# Exemplary Design Research

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## *Abstract*

In this paper, we will look at what role a research program and an interventionist research strategy based on design experiments may play for the advancement of knowledge relevant to design and designers. We suggest the notion of exemplary design research driven by programs and experiments and by this we refer to research based on the explicit formulation of design programs that act as a frame and foundation for carrying out series of design experiments. It is 'exemplary' in the sense that it enables critical dissemination primarily by creating examples of what could be done and how, i.e. examples that both express the possibilities and

characteristics of the design program as well as more general suggestions about a certain (change to) design practice.

## Introduction

Many design education programs are currently under-going radical transformations as they move towards university status. Research and research-based education becomes part of the everyday of the design school. Also in design studios and design consultancies, design research is becoming a new venue of activity. But what is design research and how does it relate to design and to the more proven knowledge production of the sciences and humanities?

To combine the terms design and research produces an ambiguity that has been discussed already by many authors. As some have phrased it we may for example ask: Is it research about design?, is it research in design? or is it research through design? [Frayling, 1993] If we compare with other terms such as "dental research" or "clinical research" we can see that the qualifiers can either indicate a particular topical area (like research into the treatment of teeth) or a particular research setting (research within the boundaries of the (medical) clinic). For us, design research is similarly a venue for knowledge production that is guided by the professional interests of design communities and the need for theoretical and methodological development. Such research may be conducted by designers as part of their work, or it may be led by academic institutions aiming at expanding our knowledge of 'what' can be designed and 'how' designing can be done. But what are the marks of excellence of such research and how can it claim its relevance and ensure credibility of its results? How does the knowledge produced relate to design itself?

## Programs and Experiments

With the notion of *exemplary design research driven by programs and experiments*, we refer to research based on the explicit formulation of programs that act as a frame and foundation for carrying out series of design experiments and interventions. It is 'exemplary' in the sense that it enables critical dissemination through examples of what could be done and how, i.e. examples that both express the possibilities of the design program as well as more general suggestions about a (change to) design practice.

To adopt a participant perspective is not unique to design research. In dental research, research questions will also be framed by the way dental problems can be conceived by those professionals that deal with dental care. This framing is not universal and can not be understood from inquiries into for example dental diseases alone. In one context where dental care is organized around clinics for dental surgery, dental research may mean explorations and evidence-based research into new surgical methods or new strategies of post-surgical treatment. In another context where dental care is primarily organized around prevention, dental research is likely to focus differently on, for example, care plans for healthy teeth and strategies for monitoring and affecting such issues as teeth brushing and other preventive measures. It is the research program that ensures that what is researched can also be transformed into viable new procedures applicable within a particular context of professional practice.

The dependency on a framing program is even more profound when it comes to design research. If we think of how to research the feasibility of new approaches to service design or how to explore a new language of form that may stem from the introduction of new materials, we must condition this research by accounting for the particular setting in which it is conducted. In this respect we may compare design research with the clinical research of the medical professions, where the search for new knowledge is pursued within the framework of the medical clinic. But unlike medical research, design research can not claim evidence for its results with reference to hard facts such as rates of recovery, cure or well-being. Design

is inherently about proposing in Jones words "a change in man-made things" [Jones J. C, 1980]. This produces a double challenge for design research, as it must both be exemplary in the sense that it demonstrates that what is proposed by the program actually can be done, and additionally evidence that pursuing such a line of inquiry will, also for others, provide opportunities of unprecedented change and novelty.

In this sense, design research has to go beyond established disciplinary modes of inquiry. The design researcher must in some sense establish a knowledge regime [Foucault, 1990] somewhat similar to a discipline in order to frame and contextualize his or her inquiry. The design research program, which we will also give examples of later in this paper, operates as such a provisional knowledge regime. That the program is provisional means that it is not unquestionably presupposed but rather functions as a sort of hypothetical worldview that makes the particular inquiry relevant. As the design research unfolds, it will either substantiate or challenge this view and the dialectic between program and probing is in our view central to this kind of design research.

The purpose of the experiment is not to 'test' the program in the sense of proving or confirming it. Of course, there is much to be gained from reflection and analysis upon each experiment we make, but it is in the relation between program and experiments the perhaps most important knowledge is gained. In this way, the set of open 'research questions' are not necessarily to be found in the actual program (as it may even take on a manifesto character, being rather normative in nature), nor in the individual design experiment (as it may even be quite similar to a *design project* not in itself explicitly answering a particular research question), but rather in the relations that surrounds them and bind them together.

When we look to a program suggesting a certain approach to the design of some new technology and then to the experiments expressing and exploring it, we need to consider them as a whole when asking questions about knowledge production. This means that whereas the experiments answer to the questions/suggestions put forward by the program, it is the combination of program and experiments that addresses the underlying research questions. Thus, while it is essentially right to

think of the design experiment as answering research questions, they do so in a particular way that relies on the existence of a program framing the inquiry. An important consequence of this is that we must take care in not overcharging the experiment with respect to what it can answer and how (especially considered in relation to other experimental research traditions).

The mutual interdependency of program and experiment is, however, not unique to design research. It is also found in the growing bulk of so-called transdisciplinary, or as some call it mode II [Nowotny, H. 2004], type of research that takes its research questions not from within the disciplinary discourse but from societal challenges arising at the intersection between different knowledge domains. Examples of such transdisciplinary research range from research involved in large technological programs, such as the European Airbus project, to more policy oriented research, as for example has been conducted in crime prevention programs in big cities [Siggard Jensen, H. 2004]. Similarly to what we said above about design research, such transdisciplinary research must by and large operate within and to some extend even co-produce the ontology and epistemology that makes it relevant and accountable.

In examples such as the Airbus project, the validity of the research made, can by and large be produced post hoc as the program eventually turns out to be successful. This will rarely be the case for design research as the scope of this research typically will be to provide and propose strategies that also must be capable of producing yet new knowledge. Action research has dealt with similar problems as it suggests an integrated approach where researchers probe for new possibilities through engaging in interventionist action with participants in the topic area. Action research has particularly been applied in organizational research, where researchers for example has taken on a kind of consultancy role in change processes in parallel with monitoring and evaluating effects of the instated change [Foote Whyte, W. (ed.) 1991].

The main argument for this approach, also relevant for design research, is that research into for example new organizational models or organizational change processes will have severe delimitations if the researcher is not able to propose

and engage with modes of change that appear relevant and promising. An obvious problem with this approach, that has also been the subject of heated debate, is that the researcher becomes dependant on the success of the intervention and in this way looses the ability to challenge assumptions and question results. Some authors have however pointed to that re-framing the action as interventionist experiments open for scrutiny both on the side of practitioners and researchers may be a way out of this potential pitfall [Argyris, C & Schön, D. A. 1991].

What we see as needed for design research is the commitment to experiments that somehow make the research program open for tests of accountability and relevance. This test, however, is not a simple question of confirmation or rejection as discussed also in [Schön, D. A. 1983]. Rather, the experiments are exploratory probes into what the program may entail and how it can be expanded and sharpened to account for how the experiments unfold [Brandt, E. 2004].

## Program and Practice

Over the last decades new research institutions have emerged that give priority to program-driven research. In the field of interaction design a programmatic stance towards technologies in use under headings such as artificial intelligence, virtual reality, intelligent agents and later ubiquitous computing have competed to define a direction for technological progress.

Through the late 90's new research and design institutes emerged that defined their research agenda from a design, rather than from a technological point of view. In what follows, we will use some examples from one such environment, the Interactive Institute formed in Sweden in 1998. The institute brought together technologists, artists and designers to create what was called a studio-based research environment nurturing cross-overs between conceptual design, artistic production and scholarly research. The examples have been taken from the Space & Virtuality and the PLAY studios.

## Augmenting Places and Moving Stories

Spatial metaphors had since the mid-90's gained wide-spread popularity among IT designers. Computer applications were seen as providing a space for experience and interaction and researchers had become interested in how such a space could be seen as structured in chat rooms, agoras or sites where people could meet and engage with one another. Furthermore the rapidly increasing development in computer-based visualization gave rise to an expectation that a naturalistic virtual environment could be created within the computer that made it possible to handle still more parts of the real world through the computer interface. There were, however, also researchers who argued that the real challenge to IT design was to envision a future where computation becomes ubiquitous and has to blend in with the physical environment of the everyday.

At the Space&Virtuality research studio, we wanted to enter this discussion in critical dialogue with these positions. To put ourselves on the stage we stated programmatically:

> *The Studio takes a constructivist stance towards the notions of space and virtuality. Lived-in space is in our view best conceived as the social construction of shared frameworks in which people act and orient themselves....*

> *..'virtuality' to us does not mean immaterial, but rather 'as alive'. Virtual worlds are 'as if worlds' that we can play with in order to understand what it would mean if we really acted in similar environments.*
> [Space&Virtuality yearbook 1999]

We also wanted to question the dominant view that innovative interaction design had to come out of technologically oriented research labs. As a preliminary statement on how to (do) design (research), we wrote:

*The research approach of the Studio is characterized by a commitment to user involvement in design, an experimental approach to the exploration of technological possibilities and a reflective research practice developed in dialogue with practitioners.* [Space&Virtuality yearbook 1999]

And finally we linked these statements to a similarly programmatic vision of what to design:

*In the Studio we will contribute to the redirection of IT design. Focus on organized task systems and specialized tools must give way to the both more humble and more demanding challenge of providing people with 'set-pieces' and 'props' for their continous construction of ever changing lived-in worlds.* [Space&Virtuality yearbook 1999]

Taken together the Studio program provided claims both in terms of viable theoretical concepts and in terms of practical do-ability and relevance that had to find justification though the research activities it proclaimed. Yet programs of this sort can never be validated in the same way as the more confined claim of a scientific hypothesis. Precisely because the program gives a certain direction to what should be explored, it cannot claim the irrelevance of search in other directions. But the program can together with the experiments that it generates extend out knowledge of what can be done and how, in a way that is also open for arguments and scrutiny from outside the program. A few coarse examples from the work within the research studio can give a sense of how knowledge is produced.

As the program brought together a diverse group of researchers several lines of inquiry evolved in parallel. Along one line researchers initiated research on space and place in the modern city, turning the idea of internet communication as forming ancient agoras upside down by asking how young people construct space and place as they move around the city instantly connected to one another with mobile phones.

FIGURE: Contesting place

In an exploration of how teenagers appropriate the city, researchers played with the notion of machines as they set up the human automat as an installation inviting by-passers in the streets of Malmö to trade a soft drink for a drawing of their personal map of the days journey.  Project by: Maria Hellström, Camilla Grunnet and Ane Skak.

Another line of inquiry took up the notion of virtuality in the context of space design. Here the initial question was how people without professional training could be brought into the architectural design process as design participants through different kinds of digital visualizations of possible space designs. Experiments showed that the sense of immersiveness that these visualizations enabled stemmed as much from the stories about future use they enabled the participants to take part in as from the generic naturalism of the representations. Over the course of several projects this line of inquiry developed a broad repertoire of approaches to what was called partner-engaged design expanding the notion of virtuality to encompass a broad spectre of game-like collaborative settings. [Johansson et al, 2002]

A third line of inquiry addressed the issue of IT design beyond "systems and tools" through seeking out everyday contexts in which prevailing notions of computation could be challenged. Process plants were one such interesting context because they are highly constructed environments with a long history of technologically mediated interaction. Together with plant operators the researchers transformed technological visions of others, particularly Weiser's idea of calm technologies [Weiser 1993] into configuration devices that made

operators able to configure computer-based monitoring and control of plant processes "on the fly". The design suggestions deliberately played with the notions of "tools" and "places" in order to question the "what" and "where" of augmentation and concepts of dynamic augmentation, temporary views and a growing awareness of the co-construction of place and action attracted attention both in industry and among our scholarly colleagues [Nilsson et. al 2000]. From process plants researchers moved to domestic settings to see if dynamic configuration could also be made sense of in households [Brandt & Grunnet 2000], and later to collaboration with intensive care nurses, who despite the obvious differences between process plant monitoring and patient care also work in a highly technologically mediated and dynamic environment [Björgvinsson et al 2005].

The different lines of inquiry gave us an opportunity to develop our thinking about space, design and participation. In the process plant project we learned how integral the configuring and sensing of mediations are to the way operators are present in their environment [Binder 2002]. This resonated with the patterns of a floating and ephemeral urban space continuously negotiated and re-constructed that our work with teenagers revealed. Similarly the open-ended collaborative design process unfolding in the work on space design seemed to be traceable also as on-going processes in the everyday practice of intensive care nurses using video technology to configure places for peer-to-peer learning. The initial commitment to user involvement became increasingly modes of participatory inquiry and collaborative learning evolving around a new everyday practice. [Binder & Hellström, 2005].

## Display Surfaces and Layers of Interaction

To complement the previous example of a high-level development, we will move to a specific series of experiments relating to one of several rather concrete suggestions in a design research program.

The IT+Textiles project was a three-year project based on collaboration between both academia and industry with focus on emerging applications in the intersections between information technology and textiles [Redström et al 2005]. In terms of context, the "IT+Textiles" program partly came out of an earlier program called "Slow Technology" [Hallnäs & Redström 2001] and after it was finished, some of the later results and ideas were used to form a new program called "Static!" [Backlund et al 2006]. Some general research issues were expressed as:

> *In light of the imminent arrival of ambient intelligence and smart textiles, the design of computational and textile things are rapidly converging. While substantial attention is directed towards the technical possibilities of these new materials, much less effort seems to be put into the challenging task of re-thinking the use of textiles and computational technology in design on the basis of a rather complex mixture of traditions, perspectives, concepts, methods and materials resulting from such a convergence. /.../ Trying to dissolve the distinction between technologies and design materials, we have combined textile and interaction design, textile and electrical engineering, philosophy and the behavioural sciences to find new approaches to issues of use and context, form and aesthetics, practice and theory.* [Redström et al 2005]

In terms of research structure, IT+Textiles was based on two layers of 'experiments'. As starting points, we used shorter, often high-risk projects with uncertain outcomes, typically involving just a few people. These shorter studies would focus on things such as a certain material or technology, a given use context, object category or a specific design method. Results from these smaller studies were then used to form larger projects involving more people and resources.

Partly as a reaction against a typically technological perspective on new 'smart materials', IT+Textiles was intended to place issues related to the expressiveness and aesthetic potential of textiles and information technology at the centre:

*We use textiles to provide the spatial structures that manifest the temporal structures generated by the execution of programs. Textile materials open up for new ways of creating the spatial surface of computational things and computational technology open up new ways of creating dynamic surfaces and behaviours in textile and fashion design. Combining these materials in the design of everyday things and environments also makes it possible to develop a deeper understanding of the interplay between temporal and spatial gestalts in design.* [Hallnäs et al 2002a, p. 59]

In the first design experiments aimed at exploring this relation, more abstract issues such as the expressions of different kinds of movements with respect to how they could be made to express various temporal structures were explored [cf. Hallnäs et al 2002b]. In the work that followed, however, this experimental design approach was complemented by more user-centred design approaches. One starting point for such work was a study of family members being away from each other, e.g., children sharing their time between divorced parents, people staying at hospitals, or generally spending long periods away from home. These interests and ideas came together in the *Interactive Pillows* [Ernevi et al 2005b]. The ideas that fed into this project are quite clearly visible in both the concept and the design of the pillows. The idea of the textile surface as a 'display', in this case of certain communication processes builds on the experimental work preceding it, as does the idea of 'using' information technology to reinterpret the use of a traditional textile object. The notion of "pillow talk" and that of hugging a pillow as something we do when longing for someone or feeling lonely, on the other hand, came from the field studies.

FIGURE: the Interactive Pillows

The Interactive Pillows come in pairs and are wirelessly connected to each other using, in the case of our prototypes, a combination of wireless local area networks and Internet. Thus, they are meant to be connected at all times independent of location. When one of them is hugged, the other one responds by starting to glow. The pillows look like ordinary pillows, but where electroluminescent wire has been woven into the fabric in order to make it possible for them to change appearance. Project by: Christina von Dorrien, Daniel Eriksson, Anders Ernevi, Patricija Jaksetic, Margot Jacobs, Ramia Mazé, Johan Redström, Maria Redström, Erik Wistrand and Linda Worbin.

Experiences with prototypes of the pillows, from both using them ourselves as well as trying them out on exhibitions and field studies, meant that new issues of interaction with textiles, and of communicating through textile objects came into view. For instance, the pillows still work as pillows; they even look like normal pillows. When they light up, they act as a kind of 'lamps' and when one uses them to communicate they become devices for communication. Thus, there are several ways of using them present simultaneously. This introduced another dimension to the temporal form/spatial surface ideas we started out with. In the *Tic Tac Textiles* project [Eriksson et al 2005a], the possibility of literary playing around with different layers of interaction was further explored, e.g., relations between interacting with the physical object itself (as in the possibility of drawing on the surface using a hot cup of coffee) and using it to communicate (as when trying to use them play this game). However, we also find ideas from the early experiments with textiles and computational technology, as in the exploration of how material

properties influence what it is like to use something. Here, the game itself is the same as ever, but the materials used transforms how it turns out in practice.



FIGURE: Tic Tac Textiles

Tic and Tac are pieces of furniture designed for a place where we have a cup of coffee and spend some time waiting, for instance at a café in a railway station. By placing your cup on the table, you also enter a cross on corresponding position of a hidden Tic-Tac-Toe gameboard on the other. Playing this game is, however, somewhat different from the typical experience of tic-tac-toe as it is quite slow (as it takes time for the heat elements to make the mark on the other table) and in practice slower and slower as the coffee gets colder (as the heat sensors need a certain amount of heat to react). As such, it perhaps reflect the feeling of time running ever slower when waiting. Project by: Daniel Eriksson, Anders Ernevi, Margot Jacobs, Ulrika Löfgren, Ramia Mazé, Johan Redström, Johan Thoresson & Linda Worbin.

On a more general level, the exploration of layers of interaction also opened up for other perspectives on the idea that we may introduce 'new' technology through 'old' things. In these experiments, it is quite clear that any such new introduction also transforms the object into something else. In some cases, a kind of parallel or alternative understanding is introduced but it also seems that there are gaps in-between. For instance, when my pillow lights up, I do not really know whether my loved one is thinking of me or if someone just happened to lean

against the pillow when sitting down in the sofa. Or, as in the Tic Tac Textiles, is the appearance of this mark on my table an invitation to start playing the game or is it just someone putting down her cup?

In terms of how the experiments challenged the program, it is therefore of some interest to see how it gradually makes the initial assumption about relations between spatial surfaces and temporal form into something more complex when issues relating to use are given a more central role. Though the notion of spatial/temporal form provides a starting point for working, it also opens up gaps between different interpretations of use. Thus, this is not only about re-interpreting the dynamics of textile surfaces, but the many layers of form and interaction that such re-interpretations open up. To continue from this point would therefore require a reformulation of the program where such layers, and their relation to what it means to use such designs, would be given a more central role. In relation to more general research issues in the development of pervasive technologies, the experiments initiated a drift towards a critique of one of the programmatic assumptions in the design of much such information technology – that of 'hiding' it in everyday things and environments.

## Cycles and Drift

What distinguishes the ordinary design program from the program in design research is the way the design research program is challenged by experiments that deliberately seeks to establish the strength and scope of the program in relation to an overarching knowledge interest. In the previous examples it is an important point that researchers challenge the notions of place and technological mediation by engaging in design experiments in rather different practical settings, as it is important that emerging concepts such as the layering of interactions are pursued and put at stake in a series of experimental trials. In design, as in design research, the program is a statement of what and how to know and act, but whereas the

ordinary design work proves its relevance through what the program can accomplish in terms of finished design, design research has to show the strength of the program beyond the individual experiments. One may say that where the program is a means for the designer to be able to pursue a particular line of design, the program is to the design researcher the suggestion that must be substantiated through experiments.

Evaluating a design research program is to a significant degree a matter of how we understand it in relation to other such programs, e.g., to what extent it enables us to think and do given things in certain, and preferably new, ways. Though the description of any eventual effects of such a program on a societal level is bound to be guesswork, we can still discuss, critically examine, compare and evaluate design programs in relation to each other. For us to be able to do this, however, they need to be 'finished' to a certain extent, i.e., it is difficult to evaluate a design program before we have enough examples of what it affords, and as such it is typically something we do in retrospect.

We might say that we evaluate the design program on basis of how well the design examples express the program's potential; to what extent they take advantage of, and present, the 'new' design space suggested by the program.

Thus, one way of describing what constitutes the end of a 'research cycle' here, is when we reach a stage where it is possible, or even necessary, to basically re-formulate the program as to account for, and generate new, experiments. In practice, we 'see' that we are approaching this point when, for instance, our experiments do not seem to generate as much 'new' knowledge as we would expect them to, and as they appear to be too similar to things we have done before. But it can also be that our experiments seem to take their starting point elsewhere, i.e., that the drift caused by the program-experiment dialectics has taken us to a point where we can formulate a new program as we now see things differently. In this case, we may also start to see earlier experiments in a different way as we trace the roots of our 'new' program.

In terms of evaluation, this means that the design research program has to be formulated in a way that enables the research team to finish a 'research cycle' within given resource constraints. More specifically, this means that the program must include an idea of what it would mean to have 'realised' it. Otherwise it will, so to speak, be left like an unfinished painting where we can trace ideas and attempts, but not necessarily see where it eventually might take us. This need for a closure that enables critical analysis can be compared to the notion of 'loops' in action research, i.e., that the intervention in question has to run through a whole cycle before one can say much about what caused which changes.

## Concluding Remarks

To briefly relate design research to more distant research practices such as design theory, design studies or design science, it is clear that there are many differences but also compatibilities in knowledge claims. Programmatic research such as the *IT+Textiles* projects address questions about interaction, materiality and temporal form that are both informed by and potentially informing research on the way design is appropriated and made sense of in the everyday. Similarly the *Augmenting places* projects heavily rely on conceptualization of the design process from the design studies tradition as well as on discussions on space and place in anthropological literature. In on-going design research such affinities operate as a way of informing and sharpening program and experiments, as for example in the social constructivist influence on the studio programme of the Space&Virtuality studio.

As the research cycle of program and experiments comes closer to closure, these influences have continuously shaped the 'journey', and experiments can be seen as empirical explorations that may eventually be analyzed from an outside perspective in their own right. Such research can in principle be conducted by outside researchers, but for us it is more important to emphasize that the design

researcher here has a privileged position as participant to both guide and reflect upon this experimental work also towards theoretical perspectives raised in other research communities. This provides the potential for a fruitful exchange between research communities. It is however still an exchange, in which the design researcher gains his/her accountability in the designerly exploration of an also theoretically coherent program, whereas for example the genuine design theorist gains authority through an otherwise descriptive and theoretically elaborated position of scholarly practice.

We opened this paper by pointing to the growing interest in research within design school teaching and design consultancy and to the uncertainty within these contexts as to what research in design entails. With our suggestion for an exemplary design research guided by program and experiments, we have sought to outline a research approach that can take advantage of designerly ways of working, yet maintain compatibility both towards design practice and to other kinds of scholarly practice. We do not argue that such research produces a special kind of knowledge, but rather that an exemplary design research driven by program and experiments provides one possible way for design researchers to take part in knowledge production relevant for design practice.

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