Creative professional practice in methods and methodology: case study examples from Ph.D's in industrial design

Dr Mark Evans, Department of Design and Technology, Loughborough University, UK

Abstract

In addition to making a contribution to new knowledge, other key requirements for a Ph.D are the application of robust research methods within an appropriate and pre-defined methodology. It is central to any methodology to collect data by various means and from various sources and opportunities exist to undertake this by the researcher engaging in creative professional practice. When considering the application of such methods, it is necessary to ask two key questions: can the process/outcomes supply robust data and does the researcher have the necessary capability as a practitioner to enable generalisations to be made. The latter issue brings into question the need for appropriate supervision, as judgements must be made on the capability of the researcher and quality/relevance of creative output i.e. do their supervisors need expertise in practice? It is also necessary to acknowledge the motivation of visually creative researchers who may have a fundamental desire to continue to engage in practice.

Much of the published material in this field focuses on more theoretical positions, with limited use being made of completed thesis that demonstrate or discuss case study examples. The aim of this paper is to contribute to the debate by exploring the issues of data collection and researcher capability/motivation during what the author defines as 'researcher-practice'. This is achieved through the use of Ph.D case studies that were either undertaken or supervised by the author in the area of industrial design. Specific examples of researcher-practice focus on the following activities:

- The use of output from practice for quantitative data collection (e.g. for comparative analysis)
- The use of output from practice for qualitative data collection (e.g. reflecting on new working practices)
- The use of practice to progress the development (design) of research output (e.g. designing design tools)

The paper concludes by drawing together the strategies employed in the Ph.D's to identify themes which enables the definition of a generic researcher-practitioner methodology.

Keywords

Practice; industrial design; case study; Ph.D; creative arts

Introduction

The data collection techniques available to the design-based researcher range from quantitative methods, with their origins in scientific investigative enquiry, to qualitative methods that are more typical of the social sciences and humanities. The nature of the research methods applied during practice-based creative activity has led to a tendency to assume that qualitative methods are the most appropriate. This is summed up by the UK Council for Graduate Education (1997, p. 16) who state that:

> Research in the practice of the Arts related subjects is more likely to employ qualitative research methods. This kind of research does not, typically, begin with a predetermined set of questions or assumptions but arises from particular situations or contexts, which can be described with sufficient precision for a project to emerge which can be scrutinised and approved by the institution and supervisor.

Ultimately, the specific combination of research methods will be dependent on the nature of the research questions being addressed and, providing these can be robustly answered, the use of both quantitative and qualitative methods may be relevant. It is important to stress that there is not necessarily a 'right' way to undertake Ph.D research, but the methodology must be capable of being robustly defended.

This paper gives examples of data collection through researcher-practice using both quantitative and qualitative methods. It goes on to extend the role of researcher-practice for 'data translation' in which practice is used to design a component of the research output but not directly acquire data.

When a research methodology has been devised that includes practice undertaken by the researcher it is fair to say that alternatives that do not involve practice exist, such as engagement with other practitioners through interviews, questionnaires, focus groups, observations and case studies. In many respects, methods that do not include researcher-practice may be more straightforward due to the problems associated in employing a single subject (the researcher) to provide data from creative activity that may well be expressive, emotional, ill-defined and with open-ended solutions. However, the scope of a Ph.D remains relatively broad and it is helpful to note the fundamental requirements as identified by Archer (2004, p. 10):

- To demonstrate competence in higher levels of research skills
- To make a substantial contribution to knowledge in a given discipline
- To become qualified to supervise others in the conduct of research programmes
- The critical appraisal by the candidate of prior research
- Close attention to the principles and practice of research methodology
- The conduct of a single major systematic investigation
- The delivery of a substantial contribution to knowledge

With relatively few pre-conditions for Ph.D study, significant opportunities exist for the researcher wishing to employ their capability in practice within the methodology. The key challenge is how to apply a researcher-practice approach as a research method.

Research methods

Moore (1983) categorises case studies as an approach to research as opposed to a research method, with a capability, "to describe and understand the phenomenon 'in depth' and 'in the round' (completeness). In this role, case studies serve a useful purpose, since many important issues can be overlooked in a more superficial survey" (Birley and Moreland, 1998). Robson (2002) identifies two types of case study: individual case studies (a detailed account from one person that can be used to explore possible causes, determinants, factors, processes, experiences etc.) and a set of individual case studies (as individual cases studies but involving the study of a small number of individuals with some features in common). A sole researcher undertaking practice would clearly fall within the domain of an individual case study and the way in which data is collected and analysed "implies the collection of unstructured data, and qualitative analysis of those data" [ibid]. In focusing on specific methods applied as part of case study research, action research is of relevance when exploring issues relating to practice (Moore, 1983; Gomm and Hammersley, 2000; Cohen and Manion, 1980). Action research has been defined as:

> an on-the-spot procedure designed to deal with a concrete problem located in an immediate situation. This means that the step-by-step process is constantly monitored (ideally, that is) over varying periods of time and by a variety of mechanisms (questionnaires, diaries, interviews and case studies, for example) so that the ensuing feedback may be translated into modifications, adjustments, directional changes, redefinitions, as necessary, so as to bring about lasting benefit to the ongoing process itself. (Cohen and Manion, 1980, p. 178)

The cyclical nature of action research has been identified by Birley (1998) who sees it as being conducted by a professional into their own activity, the aim of which is to bring about an improvement in practice. The notion of an "action research cycle" is noted by Robson (2002) and involves "planning a change; acting and then observing what happens following the change; reflecting on these processes and consequences; and then planning further action and repeating the cycle". Providing an appropriate data collection process can be put in-place, action research can be considered as being an appropriate research method when exploring issues relating to professional practice. There are similarities between action research and reflective designing, in which the subject or researcher undertakes practice and articulates the process and outcomes. The process of reflective designing is described by Schon (1983, p. 79):

> The designer's moves tend, happily or unhappily, to produce consequences other than those intended. When this happens, the designer may take account of the unintended changes he has made in the situation by forming new appreciations and understandings and by making new moves. He shapes the situation, in accordance with his initial appreciation of it, the situation 'talks back', and he responds to the situation's back-talk.

The use of practice within a case study can be employed when data is collected through reflective designing/action research. However, the use of such methods is by no means straightforward as a strong argument must be given for the ability to generalise from the practice of an individual (possibly a recent graduate) who may have had little or no experience in a professional environment. There is also a degree of uncertainty when attempting to develop tools to enhance practice, as the possibility exists for them to fail to deliver the required benefits.

Motivation

When faced with significant challenges, it is easy to understand why more conventional data collection techniques might be employed during a Ph.D, such as interviewing practitioners. It is therefore necessary to consider the underlying motivation that leads researchers to engage in practice. Experience of this activity in the area of industrial design as part of the author's Ph.D plus subsequent supervision has identified three primary factors:

- **Designers enjoy designing**
  The practicalities of the design-based Ph.D (or Ph.D's generally in the creative arts) often fails to recognise the wider needs of the researcher who would typically have bachelors and masters degrees in their field and where the structure of their degree programme(s) would have been practice-based i.e. they have considerable prior history of creative practice; they enjoy creative practice; and they may well miss the fulfilment of creative practice if none was undertaken during a three to five year full time Ph.D.

- **Students need tutors that can design**
  Practice-based learning at undergraduate and masters level requires a significant taught input by competent practitioners. It is all too common for academics to loose or fail to develop capability in practice as they move through an academic career that is based on teaching and research. The typical route by which full-time academics with a practitioner background acquire a Ph.D is through part-time study. In order to maintain competence as a practitioner for the benefit of students, there is a case to encourage the use of practice in staff Ph.D's.

- **Research outcomes need designing**
  An unexpected outcome from the author's experience of Ph.D supervision in creative disciplines has been the scenario where professional practice was necessary for the progress of the research. 'Tools' are a popular and relevant outcome from design-based Ph.D's and situations arise where the tool itself must be designed in order to facilitate its validation. It is therefore necessary to consider the use of researcher-practice where practice is not a direct means of the data collection but a process by which research outcomes can progress to validation.

These three motivational scenarios will now be contextualised and the methods/methodologies applied within three Ph.D's discussed, making specific reference to:

- The use of output from practice for quantitative data collection (e.g. for comparative analysis)
- The use of output from practice for qualitative data collection (e.g. reflecting on new working practices)
- The use of practice to progress the development (design) of research output (e.g. designing design tools)

The use of output from practice for quantitative data collection

Title of Ph.D: The integration of rapid prototyping during industrial design practice
Researcher: Mark Evans
Supervisor: Ian Campbell
Quantitative output: Cost and time data for contrasting techniques

As designers make the career transition from practitioner to educator, it is all too easy to lose the core competencies of professional practice when the role as an academic takes over. This can be compounded by a requirement from institutions to focus non-teaching activity on research and possibly attain a Ph.D. Such progression may not necessarily be in the best interest of students, where emerging skills and knowledge are developed through demonstration of technique and direct modification of their work by the tutor. Having been employed as an in-house and consultant industrial designer, the author took up a full time academic post as a lecturer in industrial design in a research-focused university. Whilst continuing to undertake professional practice as part of this role it became apparent that the University would not award a Ph.D for designing a product. However, examples of such practice exist elsewhere, such as a Ph.D arising from the industrial design of seating for orchestral musicians awarded by the National College of Art and Design, Dublin. A published summary of this thesis identifies activity typical of professional industrial design practice: “a great deal of the work was informed by the collation of facts, statistics, data and testimony. The marriage of the two was the thrust of the thesis: an integrated process interweaving the two strands, in which the facts guided the creative search, the ideas generated further questions that needed factual answers which, in turn, sparked further creative activity” (p. 22).

The strategy undertaken during the authors Ph.D avoided any attempt to translate the design of a product into a Ph.D due to the problematic nature of research questions and the necessity to generate new knowledge that was above and beyond that undertaken by practitioners. This position led to the formulation of research questions and methodology that would facilitate data collection through the design of two (but ultimately four) consumer products. The focus of the study was in the field of professional practice with the aim of facilitating the integration of a specific and emerging technology (rapid prototyping). To undertake this, a four phase research methodology was devised:

Phase 1: Literature review - Nature of industrial design/rapid prototyping.
Phase 2: Draft method - Practitioner feedback; revised method
Phase 3: Comparative evaluation - Product design activity; evaluation of physical models (x3)
Phase 4: Resolution of modelling issues - Additional case study(s); final method for integration of rapid prototyping defined
Phase 5: Validation - Appraisal framework

Having defined a draft method for the integration of rapid prototyping within practice, this was executed through a case study which identified problematic issues through a method of reflective designing and the recording of design activity. The evaluation and appraisal of the strategy for integration provided an opportunity to reflect on and modify this through additional case studies by employing the cyclical nature of action research as identified by Cohen and Manion (1980).

Key outcomes from the comparative evaluation in Phase 3 were the production of two appearance prototypes for a relatively complicated consumer product. One appearance prototype was produced using rapid prototyping and the other using conventional workshop-based techniques. Costs and component build times were recorded to provide quantitative data for each appearance model. As the product contained electro-mechanical elements, the reflective nature of the method enabled the use of rapid prototyping to be extended for the production of a fully working appearance prototype for which production/finishing/assembly data was recorded. The recording of quantitative data was an essential part of the evaluation

process and provided objective information during appraisal. When the findings were presented to practitioners as part of the validation process, the use of ‘hard data’ provided a commercial realism that was easily understood by the interviewees.

Whilst one additional case study had been planned for Phase 4, a total of three were required to resolve issues identified during Phase 3. These focused on the fact that considerable rigour was needed to produce the 3D computer geometry required for rapid prototyping; rapid prototyping could not make a cost-effective contribution to the production of physical sketch models; and as a remote build system, rapid prototyping removed the ability for the designer to engage in the definition of form through the tactile sculpting of a physical material.

These issues were the subject of further literature review and the identification of potential solutions. The three issues went on to be investigated and resolved to varying degrees of success. Having explored the three issues, the outcomes enabled the final Computer Aided Industrial Design/Rapid Prototyping (CAID/RP) method to be defined. The key feature of the CAID/RP method was the capacity to operate almost exclusively in a digital environment whilst still engaging in a degree of tactile interaction with the emerging form. This strategy facilitated the use of rapid prototyping in the production of the key forms of physical model required during industrial design practice i.e. sketch model, appearance model, appearance prototype.

The final phase of the Ph.D was to validate the CAID/RP method using an appraisal framework. This involved interviews with industrial design practitioners. The interviewees received a briefing on the method followed by the completion of a questionnaire that was later normalized using a weighting/rating method (Pugh, 1991).

Completion of the Ph.D resulted not only in the development of research capability, but skills and knowledge in computer aided industrial design; haptic feedback modelling; the finishing of rapid prototype components; and maintenance of sketching capability. All of these were found to be of direct relevance to undergraduate and masters teaching.

The use of output from practice for qualitative data collection

Title of Ph.D: The development of a curriculum for the study of digital industrial design
Researcher: Noor Al Doy
Supervisor: Mark Evans
Qualitative output: Reflective designing through the use of advanced design technologies

The typical route to a Ph.D is via bachelors followed by a masters degree, although it is becoming increasingly common to find candidates that progress directly from undergraduate study. For those students with bachelors/masters qualifications in creative disciplines, this would have necessitated engagement in a high level of practice for between three and six years of study. For those with a background in this level of creative practice, the transition to Ph.D can be extreme as literature reviews and primary data collection have little in common with creative practice. Having decided to undertake a Ph.D, the absence of a creative activity that was central to previous studies can come as somewhat of a shock.

Having acknowledged the contribution of practice as a research method or component of a research method, if undertaken by a suitably qualified researcher its inclusion can provide variety in the scholarship and continuation of an activity for which the student usually has talent and passion. Those that have completed a Ph.D are all too aware of the motivational issues experienced during the course of the research and the contribution of creative practice towards a suitably qualified Ph.D candidate's motivation should not be underestimated.

During a Ph.D to develop a curriculum for the study of digital industrial design, the typical research methods of literature review, interviews and questionnaires were employed to develop parameters for the research and specify a totally digital workflow for professional practice that progressed from first concepts through to pre-production. The Ph.D employed the following five phase research methodology:

Phase 1: Literature Review – The nature of industrial design practice; tools; education
Phase 2: Development of method - Questionnaire to establish extent of use; definition of a draft digital industrial design method; evaluation of method via action research; revisions to method
Phase 3: Appraisal of method - Interviews with practitioners to receive feedback
Phase 4: Development of digital industrial design curriculum - translation of findings into an academic curriculum
Phase 5: Validation of the digital industrial design curriculum - Interviews with educators, exposure of students to the curriculum, final appraisal

Having defined the digital industrial design method, it was necessary to provide data on its capacity to deliver the potential benefits that had been identified through the literature review. To achieve this, reflective designing with the use of a design diary was employed to record the activities undertaken during the design of a consumer product. This included the comprehensive documentation of sketches, models (2D/3D) and prototypes produced during the design activity. This was achieved through 14 design modelling operations which took place during the three distinct phases of the design process. Specific modelling operations include the use of a digitizing tablet with interactive display (Wacom Cintiq); laser cut contour modelling; virtual prototyping and virtual reality.

As the researcher had bachelors and masters degrees in industrial design, they were already a capable designer. However, it was essential that the design-based action research took place in a context that closely followed commercial activity, so modes of practice were cited from relevant literature and use was made of the supervisors experience as a practitioner to ensure that this followed the format of a live project.

The use of practice to progress the development (through design) of research output

Title of Ph.D: Enhancing collaboration between industrial designers and engineering designers
Researcher: Eujin Pei
Supervisor: Mark Evans
Research output: The design of a card-based tool to enhance practice

When undertaking research into practice, it is not uncommon for the outcome of the Ph.D (the new knowledge) to be a tool that has the capacity to enhance practice. As the aim would be for the tool to be used by designers, there are expectations and requirements that

it should be well designed on a visual level, not just functional. Whilst it is quite feasible for a researcher to commission a consultancy to undertake the design work, if self funded or the recipient of a studentship, the cost would rarely make this a viable option. It therefore becomes the responsibility of the researcher to engage in professional practice that generates neither quantitative nor qualitative data, but where their practice is essential for the progression of the research agenda i.e. the tool.

In a Ph.D that aimed to enhance collaboration between industrial designers and engineering designers, data collection was undertaken through literature review and interviews with practitioners. This led to the specification for tool that was loosely based on a children's gaming card- format. It was then necessary to design and prototype the cards to allow validation by practitioners. The methodology employed for the Ph.D in the development of the tool followed six phases:

Phase 1: Literature review - Industrial/engineering design, collaboration, design methods
Phase 2: Practitioner interviews - Interviews/observation to identify barriers to collaboration
Phase 3: Categorisation of design representations - Interviews; taxonomy
Phase 4: Draft collaboration tool - Collation of data to produce first embodiment of tool
Phase 5: Refinement of collaboration tool - Pilot study
Phase 6: Validation - Practitioner interviews; case study; definition of final tool

Having explored options for virtual and physical tools, the card-based format was selected due to its portability and accessibility. The design of the cards went through three iterations following practitioner evaluation, but the researcher's capability as a designer was essential in making the cards useable, believable and appropriate for the target market. The pack consisted of 134 cards which were sub-divided in to three sections. Section 1 illustrated key design stages of new product development (x4) on the front face with a definition of the design stages where industrial designers and engineering designers collaborate during the design process. The reverse had information on the popularity of design representation used by each group during each stage. Section 2 described key design and technical information used by industrial designers and engineering designers during the design process. The front face had a definition of design and technical information and the reverse had information on the popularity of specific representations for the communication of design or technical information. Section 3 defined the representations used by industrial designers and engineering designers during the design process. The front face gave a definition of the design representation and the reverse face showed the design/technical information that was embodied in the representation plus the popularity of the representation when used during a design stage.

The potential for the researcher to engage in practice for which the primary purpose is not data collection extends its role within a Ph.D. The role of practice therefore becomes that of 'data translation' as opposed to data collection.

Conclusions

If employed within an appropriate methodology, the use of practice can provide rich contextual (quantitative and/or qualitative) data that would be difficult or not viable to collect using any other means (such as observing a practitioner progress a project from start to finish). However, the extension of the role of creative practice as a means of translating data into a research output presents an additional dimension that has been largely overlooked in the debate on practice in Ph.D's as it falls outside the remit of how to collect data and the validity of that data.

Having identified three roles for practice within a Ph.D (quantitative/qualitative data collection and data translation) it is possible to integrate common elements of the three methodologies to identify themes and propose a generic strategy that may be of relevance to researchers who are considering employing practice within their Ph.D. The six phase methodology has the potential to move the direction of research from conventional literature-based/empirical data collection to one where the developed tool/method is evaluated and or designed through researcher-practice. The six phase researcher-practice methodology comprises the following activities:

Phase 1: Literature review - Areas of study defined; prior knowledge identified; research methods selected
Phase 2: Empirical studies - Stakeholder feedback
Phase 3: Draft tool/method - Case study evaluation
Phase 4: Refined tool/method - Case study evaluation
Phase 5: Validation - Practitioner/expert feedback
Phase 6: Final tool/method - Conclusions

Whilst it is acknowledged that the methodology is not prescriptive and would require modification according to the nature of the research questions, it forms the starting point for those wishing to engage in the emerging and expanding area of researcher-practice.

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Dr Mark Evans

Mark Evans is a Senior Lecturer in the Department of Design and Technology at Loughborough University. He has bachelors, masters and Ph.D qualifications in industrial design and prior to joining the University worked as a consultant and in-house industrial designer. Since joining the University he has continued to undertake professional practice for organisations such as British Airways, Honda, Unilever and British Gas. His Ph.D employed practice-based research methods to investigate the use of rapid prototyping during industrial design practice which resulted in the design of four consumer products. Current research is supported by five Ph.D researchers working in the areas of design modelling (the role/function of digital sketching/CAD/CAID) and the management of design activity. External examinerships have been held for undergraduate, masters and research degrees and overseas appointments include visiting professor at the Rhode Island School of Design (RISD) and international scholar at Massachusetts Institute of Technology (MIT) CADLab. He is a member of the Arts and Humanities Research Council's (AHRC) Peer Review College.