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NURTURING DESIGNERS IN PHD RESEARCH
ESTABLISHING A TRANSDICIPLINARY GRADUATE SCHOOL

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ABSTRACT

As design as a profession and an academic discipline are maturing, there is a need to establish and improve the standards of design research. Especially in the area of PhD education, the growth in quantity and quality is a concern that universities are currently dealing with. In this paper we describe these developments, observations from our own faculty, where the number of PhD researchers in design has grown from about a dozen to a hundred in about twenty years. We finish by discussing the state and plans for structuring the PhD program.

Keywords: education, PhD research, Graduate School.

INTRODUCTION

Design is in flux. It is called upon to contribute to solution of large multidisciplinary projects. At the same time there is a resurgence of the appreciation of craft as a driver of innovation. In the past decades, higher education in design has broadened to cover the range from arts academies to technical universities, and interdisciplinary mixes involving aspects of technology, business, and people studies are developing frameworks for finding their own and each other's position in the field. As part of this higher education, there is a rise in the number of design students pursuing as a PhD researcher (or 'PhD student' depending on whether one wishes to frame PhD projects as research or education; we will use both terms exchangeably in this text), as well as a growing interest from graduates of neighboring disciplines to pursue a research career in the design research field.

Design is a late arrival in the PhD business (Durling, 2002). Historically, PhD programs have often evolved in well-defined areas of disciplinary interest with a well-established research agenda with a focus on gaining knowledge. In contrast, the rise of design education had taken another course. Design schools themselves have various backgrounds and the emphasis has been the *application* of knowledge rather than the *development* of new knowledge (Harris *et al.*, 2003). And as Durling (2002) stated *'Practice is an important way in which design educators keep themselves abreast of the latest thinking and techniques, which directly informs teaching and thereby benefit students.'*

As the design field is maturing, we see design research coming of age. There is a growth of journals and conferences on design and design research, universities are defining research programs, and inroads are being made into gaining acceptance in academic circles hitherto dominated by the established disciplines (Durling, 2002). This emergence of design as a research discipline has had to deal with some barriers.

Design training (and designers' personalities) are often found to differ from those of the archetypal academic scientist. Design thinking typically involves thinking in terms of solutions rather than problems, a drive for trying out new methods, and using visions rather than deductive thinking. As Mintzberg and Westley (2001) argue, all of these have their place, depending on the problem at hand, but some problems lend themselves better to some ways of thinking, and some people are more suited to some rather than to others. This impacts designers doing research in two ways: a need for training designers in established patterns of doing research, and a need for establishing designerly patterns of doing research into the mainstream of academic science.

Regarding the first, designers doing research are often creative persons that like to develop their own way of doing research, which is good as long as they apply the basic rules of scientific research. This could be difficult since within the design research community there is no common sense about the quality of research methodology in design research. Several authors have argued that the standards of research methods need improvement (Dorst 2008; Blessing and Chakrabarti, 2009; Valkenburg and Kleinsmann, 2009), pleading for a better training of design researchers on existing research methodologies, especially those that have their origin in the more mature field of social sciences. Regarding the second, the interaction between design and research brings out methodological debate about how the act of designing can be a part of research (Brandt & Binder, 2007; Horvath, 2007; Stappers, 2007). Dealing with the tensions in relevance (for design, for society, for science) and method (experimental, reflective, explorative) are becoming a joint struggle of the field, finding its place among the other academic disciplines. Amidst these differences and challenges, the design research field is currently taking the step from being a multidisciplinary research field, with a broad mixture of knowledge and research methods, towards a trans-disciplinary field in its own right, with a steadily growing body of knowledge regarding both content and methods of research.

Other influential trends worldwide are the growth of academic education in a financial climate that is not dominated by growth. As a result universities worldwide are attempting to rationalize, or at least make more efficient, the processes of PhD education. An example of this is the Bologna declaration (1999) in which European education is brought into a joint structure.

THE LOCAL SITUATION

Industrial Design Engineering at TU Delft started some 40 years ago, and has grown by now to a school of 2000 students, including approximately 100 PhD students. The 'blend' of design in Delft has always included the disciplinary areas of business, technology, and aesthetics and ergonomics. Until 1995, there was a small number of staff working on a

PhD, and most people attracted for PhD research projects had received their research training in another discipline. Since 1995 there was a rise of MSc graduates returning to or continuing in a PhD project, which meant the school had to deal with students with a limited research training, and with a 'new' set of skills for research; at the same time, the government and university increasingly stressed the need for efficiency, i.e., that PhD projects would be completed within the prescribed four year period. Within these developments, the school structured its research into three foundational programs and a number of thematic applied areas (Figure 1).
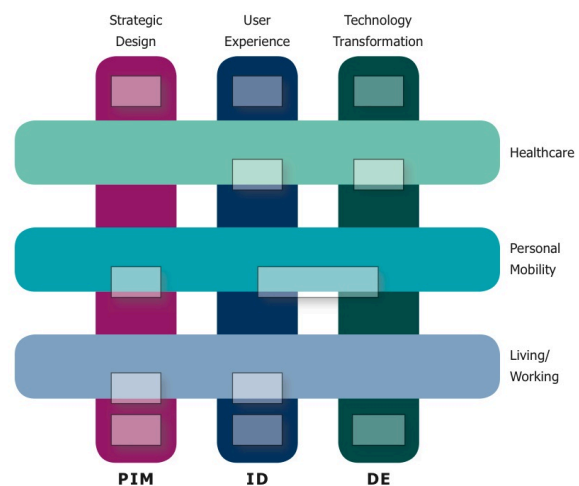

Figure 1. Research program structure in the IDE research portfolio (from Hekkert et al, 2009).

In the school, the need emerged to cope with the growth of PhD students and the corresponding need for education and supervision, and the opportunity of achieving a transdisciplinary research area by establishing connections between the research projects framed by the emerging field's criteria, rather than those of the older 'mother' research disciplines. After a decade of experience, the IDE approach turned out to fit well into the 2010 university-wide initiative of structuring education and supervision in the form of a Graduate School. The university's aims were mainly on economy of scale, efficiency, and quality control. And although at IDE the priorities had lain with integrating the different research approaches in the field, and dealing with the developing field regarding content integration, research education, and development of research methods, the two motivations led to very similar solution.

The Graduate School has to fulfill the following three aims:

1. to improve research quality by strengthening the PhD researcher's knowledge on research methodology. If this is set up in collaboration this avoids that all individual PhD researchers need to reinvent the wheel. On the other hand, already within the school a broad range of research approaches and methods, from different disciplines and emerging ones, was present. A unified model of prescribed research courses university-wide would never fit the needs of individual research projects.

2. to further develop methods and techniques that will enable PhD researchers to use their design skills within research. Here special attention is needed for the relation of research methods, research content, and the requirements and opportunities of design(ers).

3. to provide a platform that mobilizes the critical mass of PhD researchers (and supervisors) for further fertilization between departments, disciplines, and application areas. By doing this, the school takes its responsibility for a further development of the trans-disciplinary field of design research.

In the remainder of this paper, we will explain how we dealt with these three aims within a context of time pressure and increasing regulation.

BUILDING A GRADUATE SCHOOL FOR RESEARCH: CULTURE, STRUCTURE AND COMMUNITY

The Graduate School has to increase the efficiency of its PhD researchers, which means that a PhD researcher has to make a transition to an independent researcher (Lovitts, 2008), and achieves that within the 'prescribed' period. Lovitts (2008) investigated what factors distinguished the successful PhD researchers from the less successful ones. Her conclusion was that the successful PhD researchers matched closely with characterizations of highly creative people (which, fortunately, are represented well among designers). Moreover, she

identified a number of other personal characteristics that played a role. Remarkably, 'analytical capacity' did not distinguish between the successful and the less successful ones, while differences in 'practical intelligence' seemed to be influential. Other personal factors were: informal knowledge, taking initiative, intrinsic motivation and the ability to deal with frustration. Among these 'motivation' in general seemed to be the key factor.

To optimize for effective PhD development, the Graduate School should increase its students' practical intelligence and support them in effectively using their creativity within a research domain. To achieve that, it should support: (1) an open research culture, (2) a clear structure to guide supervision, and (3) a strong research community (see Figure 2). We discuss these elements in turn:
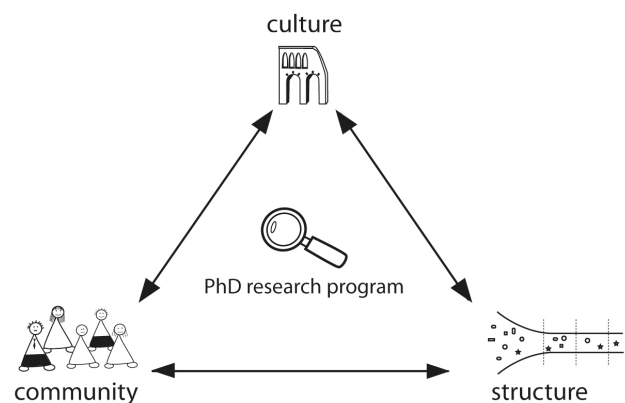

Figure 2. Elements of our PhD program.

CULTURE

The first one is *research culture*. Within the Graduate School, the research culture should promote academic independence of the PhD researchers. This independence is fostered through conducting solid research, which is monitored by a motivated supervisory team that takes on the responsibility to put a substantial amount of time in the supervision. At the university level, a list of seven core components a supervisory team were taken as guidance (see (Sonneveld, 1997)), to determine what the Graduate School is expected to establish, in order to promote efficient guidance for PhD projects:

1. **Transparency** regarding the expectations and responsibilities between the PhD researcher and the supervisory team.

2. A clear **timeline** and **structure** of the PhD trajectory
3. **Clarity of expectations** of all stakeholders (including external ones, e.g., financing parties, colleagues, industry partners etc.)
4. Transparency regarding **additional tasks** and **deliverables**
5. A clear understanding of the expected **phases** of the project, and of the **supervision styles** which would be used
6. Clarity about expected **bottlenecks**
7. Clarity about the availability of external support (e.g., grants) and possibilities of delegating parts of work.

This list had been based on the experience of several international universities regarding problems that occurred with PhD projects; most of these point at unclear agreements, and unawareness (in students, and supervisors) of opportunities. These components overlap with the implications for Design-focused Professional Doctorates that Love (2003) identified.

Although these seven components did not all receive an explicit implementation yet, most of them were already daily practice in our faculty (see below). However, experience at our faculty had been similar: the PhD projects that failed often did so because of one or more of these components had not been implemented properly. So, to increase the quality of the supervision, the school had to pay more explicit attention to these core components. We also think that the supervisors should be assessed on these components during their own annual reviews, and, where necessary, receive additional schooling themselves.

Fortunately, the faculty had a thriving (in)formal network. PhD researchers from different departments and disciplines communicated with each other and other academic staff members on a daily base. Additionally, the school organizes debates about the research with (international) peers in the field. For every PhD researcher, the faculty organizes at least one formal peer review meeting about a year into his/her research. Presenting work at international conferences and to peers in the industry is encouraged, and part of the culture. To support this further, events and seminars are organized in which PhD researchers discuss their

work with other academic staff members within the faculty. Moreover, the PhD researcher are prepared for the labor market, both explicitly by discussing their future career and by providing (research) opportunities relevant for this future career (e.g. they are able to get their teaching degree, they learn to execute workshops in industry and they are stimulated to start their own company). But also implicitly, many PhD researchers build up their network through the intense involvement of industry in our projects.

STRUCTURE

The second one is *structure*. To facilitate the progress of PhD research, 'the PhD mentor system' was started around 2003. Within the faculty, three PhD mentors are responsible for: (1) monitoring the progress of the PhD researchers by organizing regular progress meetings and by providing advises about the feasibility of the PhD proposal (based upon the viewpoints of peers in the field). Figure 3 shows the meeting structure that we set up for the PhD researchers, (2) monitoring the relationship of the PhD researcher and his/her supervisory team, (3) connecting different (PhD) researchers that deal with similar topics/problems, (4) being confidential person for the PhD researcher, (5) signaling opportunities such as external courses to promote cross-over of experience between PhD projects. There are about 100 PhD researchers within the faculty and each mentor takes responsible for one third of them. The mentors themselves have had experience in doing a PhD, and in supervising PhD students. To avoid conflicts of interest, a PhD mentor is an outsider: he or she only mentors PhD researchers outside his/her own department, and his/her involvement with the PhD project is only regarding the process, not regarding the content of the research. In the case of a conflict or problem, the mentor tries to resolve the conflict with the people involved. The PhD mentor reports directly to the Research Director and has short communication lines with the Dean and the chairs of the departments. We have the mentor system for about ten years now and it has become a mature element of our PhD policy that is accepted by our research community, because it has proven to be effective; bad research project were killed quicker, conflicts

between a PhD researcher and the supervisory team were detected early and therefore resolved quicker and last but not least it has improved departmental integration and fertilization between research projects and it created an open atmosphere.

One element of structure along this track is the Doctoral Education plan, compiled by the each PhD researcher together with the supervisory team. The plan was intended to clarify what is expected of PhD researcher and supervisory team (hours of education followed, deliverables, hours of supervision provided: promotor 50h/year and co-promotor 150h/year). At first, these plans were made quite ad hoc and there was no check if the plan was executed. Over the years the elements took on more shape, and the plan became a 'contract' between the parties involved. Currently, the form of the plan is being developed and formalized university-wide. At university level, also a Doctoral Education program for PhD researchers is instated, consisting of three components:

(1) *Discipline related skills*, which are skills that are additional to the specific knowledge required for the specific topic under investigation.

(2) *Research skills*, which are skills to improve the basic quality of the research like scientific writing and research methodology.

(3) *Generic or transferable skills*, which are skills to improve the personal abilities of the PhD researcher like personal effectiveness, intercultural collaboration, etc.

The educational load of all three components is 15 ECT (45 ECT in total). The PhD researcher could gather these points by 'learning on the job', following courses or by self-study. The university chose for an elective format (Harris *et al.*,2003), making only two courses obligatory: the PhD start-up course which is a general course about 'what every PhD researcher should know' and one career development course. Because the generic and transferrable skills of most of our PhD researchers (both those with an MSc in design and others selected for the programs) are above the average level, the emphasis of our doctoral education lays on discipline related skills and research skills. Concerning research skills, we provide opportunities

to follow general research methodology courses, which are not present in our local education (e.g. at institutes for social sciences), but we also provide a course on design research methodology tuned specifically to the content of the field, and the skills of those working in it.

Formalizing the Doctoral Education plans, and tracking their implementation, is expected to better spot and mend knowledge gaps that individual PhD More importantly, we expect to develop a better grip on the particular types of Doctoral Education that is most effective for improving design research. In this respect we see the maturing field of design research, and the coming of age of research-linked MSc education in design, connect to PhD research in a natural way.

- 0 months   -   selection, admission
- 3 months   -   education and supervision plan (contract)
- 9 months   -   go-no go decision, preparation for 11 months
- 11 months   -   peer feedback to PhD researcher AND supervisors
- 21 months   -   progress and quality check
- 33 months   -   progress and quality check
- 42 months   -   progress and quality check

Figure 3. Placement of mentor meetings along PhD process.

COMMUNITY

This brings is to the third element: *a strong research community*. This community is fostered through formal and informal arrangements. Since more and more PhD researchers come from our own Master program, a substantial amount of our PhD researchers know their way within the faculty. They know the 100 staff members and also other PhD students, which enables cross- departmental knowledge exchange. Also, academic staff members are quite approachable for PhD researchers, since they are seen and treated as junior colleagues (and not as students) that are motivated and the ones that pep things up. These informal factors are reinforced by several formal activities. For example, every year a PhD-day is organized by PhD mentors together with PhD students. On this day, PhD researchers present their work to their colleague PhD researchers and academic staff members. After four years of organizing the PhD-day in Delft, this event is now becoming a joint activity, organized together with the industrial design schools of the other two

Dutch Universities of Technology in Eindhoven and Twente.

Another example is the PhD researchers' association called PROMOOD, which organizes formal and informal meetings for PhD researchers. One recent series, called 'food for thought', featured an invited speaker that presented a topic related to design research, followed by a discussion among PhD researchers (with no supervisors or other staff present). For some supervisors, this independent activity of their PhD researchers was difficult to accept at first. Meetings such as these strongly contributed to the creation of a design research community. On top of that, our PhD researchers participate in a variety of summer schools organized at other universities (e.g., the Summer school on Engineering Design Research that is organized by Andreassen, Blessing and Weber every year, or the Social Shaping of Innovation - PhD Summerschool in Denmark organized yearly by Jacob Buur); these latter activities are further signs of design research as a maturing international field. These summer schools contribute to a knowledge exchange between our PhD researchers and researchers from other institutions and therefore enable our PhD researchers to become part of an academic community. Also, they encourage the flow of ideas between these institutions.

One of the improvements that we want to make locally is to further facilitate discussions on how the individual projects fit into the research portfolio (see Figure 3). To strengthen the development of the transdiscipline of design research, it is important that those working in this field know how to frame their research as part of this field, rather than having to position it within the traditional disciplines. This makes it easier for them to integrate their research topic into an academic community and it will provide us as a faculty, and the design field as a whole, with a clearer message about what we stand for.

CONCLUSION: ON THE FUTURE OF DOCTORAL RESEARCH

In this paper, we showed our approach to improve PhD research projects in the design research field. We showed that our PhD researchers form the heart of our research community and we believe in encouraging a lot of human interaction in an open atmosphere. In order to become a transdisciplinary field, we set an 'Umbrella' PhD program in which the knowledge of various disciplines is combined (Justice, 2003). To conclude, we reflect upon some key elements and their implications for others and us.

We acknowledged that the master-fellow relationship between PhD researcher and supervisor is the fundamental way of developing PhD researchers (rather than a classroom based student system proposed by some). However, to ensure effectiveness and efficiency, a mentoring structure, involving an outsider's independent eye, is important to guarantee quality standards (and to support the learning curve of new supervisors). In addition to these performance measures, the PhD mentor also guard the balance of power between the PhD student and promotor.

The mentoring system could become a success, because over the years a climate was debated which promoted debate and transparency around our PhD Research. From discussions with staff-members from other engineering faculties in our university appeared that this is a prerequisite to make this system work. Most design schools have this open atmosphere and designers are used to present and discuss their work, but this is not the culture in all departments of universities. We think that this system would work well in other design schools as well. When the design school is small, one should aim for one mentor that is responsible for all PhD researchers. This would be an optimal connector of all research done and it will enable to provide the design school with a clear face. At a small school, it is easier for staff and PhD researchers to be aware of everyone and everything, which makes the spontaneous emergence of a community and culture more likely. As our school grew, we found it needs some help. We proved that implementing this system in a large school also works.

Formalizing doctoral education is a step towards further professionalization of design research, because the training and development of research methodology and design skills becomes more a community responsibility, where in the past it would occur in isolated pockets of individual supervisors.

However, this training should not be strict and prescriptive as it is in some other fields: design research is still in flux, and there is not a consensus on what constitutes high quality design research. But there is ample scope for discussion, and ample fruit to be expected from it.

In the discussion about the quality of design research and its results often researchers focus on either the knowledge-gap (improving cognition of a complex reality), or the other the problem-solving gap (improving the competence and skill of agents having to face that complexity) (see Love 2003; Pizzocaro, 2003). These two foci are sometimes incompatible since the way they see 'good research' is quite different. Based on the work of Durling (2002) and Pizzocaro (2003), we made those differences explicit in Table 1.

Table 1 The main differences in opinion about design research (based on: (Durling, 2002) and Pizzocaro (2003)).

Knowledge gap	Problem solving gap
Formal methods	Investigative and less formal
Rigor	Personal journey
Peer reviewed journals	Journalism
Knowledge diffusion	Personal development
Open for others	Not accessible
Explicit knowledge	Tacit knowledge

Hopefully, by highlighting the characters of the two, the discussion of the quality of design research becomes more focused since both components are different and sometimes even incompatible, but also both necessary for the creation of a mature research field.

In our faculty, there is now a substantial amount of PhD researchers in different areas of design research. Studying this population can provide a key for developing a better grip on the quality standards of different types of design research projects. In order to do that, we will analyze and evaluate the Doctoral Education plans of or PhD researchers and connect these to the success of a certain PhD project. This may bring empirical evidence on the type of education that is needed to bring the debate about good and bad design research to another level (Love, 2003; Durling and Friedman 2000).

A final remark that we want to make here is to stress to retain the strong link between the PhD researcher and his/her supervisory team. Several of our colleagues from the engineering faculties disagree with it, and put forward the vision that the research quality should be improved by providing a more substantial amount of prescriptive doctoral instruction instead of making a stronger connection between a mature PhD researcher and his supervisory team. Maybe in the more engineering types of research, the skills necessary are better transferred through courses, but in design research – as in design practice- we believe that the struggle in (reflective) practice is the key to growing into a mature researcher.

Therefore, it is important that PhD researchers communicate with other peers in their research field. These peers are not only academics, but they could also be professional organizations, governments, industry people etc. Communication with these various people is necessary for the PhD researchers, because of the transdisciplinary nature of our discipline and the fact that within their PhD research they have to fill both the knowledge-gap and the problem-solving gap (Pizzocaro, 2003). Interactions between different kinds of peers also have that advantage that these also prepare the PhD researchers for their post-doctoral career (Cooper and Love 2003).

Durling (2002) stated that as a consequence of the short history of design research and the emphasis of design education on design practice, the understanding of the nature of design was limited. He claimed that there was haste in implementing new forms of PhD trajectories without sufficient planning and without learning from PhD trajectories in other disciplines.

However, in the ten years that expired since the article was written, we see a more structured approach in PhD programs. This article presented one example, which is in line with the nature of the PhD study as Durling (2002) proposed. Design research is beginning to take its place between the arts and sciences; conferences and journals mature; we are finding out communalities and differences in relation to the other disciplines. We are not there yet, but if we continue this leap forwards and by explicitly debate the quality standards needed, we will establish a mature research community in the coming years.

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