm. The analysis aims at building an understanding based on the empirical data: analysis is the "magic" step that turns data into research results. Good research requires documentation of both the resulting understanding and how it was achieved. Descriptive answers will often need more documentation of how the analysis was done, while design research may take the analysis more as inspiration for a design result, and may not need a very formal analysis. What counts as a suitable analysis depends on the RQ, the data, and the paradigm.

3.2 Where Does the Understanding Come From?

The various paradigms differ as to which perspective on the "reality" to be studied is taken as the basis and who defines that reality. Is there a problem? Whose problem is it? From whose perspective do we seek to understand the situation or problem? Do we study naturally occurring settings or do we carry out more focused experiments or investigations? Several questions or "parameters" influence where the knowledge that is produced by the research come from.

In positivist research, where the reality is objectively given, the data collected will be independent of who is collecting them. However, the degree of openness to emerging issues during the data gathering may vary among the paradigms. A survey has only pre-defined answers to select [39] and if these do not fit with the respondent's experiences or viewpoints, there is often a category called "other" that the respondents can tick off. However, a high number of "other" responses will not give much information to the researcher, and may also lead to a low response rate and

even less convincing results. In fact, a high number of "other" responses can indicate that the survey has missed important viewpoints or experiences among the respondents in the target group. For the respondents, having just a very short time to understand the questions and to reflect on their own situation/experiences may influence their choice among the response alternatives in unfortunate ways. A positivist understanding of data collection delineates and restricts the researchers' interpretation of what is said more than the interpretive one.

Working within an interpretive paradigm and accept – and even understand – how the world is experienced from the informants' perspective is difficult to learn. One of the challenges we experience in our teaching is to teach technology students to see other people's use of and experiences with technology in a non-normative way, and not as experts who evaluate "good" or "bad" use of the technology.

An ethnographer who spends a long time in the field will observe and talk with the members of the community several times and in many different situations. Some events do not occur very often, and the ethnographer is not able to participate in these unless they happen to take place when the s/he is present. Immersing oneself in the field is central to the ethnographer, who hopes to be present in many different events and situations in the community studied and have the community members talk about as many aspects of their reality as possible. Spending only a few days observing is therefore not considered sufficient as a fieldwork for doing an ethnography. However, doing a set of interviews about some particular experiences can constitute the data for a good case study of a selected and delineated RQ.

The point we want to make is the differences in data gathering originating from the question of who is making these delineations of what to study: the researcher or the researched. In our design and research teaching we have found that focusing on some simple questions help us understand and choose between research methodologies and paradigms. We differentiate by three aspects: 1) who owns the problem that we study, 2) whose meaning and perspective is captured by the study, and 3) who delineates the fieldwork or frames the study. In the following, we use these three questions as characteristics for discussing some commonly used methodologies for research and design. The next section therefore briefly present some often used methodologies for giving descriptive and constructive answers before we discuss how these three questions help to make clear where the understanding comes from.

4   Methodologies for Descriptive and Normative Questions

To our knowledge there are mainly two classic research methodologies from social science used for descriptive and normative RQs in use-oriented design research: case study and ethnography.

A case study is a bounded study of a phenomenon in its real context. The researcher often studies a naturally occurring setting using the methods of interview, observation and document analysis for data collection [62, 68, 73]. In a positivist case study, observation rarely occurs as such data are difficult to analyse [73]. However, these three data collecting methods are not essential or limiting in any way; any data that can support a study of a phenomenon in its context can be valuable, e.g. telephone calls, chat logs, workshops.

Ethnography comes from social and cultural anthropology where an ethnographer is required to spend a significant amount of time in the field. Participant observation and immersion in the field are central to an ethnographic study [13]. Ethnographers immerse themselves in the lives of the people they study [41: 380] and seek to understand and describe the phenomena studied in their social and cultural context. Several examples exist of studies of IT in use [65, 72, 1, 76, 56]. In an

ethnography, there is usually no a priori research questions, the phenomenon and the people are followed as events unfold.

A case study can contain a number of interviews and observational data, and may look similar to an ethnography, where the same methods for data collection are used. However, a case study is a bounded study where the researcher sets the boundaries, while immersion in the field without any pre-set boundaries is a distinguishing feature for an ethnography. The researcher delineates the case study and owns the research question, but in an interpretive case study s/he also aims to understand what makes meaning from the informants' perspective. An example is a case study where the researcher listened to telephone calls to a Tax Information Call Centre [66]. Listening to telephone calls and interviewing call centre employees did only give a limited picture of the tax issues experienced by the callers, an awareness that was carried through to the analysis, design suggestions, discussion and conclusion of the study.

For an ethnography, inter-subjective understanding is gradually built through the research process and simultaneously influences the process. The delineation is emerging during the fieldwork, and the meaning of the data is seen from the perspective of the people that are studied.

5 Methodologies for Constructive Questions

Just by describing something, we may contribute to changing the phenomenon in question, even unintentionally. By, e.g., uncovering problems in an IT system, the designers may take steps to change unfortunate design choices or improve a training scheme. However, in this paper we refer to RQs aimed at intentional change: we use the nature of the RQ asked to provide a presentation of types of methodologies: asking constructive questions needs different methodologies than asking descriptive questions. This simple typology is sufficient for our conceptual discussion.

Action research is the social scientist's main way of answering constructive questions [35] but is also used in research on IT and organization development [3, 17]. With its roots in social science, action research traditionally did not result in technology design. We therefore present action research and design separately.

Action research (AR) aims to solve both practical problems in an organization and contribute to academic research. The researcher is part of the change work, which takes place within a mutually acceptable ethical framework involving both the researcher and the organization [3, 48].

Commonly used methods for data collection are more or less the same as in a case study, but the purpose is different: action research aims at planning the change and evaluating the results as they happen. In action research, the organization owns the problem to be addressed, and most often also the meaning perspective. The boundaries are set together with the researchers, who also take part in negotiating the definition of the problem.

5.1 Design research

Design research is described in a number of ways depending on whether the design tradition is rooted in an "art and design" or an "engineering" and computer science tradition. The art and design tradition offers several ways of describing the role of research in design [20, 74, 75, 19]. Design research can be characterized as research "into", "through" and "for" (art and) design [20, 74, 75]. Research "into" design is research into the activity of design with a practical or a theoretical lens (e.g., [58, 50]). Research "for" design is aimed at developing "new methods, tools, or approaches"

[74: 169] that contributes to developing the design discipline [14, 15, 37]. Research "through" design is referred to as "research practice focused on improving the world by making new things that disrupt, complicate or transform the current state of the world." [74: 169].

"Research into design *and research* for design *both refer to the outcome of a research project; the type of knowledge that is produced. Research* through design *differs in that it is an approach to doing research. It can result in knowledge* for design *and* into design*."* [74: 169].

Zimmerman and Forlizzi see Research through Design as the main category of design research. This view fits with a major part of research in computer science and engineering with its long tradition of theory-based experimentation where a functioning artefact can represent a "proof" of a theoretical hypothesis (e.g., [30, 54]). However, with a background in user-oriented and participatory design, we can approach design research differently.

Below we use the same way of differentiating between research methodologies as above: 1) who owns the problem, 2) whose meaning or perspective is guiding the research, and 3) who delineates the researched area of concern to characterize different methodologies from the design field. In this brief overview, we include three major strands in use-oriented design research: user-centred design, participatory design and research through design.

User-centred design (UCD) refers to a broad range of design approaches where users are involved to a larger or lesser degree. UCD spans from designers looking at users as inspirational sources to involving users in the design or supporting users in designing themselves. The idea to be explored in the design is often grounded in the use context; hence UCD often involves descriptive research as a basis for the design part of the research.

Research in UCD includes research into design: what happens during design as well as research for design: how can new methods change the design process as well as its results. UCD explores how the design process is carried out, which methods work and how (e.g., new ways of working with users).

Various ways of evaluating the design result with respect to the design idea it is supposed to materialize as well as the user experience can be categorized as both design through, for and into design.

Participatory design (PD) is a particular version of UCD where the problem is negotiated and hence owned by the users and designers together. Both users and designers get their meaning or perspective represented in the research project and in the design (process and result), and the delineation of the research field (and the area of design) is negotiated and shared by the designers and users. Historically, the aim of PD is democratic participation of future users in the technology design and to empower people with less power [7, 2, 26, 67, 33].

The three principles of PD: give the users a say (not only a voice), provide mutual learning between designers and users, and facilitate co-construction and co-design of the design results require the design process to be organized as a cooperative process. Mutual learning links to the inter-subjectivity aims of ethnography, and adds a critical perspective aiming for empowerment. This focus makes PD belong to the critical research paradigm [61].

Research through design (RtD) emphasizes making as the main research activity, as the way to discovery (e.g., [75, 74, 43, 22, 21]. This methodology focuses on the artefact as a concretization of a design concept and on the materials and forms that goes in to the artefact. Studying the results of research through design includes usability studies over short or longer time periods (e.g., [52]).

RtD is the most common type of research in design disciplines (both based in art and in engineering). The research produces knowledge that contributes to developing new kinds of artefacts and to enhancing materials and the possible forms and

functions they can represent [58]. A telling example from architecture is Gramazio and Kohler [25]'s use of digital tools in their work resulting in new forms and new production techniques (and machineries) not possible without digital production tools: fine-tuning the bricks' angles in a wall to allow daylight without windows, making brick wall modules that are glued rather than bottom-up brick-laying with mortar.

The idea for the artefact may come from the use context, like Gaver's prayer companion departing from forms and shapes in the monastery (vases and mugs) and from the nuns' concern with praying for people in need and thus presenting a selection of news about people in need [22]. The basic idea can also be more conceptual, like slow technology [51] where the research concerns how to give form and function to a piece of technology, which is designed to be slow. It is the artefact that represents the knowledge [43: 28].

5.2 Differences and similarities between design research methodologies

Research in UCD that fits with RtD is concerned with the artefact itself (the forming of an idea) and on how the forms and materials answer to users' needs and wishes. How the users' ideas are gathered is a process aspect (what happens in design) while how users experience the resulting design artefact is concerned with the shape and functioning of the design result-in-use (the artefact itself). User experience studies cover a spectrum from (positivist) usability measuring trials to rich descriptions of users' experiences of an artefact in its real use context.

In UCD, the question of ownership of problems and solutions is less straight-forward. It is the designer who delineates the research field and the question to focus on the design of an interactive system. However, it may be the users who own the problem and hence define what a good system is. The meaning of the research will to a large degree be defined by the researcher through the design, but can include information from the users as to how their meaning is represented in the research and in the design result.

PD fits with all three design research categories. Much of the research reports from the PD processes and concerns how to involve users in defining the problem and its solution [61], qualifying as both research into and for design. Research about the artefact itself (RtD) concerns how the ambition of empowerment is achieved by the design process and by the design result: the artefact-in-use [5, 9, 10, 11].

Some of Gaver's design examples have similarities with UCD. For instance, when designing the prayer companion to be used by nuns in a monastery [22], the designers had several meetings with the nuns they were designing for as part of their design process. Their aim was to design something that would be of value and be used by the nuns. This way of carrying out design in close contact to the future users of the design result, has some important similarities with PD as well as some important differences.

RtD does not require mutuality nor does it have to take place in naturally occurring settings. In RtD it is the designer – the researcher – who owns the problem. The meaning or perspective addressed in the idea explored is basically the researcher's perspective in the same sense that art is basically the artist' perspective. Even if the artist is interested in how viewers experience his/her art, the audience often plays a secondary role as to how the art piece is made: it is the advancement of the field that is the main purpose of the activity. RtD main focus is on the artefact and on the artefact's effects when placed in its use context. Often one of the goals is to make "the right thing" [75] representing the research idea. This means, however, that the designer's interest in the public (users, clients) may be limited to how they respond to the artefact.

We also see the focus of "design thinking" on empathizing with the users to be both similar to PD and to a position where users are seen as secondary to the artefact itself. In both cases it is the researcher who delineates the area of study and the scope of the research.

6 A Conceptual Framework for Research and Design

We find that concepts of paradigms and methodologies are helpful in clarifying for oneself and others where the knowledge come from, the researchers' role in the research, the context and delineation of the knowledge produced, and the conclusions that are drawn. We have found this helpful in our research as well as in teaching of design and research. Many students come from IT departments where positivistic science is the gold standard of research. As a way of opening up for research based on other philosophical assumptions and stimulating reflections about the philosophical assumptions behind own and others' research, we suggest three simple questions that may make it easier to differentiate between positivist and other paradigms. They are not meant to be answered in a mechanistic way; instead they can help reflecting on the methodology used by oneself and others, to prepare students to reflect on the differences between UCD and PD, between RtD and UCD, or between a case study, an ethnography and the insight phase of UCD, and the role of their design in their research. These questions necessarily center around where the knowledge comes from, what worldview is presented, and who delineates the research.

The difference in 1) *who owns the problem* and 2) *whose meaning is represented* locates a research project as belonging to different epistemological and paradigmatic categories. In classic positivist research, the researchers' actions and choices are seen as independent from the views of the users or community members as the reality is seen as objective with and independent existence. The researcher owns the problem and also decides the view or meaning-making perspective.

The situation that I, the researcher, define what is researched differs from when you, the "client" or "user" (co-) defines what the problem is. If I am focused on getting people to answer my questions or do things I want to observe, the research process will be different from when I am open to their choices about what they find relevant to talk about and do. In interpretive research, the strive for intersubjective understanding will open up for perspectives and knowledges of the user/client/community member. Question 1 and 2 differentiate between positivist or interpretive/critical research, as illustrated in Table 1 below. Note that in critical research the aspects of power and emancipation needs to be discussed in each study.

Table 1. Questions that differentiate between paradigms: 1) who owns the problem, and 2) whose meaning is represented, differentiate between positivist or interpretive/critical research.

Who owns the problem / Whose meaning….	*Researcher*	*User / client*
Researcher	Positivist (e.g.case studies)	Positivist AR
User / client / community member	Interpretive (e.g.Case studies, UCD, RtD)	Interpretive Case studies, PD, AR, Ethnography

Most research in the design areas fall into the category of the researcher owning the problem to be researched while it is the user / client who owns the definition of the context to be studied and the meanings given to the problem and its possible solutions. In UCD the user's needs and situation is input to the researcher, who often is the one who defines the problem to be solved. If the researcher defines neither the problem nor the meaning making, we have the case of an open ethnography or PD approach, where the researcher adopts the users' perspectives or problems. PD requires the researcher/designer to see the perspective of the user participants and reflect on the knowledge that is developed and shared during the design process.

The third question 3) *who delineates the fieldwork* differentiates mainly between the interpretive/critical methodologies, see Table 2. In an ethnography, the researcher aims to achieve an inter-subjective understanding of meaning and (potential) problems as seen from the community member, and their activities and perspectives influence to a large degree the delineation of the study: in an ethnography, immersion in the field is important. While immersed, the ethnographer learns about the community also from events not chosen by the ethnographer. In contrast, a case study is delimited and bounded by the researcher: A similar-looking study may be framed as a case study if interviews and observations were carried out but not as part of an immersion in the field, and different conclusions can be drawn from the two studies.

Table 2. For interpretive research, question 3) who delineates fieldwork, differentiates between the methodologies.

Who delineates… / Who owns the problem	Researcher	User / client
Researcher	Case study, RtD, UCD	AR, Case Study
User / client / community member	-	PD, Ethnography

When working with user participation in design (PD), the inter-subjective understanding developed together with the users is important. Research where the researcher owns the problem and the user/client delineates the field work will seem strange. We find that this framework helps us to discuss conceptual aspects of which knowledge is produced in the research and design methodologies, and how.

7   Discussion

There are two major discussions we would like to raise in this paper. One concerns the confusion between design methods and research methods in design research, and the other concerns the range of possibilities for combining paradigms, methodologies and methods to fit the research question one wishes to answer.

7.1   Design Methodologies in Design Research

There is a range of design methodologies and methods that can be drawn on in design projects, for developing design ideas, selecting ideas, concretizing them, and evaluating them [60, 58, 59, 9, 11]. The evaluation of each of these "design moves"

builds on the vision: whether or not a move leads towards the goal or not [64]. Commonly used methods are various kinds of workshops [6, 34], prototyping [28], and experiments in the lab and in the field [37]. Brainstorming activities can be seen as a kind of workshop, while bodystorming [12] can be seen as a field trip resembling observation. Many design research projects need to address a range of different topics and areas and therefore need to handle an "epistemological pluralism" recognizing "that, in any given research context, there may be several valuable ways of knowing, and that accomodating this plurality can lead to more successful integrated study. [46]".

Frayling [20] distinguishes between design "research with a small 'r' in the dictionary" referring to "gathering of reference materials", and "research proper" [p. 5] which is what researchers do [44]. Frayling's distinction between research with a big or a small "r" points to the confusion that an activity (or method) may be a part of gaining knowledge in design of an artefact or it can be a research activity aiming at producing knowledge beyond the artefact – or both!

In order to construct an account of the research that is credible, transferable and confirmable [27], the analytical distinction between production of knowledge for design of an artefact and for research is useful. In design research, we have two hats where one is concerned with the design result we aim to produce while the other emphasize the knowledge we get that goes beyond the project and the artefact. We think it makes sense to distinguish between design research where the knowledge requires the researcher to design in order to answer the research question and design research that can be done without the researcher designing. This brings us to looking into the kinds of knowledge one produces if design is part of the research approach.

RtD is mainly concerned with how a particular design idea can be materialized: which forms and materials fit to embody the idea (e.g., [24, 29]). Starting out with an idea or concept makes this research different from starting out with the materials. Research about how an idea can be concretized requires the researcher to design in order to answer the question.

Frayling's notion of "research into design" does not involve the researcher in the same way: it is possible to be an observer to the design process, using methods from case studies or ethnography studying how the design happens (e.g., [58, 8]). The same holds for "research for design": knowledge about how the design process happens and how it can be improved may not require the researcher to do design in order to answer the question. Gaining knowledge about new tools and approaches can be done as an ethnographic study of, e.g., user participation in design, e.g., [61] but it can also be carried out as a design process in a particular environment. Research about how a new method or approach enables the designer to concretize an idea can differ from research about how a design idea can be concretized, which fits better with the category research through design (as argued above). Research about the design process and the design result can be done without the researcher doing design. Knowledge about the design process and the design result may be used to improve design processes and results (in line with [15]).

Research that requires the researcher to design in order to answer the research question often concerns the concretization of a design idea, e.g., concretizing concepts like mastery, empathy, openness, slowness (e.g., [52, 29, 24]. The activity of finding materials and forms to materialize the idea in ways that are feasible and useful produces knowledge about how to utilize and enhance the available materials and forms, and to shape how they communicate and function. Stappers and Giaccardi [63] discusses the knowledge one gains from design:

"Because a 'thing-in the-world' has multiple facets … it is likely that the designer will learn about many things, such as:
1. *The prototype he is making …*
2. *The technology he uses to make it …*

3. *The interactions between his prototype and people …*
4. *The people who interacted with his prototype [where & when they will use it] ..*
5. *The knowledge/technology domains relevant to the realization of the prototype or the understanding of the phenomenon under study … [e.g. creativity theory]*
6. *How the designer went about doing the designing …*
7. *The trust she has in the feasability of a solution or principle …*
8. *Its generalizability … [use for other problems]*
9. *How the research was done and how it could be done better*"

When the artefact-in-shaping is in focus, the knowledge produced concerns materials and forms and how they can be developed to achieve new properties and possibilities [31, 32, 57, 71]. A major part of research in computer science is enhancing the material for design, e.g., smaller, faster computer components.

7.2 Flexibility and Rigour in Research

There is normally a concern that research is rigorous and relevant (e.g., [18]) for it to be credible, transferable, confirmable and independable [45]. We argue that our three questions: 1) who owns the problem, 2) whose meaning/view is described, and 3) who delineates the study can be used to make analytical distinctions between paradigms, methodologies and methods that applies to answering both descriptive, normative, and constructive research questions. These elements allow us to be flexible about how the research is carried out and described.

Research carried out under the paradigms positivist, interpretive and critical can use some of the same methodologies, as these represent approaches to gathering and analysing data in different ways. For example, the case study methodology can be used within all three paradigms but the data, analysis and results will be different. In an interpretive case study the researcher delineates the fieldwork but the users/clients can own the problem and the views described. Both UCD and PD are methodologies that contain cooperation with users to produce answers to a constructive RQs. In PD, the users and the designers together own the problem and delineate the field, while in UCD, the researcher owns the problem and delineates the field. We particularly want to emphasize that the concepts suggested in this paper can be used to distinguish between a PD mindset and situations when PD is used manipulatively to entice users to accept new IT solutions.

At the lowest conceptual level is the methods, and many of the methods can be used in most of the methodologies – the way they are used depend on the RQ, the paradigm as well as the methodology. An interview can be formal and controlled like a survey or it can be a long conversation in naturally occurring settings driven by the informant with no ambition from the researcher to influence the topics or pace of the conversation. The last version fits with PD and ethnography while the first are more relevant in a case study or some types of user-centred design.

Choices on one analytical level (like paradigm) will rule out some methodologies and favour others, and a similar screening will happen at the next analytical level (methodologies). We find that reflections around the three questions enable a more flexible way of selecting methods that fit to the overall research design as well as the circumstances in a particular research project. Research does not always happen as planned, and it seems useful to have a flexible but analytically clear framework to build your research approach. Maybe the plan to do an ethnography was not possible to carry out, and you ended up with more limited fieldwork, which is good enough for a case study – and you can present your research in that way. Maybe you wanted to do PD but did not get access to users in any substantial way and have to work with a less participatory UCD methodology. Perhaps the insight phase of a design project

turned out to be very interesting and the role of the design were reduced: the UCD-project can be framed as a case study with some implications for design. Much of the necessary rigour can be taken care of in the way we conceptualize and write up the research influencing the kinds of general insights [40, 69] and conclusions we draw.

Returning to our initial interest in Gaver's explanation of design research as very different from UCD and PD, we can now suggest a response. Gaver contrasts design research with positivist truth-seeking research and argues that design is different: he argues that design is not independent of the subjective designer and aimed at the particular. We argue that interpretive and critical research paradigms give a better basis for design research. The research in Gaver's example: The Prayer companion, have many similarities with interpretive research answering descriptive questions leading to a design. In a PD version of Gaver's project the nuns would participate in defining the issue to be addressed and delineating the process: They would have been part of designing the design process and the design result, and their problems and needs would be part of the design. They would probably still have focused on making an artefact with form and material fitted to the monasterial setting.

All kinds of design research often includes fieldwork, analysis and design in different proportions. Some of this research produce an artefact, some result in descriptions and analyses that conclude with (textual) implications for design. The methods involved appear to be very similar in that they for example involve interviews or observations for both design and descriptive research. The analytical distinctions we have presented in this paper are useful for differentiating and integrating paradigms and methodologies from qualitative research aimed at descriptive answers with design research aimed at constructive answers.

8 Concluding Remarks

In design research, we often wear two hats where one is concerned with the result of the design process while the other emphasizes the knowledge we produce beyond the project and the artefact. We think it makes sense to distinguish between design research where acquiring this knowledge requires the researcher to design in order to answer the research question and design research that can be carried out without the researcher designing. We have suggested the questions 1) who owns the problem, 2) whose meaning/view is described, and 3) who delineates the data/fieldwork as conceptually grounded as well as practical and simple questions to ask when doing research that concerns design. The questions aid conceptual clarity by cutting across the similarities and differences between research and design methods and focus on what kinds of knowledges are produced. They represent a way of coarsely describing the research and design methodologies that make the similarities and differences between them visible for reflection. The typology of research questions can help us make an analytical distinction between the knowledge produced in a design process: is it aimed at producing an artefact or is it aimed at knowledge beyond the project.

Distinguishing between the three analytical levels: paradigms, methodologies and methods also provide clear choices as to what kind of knowledge the research is aimed at producing. Combined with the three questions above we can easily arrive at suggestions for a coherent set of methodologies and methods. However, we argue that the main feature is the flexibility offered by the framework in planning, carrying out, evaluating and presenting research.

These concepts have proven helpful in teaching students about research methods and supporting them in applying them in their own work. We also find this conceptual framework useful in our own reading of research and design carried out by others.

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