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Re / materialising Design Education Futures

Unpacking models, approaches and materialisations of the design PhD

Laurene Vaughan and Andrew Morrison

Abstract: Doctoral education in design has been expanding considerably since the mid 1990s and is now globally a lively part of many design schools. In this article we unpack what it is that constitutes, and is specific to, a doctorate in design. We offer a mapping of current international approaches, models and formats of the PhD in design. The design PhD is a site of considerable material, cultural and discursive innovation in terms of its genres, concern with design materials and communicability to interdisciplinary and professional audiences. This article presents one of few such analyses of the doctorate in design by addressing matters of its socio-cultural and economic location and interplays between practice and critical analysis. We argue for an open, unfolding mode of understanding the emergent character, discursive innovation and multimodal qualities of a wider knowledge materialisation of the PhD in design.

Key Words: Design PhD, mapping the design doctorate, discursive innovation, reflection

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Author

Laurene Vaughan /
RMIT University /
School of Media
and Communication /
laurene.vaughan@rmit.edu.au

Andrew Morrison /
Oslo University of Art and Design /
Centre for Design Research /
andrew.morrison@aho.no

Introduction

Doctoral education in design is maturing fast, both pedagogically and in terms of research and associated publications; and yet there is still some uncertainty as to what a design PhD is, or why we would have them. Our aim in this article is to pose both the breadth of diversity that exists in what we classify as a Design PhD, and that with this there is a need for us to celebrate this diversity and to ensure that design PhDs just as we do in the practices of design.

In recent years a number of international events have taken place that examine and discuss the character, variety, diversity and complexity of teaching and learning the PhD in design (see, for example, Durling & Friedman, 2000). A set of international papers entitled 'Practice, Knowledge, Vision' came out of a Doctoral Education in Design Conference held in Hong Kong in 2011. A substantial book of edited chapters called The Unthinkable Doctorate (Belderbos & Verbeke, 2007) emerged from the same named event, resulting in subsequent explorations into new forms of doctoral education at Sint-Lucas School of Architecture, Brussels and Ghent in Belgium. This was just one example within design and architecture critical reflections by members of the academy (Heynen, 2006). Recent DRS and CUMULUS conferences have included work relating to post-graduate education and, in particular, methods in design research. In Norway, where the 2013 DRS / CUMULUS conference was hosted, considerable work has gone into discussing the changing character of the design PhD (e.g. Dunin-Woyseth & Michl, 2001; Michl & Nielsen, 2005; Dunin-Woyseth & Nilsson, 2012; Morrison, 2013). In Sweden, a national doctoral school has tackled a multitude of issues to do with practice-based inquiry and the diversity of design domains a PhD school needs to address. Most recently, as an open initiative into reframing doctoral design education, Carnegie Mellon University held an international symposium that drew together many, though not all, key players in unpacking the needs, interests, motivations, challenges and successes in shaping, running and revising PhDs in design (Tonkinwise & Vaughan, 2013). Here the focus was on the North American context, one that differs considerably from established and larger doctoral programmes in Europe and Australia.

Overall, doctoral design education is also expanding its scope and reach (Durling, 2002; Doucet & Janssens, 2011): doctoral students in design are now placed within wider funded research projects, they are embedded in networks of inquiry and practice, and they publish in a variety of formats. Increasingly there are also article-based theses and media-rich reflections in and on practice. Attendance and participation at the main design research conferences—IASDR, CUMULUS, Nordes, Design and Emotion, especially the sharper focus on design and learning at CUMULUS and the special interest group on education in DRS—provide us with the platform on which to discuss these matters and to share related research. Within this discourse there is also an increasing understanding of the need to identify the unique qualities of researching and supervising in these domains and the different strategies that are being drawn on to do this (Allpress et al., 2012; Vaughan, 2012).
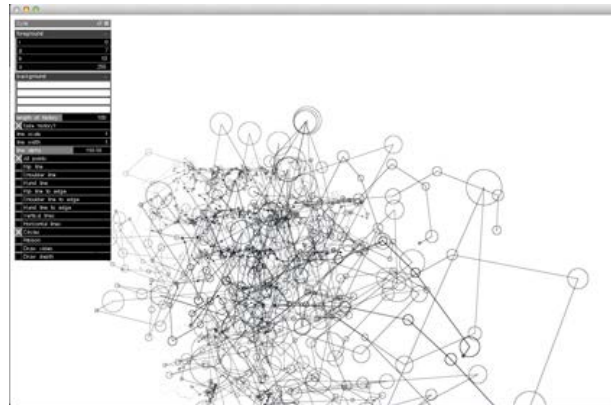
Figure 1: Still image of selected settings in the tool 'Sync' designed to chart full body movement
capture and representation (Lise Hansen)

In this article we endeavour to map out some of the variations across different doctoral programmes and approaches. Underpinning this mapping exercise is a celebration of the diversity and richness of design PhD programmes, and a commitment to the important contribution that this degree makes to the overall spectrum of design education, and to the professional practices of design as well. In brief, this is about the malleable and the emergent in design inquiry and related cross-disciplinary project-based pedagogy that has been labelled 'alterplinarity' (Rodgers & Bremner, 2011).

Two matters are important in a critical reframing and mapping of the doctorate in design. First, doctoral design education is a crucial part of building research capacity for a critical design material culture that extends beyond design classrooms and connects with wider interdisciplinary inquiry, one that increasingly looks to design for innovative and situated knowledge production. This is illustrated in an example from our doctoral students' work in Figure 1 that illustrates an output of the development of a digital tool co-designed to mediate full-bodied movement as material for interaction design (Hansen 2013). Second, the PhD in design is a site for emergent researcher-designers to engage in and build partnerships with industry and to reflexively relate knowing through practice with analysis. This is indicated in Figure 2 that makes material the invisible fields of WiFi technology (Martinussen & Arnall, 2010): it is the mediated result of building a physical and electronic rig and the use of 'light painting' to capture this otherwise unseen conductive means to mobile communication.
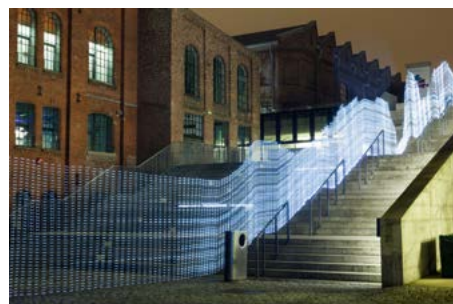

Figure 2: Light painting WiFi (Einar Marinussen & Timo Arnall)

**Dwelling and design
learning**

Our text offers a broad mapping of some of the main features and operations of the doctorate
in design. This offering addresses the challenges of unpacking, relating and differentiating
between different prgrammes and contexts in which the design PhD is enacted materially.
The mapping attempts to place these in relation to the grain and grittiness of specific contexts
and needs, as well as their comparative pedagogical and content proximities and variations.
We see this itself as a mode of critical formation; a manifestation of the emerging character of
the PhD in design that is centred in how design works, how research in design is crafted, and
the ways in which knowledge in and through design may be communicated.

In addition to acknowledging this emergent condition, we also heed the call by Shotter
(2011) to 'dwell' in a situation of analysis as a stance and an action that allows for greater
prospective understanding. The article therefore posits 'an open view' on such a mapping.
This is a view that can only be extended and refined through wider communication in the
active engagements of designers, educators and researchers in forging richer and stronger
PhD programmes in design.

**Mapping the diversity of
the field**

From the authors' individual and joint experiences in shaping, managing, teaching, redesign-
ing and researching doctoral education in design we see a need to develop a wider view on
the nature and character of the design PhD. Much of the discourse at these research events
(listed above, see also Friedman, 2003) has addressed these issues of forms of doctoral
submission (What is the thesis?), methodology (to research through practice, or not), and
new areas of design practice and inquiry (the introduction of HCI, Service Design, Design for
Social Innovation, or the design business interchange). However, this discourse and knowl-
edge exchange, through examples of curriculum, submission forms, methods and ideology,
has failed to embrace the complexity of design education, research and practice and the
changing nature of the academy too. We believe that it is time for us to critically consider how
the design doctorate can, should or does relate to the changing nature of design research
(in the academy and industry) and required academic qualifications for design researchers.

As those of us who work within a global design education context know, there is a
diversity of doctoral programmes and schools in the education market place. These cover
a complex mix of distinct interests and combinations. They refer to a range of professional
and practical knowledge. They also reflect contemporary pressure and expectations within
the academy for design faculty to publish and to bring design knowledge and insights into
research via different media, thereby connecting with a wider public, and with industry.

In a previous paper 'Form, fit and flair' (Vaughan & Morrison, 2013), we endeavoured
to map out the key components in the on-going negotiation that constitutes the pedagogies
and research practices involved in doing a doctorate in design. *Form* points to more known
matters of the structure and formats of curriculum, teaching approaches and modes of pub-
lication. These formats need to *fit* into changing practices, tools and modes of knowing that
design can include. We argue that in addition design itself brings special ways of working,
researching and knowing to design doctoral education. Consequently doctoral design
education has the potential to both develop a particular identity, and indeed *flair*, that is
realised and critiqued from within, but also through its interdisciplinary linkages with the wider
world, including industry. This may be extended to the ways we also communicate design
research, through a mix of formats, technologies and events.

The matrix of key aspects in doctoral education in design we have devised and present
below is offered therefore as a device to revise and reposition: first through a conference, its
review processes and assembled discussions along with a review process in and within this
journal. It is important to state that we do not intend this matrix to be a decisive and divisive
tool. It is part of a broader discursive innovation and process around how we shape and
come to know how design PhDs are made and communicated and what they might become
(e.g. see online papers in Tonkinwise & Vaughan, 2013). In making it we have both seen

the value of shaping a space and schema for shared discussion regarding the many issues pertaining to the design doctorate. To be clear, we are undertaking this mapping not with the ambition of using the data to design THE design PhD. Rather, we are seeking to identify the qualities, knowledge contexts and cultural differences that underpin design education at doctoral level, in the same manner that we understand the diversity in the practices of design. As we discuss in the conclusion, this is one step in a larger research inquiry that needs to be extended to and across different institutions, design domains and settings.

Mixed modes of knowing

In general, discussions on doctoral education in design have been concerned with what types of knowledge are needed to underpin our educational goals when developing further PhDs that are located in design, and their reach from engineering to art related aspects. This is important, as tensions still remain between what has been termed Mode 1 and Mode 2 of knowledge building (Nowotny et al., 2001), the former referring to more traditional and established disciplinary academic domains and the latter to more situated and practice-informed ways of working, which are: 1) associated and abductive; 2) emergent and 'designerly' ways of knowing (Cross, 2001); 3) thinking and practice informed inquiry (Tin, 2013).

Figure 3: The making of an Internet-connected wooden tree called 'Tre' (Jørn Knutsen)

While these modes may inform one another, and indeed are needed to build richer transdisciplinary research and education in graduate level design, a design doctorate education needs to be realised that makes fuller use of Mode 2 knowledge making. As a result, related Mode 2 practices and rhetorical forms that best reflect their richness, ontologically and epistemologically, are often difficult to publish and communicate in journals and conferences that place their definitions and criteria for academic rigour largely in Mode 1 zones. Design researchers and design educators themselves need to experiment and compose alternative forms that fit the types of design activities and inquiry in play (e.g. Fig. 3). Further, flair here refers to lifting this design-centred content, related work practices and reflective articulations to be inflected specifically with designerly, material and performative characteristics.

**Designerly ways of
knowing and the PHD**

The catalyst for the exploration—across hemispheres, contexts, languages and legacies in design and research —is a need from our own pedagogical and research activities to better understand and develop PhDs in design. This fits with the formal, disciplinary domains related to design research in many respects. Yet, it extends beyond them to celebrate that design inquiry and design education is actually more reflexive in its workings, shifting between formal concepts and notions that arise from an ecology of design practices. For us, there is a need to also celebrate the dynamic and challenging character of designing and what it brings, more patently and less tacitly, to what we develop in the activities of design. This may mean less problem solving than finding solutions, and how the flair of the resultant processes, hybrid products and entwined systems and services may be interpreted. In the longer term we see

this research to be the first phase in a larger and unfolding research project into a more
nuanced detailing of the matrix that would be conducted online and is one part of the larger
'project' that design graduate educators face in understanding and shaping the future of
doctoral education in design.

Here we see the wider contexts and cultural settings of design research as being crucial
to a doctoral design education that relates design studies and inquiry to a variety of emergent
practices and especially technologically mediated ones. Such practices may be in conjunction
with industry partnering, resulting in a diversity of discourses and professional arenas outside
the academy. This means that in offering a tentative mapping of many of the components of
doctoral education we need to look beyond single site programmes or weighting in particular
contexts on specific domains, be they product or interactions for example.

Positioning the design PhD in the field

Discussion of the design PhD cannot be considered in isolation. As a research training
degree the PhD must be considered within the broader context of design research and its
evolution. Following on from the developments of the design degree within universities, over
the past 15 years we have seen graduate education, the development of the design PhD
and design research as areas of academic endeavour expand exponentially—both seeking
identity, methods and recognition. As argued by Victor Margolin (2010, p. 70):

> Today [design PhDs] 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 programmes appear to be devised locally without refer-
> ence to elsewhere.

Such questions about what is a design doctorate, what is it for, and what is its relation-
ship to design research, scholarship and practice, in themselves evidence the diversity of
what constitutes design from various perspectives. These are variances that are based on
criteria of nationality, profession, academic tradition and scholarly position. Margolin (2010,
p. 70) argues that that one of his concerns is that design research remains 'cacophonous
and without a shared set of problematics', or what he would desire—'a consensus as to how
we identify the subject matter of design and, of equal importance, what design research is for
and how different communities of researcher contribute to its purpose' (Margolin, 2010, p.71).

This points us in the direction of what is one of the key underpinning issues related to
the role and form of the design PhD—what is it for? Traditionally across other fields the PhD
is the prerequisite qualification for pursuing a career as a university academic (Golde, 2006;
Menand, 2010). This is not the case for design, where until recently in most countries the
Master Degree has been deemed to be the research qualification for the field. Traditionally
too, design academics have entered the academy from the professions, whereby expertise
in practice and technical skills were the key selection criteria for employment. The exception
to this were design history or theory faculty who have tended to be been drawn from the
humanities fields, and material science or technology specialists who would typically originate
from the natural and applied sciences.

However, like the rise in the importance of design research both within and outside of the
academy, so too is the rise in the doctorate being the required qualification for on-going
academic employment. These developments mark more than minor shifts in the machinations
of the design school, whether institutionally it is a stand-alone entity or part of a larger
university. Although a late arrival in the higher education domain, the design school and
design faculty are now being expected to perform and be measured in the same manner
as their colleagues from other disciplinary domains.

Perhaps one of the core problems in considering what a design PhD is or should be,
is the very nebulous nature of the word design. A design PhD may be theoretical, historical,
technical, poetic or performative. It may be aligned to any number of design professions or
fields of practice, from architecture and engineering, to communications, fashion or service

design. It may be undertaken within the model of the laboratory, the studio, the library or 'the street'. The application of the knowledge may span Frayling's (1993) categories of design 'through, for or about'. It may also be 'through, for and about', depending on the nature and context of the study. In addition, the form of the PhD, its measures and modes of inquiry will be equally driven by the educational context that it occurs in, including the location of the awarding institution (Davis, 2008).

When considering what a PhD in design is, an important issue that needs to be addressed is the changing role of doctoral education both in design and, more broadly, in the academy (Menand, 2010, p. 141). The PhD is no longer dominated by the expectation of it being a university teaching training qualification, in that it is the perquisite for teaching. It is now understood more broadly as being a research training qualification and thereby, as the discourse of innovation and research expands into all areas of knowledge and professional practice, the potential destination for a PhD graduate may well be in government, in business or the professions in general.

Ironically for design, this is being realised in both directions. The PhD in design is increasingly becoming the required qualification for research active design academics (who must also be participating in the undertaking of research and disseminating outcomes through publications, prototypes, patents etc.). Simultaneously, there is an increasing demand for design researchers across domains of commercial and private practice in the pursuit of innovation (Everson & Dubberly, 2011).

Perspectives

In response to the authors' observations of doctoral education in design, the following list of categories of forms, contexts, modes of study and evaluation of PhDs has been drafted:

Initial Observations of Doctoral Programmes
Structures and Activities

Place	The location of programmes is fundamental to all other observations
Mode of Study	Research only Coursework + research Research Methods
Supervision/Advising	Internal External No of people involved in advising/supervision
Context of Study	Project funded research Self initiated Embedded within organisation
Funding source	Project grant Self funded Government funding Industry funding
Milestone activities in progress of study	Completion of coursework Examination Progress review Proposal approval Completion seminar

Submission format	Thesis/monograph
	Thesis by research publication
	By publication past practice
	Project or by practice
Examination	Viva – Public
	Viva – Private
	Thesis only – no viva
	Project and exegesis – no viva
Examiners	Internal
	External
	Mix
	Examiners identified
	Examiners anonymous
Enrolment status	Part-time
	Full-time
	On campus
	Off campus
Field of inquiry	Design studies
	Design history
	Practice
	Material science
	Methods
	Interdisciplinary
	Industry
Expected student university roles/activities outside of study	Teaching
	Researcher assistant
	Member of research team
	Co-publishing

Table 1: Main categories charting the diverse character of design PhDs

It is important to recognise that there is considerable variation in the nature of PhD degrees (Table 1). They may focus more on a Design Studies approach, drawing on discipline-based knowledge generated from outside the practices of designing. They may also be tightly connected to engineering and product engineering, and linked to related conferences and organisations such as The Design Society. They may alternatively be connected to the intersection of interaction and technology but not aim to follow the formal prescriptions methodologically or rhetorically as embodied in Human Computer Interaction oriented arenas and publications housed in the ACM Digital Library.

Many design schools nevertheless arrange a mix of domains and methods that are connected to design practice. This increasing inclusion of knowledge built in and through practice, already formalised in the professions of nursing and social work for example, may feed and inform philosophical writings or the generation of analytical concepts and mode of reflective writing about design as essayistic criticism.

In addition to pedagogic frameworks and modes of inquiry, we have also identified that there are variations across programmes based on modes of study, involvement or employment of doctoral candidates in the daily life of the design school, teaching duties, and funding

models. We have included these in the categories as we they help to identify the differing social, cultural and economic frameworks present in the course of a doctoral degree, and the relationship between the doctorate, the academy and design practice.

In our initial survey we have identified eleven categories of diversity. The left hand columns include broad categories that are core to design PhDs; the right hand columns note sub details that vary across contexts, and within countries, their states and regions and even institutions. We discuss these categories in more detail in the next section, where we map onto them our experience of teaching, consulting, researching, examining and designing within different PhD programmes.

Discussion on Forms

As a first step in our research project into the various forms of the design PhD, we undertook an initial mapping of our respective experiences. Although each of the categories that has been identified may seem at first glance obvious and instrumental, it is our hypothesis that an issue such as place, or funding source, can have a profound influence on the research that is undertaken, what is reported, to whom and how.

Let us now explain some of the criteria in more detail. In so doing we hope to show how such seemingly simple terms are in fact signifiers of far more complicated and systemic issues where one aspect such as a mode of study may in fact highlight a range of socio-cultural issues, funding opportunities and the pace of a study to successful completion. An initial evaluation of this reflective mapping has revealed that although there are many similarities in programmes in terms of academic progress and pedagogic premises, how these manifest in practice can be quite different. As, for example, the integration of students into the life of the school, expectations of teaching, modes of study, and length of enrolment.

Places: The authors of this research have been involved in differing roles in design PhDs in Australia, Austria, Belgium, Denmark, Finland, New Zealand, Norway, South Africa Sweden, UK, and USA.

Mode of study: The mode of study that the doctoral programme has designated has significant impact on the student experience, length of study, funding and outcomes. For example a PhD undertaken through 100% research only (plus research methods which would be common to all study), is different to a mixture of two years coursework plus three years research thesis.

Supervision: There are differing models of supervision across modes of study, countries and institutions. This may vary from the model of 'master and apprentice' with the PhD candidate working in relation to the supervisor in an almost trainee approach; to the other end of the spectrum with peer supervision amidst a community of learning in the context of a larger research or professional community.

Context of study and funding sources: There are many potential variances in a project (e.g. research measures, expectations and available resources to a research candidate) depending on who initiates a project and who funds it. A self-funded and self-initiated body of inquiry may lack resources, be isolated, be unbounded and exploratory in comparison to a doctoral inquiry undertaken within an industry-financed research scholarship within a funded project.

Milestone activities in progress of study: Various modes of study and the inclusion or exclusion of coursework, graduate research skills training and public or private progress presentations all impact on the progress of candidature, possible timeliness of completion, and quality of research submissions.

Examination: There are vast variances across institutions regarding the formats and expecta-
tions of examination of the final doctoral submission. From the allowance of internal examin-
ers, dissertation committees, opponents or the requirement for international
examiners, each examination approach provides challenges for examiners in evaluating the
quality and appropriateness of a submission, and for the nature of the scholarly community
from which that the PhD has emerged.

Enrolment status: We have identified variances in programmes and in colleague's expecta-
tions of the quality of PhDs and of doctoral communities between part time and full time
students. Variations in enrolment may also reflect differing modes of study, funding and contri-
butions to other aspects of design school academic life.

Student university roles/activities outside of study: The varying expectations of inclusion of
doctoral students within the life of a school references not only variations in enrolment and
funding, but also expectations of graduate destinations post-PhD. For some institutions PhDs
are factored into teaching staff requirements and such teaching is an important part of
doctoral training. In alternative programmes inclusion of PhDs in other research activities is
seen as a requirement for establishing track records for future work as design researchers.

These are just some of the variations of the categories listed in the table presented
earlier. They are merely surface markers for what are broader pedagogic issues and the
economic realities of contemporary university life. It is anticipated that as this research project
progresses we will use a variety of research methods to identify a broader understanding of
the differences between and across different design PhDs. We will go beyond the surface of
the data table to build rich links that we anticipate will increase the design education field's
understanding of what the current landscape of design PhDs is, and how we may want to
redesign our own programmes as befits our respective contexts.

Discussion on Flair

Included in the article are a series of images that are selected to illustrate some of the
outcomes of the character of the PhD in design form our two home institutions, Communica-
tion Design at RMIT in Melbourne and the Centre for Design Research at AHO in Oslo.
Our ambition here is to use these examples as a means of articulating our argument for the
importance of us as academic institutions embracing the literacies and affordances of design
in design doctoral submissions.

Figure 4: Example of the format of the presentation and exhibition (Neal Haslem, 2012)

The examples from RMIT have been chosen to indicate the potential generative nature
of the formats and presentational components in the RMIT PhD in Design through practice.
This is a tripartite model of submission, comprised of an exhibition of project work, an exegetical
text (of between 20,000–40,000 words) and an oral public presentation (Fig. 4). The three
components of the submission are unweighted—together they make the 'whole' of the
submission which is examined by three external examiners. The aim is that this model
embraces the multi-literacies of practice – what is made, written and embodied or spoken
through the practitioner researcher.

    The presentation of information is a vital part of design practice and research. Integrating
the aesthetics of the design submission to the core argument and practice community is
essential if we are to engage broader non-academic audiences in doctoral submissions.
Figure 5 is an example of one such attempt by a student to design a text that has synergy
with interaction design publications.

Figure 5: Designing a thesis format consistent with the publication form of the field (Jeremy Yuille, 2013)

    The methods and contexts for design research are evolving, from the use of artefacts
as methods (Figs 6 & 7), of undertaking complex embedded real world projects as the site of
investigation (Fig. 8) or of having non-designers engage in design research (Fig. 9). Ensuring
that the richness of this is maintained in submissions is vital for building our field
(Figs 10 & 11).

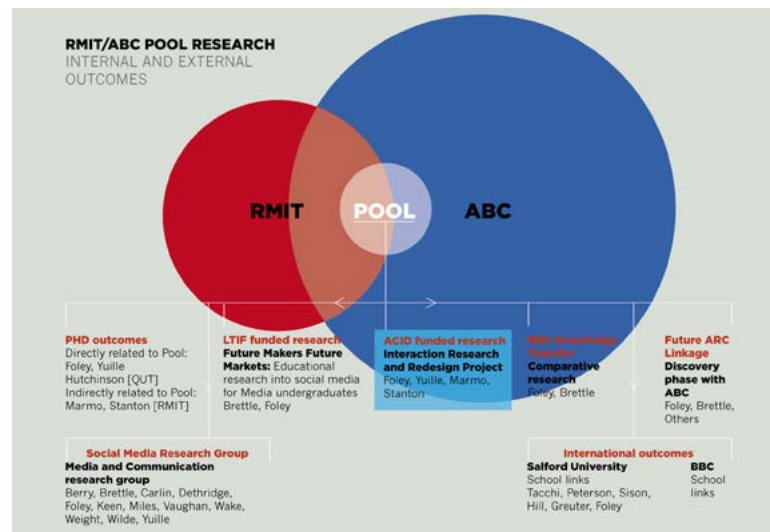Figures 6 & 7: Use of playful triggers as a research method (Yoko Akama, 2008)

Figure 8: Details from the Pool ABC Collaboration Project (Marius Foley, 2013)
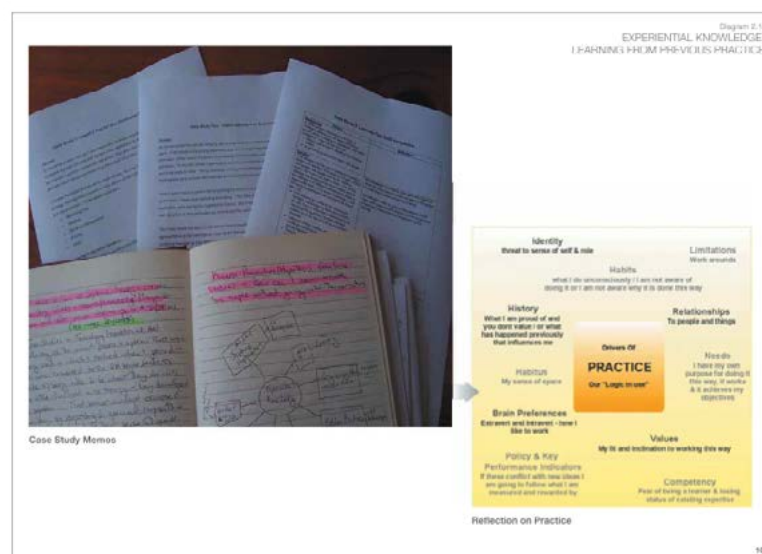

Figure 9: Field notes to visualisation by a non-designer (Nifeli Stewart, 2012)

The examples chosen from Oslo are from an inquiry that centres on the required single format expository doctoral thesis. The thesis includes a lengthy public defense with two external examiners accompanied by two lectures by the candidate, all based on a formal academic written thesis with no required exhibition or award for the design work the thesis entails.

However, most of these theses now take the form of compilations of articles and papers and an exegesis. These are typically media-rich productions, incorporating films, illustrations, inforgraphics, photographs and digital or online archives (Figs 10 & 11).
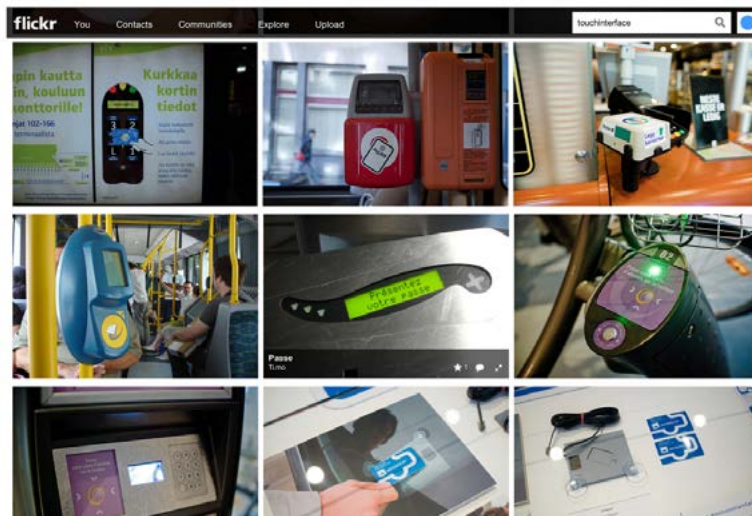
Figure 10: Shared, online Flickr archive of pictures of RFID interfaces (Timo Arnall, 2011)

Figure 11: 'Immaterials: Ghost in the field' film featured in German design magazine 'Weave', with video still top
right. (Timo Arnall, 2013)

The examples show the clear role that mediation and re-mediation has played in different
theses. This has extended to, and been a matter of, creating deliberate linkages between
films in related websites, the currency of the research in the context of exhibitions and the
use of visual illustration within the print thesis itself, that is from articles in a compilation type
document and from an exegesis.

Conclusion

In the introduction we declared that we were not undertaking a mapping of doctoral pro-grammes without any expectation of designing THE design PhD. In fact, our ambition couldn't be further from asserting declarative surety. Our aim has been to use a diverse range of methods to collate the various approaches to design PhDs globally and, from this, to then identify the various pedagogic approaches and contexts for design PhDs. The material form, or what we have named flair, of these design PhDs has been integral to our exploration. Underpinning our conclusions is the conviction that it is essential that we design PhDs with the same integrity that we do any other design outcome. By this we mean that the design of submissions must be aligned to the mode of study, the context of the research and the domain of design practice that it contributes to. Akin to Shotter (2011, p. 258) there lies ahead an extended work into the design PhD through more nuanced, detailed and 'designerly' communication.

Our task in our writing, then, and our task in the phronetic, descriptive disciplines in general, is to turn passing events, unique events which exists only in the moment of their own occurrence, into 'moving' accounts of events, into dramatic or poetic scenes, or scenic events, which can exist in their inscriptions, and which, on being read, or in being experienced in some other manner, can 'move' readers in a way similar to how people were moved by the original events.

The catalyst for our inquiry is our shared commitment to the importance of doctoral education not just to train the design academics and scholars of the future, but also to create an engaged and able community of research design practitioners and thinkers who can harness advanced skills in design and research. It is then possible to apply our knowledge to the broader domains of design practice and inquiry, so that these embody and enact the form, fit and flair we see as already in play and available for further design, pedagogy, learning and research.

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CUMULUS-Oslo-2013

Laurene Vaughan /
RMIT University /
School of Media
and Communication /
laurene.vaughan@rmit.edu.au

Associate Professor Laurene Vaughan is Deputy Dean (Design, Games, Interaction) in the School of Media and Communication at RMIT University. She is a founding Research Leader of the RMIT Design Research Institute. Laurene was invited to the position of Neirenberg Chair, Distinguished Professor of Design, at Carnegie Mellon University, 2012–2013. She has over 15 years experience in graduate research education. As a practicing artist, designer, writer and educator, Laurene has a passionate commitment to design and creative practice-based research. In 2011, for a sustained contribution to postgraduate student education through a multidisciplinary design and practice driven pedagogy, she was awarded an Australian Learning and Teaching Council Citation Award for Outstanding Contribution to Postgraduate Student Learning

Andrew Morrison /
Oslo University of Art
and Design /
Centre for Design Research /
andrew.morrison@aho.no

Andrew Morrison is Director of the Centre for Design Research at the Oslo School of Architecture and Design (AHO) in Norway (www.designresearch.no). He is a previous leader of the doctoral programme at AHO, and has published on a number of aspects of doctoral education, amongst these being: interaction and new media design, the network city and, currently, cultural landscapes of the future arctic.