RESEARCH IN ART AND DESIGN EDUCATION: A REVIEW

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ABSTRACT

The article presents a review of studies done on research in art and design education, particularly visual communication design. It examines the prevalence of research in postgraduate and undergraduate design programs and evaluates research methods applicable to the field. Including an overview of suitable methods for practice-based research such as Action Research and Reflective Practice, an outline of research emphasis at postgraduate level comprising formal research methods and alternative research methods. As well as the nature of problem in undergraduate studies such as lack of proper research infrastructure and appropriate models of practice in research and education.

Keywords: Design research, art and design education, research methodology, practice-based research.

INTRODUCTION

There is consensus amongst educational researchers on the growing importance of research in higher education in art and design (Mimoso, 2011; Yee, 2010). Yee (2010) states that the emergence of "a number of major international conferences dedicated to doctoral research reflects the growing interest in the nature of research and practice of the field" (p. 2). Design history, theory, research methods, and design management have become essential elements in research-based universities (Kennedy, 1997). This shift from an emphasis on training in traditional vocational courses to a focus on research being integral to the course, signals a transformation in design higher education. Furthermore, design practice has become more directed, in the sense that it now works from premise to conclusion, and seeks an understanding of research methodologies as the key component that allows creativity to flourish (Bennett, 2006). For instance, Mottram (2007) says that explanations for creativity, and probably for other human functions, are starting to reflect behaviours that were once commonly known and understood as central to training artisans and designers. She observes that cognitive science now sees deliberate practice as one of the conditions for creative activity.

Concurrently, the challenge for design education is to move beyond the making of a designer to equipping a graduate with lifelong learning skills to succeed in the ever-evolving design industry. As Isaac Asimov (1985) said, "The only constant is change": as long as a designer is trained to think, he or she will always be able to adapt to change. Perhaps the best way to train thinking is to provide the know-how to conduct research with rigour, especially since "it is useful in developing higher-order skills of critical thinking, analysis and scientific inquiry" (Cross *et al.,* 1992, p. 51). Furthermore, research plays an important role in art and design education, now that the number of students opting for courses in art and design research has grown considerably (Hockey & Allen-Collinson, 2000; Newbury, 1995; Yee, 2010). Referring to art and design students, Newbury (1995) mentioned that "certainly in the United Kingdom . . . the number of research students registered for higher degrees has more than doubled in the last five years" (p. 53). Art and design departments have expanded rapidly in recent years (Newbury, 1995), and knowledge and skills to conduct research have become necessary components in undergraduate and graduate programs (Bennett, 2006). Besides being a positive addition to the design students' skill set, research also "enhances their physical output as it expands their creative freedom" (Bennett, 2006, p. 13). As defined by Khoury and Khoury (2009), "research is an insightful method for the generation of meaningful design" (p. 837). This indicates that our future designer needs to be equipped with research knowledge to be innovative in design. Hence,

the review presented in this article seeks to provide an overview of the use of methods in research projects in the field of art and design, particularly in visual communication and design practice.

RESEARCH METHODS IN ART AND DESIGN EDUCATION

Overview of Research Methods in Art and Design Education

Owing to the inherent investigative instincts of designers, the very act of research in design education can be viewed as an extension of what comes naturally to them. After all, Friedman (2003) describes research as simply a way of asking questions. Research, according to Durling (2002), "asks questions, selects appropriate methods, tests the questions, analyses the results, and disseminates the conclusions unambiguously" (p. 81). Yee (2007) counters that the process of asking questions in design is often hidden, carried, and adapted, whereas research has to be open, rigorous, and replicable. Instead of focusing on the differences, Newbury (1996a) lists four common criteria of research that apply to any field of study, including art and design. He asserts that regardless of the academic discipline, research ought to be systematic, rigorous, critical, reflexive and communicable. Yee (2007) affirms this by referring to Archer's (1995) definition of research as a "systematic enquiry whose goal is communicable knowledge"(p. 6), before going on to identify suitable methods for practice-based research such as Action Research (McNiff, 1988) and Reflective Practice (Schön, 1987).

Action Research

The introduction of Action Research is widely attributed to Lewin (1946), whose formula encompasses a cycle of planning, acting, observing, and reflecting. By applying this method to real-life situations in which the researcher becomes an involved participant, the solutions are assessed for the results they produce, allowing the researcher sufficient scope to analyze and revise the plan to improve the situation, and then start the process all over again in a continuous spiral (Charles & Ward, 2007).

In data-driven Action Research, generation, intervention, and testing of theory coexist in an iterative circle (Checkland, 1991). In contrast, theory-driven research "becomes a process of extending, refining or challenging existing knowledge" (Yee, 2007, p. 5) by allowing existing literature and knowledge to generate creative ideas. Hart (1998) and Swann (2002) propagate an imaginative approach to research. According to Hart (1998), it entails "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" (p. 30).

Action Research "underpinned and guided the research processes" (Saikaly, 2004, p. 9) of various proposed alternative research methods (e.g., Findeli, 2008; Findeli *et al.,* 2008; Marshall & Newton, 2000; Sevaldson, 2000). The "action" usually occurs in the course of making the creative output. And art and design researchers have either renamed Action Research (Findeli, 2008; Sevaldson, 2000) or presented it as alternative methods (Marshall & Newton, 2000) for design research. These are highlighted below:

1. Findeli (2008) described Action Research as "project-grounded research". It stems from projects that implement a systematic process aimed at seeking and acquiring knowledge of the world we live in by looking through 'designerly' lenses.

2. Sevaldson (2000) brought forward a generic model for design research, the "integrated conglomerate approach". The "action" happens in the course of learning through doing and exploration through practice.

3. The research approach "grounding research in practice" of Marshall and Newton (2000) asserts the necessity for research to exist in the context of practice for the purpose of refining the activity based on the tested propositions, wherein the engagement is more concerned with practical considerations rather than the rigor of the research methods used.

Jonas and Chow (2008) also mentioned that Action Research is usually known as "research through design" elsewhere in design research.

Reflective Practice

Nickols (2000) concluded that there are three distinct types of knowledge: explicit, implicit, and tacit. Explicit knowledge is 'existing' knowledge that has already been expressed through words, data, formulae, specifications and other tangible means (Lee *et al.,* 2006). Knowledge that has not been articulated but can be identified and expressed by observing the behaviour or performance of someone who is competent is implicit (Nickols, 2000). Tacit knowledge, however, is a kind of inherent knowledge gained from experience, intuition, or emotions that cannot be articulated. Polanyi (1997) simply explains it as that scenario in which "we know more than we can tell." Examining the diverse definitions of tacit knowledge by various authors on the subject, Haron (2005) found that the "concepts of personal, experientially acquired, goal attainment values and collective" were the most commonly associated with this kind of knowledge.

Design, as a practical discipline, often produces tacit knowledge. Schön (1987) describes this as 'knowing-in-action', which a professional performs intuitively and can be observed from the patterns of his/her behaviour. Schön also recognizes the use of 'reflection-in-action' as a thought process of professionals where they stumble upon an unpredicted outcome in the middle of a task, become aware of it, analyze its effect and respond by making changes to their actions.

The trend seems to favour "reflective enquiry into practice" (Yee, 2007) for the study of visual communication. Loughran (2002) puts reflective enquiry into practice in the context of "purpose, framing, and articulation". By distinguishing a problem or situation that forms the purpose of the research at the onset, students can frame (and reframe) the issue as their perspectives change in the course of the design process, all the while recording their thoughts and decisions for further and deeper reflection. Schön (1992) observes that "the designer *constructs* the design world within which he/she sets the dimensions of his/her problem space, and invents the moves by which he/she attempts to find solutions" (p. 142). With greater reflection being put into words, there is a lot more knowledge that can be gleaned from the design practice, as "designers put things together and bring new things into being, dealing in the process with many variables and constraints, some initially known and some discovered through designing" (Schön, 1987, p. 41–42).

Glanville (2003) and van Schaik (2000, 2003) claim that Reflective Research is a effective approach for design research, as it requires students to reflect on their research process through "abstraction of themes, testing and re-abstracting—a distillation" (Glanville & van Schaik, 2003, p. 37). Also, by reflecting on their own work, students can not only understand how they themselves do things, but also magnify their knowledge and ability through a line of questioning that probes deeper into their area of research and helps them crystallize their thoughts. Through Reflective Research, Glanville and van Schaik are more concerned to know the "how" than the "what" of a research process, as they find that design is a process more than an outcome, and therefore is more revealing when studied throughout its various stages of activity. Similarly, Yee (2007) has used Reflective Research to understanding her own practice, especially on research projects that involved multi-disciplinary research teams.

To sum up, Action Research and Reflective Practice/Research are both used in design research as practical approaches for students to explore the nature of their practice and to improve it (Glanville & van Schaik, 2003; Schön, 1983, 1987; Yee, 2007). Both approaches encourage students to become knowledge-makers rather than knowledge-users (Carr & Kemmis, 1986). This denotes that research knowledge and skills play an important part in design practice, and it empowers students to answer the question of 'How does it relate?', especially with regards to the relationship between practice and research, and between practice and society.

Research Emphasis at Postgraduate Level

Since the late 1990s, there have been several studies on research methodology in art and design education. However, these studies have been conducted mainly in Western countries and at master's or doctoral levels. According to the reviews, most of these studies focused on developing appropriate models of practice in research education and training. The proposed models include imaginative approach, reflective practice or enquiry, designerly method, design as research, interpretation

approach, bricolage method, and visual research method. Mimoso (2011) states that, as the research training in 'art and design is at a formative phase' (p. 4), there is a need to devise alternative methods for art and design research, especially since it is practice-led. She further urges that it is important to develop a language of research for communication between researchers in art and design disciplines, as well as to demonstrate their research process and findings to other academic disciplines.

The Formal Research Methods

Allison (1992) sets out seven general categories of research methods used in art and design: historical, philosophical, experimental, comparative, descriptive, naturalistic, and practical. Yee (2010) and Gray and Malins (1993) identify the first four as being "classic" research methodologies widely accepted in the research community, whereas the last three are more closely related to artistic practice than scientific research. In his assessment of scientific research, Archer (1995) acknowledges that science is primarily concerned with producing valid explanations that still stand when tested in wider fields of application. The subject matter may range from anthropology to astrophysics, but what matters is that the research is conducted "scientifically". Francis Bacon's approach in 1620 laid out three ground rules for this process: empiricism, objectivity, and inductive reasoning. This means that the evidence must come from the physical world, be free of the observer's value judgment, and should eventually result in the creation of formulas or general laws—for example, Newton's laws of physics. Over three centuries later, Karl Popper, the mathematician and philosopher, disputes Bacon's rules, arguing that there is a "logical asymmetry between verification and falsification". He gives an example about how repeated observations of white swans may lead us to generalize that "all swans are white", but a single observation of a black swan instantly disproves the universality of the white swan theory. Therefore, he insists that the true aim of scientific enquiry should first be a systematic attempt to refute theories and propositions rather than verify them, as they are mostly unprovable. As Archer (1995, p. 7) summarizes, scientific researchers today need to be "liberal about the sources of conjecture and hypothesis" when they begin their research, and then be "skeptical in the handling of research data and argument", and finally "astringent in testing findings and explanations" upon completion of their research. This kind of procedure is resulted in the concepts of quantum science, relativity, and chaos, which arose in the twentieth century (Gray & Malins, 1993).

Unlike science, which is largely concerned with the physical world, the humanities often refer to metaphysics (such as theology, philosophy, and ethics) and the arts (such as literature, art, and music). Noting the subjective nature of the arts, Archer (1995) outlines the value of the art research as "expression in appropriate media; creative reflection on human experience; the qualitative interpretation of meaning in human expression; judgements of worth; the exploration of truth values in text; the categorisation of ideas, people, things and events; and the tracing of, and commentary upon, the provenance of ideas, people, things and events" (p. 8). Some of the common qualitative methodologies used by social science researchers that are also appropriate for art and design researchers are phenomenological, hermeneutic, axiological, ethnographic, holistic, naturalistic, descriptive, experiential, and dialectical strategies (Gray & Malins, 1993).

The Alternative Research Methods

An emergent trend in design research draws from visual anthropology and sociology methods by which the researcher creates visual representations to study society, examines current images that provide information about society, and then collaborates "with social actors in the production of visual representations" through stills or film cameras (Banks, 1995).

Jonas and Chow (2008) propagate the use of an integrated knowledge and communication platform for Research Through Design, which led to the development of MAPS (Matching Analysis Projection Synthesis), an instrument that supports both scientific and designerly methods. It is designed to help researchers create a suitable interface combining appropriate practice-led design, innovation, and research processes through the generic process of analysis, projection, and synthesis, geared towards producing artefacts and new knowledge as research outcomes.

This is similar to the pick-and-mix concept of bricolage (Yee, 2010), which requires a greater awareness and understanding of different kinds of research methodologies. The concept of bricolage,

which was coined by Levi-Strauss (1966), is described by Yee and Bremner (2011) as "making-do" and "a bricoleur (someone who employs the bricolage method) is described as a resourceful and creative 'fiddler or tinkerer', and one who out of necessity uses available materials to create new objects from existing ones" (p. 3). Bateson uses the analogy of a pair of binoculars to explain the concept, likening it to looking at the same thing through different lenses, giving the subject a wider range of perspectives.

However, there is another group (Jones, 1980; Lawson, 1990) that feels strongly against borrowing existing research methodology from the sciences and humanities. As Cross (1999) puts it, "we do not have to turn design into an imitation of science, nor do we have to treat design as a mysterious ineffable art" (p. 7). Gray and Malins (1993) have identified distinct research procedures used in the design field that are just as rigorous—invention, selection, synthesis, analysis, development, refinement, and resolution. They observe that most design methods are based on a structure that broadly covers "collection of data (visual, written, oral), selection, analysis & synthesis, testing against known visual and performance norms, human reactions and responses, and compromise with regard to context, function, ergonomics, manufacturing & material constraints" and still leaves scope for "human intuition, emotion and invention" (p. 8).

Summary of Approaches to Design Research

Recent studies outlined by Saikaly (2003, 2004) suggest that there are three approaches to design research at the master and doctoral levels:

I.   The sciences and humanities approaches, which are "the systematic and methodical approaches to research". This can be described as academic research with a planned procedure and is commonly used in social sciences, the arts, and humanities research. It comes in the format of a formal research procedure: identification of a problem area or topic; a review of literature; a detailed plan of research design; a process of collection and analysis of data, reports, and discussion of the findings; identification of limitations; and proposal of future research direction.

II. The practice-centred approach, in which the development of design projects are considered a form of research. The approach is not well received, as no researcher has demonstrated that any of the current forms of design practice process is rigorous enough to be considered a research process.

III. The practice-based approach, in which the development of design projects is not the objective of the research but a means to knowledge. This approach is comparable to action research and it employs discovery through action (design practice) to seek new knowledge.

Various studies consider the first approach of sciences and humanities inappropriate for conducting design research, largely because it appears alien to many designers and artists (James, 2003) and lacks design practice components such as the making process and the creative output (Franz, 2000; Saikaly, 2003, 2004; Siu, 2007; Yee, 2007, 2009, 2010).

The third approach, the practice-based approach, is the most commonly used in art and design research (e.g., Findeli, 2001; Franz, 2000; Glanville & van Schaik, 2003; Marshall & Newton, 2000; Sevaldson, 2000; Sheth, 2000; Yammiyavar, 2000). This is mainly because this approach uses design practice to discover and seek new understanding and the "research processes are iterative, reflective, interpretive and dialectical" (Saikaly, 2004, p. 9).

However, Strand (1998) reported that design research is not considered genuine research activity because it lacks "original and systematic investigation" and is not "verifiable publicly through publication and peer review" (p. 7). And so in order for design research to gain recognition from the academic body, the focus should not be on what type of research method is more suitable for the domain of design research, but rather on knowing how to conduct formal research procedures (the "how" of design research) so that "original" ideas can be derived from the research process and subsequently used to produce the creative output.

The Nature of the Problem in Undergraduate Studies

Presently, undergraduate courses in visual communication are project focused and students are not necessarily taught research methodologies. Khoury and Khoury (2009) attribute the reasons for the lack of knowledge and skills in research methods to the following situations:

a. Even though undergraduate students are currently being taught numerous artistic and technical skills, there is a lack of emphasis in teaching visual communication students how to conduct research, analyse data, interpret results, and write reports.

b. Although undergraduate studies are the core of visual communication training, "undergraduate programs commonly have very little or no written research requirements. Courses are typically project oriented and students are not necessarily taught independent learning" (p. 840).

c. Since many design faculty members graduate from Master's programs with no criteria for writing and there is a limited number of PhD programs in design, it seems inevitable that a weakness in undergraduate design writing would arise from a related shortfall amongst design faculty.

These observations were supported by various studies that illustrate the lack of knowledge and skills in research methods in the form of:

A. Lack of proper research infrastructure in visual communication education (Hockey, 2007; Newbury, 1996b; Siu, 2007).

   i. Recent studies outlined by Hockey (2007) suggest that "academic research in art and design can only really develop if there is adequate infrastructure to support this move. Part of the output of such an infrastructure needs to be the development of events or processes that expose students to the aforementioned features during their educational experiences prior to doctoral study. This could be done either directly (research methods courses), or via seminars on the institutional and intellectual realities of practice-based PhD research" (p. 169).

   ii. Newbury (1996b) based on Allison (1994) states that, in order for art and design to "achieve parity of status with the more traditional academic disciplines, academics within the field of art and design (should) create an environment appropriate to the development of research" (p. 215).

  iii. Siu (2007) concludes that one of the key inspirations and experiences of reforms in research programs is that universities can "provide different types of support to research" (p. 25).

B. Lack of appropriate models of practice in research and education in visual communication (Mimoso, 2011; Newbury, 1996b; Strouse & Arnold, 2009).

   i. Mimoso (2011) found that "many students did not have skills in information retrieval and management, the lack of which can frustrate the development of a research project" (p. 5).

   ii. Newbury (1996b) contends that "a more systematic and rigorous approach [is needed] to understanding and referring to previously completed research, and to communicating research findings to the field" (p. 216).

  iii. Strouse and Arnold (2009) based on Tornello (2003) report that "the majority of design programs in the United States expect students to experiment and innovate their own methods and approaches without equipping those students with fundamental knowledge about research" (p. 1135).

Many researchers have also noted the importance of teaching research methodology to undergraduate students. Coumans (2011), Hockey and Allen-Collinson (2000), and Strouse and Arnold (2009) agree that, to contribute to the design process as well as to produce a more robust design practice, it is essential that students are well aware of the origins of the methodologies being used as well as the

kind of data that can be obtained and how it applies to their study. Heller (1998) reinforces the importance of teaching research methods by stating the possibility of negative effects on the lack of knowledge and skills in research methods:

a. Students who focus on the acquisition of technical skills tend to adopt a surface approach to learning, rather than lifelong self-initiated learning.

b. Students who regard education as a passive process may be discouraged from further growth in a challenging graduate study.

CONCLUSION

The review of research methods in art and design education identified three aspects:

1. Knowledge and skills in research can be viewed as a key intangible asset for design practice (Glanville & van Schaik, 2003; Schön, 1983, 1987; Yee, 2007).

2. Design research i) has to be systematic as it is carried out in a methodical and organized manner; ii) should be rigorous as it is carried out in a domain that requires the application of precise and exacting standards, and iii) is an enquiry as it is to determine facts or to seek answers to questions (Coumans, 2011; Cross 1984; Hockey & Allen-Collinson, 2000; Strouse & Arnold, 2009).

3. Design education is filled with many alternative research methods because several researchers found it necessary to propose their "own" approaches while doing design research. This led to considerable confusion in design research (Camino, 2010) since "the research tradition in this field is very young" (Sevaldson, 2000, p. 163).

Based on the above, this article concludes that the training of knowledge and skills for research at undergraduate level should start from the basic – how to conduct research in a step-by-step manner with precision and rigour. Students should not be overwhelmed with different research approaches, either traditional or alternative methods. Papastergiardis has also stated, "the main problem with developing a research culture in an art school is not to do with the angst of creativity, but with the structure of research" (2002, p. 9). Therefore, further research could to be done to empirically test on the main steps of research in art and design research, such as identifying research topics and research questions, selecting relevant contexts and subjects, collecting relevant data, analysing and interpreting data and discussing and presenting findings. This would be best achieved by qualitative studies, such as phenomenographic approach to product in-depth empirical findings about the varied ways in which research is conceived by art and design students.

REFERENCES

Allison, B. (1992). *Allison research index of art & design*. Leicester: Leicester Expertise.

Archer, B. (1995). The nature of research. *Co-design: Interdisciplinary Journal of Design*, 6–13.

Asimov, I. (1985). Our Future in the Cosmos-Computers. In J. Burke, J. Bergman, & I. Asimov (Eds.), *The impact of science on society* (pp. 59 – 75). Retrieved from http://history.nasa.gov/sp482.pdf

Banks, M. (1995). Visual research methods. *Social Research Update, 11.* Retrieved from http://sru.soc.surrey.ac.uk/SRU11/ SRU11.html

Bennett, A. (2006). *Design studies: Theory and research in graphic design*. New York: Princeton Architectural Press.

Camino, M. (2010). An examination of the journal used as a vehicle to bring about a synthesis between theory and practice in art and design higher education. *Journal of Writing in Creative Practice, 3*(3), 317–340.

Carr, W. and Kemmis, S. (1986). *Becoming critical: Education, knowledge and action research*. London: Falmer Press.

Charles, L. and Ward, N. (2007). *Generating change through research: Action research and its implications*. Retrieved from http://www.ncl.ac.uk/cre/publish/discussionpapers/pdfs/ dp10. pdf

Checkland, P.B. (1991). From framework through experience to learning: The essential nature of action research. In H. E. Nissen, H. K. Klein, & R. Hirschheim (Eds.), *Information Systems Research: Contemporary Approaches and Emergent Traditions* (pp. 397–403). Amsterdam: Elsevier.

Cross, N. (1984). *Developments in design methodology*. Chichester, NY: John Wiley & Sons.

Cross, N. (1999). Design research: A disciplined conversation. *Design Issues, 15*(2), 5–10.

Cross, et al. (1992) *Research in design thinking*. The Netherlands: Delft University Press.

Coumans, A. (2011). Muscular design. *PreDesign Forum*. Retrieved from http://www.predesignforum .net/view.php/ page/musculardesign

Durling, D. (2002). Discourses on research and the PhD in Design. *Quality Assurance in Education, 10*(2), 79–85.

Findeli, A. (2008). Searching for design research questions: Some conceptual clarifications. In *Questions & Hypotheses* (pp. 286-302). Berlin: DRN Learning Conference.

Findeli, A., Brouillet, D., Martin, S., Moineau, C. and Tarrago, C. (2008, May). *Research through design and transdisciplinarity: A tentaive contribution to the methodology of design research*. Presented at the Swiss Design Network Symposium, Berne, Switzerland.

Franz, J. (2000). An interpretative-contextual framework for research inand through design. In *Proceedings Doctoral Education in Design*: *Foundations for the Future*. La Clusaz, France: OUTePrints. Retrieved from http://eprints.qut.edu.au/ 7804/1/7804.pdf

Friedman, K. (2003). Theory construction in design research: Criteria, approaches, and methods. *Design Studies, 24,* 507–522.

Glanville, R. (2003). An irregular dodekahedron and a lemon yellow Citroen. In L. van Schaik (Ed.), *The Practice of Practice* (pp. 258–265), Melbourne: RMIT Press.

Glanville, R. and van Schaik, L. (2003). Designing reflections: Reflections on design. In *Proceedings of the 3rd Doctoral Education in Design Conference* (pp. 35–42), Tsukuba, Japan: University of Tsukuba.

Gray, C. and Malins, J. (1993). Research procedures/methodology for artists & designers. In *Principles and Definitions: Five Papers by the European Postgraduate Art & Design Group*. Winchester: Winchester School of Art & Design.

Hart, C. (1998). *Doing a literature review: Releasing the social science research*. London: SAGE.

Haron, H. (2005). Conceptualization of tacit knowledge dimension. In *Proceedings of the Postgraduate Annual Research Seminar* (pp.12–17). Johor Bahru: Universiti Teknologi Malaysia.

Heller, S. (1998). *The education of a graphic designer*. New York: Allworth Press.

Hockey, J. and Allen-Collinson, J. (2000). The supervision of practice-based research degrees in art and design. *Journal of Art & Design Education, 19*(3), 345–355.

Hockey, J. (2007). United Kingdom art and design practice-based PhDs: Evidence from students and their supervisors. *Studies in Art Education, 48*(2), 155–171.

James, D.D. (2003). A working model for postgraduate practice based research across the creative arts. In *The Third Doctoral Education in Design Conference (DED3) proceedings* (pp.15–24). Tsukuba, Japan: University of Tsukuba.

Jones, J.C. (1980). *Design methods*. NY: John Wiley & Sons.

Jonas, W. and Chow, R. (2008). *Far Beyond Dualisms in Methodology – an Integrative Design Research Methodology Medium*. Paper presented at DRS conference Undisciplined!, UK, Sheffield.

Kennedy, M. (1997). Connection between research and practice. *Educational Researcher, 26*(7), 4–12.

Khoury, M. P. and Khoury, T. E. (2009). Writing & research for graphic design within undergraduate studies. In *International Association of Societies of Design Research: Proceedings of the 3rd IASDR World Conference on Design Research* (pp. 839–846). Seoul: Society of Design Science.

Lawson, B. R. (1990). *How designers think*. London: Butterworth Architecture.

Lee et al. On the concept and types of knowledge. *Journal of Information and Knowledge Management*, 5(2), 151-163.

Lévi-Strauss, C. (1966). *The savage mind.* Chicago: University of Chicago Press.

Lewin, K. (1946). Action research and minority problems. *Journal of Social Issues, 2*(4), 34–46.

Loughran, J. J. (2002). Effective reflective practice: In search of meaning in learning about teaching. *Journal of Teacher Education, 53*(1), 33–43.

Marshall, T., & Newton, S. (2000) Scholarly design as a paradigm for practice-based research. In *Working Papers in Art and Design, 1*. Retrieved from http://sitem.herts.ac.uk/artdes_research/ papers/ wpades/vol1/ marshall2.html

McNiff, S. (2007). Art-based research. In J. G. Knowles & A. L. Cole (Eds.), *Handbook of the Arts in Qualitative Research: Perspectives, Methodologies, Examples, and Issues* (pp. 29–40). Thousand Oaks, California: Sage Publications Inc.

Mimoso, C. (2011). The Research Training in Art and Design. In *Conference Proceedings of Doctoral Education in Design Conference*. Hong Kong: Hong Kong Polytechnic University.

Mottram, J. (2007). Marks in Space. In M. Frascari, J. Hale & B. Starkey (Eds), *From Models to Drawings: on representations in architecture London* (pp. 193–200). Routledge/Taylor and Francis.

Newbury, D. (1995). A journey in research, from research assistant to Doctor of Philosophy. *Journal of Graduate Education, 2,* 53–59.

Newbury, D. (1996a). *The Research Training Needs of Postgraduates in Art and Design: A Practical Response*. Paper presented at International Conference on Art and Design Research, No Guru, No Method?, Finland, Helsinki.

Newbury, D. (1996b). Knowledge and Research in Art and Design. *Design Studies*, 17(2), 215–19.

Nickols, F. W. (2000). The knowledge in knowledge management. In J. W. Cortada and J. A. Woods (Eds.), *The Knowledge Management Yearbook 2000–2001* (pp.12–21). Boston, MA: Butterworth-Heinemann.

Papastergiardis, N. (2002). Melancholy moments and the art of research. *Campus Review.*

Polanyi, M. (1997). Tacit knowledge. In L. Prusak (Ed.), *Knowledge in Organizations*. Butterworth-Heinemann: Boston.

Saikaly, F. (2003). *Design re-thinking: Some issues about doctoral programmes in design.* Paper presented at the Techné: Design Wisdom: 5th European Academy of Design Conference, Barcelona.

Saikaly, F. (2004). Approaches to design research: Towards the designerly way. In *Design Research Society International Conference 2004 – FUTUREGROUND,* Australia: Monash University

Schön, D. A. (1983). *The reflective practitioner*. London: Temple Smith.

Schön, D. A. (1987). *Educating the reflective practitioner: Toward a new design for teaching and learning in the professions*. Jossey-Bass Higher Education Series. San Francisco; London: Jossey-Bass.

Schön, D. (1992). Designing as reflective conversation with materials of a design situation. *Research in Engineering Design, 3,* 131–147.

Sevaldson, B. (2000). The integrated conglomerate approach: a suggestion for a generic model of design research. In *Doctoral Education in Design Conference, La Clusaz, DRS* (pp.163–170). Tsukuba: University of Tsukuba.

Sheth, S. (2000). Refocusing praxis: The problem for design research. In S. Pizzocaro, A. Arruda, & D. De Moraes (Eds.), *Design plus Research, Milano, 18–12 May 2000* (pp. 366–369). Milano, Italy: the Ph.D. programme in industrial design, Politecnico di Milano.

Siu, K. W. M. (2007). Balance in Research and Practice: the Reform of Research Studies in Industrial and Product Design. *Global Journal of Engineering Education, 11*(1), 15–28.

Strand, D. (1998). *Research in the creative arts*. Canberra: DETYA.

Strouse, R. and Arnold, J. (2009). Design research in undergraduate design education: Relevance and implementation. In *International Association of Societies of Design Research: Proceedings of the 3rd IASDR World Conference on Design Research* (pp. 1134–1144). Seoul, Korea.

Swann, C. (2002). Action research and the practice of design. *Design Issues,18*(2), 49–61.

Tornello, M. (2003). Practice and education: Benchmarking user-centered research in industrial design. *Unpublished Design Research*, ASU, Tempe, AZ.

van Schaik, L. (2000). Interstitial modernism—"Second order" or meta modernism at RMIT. In L. van Schaik (Ed.), *Interstitial Modernism,* Melbourne: RMIT Press.

van Schaik, L. (2003). The practice of practice: Practice based research in architecture. In L. van Schaik (Ed.), *The Practice of Practice.* Melbourne: RMIT Press.

Yammiyavar, P. (2000). Is industrial design research really different from other research? In S. Pizzocaro, A. Arruda, & D. De Moraes (Eds.), *Design plus Research, Milano, 18-12 May 2000* (pp. 251–257). Milano, Italy: the Ph.D. Programme in Industrial Design, Politecnico di Milano.

Yee, J. (2007). Connecting practice to research (and back to practice): Making the leap from design practice to design research. *Journal of Design Principles and Practices, 1*(1), 81–90.

Yee, J. (2009, June). *Capturing tacit knowledge: Documenting and understanding recent methodological innovation used in design doctorates in order to inform postgraduate training provision*. Presented in Experiential Knowledge Conference, UK, London

Yee, J.S.R. (2010). Methodological innovation in practice-based design doctorates. *Journal of Research Practice, 6*(2), Article M15. Retrieved from http://jrp.icaap.org/index.php/jrp/ article/ view/196/193

Yee, J. S. R. and Bremner, C. (2011). *Methodological bricolage—What does it tell us about design?* Presented in Doctoral Education in Design Conference, China, Hong Kong.