The Role of Hypothesis in Constructive Design Research

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Abstract

It is, today, widely appreciated that Research-through-Design – or Constructive Design Research as we will call it in this paper – allows for designers to produce knowledge based on the skills and capacities of the design field itself.

However, most of the research fails to bridge the gap between the general notions of constructive design research and the detailed research activities of the field. We therefore suggest bridging this methodological gap in the academic discussion with what we have ended up calling the "entrance level of constructive design research".

As a step towards to a more nuanced and solid perspective on how to keep constructive design research on track, this paper offers a model for understanding the role of hypothesis in constructive design research. The model allows for understanding the hypothesis's relation to research motivation, questions, experiments, evaluation and knowledge production. The intention of the model is to have it serve as a tool in the research process aiding the researcher to understand at what "level" discussions and claims are brought forward, and what consequences these might have for the research work at hand. Thus, the paper claims the central position of the hypothesis as a key-governing element even in artistic led research processes.

KEYWORDS: Constructive design research, hypothesis-making, motivation contexts

Introduction

Within the field of design research it is well known that the debate and speculations around the methodology of Research-through-Design originated with Christopher Frayling's pamphlet to the British Research Council (1993) and Bruce Archer's article "The Nature of Research" (1995). We see Frayling's (political) pamphlet as a sort of pivot that brought a discussion that have been developing in the design research community ever since. The notion of Research-through-Design framed the possibility of design research being done on

the basis of design practice or through practice, i.e. by artistically/creatively making objects, interventions, processes etc. in order to gain knowledge.

While Frayling and Archer threw in the idea that artistic and creative processes could be legitimately used as a research method and ought to be appreciated as accounting for the identity and singularity of design research, it was not until almost a decade later that more systematic attentions were given to the subject (among others Buchanan, 2001; Cross, 2001; Friedman, 2002; Margolin, 2002; Sevaldson, 2010).

In the aftermath of the foundational discussions, research projects began to emerge which overtly committed themselves to exploring how research could be conducted through design. In recent years, this research have provided valuable insights and descriptions of what Research-through-Design is and reported on an enormous wealth of methods, techniques and experiments done in the field. This has led to an increased diversity in the type of knowledge that the methodology produces, as well as a continued discussion of the relevance and formatting of the research approach. It is, today, widely appreciated that Research-through-Design allows for designers to produce knowledge based on the skills and capacities of the design field itself.

We see the methodological discussions so far focusing on either the overall discussion of whether or not Research-through-Design is valid, relevant and different from existing research practices, or on the individual cases, experiments or activities and their arenas of dissemination. Because of this, we suggest that more nuanced and formal accounts of the methodology are needed. We therefore suggest bridging this methodological gap in the academic discussion with what we have ended up calling the "entrance level of constructive design research". We see motivational contexts and hypothesis-making bridging between the overall methodology and the concrete design research. Therefore this paper seeks to revitalise the hypothesis as a guiding tool for the research work at hand, and focus rigid attention towards the process of hypothesising itself.

From Methodology to Concrete Research

In recent years some researchers have set out to develop a fine-grained methodology enabling us to make such critical distinctions and to recognize research through design in all its rich and various forms. Among the literature on this topic, we have chosen to go into a more detailed examination of the work of Koskinen et al. (2011), Zimmerman & Forlizzi (2008) and Brandt & Binder (2007).

Constructive Design Research

In this paper we have decided to use the term Constructive Design Research drawing on a recently published book by Koskinen, Zimmerman, Binder, Redström and Wensveen (2011). The authors claim that design researchers need methodological and theoretical flexibility. They propose to understand the methodology of constructive design research as being shaped primarily by three different contexts: the lab, the field and the showroom. Each one of these contexts is characterized by their own research culture adapted from other research traditions, viz. the natural sciences, social sciences and art. Constructive Design Research is defined as: *"Design research in which construction – be it product, system, space, or media – takes center place and becomes the key means in constructing knowledge"* (ibid, 5).

Koskinen et al. propose the notion of Constructive Design Research emphasising that much research has been conducted since the early days of Research-through-Design. For example they state that the body of research has clarified and appreciated many of the things, which was unclear and under-researched in Frayling's first and rather vague definition of Research-through-Design.

While we recognize the need for flexibility in design research theory and methodology and sympathize with the view of Koskinen et al. that design research is *"…a science of the imaginary"* (ibid: 42) we also see Koskinen et al. providing little tools for handling and bridging between the actual detailed methods and techniques in processes of constructive design research. As such a categorization of design research contexts as the ordering principle for guiding actual research work, and for that sake research education, needs to be further developed and supplemented beyond the typology of lab, field and showroom as presented by Koskinen et al. One could say that in addition to the distinction of where the research efforts are aimed and validated (lab, field or showroom), we would like to propose a distinction of "motivational contexts". Following the overall argument of research through design, we strongly support that design research be conducted by designers using design skills, and in order to underline this position we wish to acknowledge that motivations for both designing and researching can come from a number of sources.

Using Motivation to Make Distinctions in Constructive Design Research

In another work, Zimmerman and Forlizzi (2008) go out on the same errand as we do. They also argue for making distinctions of constructive design research (they call it 'research through design') on the basis of what motivates this type of research at the entrance-level. In addition, and in support of their argument, they have interviewed a large number of HCI-researchers, who adhere to the model of constructive design research asking them about their motivations for initiating projects (Zimmerman et al., 2007). Following from this, the authors propose two motivational contexts (Zimmerman & Forlizzi, 2008). Either, they say, constructive design research is initiated by formulating a research question out of an existing theory or philosophy, which is then investigated through a process of making and designing artefacts – an approach which is referred to by the authors as the "philosophical approach". Or design researchers take a "grounded approach" in which they focus on real-world problems by making things that suggest *"a specific, preferred state that is the intended outcome of situating the solution in a context of use"* (Zimmerman & Forlizzi, 2008: 43).

While we agree with Zimmerman and Forlizzi in that motivations are central for developing a more nuanced understanding of the methods of constructive design research, we argue that their distinction between a philosophical and grounded approach is incomplete. We need to distinguish between more than two types of motivations, and the boundaries between them are not waterproof – as Zimmerman and Forlizzi seem to believe (see also Markussen et al., 2012). More often than not the philosophical and grounded approach go hand in hand in constructive design research.

Also, what Zimmerman and Forlizzi leave out of considerations is that both of these approaches somehow presuppose the construction of hypotheses as a steering tool for formulating research questions to be explored through the process of making and designing things. The steps taken at the entrance-level of the research process – from motivation, to hypothesizing to the formulation of research questions to experimentation – holds the key for developing a methodology of constructive design research. We do not stipulate that this is a linear process. On the contrary, one can step into the entrance-level of a research project from any one of these stations. There is no prescribed order or linearity to it. A research

project can be born out of a clearly articulated research question, but a research question can also be generated from pure experimentation without having a clear aim or strategy. Our claim is though that the notion of hypothesis-making is crucial for understanding the interdependency of these steps, but only few design researchers has paid attention to this.

Experimental Design Research

The focus on the centrality of hypothesis-making is also absent from Brandt & Binder (2007) who put more emphasis on the experiment being the core of design research. The notion of 'exemplary design research' is introduced by Binder and Redström (2006), who argue that design experiments must engage with a reality of designing outside the research setting, i.e. they must be exemplary and interventionist, since there is interdependency between the design research programme and the inquiry. We are in line with Binder and Redström's claim that it is necessary to engage with a context doing design research. On the other hand we argue that they fail to address what we refer to as the entrance level to constructive design research.

Later Brandt and Binder (2007) suggest a diagram, which captures the relationship between research questions, research programme and design experiments in exemplary design research. They emphasise that a programmatic approach to design research does not necessarily obviate a research question. They argue that the research typically provides insights that are broader than the programme, which means that the research question has a larger scope than the programme. They offer a visualisation of how the question relates to the programme and the experiments as shown below.
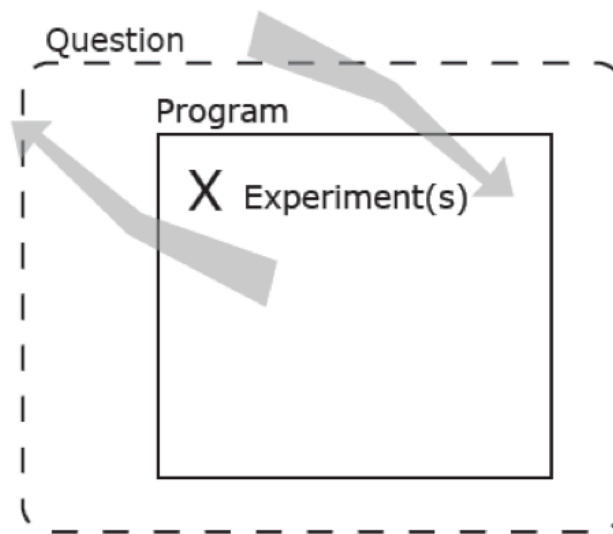

Figure 1: Brandt & Binder's diagram showing the relation between research question, programme and experiments (model adapted from Brandt & Binder, 2007).

Brandt and Binder argue that the programme is an *"intermediary between research question and empirical exploration"* (Brandt & Binder, 2007: 3). In the paper they address this through an analysis of three PhD-studies. In one analysis they briefly touch on the development of a research question on the basis of a motivation derived from industrial design practice. However they do not go into details with the construction of research questions.

We argue that the construction of research questions cannot be appropriately understood without a more elaborate description of the relation to motivational contexts and hypothesis-making. In fact, hypothesis-making is present, if only implicitly or tacitly, in each step throughout the research process. It is impossible to engage in experimentation, programming or the formulation of research question without being engaged in some kind of hypothesis-making activity - be it vague and imprecise. A researcher, no matter if she adheres to traditional research fields or constructive design research will always cling onto some kind of presumption or belief about the constitution of the domain she is making inquiries into. What in the philosophy of science is known as axioms, i.e. those background assumptions and premises that are taken for granted and never questioned, but the awareness of which is important for judging and evaluating the quality and validity of the research outcome.

Interestingly, Koskinen, Zimmerman, Binder, Redström and Wensveen (2011) notice that any successful research program has a negative and positive heuristics: *"A negative heuristic consists of a "hard core" of beliefs that is not questioned, and a negative protective belt of auxiliary hypotheses that can be subjected to debate and can be wrong. A positive heuristic tells which questions and objections are important and in what order they are tackled when they show up"* (Koskinen et al., 2011: 39). This is an accurate observation, but it says nothing about how the "hard core" of beliefs are correlated with the belt of hypotheses, and how these hypotheses are created as support of the core beliefs. Nor does it offer insight into how the negative and positive heuristics are translated into research questions, programmes and experiments.

Based on this literature review and reflections on the nature of constructive design research, we see that there is a discussion we need to take as a research community – a discussion that is positioned between the concrete examples of experiments of constructive design research on the one hand, and epistemological, philosophy of science discussions of the nature, relevance and rigidity of constructive design research on the other. Between these two subjects lie an *'entrance level'–discussion* pointing towards the processes leading to the solid producing of knowledge in constructive design research, that is, how experiments are set up, motivated and argued as relevant. We call it the entrance level since, as new projects are undertaken, certain steps should be covered to ensure that the constructive design process uncovers knowledge that is relevant to a larger community of design scientists and practitioners.

Hypothesis-making

Constructive design research is not only different from the wider scientific community, although plenty efforts have been put into this argument lately. This has, of course, been done to legitimately distinguish constructive design research from other types of inquiry. However, we see that it is now time to solidify the scientific process itself within constructive design research by way of known terms describing the knowledge development process. Using these standard ways of describing the scientific process in terms of motivation, hypothesis and research question, our rather new and emerging field of research is correlated to the concepts being used in other research fields.

Model: ways of constructing hypothesis

With this paper we want to provide a model describing constructive design research that enables not only the categorization of methods and techniques, but facilitates a process of framing and reframing the actual research work. Along these lines we see our contribution as an operationalization of Koskinen et al.'s (2011) methodological work as well as the closely related discussion in e.g. Zimmerman et al.'s papers from (2010) and (2008), both of which refines the discussion on epistemological distinctions of relevance and rigor. We do so by presenting a model of constructive design research in which hypothesizing is seen as an ongoing process that is framed by the overall research motivation for doing the research and developed in a continual process centred around the experiments conducted and in close articulation with the research question. Similarly to Brandt and Binder's (2007) model, the model describes a constant reframing of the research activities. However, we are consciously introducing a hierarchy within the constructive design research process, as developing a hypothesis happens on the foundation of a clear motivation, after which the narrower research question can be put forward and criteria for evaluation can be found and used. Lastly new knowledge – the point of the whole exercise – can be reliably disseminated from the research after meeting the criteria of the evaluation. However, as the model illustrates, the centrality of the experiment as the drive wheel in constructive design research, can qualify (and be qualified by) each point in this hierarchy and also produce a form of knowledge as concrete objects or experimental design proposals.

The intention of the model is to have it serve as a tool in the research process aiding the researcher to understand at what "level" discussions and claims are brought forward, and what consequences these might have for the research work at hand.
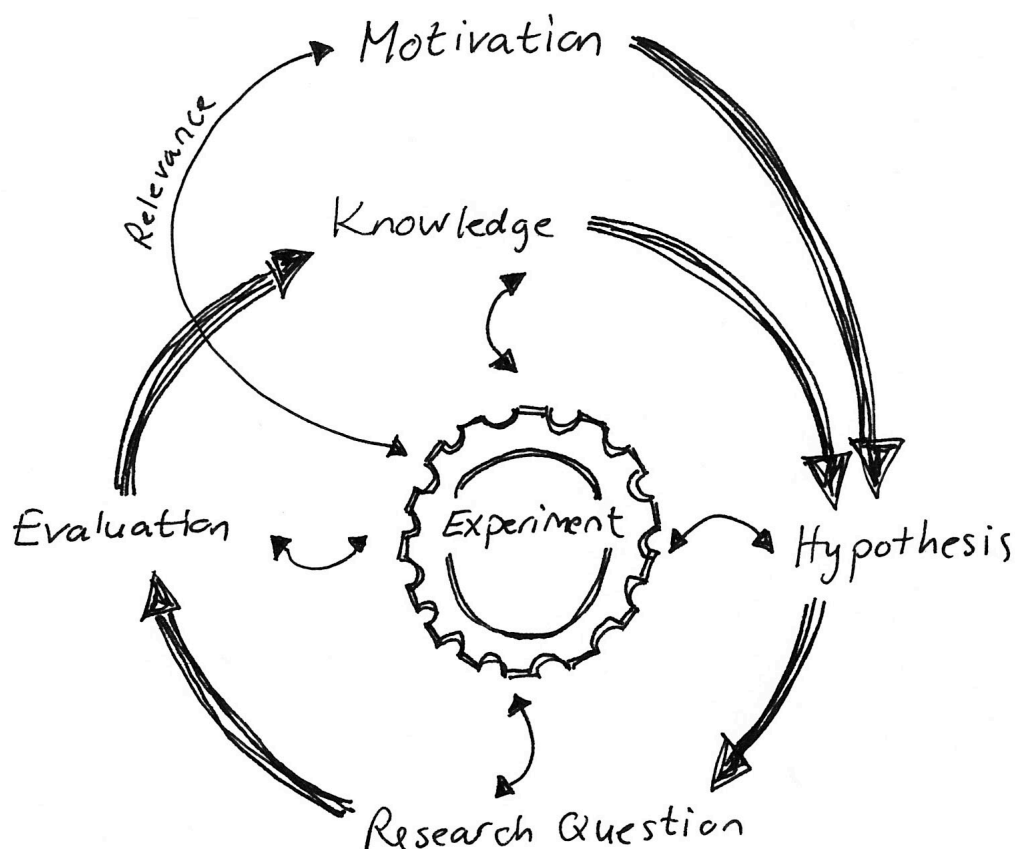

Figure 2: In the above model we suggest that the experiment serves as the drive wheel of constructive design research. As such it can inform at (and be informed by) every level in the research process.

Hypotheses are constructed and qualified as an experimental process of abductive reasoning (Peirce, 1958). Abductive reasoning means that knowledge, empirical findings, concepts and ideas are combined as a form of abstract prototypes to be tested and debated according to their relevance to practice, academia, and practicability or feasibility of the experiment. This debate can be undertaken through academic discussion or experimental design work, as illustrated in the model.

The hypothesis articulates the premise(s) under which any research work must be read and understood. It articulates and de-limits the validity of the studies and frames the methodological landscape. Following this, the research questions are more detailed accounts of what is subject to study, and point out appropriate research techniques and even possible outcomes. Preceding these the motivation of the research contains both the internal and external relevance of the research. The actual concrete research activities are in this model described as experiments. Experimental work is not limited to be the construction of prototypes or artefacts but also means the evaluation or exposure of these in the context they are developed for (Koskinen et al., 2011).

Having the experiment as a drive wheel in the model means that construction is not limited to a position in a more linear phase-model where it can be undertaken after a solid research question is attained and subsequently exposed to evaluation. The constructive design experimentation can be fruitfully brought to play at any point of the research process and used as a dialogue partner to explore options.

In constructive design research the experimental activities are at the core in much the same way as the observational or participatory studies are essential to the social scientists, the textual analysis in the humanities, and the laboratory or field experiments defines the natural sciences. Experimentation facilitates constant exchange and challenge of research questions inviting for a re-framing of them. Similarly, the hypothesis and the evaluation can be informed by the experiment and in many cases the experimental outcome can be seen as the solid form of knowledge to be disseminated in the community. This is for example the case when a product or prototype applies novel technologies in an unforeseen way within the interaction design community, and in that way inspires other researchers to discover the potentials of that technology. In constructive design research experimentation is happening continually and, as such, the experiment provides a vehicle for talking back to and reframing the foundation of the research itself. Something that is often evident when constructive design researchers e.g. reformulate the entire title of their PhD project to allow for new nuances that have been discovered in the practical experimental work.

Motivational Contexts

Research motivations come in many forms. During the review of a selection of 6 PhD theses, which we believe belong to the field of constructive design research, we have been able to identify at least 6 motivational contexts: A practice based/artistically inclined approach, an ethical, political, empirical or technological provoked approach and finally a theoretically informed approach.

What we have seen in the field of constructive design research so far is that motivations often are comprised of either a tension or an attraction between at least two of the motivational contexts that we state above. We are not able to claim the list of motivational contexts as complete, as new approaches and motivations will be developed continually. The point is primarily to illustrate how juxtapositions seem to encourage research.

A practice based and artistically inclined approach combined with a technological provoked approach

As a matter of definition, much constructive design research work stems from a foundation in design practice and/or is motivated by an artistic curiosity. Some researchers go full in and take a clear practitioner's approach by working through their design proposals via the workshop, making textile works of art that contain both hypothesis and experiment, or explores juxtapositions of a new technology and a practical production method. Linda Worbin (2010) does this by using a range of new materials to explore aesthetical expressions in combination with new technological materials.

A practice based and artistically inclined approach combined with an empirical approach

Kristina Niedderer (2004) on the other hand takes her point of departure in bringing an empirical observation from her own practice into collaboration with a theoretical position of performative objects in order to explore whether social patterns can be embedded in the object and the object thereby can perform as a stage or prop for a particular social setup.

An ethical approach combined with a practice based and artistically inclined approach

Otto von Busch (2008) finds his foundational motivations in an ethical position towards the consumer society and passivity and disengagement of users or recipients of high-fashion products. Like the aforementioned two examples, von Busch explores this motivation through an artistic and practice-based approach, in this case fashion design, and applies these skills in explorations of what it could take to reformat the relationship between consumer, product, and industry.

An ethical approach combined with a technologically provoked approach

From Eindhoven two examples of PhD projects seem to have been driven by a similar sort of ethical foundation. Philip Ross's (2008) work takes on the problem that although design of new technology often claim to be value-neutral, new technology sets certain frames of expression through how it is designed and conceived. Ross couples ethics and aesthetics, and explores ways to understand this complexity by working as a designer through constructing several product/interaction design experiments, where modes of conduct are embedded.

An ethical approach combined with a political approach

Similarly Ambra Trotto's dissertation, Rights Through Making (2011), takes on a deeply ethical challenge of revitalizing human rights through involving citizens in processes of construction. *"My endeavour is to structure a praxis, which can prepare the ground for pervasive ethics to bloom"* (ibid, 27). Following from this, Trotto then develops several design workshops and experiments that allows primarily designers to articulate human rights concerns and ideals in such a way that it from a use perspective can become a basic approach to everyday life and a basis for any decision and attitude towards other people.

An empirical approach combined with a technologically provoked approach

The empirical approach can be exemplified with the research of Christian Dindler. His dissertation, Fictional Space in Participatory Design of Engaging Interactive Environments

(2010), focuses on the notion of engagement as a problematic phenomenon noticed in the world, and is subsequently subjected to experimentation as well as theoretical scrutiny. The other part of Dindler's research motivation can be found in the promise that new, interactive technologies could be used to develop new ways of engaging users in e.g. museum exhibitions or other events.

The theoretical position

Lastly, in constructive design research it seems that a theoretical position is rarely the starting point of the research. Of course, one could imagine how a theoretical concept could be used as pivot in a range of experiments to test or deepen the understanding of the concept itself. In most cases, however, theory is brought into the research as a way to qualify and distinguish aspects in the experimental process.

In Dindler's case the motivation for working with the topic of engagement is the juxtaposition of an empirical finding combined with an interest in new technology. His research is qualified with theory from philosophy of aesthetics, participatory design and interaction design. Von Busch (2008) finds his theoretical grounds on a broad base of philosophy, but also includes a narrower field of emerging theories ('hacktivism') and he uses these to broaden the scope of fashion design. Lastly, Niedderer (2004) uses the theoretical concept of the performative object to develop a solid understanding and discussion of the experiments she makes, qualify the hypotheses and answer the research questions.

Conclusion // Motivation and hypothesis-making

The continued discussion on constructive design research is necessary for the maturing of design research as a discipline. As a matter of fact, the rich literature and ideas on the topic that are dispersed throughout papers, articles and concepts all together add up to the foundation of a theory of science for design research. Every field of research has – or ought to have – its own theory of science. A theory of science is the systematic treatment of the methods of inquiry dominating a research area. In philosophy, for example, the theory of science consists in a systematic introduction of how a philosophical method of inquiry can be based upon various schools of thought, e.g. hermeneutics, existentialism, phenomenology, logical positivism and political philosophy. In literary studies, the theory of science consist of a systematic introduction to methods of performing a consistent textual analysis on the basis of analytical reading strategies from either structuralism, deconstruction, new historicism, and so on.

In a similar vein, in this paper, we have attempted to demonstrate that although constructive design research is used as an all-inclusive label for a method of doing research through the process of making, it is actually possible to give a more detailed description of this method by making some conceptual distinctions between what we regard as underlying motivational contexts. On the basis of our examination of 6 PhD theses, we have proposed a non-exhaustive list of such contexts (practice/artistic, empirical, ethical, political, technological, theoretical) that are likely to shape the hypothesis which frame and guide a research process. A lurk into an understanding of how these contexts influences, not only the formulation of hypothesis, but also – and more importantly – the articulation of research questions as well as the planning and execution of experiments is what is missing in the existing research literature. By introducing the concept of "entrance-level", we have tried to close part of this knowledge gap and to provide design researchers with a conceptual steering tool enabling

them to connect hypothesis-making to experimentation as it may be performed within the lab, the field or the showroom. The answer as to what constitutes the art and craft of good design research seem to rely on being able to make this connection.

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