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Knowledge generation in doctoral design education

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Abstract: Knowledge generation in doctoral design education and its endeavour to meet a variety of interdisciplinary issues from engineering to aesthetics, sustainability and stakeholder requirements can be labelled with what Rittel and Webber called a “wicked problem” [1]. The following article reflects on conditions, methods and challenges to combine design theory and design research practice on a doctoral level. The study case for these reflections is the PhD course, PD 8300: “Topics in design research” at the Norwegian University of Science and Technology. The course introduces among others a disciplinary architecture for industrial design and three theory of science philosophies related to three paradigmatic design theories: Critical rationalism to Simon, Pragmatism and Hermeneutics to Schön, and Social Constructivism to Krippendorff. Further the course attempts to mediate research skills such as writing, analysing and evaluating texts and structuring one’s PhD work. The article is meant as a contribution to the on-going discussion on teaching design theory at different industrial design schools in Scandinavia and as contribution to appraise and develop doctoral education in industrial design.

Keywords: Industrial design curricula, PhD education, industrial design as academic discipline, theory of science, design theories

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Introduction

Lately, substantial concern in the design community has arisen about what the industrial design profession will look like in the near future. Industrial design schools restructure their curricula to develop soft skills, interdisciplinary problem solving, or consideration for the environment to find a niche in a market which is increasingly driven by innovation and constant variation. Besides these challenges for the design profession, educators do not only struggle with the issue of complexity of subjects but also with the disadvantage that many theoretical foundations of design methods and tools are rarely made explicit. Appropriate knowledge seems critical to the industrial design profession's survival. Design research is one reliable source for new information that enhances the possibility to identify future trends, needs and patterns and validate decisions. But what kind of knowledge is important for today's design research? Addressing this question, the following article discusses an interdisciplinary approach to include theory of science in the industrial design doctoral course and combine it with research training for PhD candidates.

Following the introduction, the second section of the article presents a brief overview of how Scandinavian design institutions treat design research and theory in PhD education. Section three describes the rationale, background and aims of the doctoral course PD 8300: "Topics in design research" at the Department of Product Design, Norwegian University of Science and Technology and thematizes specific challenges for PhD candidates in the design field. Section present the contents of part one of the course, while section five analyses benefits and challenges for the students. Conclusively, section six reflects on further possibilities to synthesize doctoral education in design disciplines.

Design education on the doctoral level: A brief overview

In his article 'Doctoral Education in Design, Problems and Prospects' Margolin draws attention to a core difficulty in current PhD education - the lack of common guidelines: "Today they (doctoral programs, M.K.) exist in many countries and more are on the way, despite the fact that the fundamental questions about what constitutes doctoral education and what it is for remain unresolved. Most new programs appear to be devised locally without reference to others elsewhere." [2] Margolin's assertion of the multiplicity of doctoral programs can partly be vindicated by referring to the 'hybrid' scientific character of design as a discipline between practice and theory and a resulting undecidedness to submit to basic or to applied research. Design is a per se normative, and design research is advantageous whenever it enables designers to make well-founded decisions. Moreover, design research has to draw on knowledge from many fields. It is not possible to find one coherent paradigm or an everlasting theory however if the most prominent approaches today can be classified within three representative areas, described below. In order to give the students an introduction to these areas, three authors were chosen who stand each for a paradigmatic theory, i.e. a theory that represents a paradigm, in design.

The epistemic flexibility of design theories is an advantage in some cases, but it also comes with challenges, especially if researchers are not aware of what kind of theories

they adopt. From a theory of science perspective, design has a rather small core of scientific “truths”, and a rather wide area of “intruders” [3]. These intruders may be a threat to an established science. However, for design research they could provide an opportunity to learn from other disciplines and cumulate knowledge to advance design theory. Considering the arguments above, it also seems difficult to review the variety of doctoral design curricula in Europe, so the focus here is on Scandinavia (Denmark, Norway and Sweden) [4]. Considering the representative areas in design theory the reviewed courses were classified within three categories: problem solving oriented, engineering approaches (EA), societal and stakeholder oriented, hermeneutic approaches (HA), and research-by-design oriented, practitioner approaches (PA). Real teaching often employs mixed approaches and the categories serve to indicate tendencies rather than final curricula. Table 1 illustrates some examples of the review:

Table 1. Examples of PhD courses Scandinavia

Institution	Course title and Link [5]	Category
Lund University, Designs sciences (a)	Empirical research methods in user-centered design	PA
Oslo School of Architecture and Design (b)	PhD school with various subjects in design, urbanism and architecture	PA
Umeå Institute of Design (c)	Design Theory, The Process of Doing a PhD, From Lines to Designs, Roles in Early Design Process: Collaboration among industrial design, interaction design and service design	HA, PA
Chalmers University (d)	Doctoral programme: Human-Technology-Design	EA
Norwegian University of Science and Technology (e)	Design research, Interaction design, Sustainable design, Industrial systems design	HA, PA, EA
Centre for Innovation in Product Development, Technical University of Denmark (f)	Strategic Foresight in Engineering, Sociotechnical Theory and Analytical Methods, Innovative processes and their staging	EA, PA
Aalborg University (g)	Service Design in the public sector, Design vs. Management: epistemological perspective and practical experiments.	PA, HA

Background

The examples above confirm to a certain degree that a unified perspective in design research hardly exists and opinions vary on what theories should be taken up in doctoral design education. Common formal denominators in the different courses are

however the focus on basic theoretical knowledge and on research training how to write a PhD thesis.

The main objectives of the PhD course “Topics in Design research” are set up similarly - to provide insights in three leading theory paradigms in industrial design and to support the development of an individual research design for the candidates' topic of investigation. This includes the ability to understand which methods are appropriate for the particular work and why, and how to integrate them in the doctoral project. The first part of the course covers a theory of science introduction for designers, as well as a discussion and analysis of the three design theories. Further qualitative and quantitative methods such as protocol analysis, observations, interviews, activity theory, participatory design, and ethnographic methods etc. are presented. The second part gives an introduction on how to write papers for scientific journals and presents possibilities to design one’s own dissertation related to choice of methods and practical information related to the PhD writing and submission process.

The objective of the first part of the course, to discuss design theory, relates to the rationale of an underlying disciplinary architecture of design as an academic field [6]. As illustrated in figure 1, a disciplinary architecture consists of:

- a statement or a system of statements e.g. articles, textbooks, journals etc. (I) about
- an object, a phenomenon or a class of objects/phenomena treated (II) with
- methods, models, instruments, calculations etc. (III) based on
- and basic ideas, assumptions, theories, principles or axioms (IV)

In this architecture, (I) statements about (II) something that is (III) represented, interpreted, modelled or manipulated by something (IV) in the light of something.

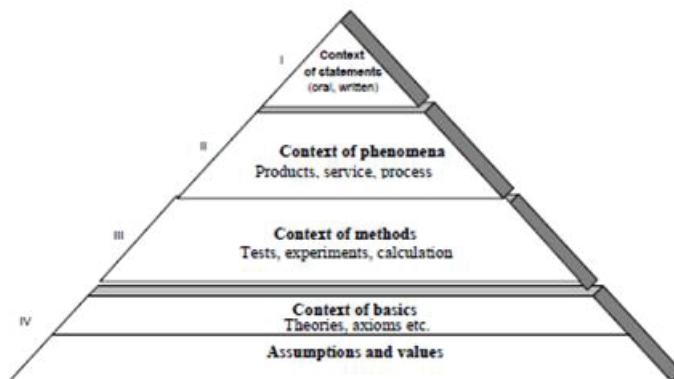


Figure 1. Disciplinary architecture

The disciplinary architecture represents a meta-model and in reality the contents from the layers merge. However, layer IV typically includes implicit assumptions and values which serve as “regulative ideas” in a Kantian sense [7]. Even if regulative ideas habitually remain tacit, they play an important role for organising thinking and governing decision-making. They are often merged with fundamental statements such

as “design is (-problem-solving, communication, reflection-in action etc.)”, “the tasks of the designer consists of” etc.

Instead of a mere content discussion of the three paradigmatic theories the course aimed also at tracing their implicit epistemological statements on level IV. In the disciplinary architecture, regulative ideas shape the theory one formulates, which in turn influences the choice of methods. It was thus a necessary follow-up in the course to continue with an appraisal of different methods in design.

The content of the course’s first part

If the need for design experts who can bring different disciplines together increases, e.g. the UK Design Council claims [8] that design educators have to raise the stakes for varied types of knowledge. Following this viewpoint it seems reasonable to improve reflection and analysis skills and thus the first part of the course took an onset in the architecture of the design discipline as described in Figure 1 to analyze three paradigmatic design theories.

The first theory was Herbert Simon's engineering-oriented, problem-solving approach, which implies two basic values: critical rationalism and (epistemological) pragmatism. The critical rationalist/positivist view stems from Popper's theory of science and manifests itself e.g. in the assumption that knowledge about nature is 'objective', unconstrained by the development of the natural sciences. For Simon, design can e.g. mediate a “...body of intellectually though, analytic, partly formalizable, partly empirical, teachable doctrine about the (design, M.K.) process” [9]. In the 'Science of the Artificial', Simon asserts further that design has to solve 'ill-structured problems' and that time and money is often lacking. Because of time-money constrains, design processes are always concerned with “resource allocation” [10].

Pragmatist/instrumentalist is the belief that something is true if it works satisfactorily and that unpractical ideas have to be rejected. Simon's theory of design as problem solving is centrally concerned with how people handle complexity by reducing the (design) problem and selecting a solution from a set of alternatives. Simon claims that a large part of design problems can be solved by heuristics belonging to bounded decision making [11].

Secondly, we analysed Donald Schön's practice oriented theory, which has had significant impact on design – resulting in various training and education programmes. Two main values in Schön's design theory are (ontological) pragmatism and pedagogy, originating respectively in Gadamer's and Dewey's philosophies. The first means that the *primary motivation* for human activities is always a practical need combined with a need to extend the field of human action. The second claims that education is a necessity and a pillar for the continuity of our culture heralding values such as critical thinking, profound expertise, lifelong and global learning, and accentuating how these values contribute to a fair society. Schön's crucial argument is that lifelong-learning is possible (and desirable). It is expressed as a hermeneutic (self-reflexive) endeavour that connects existing professional experience with surprise, or even confusion within a situation which is uncertain or unique. This 'reflection-in-action' can (dialectically) contribute to a new understanding of the problem and change a situation. By becoming aware of former tacit frames, the practitioner sees now new links and relationships to the problem. Schön asserts that the cultivation of the capacity to reflect in action (while doing something) and on action (after having done it) as well as the ability to engage in a process of continuous learning is defining characteristics of professional practice.

Schön's theory is language centred and so is the third approach, discussed in the course, Krippendorff's theory. This theory is epistemologically based on weak social constructivism and the belief in interpretability of everything by language. Constructivism argues that humans generate knowledge and meaning from their experiences. Weak constructivism sees a relationship between the construction of knowledge from individual experiences and the acknowledgements of objective (universal) knowledge. Strong constructivism believes that *all facts we possess* are constructed or even stronger - that there is no independent reality and *all facts* are constructed [12]. Social constructivism believes that individual knowledge and social knowledge the same, which culminates in a shared knowledge concept and a "social construction of meaning" [13]. Krippendorff puts a lot of emphasis on what artifacts mean to the people affected by them (design semantics). For him, design: "...brings forth what would not come naturally (...); proposes realizable artifacts to others (...) must support the lives of ideally large communities (...) and must make sense to most, ideally to all who have a stake on them" [14]. This human-center, hermeneutic approach opens, among others, methodological possibilities for a discussion about relationships between professional designers and the network of stakeholders they cooperate and communicate with.

The discussion and analyses of the three texts were meant to contribute to increase the participants' understanding of implicit values and statements in design theories and teach them to be aware of the relationships between choices of theory and related methods and outcomes.

Part 2 of the PhD course was pragmatically oriented and had the objective to enable the candidate to put his/her own research activities in the context of design research. The candidate was also to become able to interpret and assess different approaches in design research in the context of his/her own research objectives. Further he/she should manage to define research questions, identify and use relevant literature and produce articles. Ideally, part 1 would contribute to make the candidate aware of their own underlying regulative ideas and values, identify them within a paradigmatic theory framework and select methods accordingly.

Analysis of the course

The discussion of the theories in part 1 made the students more conscious of their own possibilities to choose an approach for their studies, further on the consequences this choice has for the selection of methods and, to a certain degree, what types of results are achievable by choosing that theory/method. However, the theory part of the course posed a great deal of challenges. In design education exist few analytic traditions and argumentatively the candidates were rather limited to justify their positions. The students suggested that this seems to be a drawback of treating theory in the design field is as something foreign to practice or as an instrument that can be applied as a recipe without much understanding of underlying values or conjectures [15].

Further, they did not have a lot of background knowledge about the authors, the history and the context of the theories. Conclusively, most of the students were more or less able to locate their own work or some of its features within a theory and give reasons for their decision.

A positive aspect was their genuine interest in how such an analysis can be done and in the relationship between theory and methods. Students on this level understand

that these texts matter to them personally and their work and that is what makes theories interesting. Design theory is experienced as foreign yet attractive, and sometimes the students also showed indications that they thought themselves as not clever enough to understand these theories, especially when related to theory of science. The learning effect for the teacher was that theory analyses improve and expand professional knowledge and argumentation skills but doctoral students need “entry points” relating to their own work. Further, the students must be brought to a threshold which they have to pass to experience success. From my point of view it is best for doctoral students (in contrast to Master and Bachelor students) to begin with the most difficult challenge and ease tasks successively, since this creates a feeling of mastering the following assignments.

Difficulties in the second part of the course related mainly to the lack for practical training in writing and assessing scientific text. In design, students are less challenged to write texts than to develop models and produce solutions. So, basic steps as how to write an article- abstract and how to develop a PhD roadmap were discussed extensively in the course. On the other hand, the candidates’ comments on part 2 were very positive (75% strongly agreed that it was a useful to exercise these steps). Despite the limitations of a 7,5 credit course, it seems helpful to separate both parts time- and effort wise and supplement each of them with exercises to train the candidates in scientific argumentation as well as in practical research work.

An additional issue is how far expertise in design theory should stretch into other disciplinary areas such as e.g. theory of science and how the gathered knowledge should be applied in a design PhD. Buchanan makes a relevant point here: “Those involved in de-sign research are easily drawn into research in other fields. Indeed, it is tempting to evaluate design research by its contributions to other fields. In design research, how-ever, the central challenge is to understand how designers may move into other fields for productive work and then return with results that bear on the problems of design practice.”[16]

Challenges and possibilities for doctoral education in design

What kind of knowledge is important for today’s design research? From the author’s point of view doctoral curricula in design education cannot be universalized or synthesized, but the debate on appropriate teaching methods could possibly continue parallel in at least two lines, which are equally relevant – one line follows the intellectual discourse on design theories, their epistemological heritage, development so far, their diversification in different design fields and their relation to other disciplines as well as their reflections to actual topics in the design field, society, culture art etc.

The other line, inspired by a didactic fiat to help (doctoral) students in design to engage with theory, can develop approaches that motivate them to understand and integrate theory into their practical work. This means moving beyond theory as something that is to be recited, and comprehend and relate it to designers’ experiences, sensual and poietic (from gr. *Poeisis* - production) knowledge. Today, possibilities to engage in theoretical design questions are few in design curricula [17]. By the same time, students seem to be happy to find an identification platform for design as an academic discipline since this gives their profession greater credibility and status. In this credo, one student

formulated her detection of Lakatos in the following way: "Even if we have a small core of truths in our discipline, I know now at least that there exists one".

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 - (b) <http://www.aho.no/en/RD/The-PhD-program/The-Research-education-at-AHO/>
 - (c) <http://www.dh.umu.se/education/phd-education/phd-courses.aspx>
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