

Connecting Practice to Research (and back to Practice): Making the leap from design practice to design research

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ABSTRACT

The proliferation of research degrees in the subject of design reflects the growing importance of research-based approaches in this discipline. However, it is not unreasonable to suggest that design (being a creative, subjective and artifact-based activity) does not naturally lend itself to the scientific, objective and knowledge-based activity of research. As a result, design researchers who have practised as designers are still rare within the design research community. Of those that do make the transition from practice to research (and back), they often enter with a misinformed notion of 'research', which ranges from a view that design research consists of a large-scale design project, to one of scientific experimentation only.

This paper draws from the experiences of the author who has undertaken and completed a research degree in the subject of Design. It is a response to difficulties faced by the author during her PhD experience and proposes to address the questions: Are there any similarities between practice and research that can be highlighted to enable designers to understand the requirements of research? What skills and knowledge can be derived from research, which can be brought back into design practice? How can we better prepare designers to undertake research? It is hoped that the issues expressed here will be a basis for continued discussion on how design education can begin to incorporate a research-based curriculum, and for professional bodies to promote the value of research to practitioners.

1. Research and Professional Higher Education in Design

In the United Kingdom, the sector of Art and Design has recently seen a considerable growth in PhD studies over the past 10 years. For example, based on the Art and Design Index to Thesis database (Christer 2006), the number of PhDs awarded in Design¹ between 1986 to 1995 rose from 82 to 180 between 1996-2005, a rise of almost 216%. Echoing this trend, Newbury (2003) points out that one of the largest providers of Art and Design education, The University of Arts

¹ Design subjects include design studies, typography, graphic design, multimedia design, visual communication, clothing/fashion design, textile design, industrial/product design, interior design, ceramic design, furniture design and interactive/electronic design.

London (formally known as The London Institute), has increased their full-time PhD student numbers from 11 in 1996 to 38 in 2001, and part-time student numbers from 4 in 1996 to 45 in 2001. The emergence of three major international conferences such as the Doctoral Education in Design (Buchanan, et al. 1998), Doctoral Education in Design: Foundations for the Future (Durling and Friedman 2000) and Doctoral Education in Design: Practice of Research (Durling and Sugiyama 2003) to discuss issues specific to doctoral education in design also reflects the growing interest in research studies as a route to personal and professional development.

Despite increased interest in PhDs, the number of designers even considering pursuing a research degree remains fairly small. In a survey conducted by Melican et al (1998) with researchers seeking doctoral degrees in design, it was found that all but one of the 28 respondents were working in academia before deciding to pursue their PhDs. Hence it can be concluded that without the link with academia, designers rarely make the leap from design practice into design research. Similarly, in the same survey, the number of doctoral researchers expressing a wish to return to design practice after completing a PhD is low, which is not surprising given that 43% of the participants expected that their doctoral degrees would have little or no impact on their status within their professional design communities.

The professional community's negative view of academic discourse has not changed much despite increased interest in research activities. While this view is understandable in a discipline new to university status and without an established research ethos, the current socio-economic and technological context requires design to consider research's importance to its professional practice. According to the Design Council website (Cooper and Press 2006), academic research can provide benefits to business in three areas: challenging existing assumptions, creating objective new knowledge and providing a wider perspective through multi-disciplinary teams. Additionally, design research outcomes can also play an important role in policy advocacy, where it can be used to promote the role of design in making businesses more competitive and public services more effective.

Technological developments in digital media have enabled the convergence of different technologies and forms of communication (Rogers 1986). The act of designing is no longer confined to a single medium and instead now requires multi-disciplinary teams to address design solutions across different media. Justice (2000) argues that this type of teamwork requires activities in line with design research, where it 'goes beyond the wants and needs of the individual designer espousing what he or she thinks the consumer wants, and into the realm of external inquiry' (380).

2. Moving from Practice to Research: A Personal Reflection

2.1. The nature of design practice

Designers, as Winkler suggests, understand research ‘as information gathering, sometimes information synthesis and analysis, but rarely as the testing of conceptual models, or the testing and application of data from findings in sociology or psychology’ (1997, 133). Many in the design profession (myself included) tend to view research and anything related to theory as generally unconnected to the everyday practice of design. Professional design practice is notoriously resistant to incorporating any theoretical models, guidelines or framework into their design process. Designers learn design through project-based practice rather than theoretical discourse: ‘Learning by doing’, as Schön (1987, 93) describes it, often performing a task before understanding the components that make up the task. Designers tend to view the incorporation of models derived from theory as creativity suppressors and often see no value to them in their day-to-day design activity. There are many examples of successful designers who claim not to engage in design theory. However, as McCullagh (2000, 41) suggests, if a problem can be framed in an appropriate context (located within theory), the subsequent design process will probably be more efficient and its solution more appropriate.

According to Friedman (2000, 16), successful design ‘requires explanatory principles, models and paradigms’. He notes that while the design profession has developed some of these, it is left to a community of researchers to develop a rich theoretical framework. In addition, I would argue that it is just as important for designers to acquire research skills in order to understand and improve on their own practice.

For example, design practice from my own experience and observation was often fast moving, relentless and focused on delivering projects on time. Like many practising designers, I found myself moving from one project to another without giving much thought to reflection, examination and dissemination of past projects. Professional development through seminars, workshops or conferences was often neglected due to time and cost constraints. Professional discourse was usually limited to reading journalistic articles rather than conducting internal enquiry within my own practice. Design research was limited to information gathering, market analysis and inspiration gathering. Although design research was part of my design process, I would agree with Durling (2000) that unless the research activity has been carefully planned, data analysis made through established protocols and an effort to disseminate the findings beyond the studio, it cannot be classed as ‘research’, defined by Archer (1995, 6) as a ‘systematic enquiry whose goal is communicable knowledge’.

Increasingly I became aware of issues brought about through practice but had neither the time nor skills to explore them in more detail. My initial attempts to address these issues only resulted in the realization that I lacked an intellectual framework in which to interrogate my practice and to place it in the context of the

discipline. This eventually led me to look beyond practice, into education and research for possible answers.

2.2. Research as a means to solve practice-based problems

Anecdotal evidence suggests that my initial understanding of research is shared by a majority of designers. It is based on the assumption that research is the domain of academia, often scientifically conducted to ‘prove’ or ‘disprove’ a theory that has little relevance to practice. Luckily for me, my employment at the Centre for Design Research has enabled me to experience research projects and activities through professional design practice. Projects running in the Centre comprise a mix between commercial design projects, collaborative student projects and contract research. Additionally, doctoral design students are also based at the Centre. In this environment, research became less of an abstract concept and I was able to relate research to practice. Specifically, discovering that practice-based concerns are valid topics for research and that there are suitable methods, such as Action Research (McNiff 1988) and Reflective Practice (Schön 1987; 1983), to support this type of enquiry convinced me that a doctoral degree would be the most appropriate step in my professional development. As a result, in May 2002 I enrolled on Northumbria University’s doctoral program on a part-time basis.

Findings from Melican et al (1998) suggest that the majority of design researchers’ decision to pursue their PhDs were motivated by two main reasons: personal intellectual development, and professional advancement. These two reasons are linked, as often personal development motives serve to further professional goals. For example, reasons for pursuing PhDs cited by fellow doctoral students in a symposium on graphic design research (*Finding the Question to the Answer: A Graphic Design Research Symposium* 2006) included: ‘learning to read and write critically’, ‘exploring concerns that originated from practice’, and ‘developing criteria for judging practice-based outcomes that might be described as intellectually robust’. Similarly, my main motivation for pursuing a PhD centered on exploring practice-based issues and developing skills to enable me to interrogate my practice in a systematic and explicit manner. It was based on the assumption that value gained in my personal development would be reflected in my professional career.

3. Learning to Research

Making the leap from design practice into design research is a challenging experience. Some would argue that research is very similar to practice and some (for example the ‘Practice as Research in Performance’ project funded by the Arts and Humanities Board from 2001-2006) would even go as far to suggest that practice is research, based on the assumption that the act of designing is investigative. From my experience though, some elements of research are still beyond the sphere of design practice. To help designers understand these

differences, I will attempt to draw some common traits while at the same time highlight key differences between them.

3.1. An Investigative Process

Research, according to Friedman (2000) can be simply described as a way of asking questions. Similarly, in a design process various problems are explored in order to come up with an appropriate solution. However, where the two diverge is in the way the questions are asked and for what purpose. Scrivener (2000, 388) distinguishes them by suggesting that ‘design innovates while research acquires new knowledge’. I would expand on his description by adding that design seeks new knowledge in order to innovate while research seeks new knowledge in order to further the discipline. Additionally, the process of asking questions in design is often hidden, varied and adapted while the same process in research has to be open, rigorous and replicable. Durling (2002, 81) suggests that ‘research asks questions, selects appropriate methods, tests the questions, analyses the results, and disseminates the conclusions unambiguously’. Practice, according to him, does not normally have these goals, and the need for rigour and dissemination is less important. I would add that the dissemination of knowledge in design practice is generally used for marketing purposes rather than as a contribution to new knowledge. However, despite these differences, it is undeniable that an investigative instinct (crucial for designing) would be a valuable asset in research activity.

3.2. An Iterative Process

During a design process, a designer will go through several iterative stages of design development which, according to Jones (1992), includes three essential stages of analysis, synthesis and evaluation (see Figure 1) in order to arrive at an appropriate design solution. Cross (1997, 439) identifies oscillations between stages as the creative element of design, rather like bridging the chasm between problem and solution. These three stages (analysis, synthesis and evaluation) can also be applied to the research process. Although it is tempting to assume research is a linear process, data-driven research such as Action Research (Lewin 1946) and Grounded Theory methods (Glaser and Strauss 1967) tend to be more iterative than theory-driven research (such as the Positivist approach in the natural sciences). Theory-driven research allows existing literature and knowledge to generate theory, and the research becomes a process of extending, refining or challenging existing knowledge. In data-driven research, research questions are developed from studying the existing research situation and being responsive to it (Dick 2002). For example, Action Research (see Figure 2) allows for theory generation, intervention and theory testing to co-exist in an iterative loop (Checkland 1991).

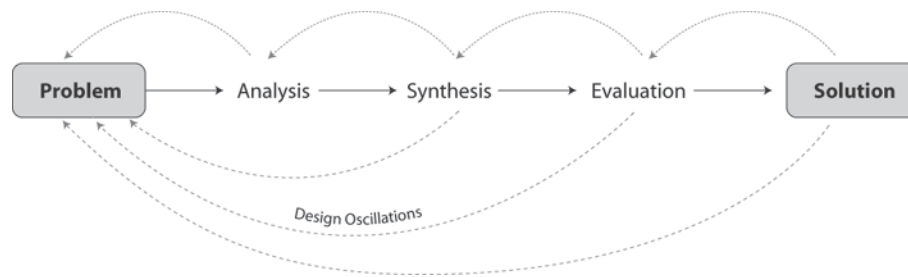


Figure 1. The Iterative Design Process

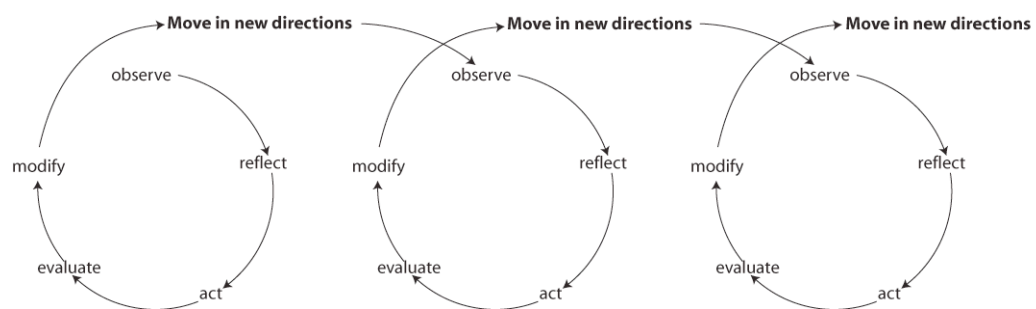


Figure 2. The Action Research Cycles (based on McNiff and Whitehead 2006)

3.3. A Creative Process

The scientific tradition rarely recognizes the ‘creative’ and ‘imaginative’ roles in the research process. However, as Swann points out, ‘without an imaginative insight into what data “might” mean and the variety of ways in which it “could” be interpreted, science would have made little progress in extending the body of knowledge’ (2002, 54). Hart (1998) emphasizes how important it is to develop an imaginative approach to research. For him, a research imagination is about: ‘having a broad view of a topic; being open to ideas regardless of how or where they originated; questioning and scrutinizing ideas, methods and arguments regardless of who proposes them; playing with different ideas in order to see if links can be made; following ideas to see where they might lead...’ (1998, 30). For example, when I was conducting a literature search for my PhD, it was often difficult to find any literature relating directly to my area of study. I had to be ‘creative’ in how I framed my research questions and identified how they might be addressed. Topics are often labelled, described and explored differently in other disciplines. The key difference between research and design is that in research, the creative process has to be evidenced and made explicit, while in design this process remains hidden and is only evident in the solution proposed.

3.4. Visualizing Information

Based on the discussion so far, a designer's ability to synthesize disparate pieces of information into a coherent solution seems to be an essential skill for researchers. I would add that designers, especially graphic designers, are at an advantage due to their ability to translate complex information into visual representation, in order to communicate and aid the reader's comprehension. Graphs, models and tables are especially useful as a communication tool for researchers in the natural and physical sciences disciplines. They offer summarized versions of theory and often aid comprehension. Additionally, the process of mapping is one of the more common ways for both design and research practitioners to organize and analyze complex information. For example, I decided to map the literature that I reviewed in order to help me organize and contextualize theories, arguments and themes derived from the literature review (see Figure 3). The visualization of the literature allowed me to use the map as a tool to facilitate my understanding and construction of prior knowledge discovered during a conventional literature review. It enabled me to construct a typology of the relationships between the pools of knowledge in terms of their relevance to my research topic. My visualization skills (gained through graphic design training) also allowed me to design a map that was an effective communication tool in order to convey the scope and focus of the study to external audiences.

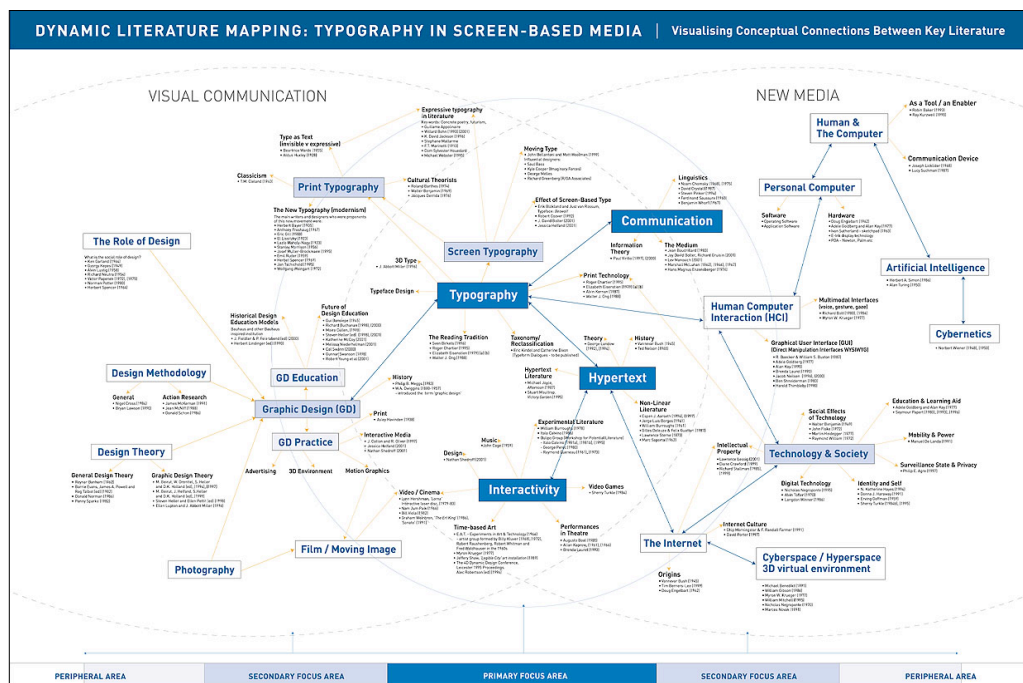


Figure 3. Literature map of a PhD topic

3.5. Understanding Different Research Traditions

Similar to design, research has different schools of thought and traditions that govern the approach and methods used. In design, this is usually evident in the visual style of the proposed solution. However, in research, unless one is familiar with the different ontological and epistemological approaches, it can be less obvious. For example, making sense of the different research traditions, and trying to decide which was suitable for my requirements was one of the most challenging experiences of my PhD. On reflection, this was due to my unfamiliarity with these traditions and their associated methods. Developing this understanding was a crucial part of research training, and helped in the identification and evaluation of methodological assumptions and research strategies of other people's works. Subsequently, it informed my decision on how my research should be conducted.

4. Connecting Research Back to Practice

Having just completed my PhD in the summer of 2006, I have had only a short period of time to reflect on my research experience. However, I will attempt to highlight areas where I believe research training has explicitly improved my professional practice.

4.1. Reflective Enquiry into Practice

According to Nickols (2000), knowledge can be grouped into three distinct types: explicit, implicit and tacit. Explicit knowledge is knowledge that has been 'articulated and, more often than not, captured in the form of text, tables, diagrams, product specifications and so on'. Implicit knowledge is knowledge that is capable of being articulated, but has not been. It can be inferred from observation or task analysis. In comparison, tacit knowledge is knowledge that cannot be articulated nor inferred from observation. For example, articulating how we operate a complicated machine or how we recognize a familiar face is not easily achievable. Tacit knowledge is normally associated with knowledge of doing, rather than knowledge of understanding. Practical disciplines like design rely heavily on tacit knowledge derived from the activity of designing.

Designers tend to explore, understand and solve problems by experimenting with a variety of possible solutions, rather than theorising about them (Eastman 1970). Not surprisingly, designers when explaining their design process often refer to the role of intuition. This refers to tacit knowledge, a kind of subconscious 'knowing'. However, McCullagh (2000, 42) believes that designers who are highly intuitive are able to 'bring a wider consideration to bear on a problem early in the project'. The challenge is to convert tacit knowledge, which is subjective and intuitive, into explicit knowledge that can be shared and communicated. This process allows designers to be aware of their underlying design process: thinking about thinking – also known as metacognition, a term first described by Flavell (1979). Meta-cognitive knowledge refers to a person's ability to understand and to

make sense of his or her own experience. One approach used to develop meta-cognitive knowledge is reflective practice (Schön 1987), an educational learning approach which promotes autonomous learning and aims to develop a person's critical thinking skills. Schön's description of reflective practice is particularly attractive to designers because it was developed through a study of an architectural studio environment. Schön argues that in a professional practice, a practitioner's knowledge is mainly tacit and implicit in terms of his or her patterns of action. He describes this as 'knowing-in-action'. The process of carrying out a course of acting, intervening, observing changes and reflecting on their effect, is described as 'reflection-in-action'.

I find this approach most useful in understanding my own practice when encountering projects that are complex and which involve multi-disciplinary teams. For example, I was recently involved in designing an interface for a software that provides a single solution for managing an integrated protein analysis 'proteomics' workflow (currently conducted in distinct stages and using different machines and software) to analyze samples within a laboratory. In order to develop the interaction design strategies for the software, it was important for me to have a basic understanding of how a scientist would analyse the protein in his/her laboratory. This involved understanding concepts and terminology related to this process by visiting a lab and reading scientific papers on this subject. Not only were we working to a tight deadline, I had to work closely with software engineers, which was sometimes difficult due to their differing philosophies and approaches. Although it was difficult to reflect-in-action due to the short deadline, reflection-on-action did take place after the project was completed and as a result I was able to identify areas where I felt I contributed to the success of the project. I was then able to further reflect on what I had learnt through a work-in-progress paper (Lievesley and Yee 2006), co-written with a colleague for the Computer Human Interaction Conference (CHI) in 2006.

4.2. Developing Critical Thinking Skills through Writing

In order to develop a coherent argument, one requires the ability to think critically. It seems widely accepted that good writing and careful thinking are complementary. According to Applebee (1984, 577), the role of writing in thinking is usually attributed to four factors: (a) the permanence of the word allowing reflection and revision, (b) the explicitness required for writing in order to retain meaning beyond its original context, (c) the resources provided by conventional forms of discourse for organizing and thinking through new ideas and explicating the relationships between them, and (d) a medium for exploring implications contained in unexamined assumptions.

Due to its historical connection with the arts and crafts movement, design education often focuses on the skill of making an object, rather than developing knowledge-related skills such as analysis, rhetoric and problem solving. Design students are generally not asked to produce a great amount of critical writing and are often assessed on their designed pieces rather than on their writing skill. At Northumbria University for example, only the final year undergraduate students

are asked to produce a formal ‘thesis’ document as part of their final project assessment. Writing is an important skill because students develop critical thinking skills by expressing their opinions and developing a coherent argument to support them. Additionally, writing develops their ability to communicate ideas to their peers. This is especially important in practice where skills in client communication and project proposal writing are essential. On reflection, the process of writing has enabled me to record my thoughts and actions, and subsequently reflect on decisions made during my practice. Writing allowed me to ‘connect the dots’ in my knowledge and allowed others to evaluate my ideas. Furthermore, as a graphic designer working with words and letterforms, writing has brought another level of awareness to my understanding of words, meaning and narrative structures.

4.3. Introduction of New Research/Design Tools

Undertaking a PhD has enabled me to develop generic research skills and research management experience. In addition, I have also discovered research methods and tools that are especially relevant and useful to the design process. For example, The Design and Emotion Society website (Design and Emotion Society 2006) clusters research tools into 2 groups: generative, and evaluative tools. Generative tools are used to collect information, represent information and define product characteristics, while evaluative tools are used to measure sensory characteristics, expression and emotional reaction to products. Having the ability to decide on the most effective and objective way to elicit information from users or clients during a fact-finding or evaluation stage adds value to the development of a project.

In a recent branding project, I used a series of word and image cards (described here as a card-sort method) to prompt the stakeholders to talk, think and feel about subjects intuitively. The cards fulfilled two purposes: the first was to enable my design team to build a brand image through stakeholder consultation, and the second to involve stakeholders in the development of the brand image through a rich and interactive sensorial experience. As a result, the participants were much more confident of the proposed solution as they were aware of and had been involved in the design process.

5. Some Considerations

Making the leap from design practice into design research has been a challenging process. While this paper draws from my personal experience that is retrospective, self-reflexive and indicative of the research methods and approach adopted for my PhD, it is nonetheless valuable in highlighting issues that need to be considered to bring research closer to practice.

5.1 Design Education with a Research Base

I believe the disconnection between practice and research in general stems from the current design education model. Design education tends to focus on teaching without a research base. As a result, Cooper and Love (2003) conclude that education institutions in the trade training sectors will compete directly against university-based design education at a lower cost to students; and the two pathways will be indistinguishable to employers. A research-based curriculum will open up depth and breadth to the field, document and disseminate research findings, build a research base of design knowledge, provide an opportunity to define design problems and evaluate design solutions through research (Justice, 2000, p.384-385). For example, recent collaborative projects with Philips have enabled graduate product design students at Northumbria to work on a research project investigating the attributes of motion and semantics in products (see for example Young, et al. 2005). Tools developed to explore motion in products (such as 4D sketching) generated a high level of interest and Philips designers were keen to try the tools for themselves.

In addition to having a lack of research training in the curriculum, the understanding and application of research in undergraduate programmes is often very different from academic research. Research is generally applied at the start of a design process, rather than throughout the whole process. According to Popovic (2000) there are four distinct areas of knowledge generation and application in a design process: (a) research before the design work is started, (b) research conducted during the early stages of the design process, (c) concurrent research carried out during the design and development stage and (d) research when an artifact is manufactured and is on the market. For a majority of design students, to 'research' is equivalent to browsing existing market examples, noting any significant design features and understanding the target audiences. This would constitute research in area (a) where the context of use and user experiences are explored. Educators should encourage students to approach a project through a methodical investigation of the problem posed by the design brief throughout the design process. Research tools and methods that have been devised and applied at different stages of a design project should also be introduced to students. These not only include traditional research methods (like questionnaires and interviews) but methods that are more suitable to the needs of design, such as cultural probes (see Gaver, et al. 1999), method cards (see IDEO 2003), persona creation (see Grudin and Pruitt 2003) and scenario development (see Carroll 2000; Cooper 1999; Kuniavsky 2003).

5.2 Industry and Professional Organizations

Practice and research are considered distinct areas within Design. This is reflected in the activity of the discipline, where most professional organizations, journals and conferences are focused in practice, education or research. There are several ways to encourage more interaction between practice and research. For example, trade journals should be encouraged to promote the value of research in

practice through their editorial commissions. Examples of the successful application of design research (like at IDEO) should be highlighted and discussed in an informational and practical manner. Discursive articles on the value and purpose of research in design should be encouraged. Additionally, professional design organizations such as the International Council of Societies of Industrial Design (ICSID), American Institute of Graphic Arts (AIGA) and International Council of Graphic Design Association (ICOGRADA) should actively promote the value of research to professionals. This could be in the form of events, conferences, talks, mentoring schemes and workshops. Often these organizations have areas devoted to the discussion of design education; why not open these up to include research as well? Encouragingly, the Chartered Society of Designers (Peters 2006) recently announced that in their newly developed Accreditation Program (<http://www.design-association.org/>), research activity would be one of the criteria considered during the evaluation of a firm's design practice.

6. In Conclusion

This paper proposes that research has a role in professional design practice and designers should be encouraged to engage in it. Design practice is increasingly seen as a valid method to explore research as Lawson (2002, 112) suggests, '...each design project allows the designers to explore and develop their own intellectual programme, and in this sense the design process can itself be seen as a form of research'. Although the issue of practice-based research is still heavily debated² and questions whether the process of making and its resulting artefact can be considered a valid research outcome, it is nonetheless useful for design practitioners to be aware of research activity that are more closely linked to practice. Research skills should be considered part of a designer's skill-set, rather than seen as a distinct strand of design practice. Research activity, as this paper proposes, draws from similar attributes to those required in design practice. It is hoped that the points expressed here have provided designers with an overview of the nature, purpose and value of research to the design process. Additionally this paper calls for educational and professional bodies to build a collaborative research culture, and develop relevant practice-based research knowledge in order to connect research with practice.

² In the editorial to the International Journal of Design Sciences and Technology (2002), Durling, Friedman and Gutherson argued against practice-based research, surmising that it has been fruitless while others such as Candlin (2000), Malins and Gray (2000) and Scrivener and Chapman (2004) have argued otherwise.

References

- Applebee, Arthur. "Writing and Reasoning." *Review of Educational Research* 54, no. 4 (1984): 577-96.
- Archer, Bruce. "The Nature of Research." *Co-Design Journal* 02, no. 01.02.03 (1995): 6-13.
- Buchanan, Richard, D. Doorden, Lorraine Justice, and Victor Margolin, eds. *Doctoral Education in Design*, Ohio State University: Carnegie Mellon University. October 8-11 1998.
- Candlin, F. "Practice-Based Doctorates and Questions of Academic Legitimacy." *International Journal of Art and Design Education* 19, no. 1 (2000): 96-101.
- Carroll, John. *Making Use: Scenario-Based Design of Human-Interactions*. Massachusetts: MIT Press, 2000.
- Checkland, P.B. "From Framework through Experience to Learning: The Essential Nature of Action Research." In *Information Systems Research: Contemporary Approaches and Emergent Traditions*, eds. H.-E. Nissen, H.K. Klein and R. Hirschheim, 397-403. Amsterdam: Elsevier, 1991.
- Christer, Kirsty. *Adit: Art and Design Index to Thesis* [Online]. 2006.
<http://www.shu.ac.uk/research/c3ri/adit/index.cfm>. (Accessed 25th September, 2006)
- Cooper, Alan. *The Inmates Are Running the Asylum*. Indianapolis: SAMS, 1999.
- Cooper, Rachel, and Mike Press. *Design Council* [Online]. 2006.
www.designcouncil.org.uk/academicdesignresearch. (Accessed 28th September, 2006)
- Cooper, Trudi, and Terence Love. "Designing Doctoral Education Programs in Design: Articulation with Post Doctoral Career Pathways." Paper presented at the Doctoral Education in Design: Practice of Research, Tsukuba, Japan, October 14-17 2003.
- Cross, N. "Descriptive Models of Creative Design: Application to an Example." *Design Studies* 18, no. 4 (1997): 427-55.
- Design and Emotion Society. *Design and Emotion Society* [Online]. Design and Emotion Society, 2006.
http://www.designandemotion.org/society/knowledge_base/tools_methods.html. (Accessed 12 October, 2006)
- Dick, Bob. "Postgraduate Programs Using Action Research." *Learning Organization - an International Journal* 9, no. 4 (2002): 159-71.
- Durling, D. "Reliable Knowledge in Design." *Working Papers in Art and Design* 1 (2000).
- Durling, David. "Discourses on Research and the Phd in Design." *Quality Assurance in Education* 10, no. 2 (2002): 79-85.
- Durling, David, and Ken Friedman, eds. *Doctoral Education in Design: Foundations for the Future*, France La Clusaz: Staffordshire University Press. July 8-12 2000.
- Durling, David, and Kazuo Sugiyama, eds. *Doctoral Education in Design: Practice of Research*, Japan Tsukuba: University of Tsukuba. October 14-17 2003.

- Finding the Question to the Answer: A Graphic Design Research Symposium* [Symposium]. Nottingham Trent University, Nottingham, 13th September 2006.
- Flavell, J.H. "Metacognition and Cognitive Monitoring: A New Area of Cognitive-Development Inquiry." *American Psychologist* 34 (1979): 901-11.
- Friedman, Ken. "Creating Design Knowledge: From Research into Practice." Paper presented at the IDATER 2000: International Conference on Design and Technology Educational Research and Curriculum Development, Loughborough University, Loughborough, 21-23 August 2000.
- Gaver, Bill, Tony Dunne, and Elena Pacenti. "Design: Cultural Probes." *Interactions* 6, no. 1 (1999): 21-29.
- Glaser, Brian G., and Andrew Strauss. *The Discovery of Grounded Theory*. Chicago: Aldine, 1967.
- Grudin, J., and J. Pruitt. "Personas: Practice and Theory." Paper presented at the Designing for User Experiences (DUX), San Francisco, California 2003.
- Hart, Chris. *Doing a Literature Review: Releasing the Social Science Research*. London: SAGE, 1998.
- IDEO. *Ideo* [Online]. 2003.
<http://www.ideo.com/methodcards/MethodDeck/index.html>. (Accessed 12 October, 2006)
- Jones, J. Christopher. *Design Methods*. 2nd ed. New York ; London: Van Nostrand Reinhold : Chapman & Hall, 1992.
- Justice, Lorraine. "Problems and Benefits of Building a Research-Based Design Curriculum." Paper presented at the Doctoral Education in Design: Foundations for the Future, La Clusaz, France, 8-12 July 2000.
- Kuniavsky, Mike. *Observing the User Experience: A Practitioner's Guide to User Research*. San Francisco: Morgan Kaufmann, 2003.
- Lawson, B. "The Subject That Won't Go Away, but Perhaps We Are Ahead of the Game. Design as Research." *ARQ* 6, no. 2 (2002): 109-14.
- Lewin, Kurt. "Action Research and Minority Problems." *Journal of Social Issues* 2 (1946).
- Lievesley, Matthew, and Joyce Yee. "The Role of the Interaction Designers in Agile Software Development." Paper presented at the Conference on Human Factors in Computing Systems (CHI), Montreal, Canada, 22-27 April 2006.
- McCullagh, Kevin. "Design Praxis: Towards a Design Context Rooted in Design Practice." In *Becoming Designers: Education and Influence*, eds. Esther Dudley and Stuart Mealing, 39-52. Exeter: Intellect Books, 2000.
- McNiff, Jean. *Action Research: Principles and Practice*. Basingstoke: Macmillan Education, 1988.
- McNiff, Jean, and Jack Whitehead. *All You Need to Know About Action Research*. London: SAGE Publications, 2006.
- Melican, Jay, Izabel Falcão Barros, Roberto Holguin, and Jooyun Melanie Joh. "So, You're Going to Be...A Doctor of Design?" Paper presented at the Doctoral education in design, Ohio, Carnegie Mellon University, 8-11 October 1998.

- Newbury, Darren. "Reflections on Building an Online Resource for Doctoral Studies in Art and Design." Paper presented at the Doctoral Education in Design, Tsukuba International Congress Centre, Tsukuba, 14-17 October 2003.
- Nickols, Fred W. "The Knowledge in Knowledge Management." In *The Knowledge Management Yearbook 2000-2001*, eds. J.W. Cortada and J.A. Woods, 12-21. Boston, MA: Butterworth-Heinemann, 2000.
- Peters, Frank. *The Professional Context* [Talk]. Nottingham Trent University, 13 September 2006.
- Popovic, Vesna. "Product Design Research and Knowledge Utilisation." Paper presented at the Design (plus) research conference 2000.
- Rogers, Everett. *Communication Technology: The New Media in Society*. New York: Free Press, 1986.
- Schön, Donald A. *Educating the Reflective Practitioner: Toward a New Design for Teaching and Learning in the Professions, The Jossey-Bass Higher Education Series*. San Francisco ; London: Jossey-Bass, 1987.
- — —. *The Reflective Practitioner*. London: Temple-Smith, 1983.
- Scrivener, Stephen. "Towards the Operationalisation of Design Research as Reflection in and on Action and Practice." Paper presented at the Doctoral education in design: Foundations for the future, La Clusaz, France, 8-12 July 2000.
- Scrivener, Stephen, and Peter Chapman. "The Practical Implications of Applying a Theory of Practise-Based Research: A Case Study." *Working papers in Art and Design* 3 (2004).
- Swann, Cal. "Action Research and the Practice of Design." *Design Issues* 18, no. 2 (2002): 49-61.
- Winkler, D. "Design Practice and Education: Moving Beyond the Bauhaus." In *User-Centred Graphic Design*, ed. Jorge Frascara, 129-35. London: Taylor and Francis, 1997.
- Young, Robert, Dan Pezzutti, Stuart Pill, and Richard Sharp. "The Language of Motion in Industrial Design." Paper presented at the Design and Semantics of Form and Motion, Newcastle upon Tyne, 11 November 2005.