

Why Research-Oriented Design Isn't Design-Oriented Research: On the Tensions Between Design and Research in an Implicit Design Discipline

Daniel Fallman

Received: 15 December 2006 / Accepted: 20 March 2007 / Published online: 27 September 2007
© Springer Science + Business Media B.V. 2007

Abstract Human–computer interaction (HCI) is the discipline concerned with the design, evaluation, and implementation of interactive computing systems. Unlike many empirical sciences, HCI researchers do not typically solely study existing technologies, styles of interaction, or interface solutions. On the contrary, one of the core activities in contemporary HCI is to design new technologies – in the form of software and hardware prototypes – that act as vehicles through which HCI researchers' ideas materialize and take on concrete form. Despite this situation, there is a very modest discussion in the discipline on the role of design as an activity in the research process; whether or not HCI could in fact be better understood as a design discipline than as an empirical science; and if, and if so how, the design element in HCI goes with its empirical claims.

Keywords Design · Human–computer interaction · Research-oriented design · Design-oriented research · Theory

This paper is specifically about the element of design as currently manifest in HCI research. We dig deeper into HCI as a design discipline by suggesting, analyzing, and discussing what appear to be tensions between two competing traditions in the relationship between design and research.

D. Fallman (✉)
Umeå Institute of Design & Department of Informatics,
Umeå University,
SE 90187 Umeå, Sweden
e-mail: daniel.fallman@dh.umu.se

Introduction

Human–computer interaction (HCI) is the research discipline concerned with the design, evaluation, and implementation of interactive computing systems – and in particular the phenomena that surround human use and experience of such technology. HCI originally grew out of the part of computer science, particularly computer graphics, which dealt with what was generally regarded among programmers to be the most rickety of computer interfaces – the computer to human interface. HCI established itself as a research discipline during the late 1970s and early 1980s.

As HCI has evolved, several disciplines have come to give their contribution to the field, each with different emphases and traditions. The pioneers of HCI, in computer science and computer graphics, brought with them application design and an engineering tradition. Quite early, parts of cognitive psychology showed interest in the new field and stressed the application of models and theories of cognitive processes when designing the meeting between human and interface. The influence from cognitive science also brought a science attitude to HCI: a strong belief in the value of empirically studying human behavior and performance. During the second half of the 1990s, influences from the social science disciplines, such as sociology and anthropology, came to gain methodological grounds in the field, broadening the scope of HCI to not only

consider the meeting between human and computer, but also to reveal the larger interactions that take place between technology, work, groups, teams, and organizations.

More recently, traditional design disciplines like architecture and industrial design have come to influence the field (Fallman 2003; Wolf et al. 2006; Zimmerman et al. 2007; Buxton 2007). Again, this has contributed to a broadening of HCI's focus where such issues as user experience, sketching, virtual and physical form, and design methodology and techniques are now highly fashionable.

Contemporary HCI is hence multidisciplinary to its nature. Today, its typical conferences and journals encapsulate such diverse areas as two- and three-dimensional interaction, interaction with mobile devices, embedded systems, ubiquitous computing, virtual worlds, interaction design methodologies, group interfaces, tangible interaction, aesthetics of interaction, social interaction, augmented reality, etc. While the many influences have allowed HCI to bloom and develop, it has been at the cost of the mutually shared values and beliefs that kept the field together during its empirical–cognitivist era. Hence, one might say that contemporary HCI is inherently diverse, lacking unifying theory. But what is it then that holds the field together?

Is HCI a Design Discipline?

What one realizes when digging into contemporary HCI research is that it is very much a field oriented toward design, in the sense that most projects in one way or the other end up bringing forth new interactive systems. HCI research today is hence not primarily directed to the study of existing technologies, styles of interaction, or interface solutions. On the contrary, one of the core activities in contemporary HCI is to conceive, propose, design, and implement new technologies – most often talked about in the form of prototypes – through which a researcher's ideas for novel and alternative solutions can materialize and take on concrete shape. These new technologies may try to answer directly to experienced problems revealed in for instance, a user-centered field study, but they might just as well be the result of innovation on the part of the researchers that are involved in the process, or why not based on theory of team interaction derived from the social sciences.

This kind of *design orientation* is vivid in the field of HCI to such an extent that it might make more sense to regard HCI as a *design discipline* rather than as a more traditional academic research discipline. What is perhaps even more interesting is to begin to understand the role of design in HCI as being involved in a *design tradition*. Later in this paper, we will argue that this tradition could in some ways be seen as different from a research tradition. Although not necessarily incommensurable, our main concern is that, if these differences in tradition are not made explicit and understood, unnecessary tension and confusion can occur as a result.

Paper Overview

This paper is thus about the tradition of design, as it is currently manifest in HCI research and that tradition's relation to the culture of research. An argument that will be made is that there currently seems to be two basic ways in how both researchers and practitioners in HCI seem to relate to design, but that these cultures are neither fully understood nor even really acknowledged as different cultures in the field.

First, it will be discussed how and why the element of design as such has been made implicit in HCI conduct both theoretically and methodologically. Second, it will be shown and discussed how overlooking design as a key element of HCI might limit the way in which the field understands and deals with itself. By shedding light on design in HCI, we suggest and argue for a distinction between what appears to be two cultures of design within HCI – namely the culture of *design-oriented research* and the culture of *research-oriented design*.

Design and Research

'Design' is obviously one of those terms that are intrinsically difficult to define, as it can denote many different things to different people: including design as a profession, as an activity, and – when design is used as a noun – as an artifact. Attempts to define design hence typically become too broad or too narrow. The definition used in this paper is inclusive rather than exclusive, and it emphasizes design as a process in which something is created – working out

the form of something new, consciously creating something which was not previously there (Nelson and Stolterman 2003).

This process of giving form to something calls for a certain level of participation and commitment on behalf of the people that are involved in the design process. This metaphorically resembles the way carpenters in a direct way must be involved with the materials of carpentry: its physical tools, techniques, and materials. Without this direct involvement, something new cannot be brought into being, whether a baker, a software engineer, or an industrial designer. To design is hence about getting oneself involved in a conscious aim to create and give form to previously nonexistent artifacts, i.e., to make things work in the real world (Coyne 1995; Jones 1970; Nelson and Stolterman 2003).

What is Research?

'Research' – here used as a common name for all kinds of academic research activities – is yet another of those terms intrinsically difficult to define. A wide variety of activities take place at a typical research university, all of which operate under the name of research or science. Few – if any – theoretical and methodological foundations are shared across all institutional borders. It is even so that, within a university, proponents of one discipline might not even recognize another discipline as scientific. Therefore, rather than to define science and research in terms of use of specific methodological techniques, it makes more sense to concentrate on what it is both research and science in its most basic form tries to achieve: to produce new knowledge.

A Basic Distinction

In relation to HCI as a field of research; that is, as an academic discipline, design as defined above appears to be a quite special kind of activity, not immediately comparable to other available scientific methods and techniques. In this section, we will try to more specifically address design and its role in HCI by pointing out what we see as two different kinds of conducts in the field. We will argue that there are distinctions to be made between a culture of *design-*

oriented research and a culture of *research-oriented design*, when it comes to the role, aim, and scope of the design element. Likewise, we argue, so is the role that research plays in these different conducts.

To briefly introduce these two notions, one can see design-oriented research – where research is the area and design the means – as a conduct that seeks to produce new knowledge by involving typical design activities in the research process. In this paper, a design component or element is used to drive and propel research.

In research-oriented design, however – where on the contrary design is the area and research the means – the creation of new products and, in that process, answering to the problems and real-world obstacles that are faced in that process, is the primary objective. In this paper, a research component is used to drive and propel design.

Why Make a Distinction Between Design and Research?

Generally speaking, seeing or proposing things as dichotomies are quite unfashionable these days. Therefore, why make this distinction? Why try to separate design from research, when they in fact appear to be approaching each other more and more? Could they not work together, complement each other, or even be the same thing?

At this point, it seems important to realize that the distinctions made in this paper are not normative distinctions. In real life, design and research may well come together in the same project and the results may be impressive. Rather, what this paper tries to do is to investigate some of the most basic beliefs upon which these two traditions have been built. By doing this, we will better understand that, ultimately, design and research are, in some particular ways, two quite different cultures. We believe that insight into these differences can aid the process of understanding the role of design in research.

In this, we knowingly base the discussion in this paper around current issues in the field of HCI, which itself is not an outspoken design research field. This is because the two concepts of design-oriented research and research-oriented design do not present a complete or even wanted state of affairs in a mature design research field. Although they represent one important dimension, it is nevertheless

important to realize that these two concepts are not a complete model. The world is obviously more complex than a simple dichotomy. Rather, the two concepts are used as vehicles – as a tool for thought – in this paper for getting closer to what appears to be some inherent tensions of the different cultures of design and research.

A source of misconception with regard to the concepts of design-oriented research and research-oriented design as applied within the setting of HCI is that one may fail to recognize that design-oriented research and research-oriented design are in fact *both* conducts in which the researchers and/or designers as a part of what they do are involved in actual design activities themselves – the bringing forth of a new artifact. Studying designers at work (i.e., doing descriptive design studies as a by-stander or observer) is hence something that is captured by neither of these two terms and an area of concern in design research not treated here.

Furthermore, it is also easy to object to the two terms because they appear, on some level, to express more or less the same thing. This argument would have it that, if research is used to propel a new design (research-oriented design), that particular design simultaneously propels further research (design-oriented research) and so on. Hence, design and research seem to fuel each other ad infinitum. Because of this, design-oriented research and research-oriented design are not dichotomies or even two separable conducts at all but rather two intertwined processes in support of each other. Or at least – a slightly more defensive objection – they could perhaps be seen as two conducts in some sense but, in reality, they are often overlapping, and within a single project, there may be people that see one's current project as a research project and those that think of it first and foremost as a design project.

Yet, another stumbling block for accepting these two terms and an important one as well, is of course built into the way one chooses to define and think about research as well as design. If we take research for instance, the development of new theories, methods, techniques, research papers, and even single lines of thought could be encompassed by a far-reaching definition of design – as they could also be seen as designed artifacts and even products. Therefore, according to this view, all research is

design. On the other hand, when the reflective design practitioner is at work, she makes use of as well as produces a lot of new knowledge and experience (Schön 1992). Hence, it seems that researchers are designers too, and designers are also researchers. Or are they, really?

There are at least three things to say in relation to this argument. First, again, we simplify this discussion in this paper by restricting ourselves to talking about design in the context of HCI as the activity of bringing forth artifacts, such as sketches, mock-ups, prototypes, and other computational artifacts of some kind. Second, it is important to understand that this paper is not about whether or not it is a good thing to have for instance trained industrial designers or architects taking part in a HCI project. What we do here is instead to look at the role of design in HCI as a specific kind of activity that can be carried out not only by trained designers, but also by other people. Who is a designer, in this view, has thus more to do with what that person is doing than what is printed on her business card.

Third, a more fundamental problem with this line of reasoning, which this work also attempts to tackle, is that, although it is correct on one level – that the designer and the researcher indeed both need to use and produce new knowledge and that they are both involved in a process where things take on concrete form (along with bakers, philosophers, stay at home dads, pirates, just about anyone really) – it becomes a too broad and inclusive definition for our purposes up to the point where it loses meaning. Everything becomes design and everything becomes research too at the same time.

We argue that, when looking into the issue of the role of design as a process in research, from a methodological and philosophical standpoint, one must dig deeper into some of the fundamental ideas and notions of research culture as well as design culture to understand that they, why they, and how they differ. The main disparity between research and design from this perspective is hence not primarily that design only produces artifacts and research only produces knowledge, but rather that designers and researchers are part of two different traditions or cultures. At this slightly deeper level, we find that, embodied within these two cultures, there appear to be some quite incommensurable basic starting points and beliefs. In the following sections, we will look at some of these.

Design-Oriented Research

Design-oriented research, what could be seen as the practice (and profession) of many academic researchers in HCI, must ultimately have the revealing of new knowledge of some sort as its main objective. In a very basic way, thus, research tries to be 'true'; it tries to describe something in the way it is. Although the prospect of any kind of research being able to arrive at anything 'true' whatsoever of course can be and has been debated and problematized from several perspectives, it still seems fair to say that 'true' lives on as an ideal for research – something to strive for. Turning it over, if research should not strive to be true, then what should it strive for?

In this respect, design-oriented research argues that this new knowledge, this new description of a state of affairs, is of a kind that cannot be attainable if design – the bringing forth of an artifact such as a research prototype – is not a vital part of the research process. In some ways, this resembles the way natural scientists may only be able to test a theory by first designing the tools or instruments with which to study a proposed phenomena (Ihde 1991; Kuhn 1962). At times, the design of a new instrument also gives rise to new, wholly unexpected discoveries, such as severe anomalies to a current scientific paradigm. Yet, it is also important to realize that design-oriented research in HCI differs from natural science in several respects, not least in that the developed artifacts are typically thrown into the real world where they become used by people (Ehn 1988; Coyne 1995). People have a tendency to use artifacts in ways that were not intended and are not controllable by the designer. The mixing of artifacts and people also brings the phenomenon of 'now' into play. Although natural scientists develop their instruments to be used in a lab setting, consciously abstracting the real world, the design-oriented HCI researcher's instruments become used by people – which inevitably carry with them experiences, presumptions, cultural and societal values and beliefs, fashion, and so on. Hence, in this respect, design-oriented HCI research is more of a social sciences discipline – relating to work in ethnography, phenomenology, and sociology – than it is related to the natural sciences.

In design-oriented research in HCI, hence, the knowledge that comes from studying the designed artifact in use or from the process of bringing the product into being should be seen as the main contribution – the 'result' – whereas the artifact that has been developed becomes more of a means than an end. It is not without value, obviously, but it is not regarded as the main result of the research process.

Typically, this implies that the artifact that is developed does not need to encompass all services, functions, and level of completeness that a final 'product' would need to embrace. The design-oriented researcher, hence, works with prototypes of different kinds, depending on what aspects are investigated. Hence, sometimes a brick could be used to sketch a mobile phone; a piece of paper may be used as a screen; and a wholly faked interface may be controlled not by an application but by an experimenter hiding behind a curtain. This implies that the artifact takes on a philosophically interesting role as a kind of middle ground between a thought experiment and a real thing.

Many of the prototypes that researchers develop are, too, anything but convincing products. They may be wholly or partly faked; if implemented, they may be unstable and lack some expected functionality. In the area of HCI, as yet another sign of recognition, they are often, to put it mildly, modestly aesthetically pleasing. Notwithstanding, they need to be neither of these, as they are not results per se – they are the means to get at knowledge. This is possible because in design-oriented research, it is the knowledge that comes from studying user behavior and user experience in relation to the artifact that one is after, not just the artifact itself.

One should also stress that design-oriented research typically includes what Schön (1983, 1992) talks about as 'problem setting' as an important part, i.e., exploring possibilities outside of current paradigms; whether these are paradigm of style, technology, or economical boundaries. Design-oriented research, hence, strives to question the initially recognized limitations of a problem description. It is able to do this because the guarantor of the design effort – its 'client' – is neither a paying third party nor its group of end users. Rather, the client for these projects is the research project in which the prototype it is situated.

Research-Oriented Design

In contrast, research-oriented design is a term that is believed to better illustrate the relationship that consultants, applied researchers, and designers from industry typically hold in relation to design in HCI.

In research-oriented design, the artifact is the primary outcome; it is regarded as the main ‘result’ of the efforts undertaken. It is quite obvious, however, that this conduct also generates various kinds of knowledge, in terms of experience, competence, implicit knowledge, as well as, sometimes, the more general kind of knowledge that can be rather similar to that typically coming out of a research project. But the argument made in this distinction is not that this conduct would not generate knowledge – the argument is rather that it is not what is emphasized, valued, and the focus of assessment.

Rather than the knowledge generated, in research-oriented design, the artifact takes on a much clearer and explicit role in what the designers stress as their contribution. A sign of research-oriented design at work is often that the level of completeness and styling of the resulting artifact is given more prominence. In this paper, the artifacts often come in the shape of final ‘products’, rather than as early, experimental, and unstable prototypes.

Yet another quite important difference between these conducts is that research-oriented design most often has problem solving within some area as a characterizing component, i.e., that this conduct is often carried out within a fixed and known paradigm. This is because, in the world of research-oriented design, the designer’s main guarantor, or customer, is typically a third party that puts up restrictions of different kinds and expects certain results (not to mention certain sales). Although research-oriented design may relate to, seek influence in, and even contribute to research (i.e., the generation of knowledge) in different ways, it has the production of new artifacts as its main motivation and goal.

Discussion

From the simple distinction between research-oriented design and design-oriented research, it seems possible

to work out some of the tensions between the two cultures of research and design. Below, some of these tensions are presented as a continuum:



Although the continuum’s left end, that of design practice, has as its main concern to create and change, i.e., to make things work and fit in, it needs to be ‘real’ in some sense. Research-oriented design must take into account all the various aspects that may interfere with the goals of creation and change. It needs to deal with ‘real’ things, such as commercial aspects, cost, time to market, sales figures, political interest, user preference, etc. Design-oriented research on the other hand, should ideally rather seek to understand and explain. Its main concern is about being as ‘true’ as possible, which is not necessarily what is ‘real’.

A simple example may enlighten this very important difference in perspective of these cultures. Computer keyboards have used the QWERTY layout ever since the days of the early typewriters, where the layout was designed to separate frequently used keys to prevent mechanical jams rather than to provide efficient user input of text. Research (which seeks the truth) shows that many other layout models for keyboards, such as the Dvorak layout, significantly increases typing speed. Alternative layout models for keyboards have done very badly in the market however, so designers of keyboards (which need to be real) keep the QWERTY layout. The main point here is that it is not negligence on the part of keyboard designers nor is it a matter of not knowing the facts that is the cause. Rather, the difference is one of fundamental perspective. Although science seeks the truth (alternative keyboard layouts provide more efficient input), design needs to be involved with the real (QWERTY keyboards are what sells).

According to the basic continuum provided above and using it as a basic model for further exploring the relationship between science and design, it seems

journals. Although design-oriented research projects need to be valued according to the quality of the knowledge that has been generated and success is when some new knowledge has indeed been created, research-oriented design projects need, on the contrary, to be assessed according to some other scheme. Commercial success or, at least, such potential is clearly one alternative, but probably not enough. For help, HCI could turn to design to seek influence in how it assesses work, in fields like architecture, industrial design, art, literature, music, and the movie industry. A first, straightforward way of dealing with these issues would be to regard design-oriented research and research-oriented design project as different contributions categories, with different reviewing systems, and different quality measures. This process has already started with the introduction of submission categories with names such as ‘Design Cases’ to many conferences. For these categories, success criteria may for instance include commercial factors, such as increased sales, branding, good-will, and so on.

Third, one of the main arguments with this distinction is that the difference in tradition and basic perspective – thus in *culture* – between research and design must be recognized and made explicit, even if both will continue to take place under the cover of HCI. A contemporary problem in HCI is that academic researchers at times seem to be more interested in conducting research-oriented design than in design-oriented research. Although design-oriented research should have the larger HCI community as its guarantor and peers – i.e., where the quality of work is judged by peer reviewing – it is easy that the guarantor of such an effort rather becomes the commercial organization that may provide one’s funding, and one may find oneself working for, and not with, these organizations.

It is important to realize that what is suggested in this paper is not a general distinction of value – i.e., that we would suggest design-oriented research to be a ‘better’ or more ‘elevated’ conduct than research-oriented design. It is rather a suggestion to recognize these as different kinds of conducts – with different kinds of ingoing limitations, possibilities, scopes, intentions, motivations, and success criteria – which we find in contemporary HCI.

As noted before, the dichotomy presented in this paper is knowingly a simplification of reality. The

world is never so simple that it allows to be captured in one dimension. But sometimes, that one dimension can open up issues for a larger discussion. Using the difference between research-oriented design and design-oriented as a tool for thought to stimulate discussion may be one such dimension.

This is also why we argue that the center of the continuum between research-oriented design and design-oriented research is not an optimal position for most HCI projects. It is not so because it is vital that one is clear about what it is one wants to do; what kind of conduct one is involved in; what one’s goals, limitations, and boundaries are; and with what and to whom it is one wishes to contribute. It might simply be too much to both do a good design, with a happy client – answering to all the real-world challenges one will face – and do a good research, with happy peers, i.e., answering to being true over being real.

References

- Buxton, B. (2007) *Sketching the User Experience*, Morgan Kaufmann
- Coyne, R. *Designing Information Technology in the Postmodern Age*, MIT Press, Cambridge, MA, 1995.
- Ehn, P. *Work-oriented Design of Computer Artifacts*, Arbetstlivscentrum, Falköping, Sweden, 1988.
- Fallman, D. *Design-oriented Human-Computer Interaction*, Proc. Conference on Human Factors in Computing Systems, CHI 2003, ACM Press (2003), 225–232.
- Ihde, D. *Instrumental Realism*, Indiana University Press Bloomington, IN, 1991.
- Jones, J. C. *Design Methods*, Van Nostrand Reinhold, New York, NY, 1970.
- Kuhn, T. S. *The Structure of Scientific Revolutions*, University of Chicago Press, Chicago, IL, 1962.
- Nelson, H. & Stolterman, E. *The Design Way: Intentional Change in an Unpredictable World*, Educational Technology Publications, New Jersey, NY, 2003.
- Schön, D. *The Reflective Practitioner: How Professionals Think in Action*, Basic Books, New York, NY, 1983.
- Schön, D. *Designing as Reflective Conversation with the Materials of a Design Situation*. *Knowledge-Based Systems*, 5, (1992) 3–14.
- Wolf, T. V., Rode, J. A., Sussman, J., & Kellogg, W. A. (2006). *Dispelling “design” as the black art of CHI*. *Human Factors in Computing Systems, CHI 2006*, Montreal, Quebec, Canada.
- Zimmerman, J., Forlizzi, J., Evenson, S. (2007) *Research Through Design as a Method for Interaction Design Research in HCI*. *Human Factors in Computing Systems, CHI 2007*, San Jose, CA, 493–502