Symposium Proceedings

Researching Design Education

1st International Symposium
for Design Education Researchers
CUMULUS Association//DRS
SIG on Design Pedagogy
Paris, France May 18–19, 2011

Editors
Erik Bohemia
Brigitte Borja de Mozota
Luisa Collina

CUMULUS // DRS

Cover design by Samantha Schulman
Communication Design from Parsons Paris School of Art + Design

Logo design by Tanya Benet
Communication Design from Parsons Paris School of Art + Design

ISBN 978-952-60-0042-8 (print)
ISBN 978-952-60-0043-5 (electronic)

Published by CUMULUS ASSOCIATION and DRS

Cumulus the International Association of Universities and Colleges of Art, Design and Media

Cumulus Secretariat
Aalto University School of Art and Design
PL 31000, 00076 Aalto, Finland
Secretary General Eija Salmi
Tel: +358 9470 30534
e-mail: eija.salmi@aalto.fi
www.cumulusassociation.org

Design Research Society

DRS Secretariat
email: admin@designresearchsociety.org
www.designresearchsociety.org

Researching Design Education

1st International Symposium for Design Education Researchers
CUMULUS ASSOCIATION// DRS SIG on Design Pedagogy
Paris, France 18–19 May 2011

Organized with the support of Paris Chamber of Commerce and Industry

Patrons of the Symposium
Christian Guellerin, CUMULUS, L'École de Design Nantes Atlantique
Michael Tovey, DRS, Coventry University

Symposium Convenors
Erik Bohemia, DRS, Northumbria University
Brigitte Borja de Mozota, CUMULUS, Ecole Parsons à Paris
Luisa Collina, CUMULUS, Politecnico di Milano

Symposium Organising Committee
Christian Guellerin, CUMULUS, L'École de Design Nantes Atlantique
Eija Salmi, CUMULUS, Aalto University
Brigitte Borja de Mozota, CUMULUS, Ecole Parsons à Paris
Justyna Maciak, CUMULUS, Aalto University
Erik Bohemia, DRS, Northumbria University
Michael Tovey, DRS, Coventry University
Sibylle Klose, CUMULUS, Ecole Parsons à Paris
Luisa Collina, CUMULUS, Politecnico di Milano
Geneviève Sengissen, CUMULUS, L'École de Design Nantes Atlantique

International Scientific Review Committee

Bernadette Blair, Kingston University, UK
Erik Bohemia, Northumbria University, UK
Brigitte Borja de Mozota, Ecole Parsons à Paris, France
Carole Bouchard, Ecole Nationale Supérieure d'Arts et Métiers, France
Luisa Collina, Milano Polytechnic, Italy
Frédérique Cuisinier, Université Paris Ouest Nanterre La Défense, France
Bernard Darras Sorbonne University France
Gaurang Desai, American University of Sharjah, UAE
Hua Dong, Tongji University and Brunel University, China/UK
Simon Downs, Loughborough University, UK
Linda Drew, DRS, UK
Mark Evans, Loughborough University, UK
Alain Findeli, Université de Nimes, France
Aysar Ghassan, Northumbria University, UK
Carolina Gill, The Ohio State University, USA
Lance Green, The University of New South Wales, Australia
Hilary Grierson, University of Strathclyde, UK
Armand Hatchuel, Mines Paristech, France
Elvin Karana, Delft University of Technology, The Netherlands
KwanMyung Kim, Ulsan National Institute of Science and Technology, Korea
Sibylle Klose, Ecole Parsons à Paris, France
Peter Lloyd, The Open University, UK
Abby Mellick Lopes, University of Western Sydney, Australia
Gavin Melles, Swinburne, University of Technology, Australia
Priscilla Nainby, Edinburgh Napier University, UK
Katrina Nordstorm, Aalto university, Finland
Eddie Norman, Loughborough University, UK
Jane Osmond, Coventry University, UK
Alice Peinado, Ecole Parsons à Paris, France
Irini Pitsaki, Northumbria University, UK
Olivia Sagan, University College London, UK
Andrea Semprini, Université Lumière Lyon 2, France
Alison Shreeve, Buckinghamshire New University, UK
Kay Stables, Goldsmiths, University of London, UK
Mike Tovey, Coventry University, UK
Johann van der Merwe, Cape Peninsula University of Technology, South Africa

Table of Contents

Foreword

The 1st International Symposium for Design Education Researchers took place in Paris, France on 18–19 May 2011. The Symposium was held under the auspices of the CUMULUS, the International Association of Universities and Colleges of Art, Design and Media and the Design Research Society's Design Pedagogy Special Interest Group. The event was hosted by the Paris Chamber of Commerce and Industry. We would like to thank to Paris Chamber of Commerce and Industry proving their magnificent building to host this important event.

One of the aims of the symposium was to develop and to establish relationships between CUMULUS and DRS Design Pedagogy Special Interest Group. The idea was to bring members from these two societies and strengthen the capacity to enhance the quality of design education through examining how innovation in education is informed by and is informing design research.

In order to do this the symposium convenors invited a diverse mix of speakers to explore the symposium's theme. Initially, the invited speakers submitted brief proposals. Then they submitted full papers which were critically double blind reviewed by members of the International Scientific Review Committee. The revised submitted papers form these symposium proceedings.

The authors of these articles come from different disciplinary backgrounds and different countries, including the Netherlands, the UK, France, Switzerland, Finland, and Italy. The outcome is a symposium that tackles diverse design education issues from a variety of perspectives, both disciplinary and institutional.

CUMULUS Association and DRS Design Pedagogy Special Interest Group coming together signals the increased importance of re-examining design education in these changing times. There are further plans for these two associations to work together. For example, CUMULUS Association and DRS Design Pedagogy Special Interest Group are planning to organise a joint international conference in 2013. The more immediate plan is to produce a Special Issue of 'Collection', a research journal on the theme of 'Informing Design Education by Research' from selected papers presented at the symposium. Another set of papers will be selected for an edited book on the theme of 'Researching Design Education'.

We would like to thank to number of people and organisations who have been helpful in organising the symposium and preparing this set of proceedings. These include Christian Guellerin President of Cumulus and Michael Tovey the conveyor of DRS PedSIG; Jacques Leroux from the Paris Chamber of Commerce and Industry and his colleagues and team who kindly

provided the venue and made the symposium delegates welcome; the team from CUMULUS Association Eija Salmi and Justyna Maciak based at Aalto University, Geneviève Sengissen and Pascale Labé and their team based at L'École de Design Nantes Atlantique who provided the logistics; Anne Schoonbrodt and Alessandro Biamonti for organising the poster session; Deborah Wickham from L'École Parsons à Paris who encourage her students to produce artwork proposals for this proceedings, Samantha Schulman and Tanya Benet whose design proposals were adopted and every member of the International Scientific Review Committee who provided their time and expertise during the review process.

This was a truly international team effort by symposium committee whose members from DRS and CUMULUS Association were dispersed across European universities. These included Aalto University, L'École de Design Nantes Atlantique, Coventry University, L'École Parsons à Paris; Northumbria University and Politecnico di Milano.

Symposium Convenors on behalf of the Organising Committee

Erik Bohemia

Brigitte Borja de Mozota

Luisa Collina

CUMULUS // DRS SIG on Design Pedagogy
1st International Symposium for Design Education Researchers
Paris Chamber of Commerce and Industry, Paris, France 18–19 May 2011

Michael Tovey (2011). *Researching Design Education.* 1-8

Researching Design Education

Michael TOVEY*

Coventry University

A fundamental question for design academics is to what end they undertake their research. Design practice does not depend on it. However design education can be linked in very closely to design research. Key questions are whether there are there sufficient links between design research and design teaching, and whether or not they should be closer. Examples from Coventry University are used to demonstrate the potential utility of research in design pedagogy for informing curriculum design and for providing the framework for investment in teaching facilities. The creation of the DRS Special Interest Group in Design Pedagogy is signalled as a vehicle for clarifying the role of design research in providing the theoretical underpinning for design education.

Design Research, Design Pedagogy, Special Interest Group.

Introduction

This paper was developed as the opening address for Researching Design Education, the 1st International Symposium for Design Education Researchers. The event was organized by CUMULUS and the DRS. CUMULUS is the International Association of Universities and Colleges of Art, Design and Media. It is a non-profit organization consisting of 165 universities and colleges of art, design and media from 43 countries. Cumulus was founded in 1990 and since then has been acting as an umbrella for many purposes and numerous projects for education and research of art, design and media. The Design Research Society is a multi-disciplinary learned society for the design research community worldwide. The DRS was founded in 1966 and facilitates an international design research network in around 40 countries.

* *Corresponding author:* School of Art and Design | Coventry University
Priory Street | Coventry CV1 5FB | UK
e-mail: adx907@coventry.ac.uk

Aim of the Symposium

The overarching aim of the symposium was to explore how innovation in education is informed by and is informing design research. The symposium focused on design education, innovation in general education through design, and on innovation in business and engineering education through design integration. There was a particular emphasis on developing research in the area of Design Pedagogy.

Key Questions

Are there any links between design research and design teaching? If not should there be? If there are, should they be close links? Does design research support design teaching?

Why undertake design research? Well, if there is a close link with design teaching, particularly if design research supports design teaching, then that will provide good reasons for doing design research. Design is a well-established area of study, and there are design courses in a great many universities and colleges. So their existence has the potential for providing the reason for engaging in design research.

Design research is not the same as research in some other disciplines. In a fundamental science such as physics if research stops then effectively the discipline comes to a halt. If there is no physics research then there is no physics. Design is not like that. If design research were to stop then design would continue, more or less regardless. Designers would continue designing things, and probably the world would notice no difference. It would seem that design research is not central to design practice.

Now much design practice includes a stage which is labelled as 'research'. It usually consists of the process of information gathering to provide the starting point for designing, to inform the evaluative framework, and the context for the design. These are crucial parts of the process and essential to its success. However this is not what is meant by design research.

Design research is an activity which is directed to exploring and understanding the nature of design, its processes and methods. It has loftier academic aspirations than the data gathering part of the design process. It is usually undertaken by academics, and it is expected to conform to conventional standards of academic scholarship and rigour.

In the UK there has been a long tradition of recruiting designers from design practice, to teach in its universities and colleges. However the stronger tendency now is to regard the possession of conventional academic qualifications as a necessary pre-requisite for holding a full time academic position. Good practical experience is desirable but a PhD is essential. In the context of the design discipline the clear implication is that to create a body of work for a PhD in design then you must undertake design research.

Design research is clearly necessary for the academic respectability of the discipline. However it is not necessary for the actual activity of designing. As has been noted if design researchers stopped doing design research, then design practice would continue, regardless. There is the basis here for a dangerous split in which what can be seen is the practitioners regarding the design researchers, the design theorists if you like, as irrelevant, and unnecessary. And indeed there is much anecdotal experience this is exactly how practicing designers do regard design researchers.

So does design research just exist for its own sake? Is it merely there to comfort academics, as they shelter in an academic ghetto, shielded from the real world of design practice?

Examples from Coventry

In Coventry University design is its oldest discipline. It began in the 19th century and it was brought into being in order to educate people to be designers. In other words its purpose was to produce a supply of design practitioners. The design education that the university offers today has that same intention.

It can also claim that it does it well. In 2005 the funding body for England's universities, HEFCE (The Higher Education Funding Council for England), announced that a number of universities were to receive special grants and 'centre of excellence' status for their teaching in specified areas. This was the Centres of Excellence in Teaching and Learning (CETLs) initiative, and Coventry secured it for Transport and Product Design.

The Centre of Excellence for Product and Automotive Design (CEPAD) is one of Coventry University's three HEFCE-funded centres for teaching and learning. It has implemented a five-year plan to reinforce existing teaching excellence within the Industrial Design Department of Coventry School of Art and Design (CSAD) and reflect upon its practices to inform future design education. The project pursued a number of themes such as the exploration of design education in the context of the design community of practice; the internationalisation of design education, threshold concepts in design education and the exploration of visual and spatial creativity through digital technologies.

One of the initial assumptions for the centre was that it needed to import approaches and theories from outside design to achieve its ends and to invigorate the design education which the university was offering. Of course there is a lot of sense in doing this as such an approach has the potential for yielding innovative and more effective teaching and learning. And a number of such imports were attempted. The team found that the notions of Communities of Practice developed by Lave and Wenger (Wenger 2007, Tovey and Owen, 2006) were particularly useful. Similarly they were able to make highly effective use of theories of troublesome knowledge and

threshold concepts developed by Meyer and Land (Meyer and Land, 2003). Other external imports were less helpful. What they did find however was that it was only when they drew this together through areas of design theory, such as Cross's work on the Designerly Way of Knowing (Cross, 2006) and Tovey's on the Dual Processing model (Tovey 1984), that they were able to synthesise their findings and to make sense of them.

The 'toleration of design uncertainty' is the key threshold which design students need to cross in order to balance their creative and evaluative processes. Using it as the common thread, the CEPAD team have demonstrated the linkages between separate research strands to formulate a coherent pedagogic framework for product and automotive design. They have concluded that the approach to designing through problem scoping and visual solutioning is shared across international boundaries, notwithstanding differences in detail. This capability appears to be a key ingredient in gaining access to the community of international design practice (Osmond et al 2010, Tovey et al 2010).

The most significant change process which this has stimulated has been the radical re-design of the undergraduate design programme, which has been implemented and will impact on 500+ students annually.

This is one of two approaches to design and engineering pedagogy which have been developed at Coventry University. The Design Approach is being applied in the Industrial Design Department and the other is Activity-Led Learning which is being applied across Faculty of Engineering and Computing. They have much in common, including the emphasis on communities of learners and the preparation for entry to professional practice through contact with real life projects.

The Design Approach involves an emphasis on project based activity. At the core of being able to engage in designerly thinking, balancing creative and evaluative thinking is a dual processing match of linear and simultaneous processes as a conversation between these two modes of thought. Design students achieving this match must confront and travel through a key threshold which has been labelled the 'toleration of design uncertainty'.

Activity-Led Learning is an approach to education based on providing stimulating activity that engages and enthuses students and creates challenge, relevance, integration, professional awareness and variety. An activity is a project, problem, scenario, case-study, enquiry, research question (or similar) in a class-room, in a laboratory, at work, or in any other educational context. Activities will often cross subject boundaries, as activities within professional practice do. Many involve design project work, particularly those for the Faculty's Architecture course. In this area there are significant similarities to the Design Approach.

In the large and multi-disciplinary Faculty of Engineering and Computing at Coventry University many of the courses within its departments have their

origins in sandwich courses delivered in the 1960s when the institution was founded. This contact and involvement with industry gave input into the course content and formation with the sandwich period providing the opportunity for the student to apply their knowledge to 'real situations' and obtain experience of working in the industrial environment.

However both in Coventry and across the sector the sandwich element has declined over the years and there have developed strong opinions that graduates, certainly in engineering, were no longer 'fit for purpose' (Royal Academy of Engineering, 2007). A conclusion drawn from both the industrial and educational inputs was that more experience in applying theoretical understanding to real problems was needed. Clearly the education of graduates requires closer links with industry to provide and help deliver the real problems referred to and, by implication, students who are highly motivated and engaged better with their courses (White et al 2009).

These issues have been addressed across the sector in the UK and other countries most notably in the USA, Australia and Denmark. Pedagogies adopted have included Problem-Based Learning [student led acquisition of knowledge] and Project-Based Learning [staff led application of knowledge].

In Coventry the Faculty wishes to develop and enhance the student learning experience to promote student retention, engagement, and achievement. Underpinning this ambition to enhance the student learning experience is the recognition that learning is more likely to be effective when students are active participants in the learning process (Wilson-Medhurst 2008). That is, the learning experience is more likely to have significant positive gains for the learner if they are active rather than passive recipients within it (McCowan and Knapper 2002).

> *Learning in a passive system has a much greater tendency to be both superficial and quickly forgotten. Active involvement in learning helps the student to develop the skills of self learning while at the same time contributing to a deeper, longer lasting knowledge of the theoretical material.....[and] ...it is almost the only effective way to develop professional skills and to realise the integration of material from different sources.*

Thus the faculty's ambition to improve the learner experience is underpinned by a learning and teaching vision to build a community of learners, through employer and profession focused activity-led education. A significant motivation for defining and refreshing the Faculty's learning and teaching strategy is that in 2012 the Faculty will move into a new £50 million building. The design of the building has been heavily influenced by the desire to create learning spaces that support and promote the strategy.

Basing a major investment strategy on pedagogic research is a clear indication of its value and importance. Activity Led Learning is an approach derived from the teaching and learning of design project work. In a sense it is a version of design pedagogy.

With this background a number of design staff at Coventry University formed the view that design pedagogy research was a very important strand of design research. Of the many reasons for engaging in design research, the provision of a basis for pedagogic development has strong practical utility. It can be argued that wherever there are decisions being made over investment in new teaching facilities for design, it is essential that there be a proper basis in design research for design pedagogy.

DRS Special Interest Group in Design Pedagogy

Such a view is not heretical within the design research community. When an approach to the Design Research Society was made with a view to setting up a Special Interest Group in Design Pedagogy, the proposers found they were pushing at an open door. The Council of the Society approved its being set up and it has successfully got off the ground.

Special Interest Groups provide a forum for specific areas of research which are of interest to the Design Research Community and its members. SIGs organise events and discussion in a number of ways to facilitate the exchange and development of best practice in the field. Each SIG is organised by a convenor who is supported by an organising group and the SIG members. DRS members are invited to join any Special Interest Group to contribute actively to research in the subject area of their chosen group. There are currently 4 Special Interest Groups:

Special Interest Group on Experiential Knowledge (EKSIG)

Special Interest Group on Health and Wellbeing (SIGWELL)

Design Pedagogy Special Interest Group (PedSIG)

Special Interest Group for Objects, Practices, Experiences, Networks (OPENSIG)

The SIG on design pedagogy aims to bring together design researchers, teachers and practitioners, and others responsible for the delivery of design education, to clarify and develop the role of design research in providing the theoretical underpinning for design education.

Known as PedSIG the group has held an inaugural one-day symposium event in 2009, a further developmental symposium later that year, and a research symposium in January 2011. Design Pedagogy was a clear and major emphasis strand in the DRS international symposium held in Montreal in 2010. The January symposium was intended to provide a bridge between the Montreal event and the CUMULUS/DRS Researching Design Education Symposium.

Conclusion: Why Researching Design Education is important.

Although it is possible to argue that design practice will continue whether or not design research is taking place, the same is not true for design education. Indeed it could be argued that the intellectual vitality of design education depends on there being a strong strand of design research. Overall it is possible to claim that there is considerable evidence that design research and related pedagogic research are essential in developing teaching and learning, in devising the design curriculum, and in determining the infrastructure needed for design teaching. The Coventry experience provides evidence of their practical utility in all of these areas. Design research has provided the basis for curriculum design, and design informed pedagogic research has been used to develop a faculty-wide approach and support a major investment strategy. The DRS Design Pedagogy Special Interest Group is bringing together other research which is directed to similar ends. Design research is not an irrelevant activity living in its own little ghetto, but rather it provides the basis for the academic core of design teaching and pedagogic innovation. By that means through the provision of the next generation of designers it links into design practice.

References

Tovey M. and Owen J. Entering the Community of Practice of Automotive Design, *Proceedings of the Sixth International Symposium on Tools and Methods of Competitive Engineering*. Delft : University of Technology; Ljubljana : University of Ljubljana, 2006.

Wenger E. *Communities of Practice learning, Meaning and Identity*, 2007 (Cambridge University Press).

Cross N. *Designerly Ways of Knowing*, 2006 (Springer-Verlag, London).

Tovey M. Designing with both halves of the brain, in *Design Studies,* 5(4), October 219-228, 1984.

Meyer J.H.F. and Land R. Threshold concepts and troublesome knowledge: linkages to ways of thinking and practising within the disciplines. In C.Rust (ed), *Improving Student Learning Theory and Practice-10 years on,* OCSLD, Oxford, 2003.

Osmond J., Bull K. and Tovey M. Threshold concepts and the transport and product design curriculum: reports of research in progress, in *Art, Design & Communication in Higher Education*, 2010, 8 (2).

Tovey M. and Bull, K. Visual Creativity and the Threshold of Uncertainty in Product and Automotive Design, *2010 Design Research Society (DRS) International Conference on Design & Complexity*, July 2010, Montreal.

Tovey M., Bull K., and Osmond J. (). Developing a Pedagogic Framework for Product and Automotive Design, *2010 Design Research Society (DRS) International Conference on Design & Complexity,* July 2010, Montreal.

Royal Academy of Engineering, *Educating Engineers for the 21st Century*, June 2007

White P., Dunn I., Farmer R. and Lawson D. Meeting the needs of Industry through Activity Led Learning. *2nd International Research Symposium on PBL*, Dec 2009, Victoria University, Melbourne, December 2009.

Wilson-Medhurst S. Towards Sustainable Activity Led Learning Innovations in Teaching, Learning and Assessment, *Proceedings of the International Conference on Innovation, Good Practice and Research in Engineering Education, EE2008*, July 2008.

McCowan J. and Knapper C., An integrated and comprehensive approach to engineering curricula, part one: objectives and general approach, *International Journal of Engineering Education*, 2002, 18 (6), 633-637

CUMULUS // DRS SIG on Design Pedagogy
1st International Symposium for Design Education Researchers
La Bourse du Commerce, Paris 18–19 May 2011

Ezio Manzini (2011). *Paper Design schools as agents of (sustainable) change: A Design Labs Network for an Open Design Program.* 9–16

Design schools as agents of (sustainable) change: A Design Labs Network for an Open Design Program

Ezio MANZINI*

DIS Politecnico di Milano – DESIS Network

To educate someone to be a designer involves increasing his/hers skills in conceiving and developing design proposals (from general visions to specific solutions) for a better world. The majority of these proposals, can be seen as didactic exercises that usually end-up in the teacher's archives and computer files. This generates an extensive amount of unused design work as well as a waste of students' and teachers' creativity, enthusiasm and expertise. In the past, this waste was, or was considered to be, inevitable. Today, in the transition towards sustainability, facing the present demand for visions and solutions (Manzini, 2009) and given the on-going changes in the design processes (Leadbeater, 2008), this waste can be avoided: design schools results and design student capabilities can become more socially effective and contribute to the solutions of the complex problems of contemporary society. How con it happen? To answer this question we must consider the emerging scenario where open source (Mulgan, Steinberg, Salem, 2005) and peer-to-peer approaches (Bauwens, 2007) make possible new organizational framework and design networks: open and collaborative design processes where design schools can play an important role (DESIS, 2011).
In the emerging scenario, therefore, design schools, with their tremendous potential of students' enthusiasm and teachers' experience, represent a social resource: a potentially powerful and useful player in the transition towards sustainability.

* *Corresponding author:* Industrial Design, Arts, Communication and Fashion
Politecnico di Milano | DESIS-Design for Social Innovation for Sustainability
Via Durando 38/A | 20158 Milano | Italy
e-mail: ezio.manzini@polimi.it

New scenario, new design

There is no doubt that today we are facing a deep (environmental, social, economic) crisis. At the same time, everybody agree that the diffusion of the networks and mobile technologies is opening new and until now unforeseeable possibilities. Finally, there is clearer and clearer evidence that these two mega-trends are converging and that, doing so, they are generating new ideas and behaviours, new economies and, most importantly for us here, new design and production processes.

As a matter of fact, what this *emerging scenario* presents is a radical discontinuity with the past century models (Manzini, 2010). Its exhaustive presentation is beyond the scope of this paper. But, to discuss about the possible role of design and design schools as agent of sustainable change, two of its main features have to be outlined: the on-going shift *form product to systems and services* and *from linear toward networked design processes*.

Services and systems. In the emerging scenario "products" are complex entities, based on the interaction between people, products and places. For instance: distributed power generation systems (to optimize the use of diffuse and renewable energies); new food networks (to create direct links between cities and countryside); intelligent mobility systems (to promote public transportation and innovative solutions); programs of urban and regional development (to enhance local economies and new forms of community); collaborative services for prevention and health care (to involve in the solution the directly interested users).

Considering these emerging scenario "products" we can easily see that they are (mainly) technical and social networks, where people mutually interact (and in turn interact with products and places) in order to get commonly recognized values. Operating in these networked systems *design* (intended as the design community of professional designers, design researchers, design academics and design media) shifts its focus from the last century product-oriented approach, towards a systemic one where the main attention is devoted to interactions. And where the 'objects' to be designed are a complex mix of material and immaterial systems of highly interconnected products, services, places and people (Manzini, Collina, Evans, 2004; Halen, Vezzoli, Wimmer, 2005; Thackara 2005; Green, 2009; Pauli, 2010).

New design networks. In the emerging scenario, designers (i.e. the experts who have been specifically trained in design thinking and design knowledge) change their position within production and consumption systems. In fact, systemic changes they have to face are driven by a growing number of actors who, as a whole, generate wide and flexible networks that collaboratively conceive, develop and manage sustainable solutions. Of course, in these new *design networks*, the position and role of professional designers (the *design experts*) change. Traditionally, designers have been seen, and have seen

themselves, as the only creative members of the interdisciplinary design processes. In the emerging scenario this clear distinction blurs, and they become professional designers among many non-professional ones. But, even if this distinction blurs, it does not mean that design experts' role is becoming less important. On the contrary, in this new context, design experts may have a lot to do in bringing very specific design competences in these co-design processes. That is, they become a particular kind of process facilitators who use specific design skills to empower the other actors' capability to be, themselves, good designers (Leadbeater, 2008; Manzini,2009; Murray, Caulier-Grice, Mulgan, 2010; Brown, Wyatt, 2010).

Design schools can play an important role in the emerging scenario and, more specifically, in these new design networks. They can generate original ideas and interact with local communities to trigger new initiatives or support the on-going ones.

Facilitating design networks

Design schools are, first and foremost, places where the next generation of design experts are educated. This fundamental educational role, can be considered an *investment on the future*: if we want to build a better future, we have to prepare better people, in this case, better designers. However, to build a better future, design schools now have the potential to play a second important role: that of *agents of sustainable change*. That is, critical and creative actors in the on-going transition towards sustainability.

It is important to note that this second role (agents of change), largely reinforces the first one (to educate future generations of designers): as the world continues to undergo fundamental changes, the most effective way to prepare future (competent) designers is to involve students in problems, opportunities and design methods that today appear radically new and as yet involve only a small number of active minorities. Thanks to this involvement, students have the potential to play a meaningful role in contemporary society now (empowering the innovation processes that active minorities are generating) while simultaneously equipping themselves to be the leading designers of the future (when the problems, opportunities and design modalities that are emerging today will become the new standards). Toward this end, within each school, a Design Lab can be established (DESIS, 2011).

The expression Design Lab refers to a team of researchers, teachers and students who orient their didactic and research activities towards promoting sustainable changes. As part of this process, they communicate with other similar Labs, exchange experiences and join forces to give their results more visibility, and find potential partners with whom to build larger scenarios and solutions.

More precisely, what these Design Labs can do is to operate, in a peer-to-peer mode, as intelligent actors of the emerging scenario new design networks. More precisely, they can use design classes and academic and professional design researches stimulating and supporting design networks in several ways:

- *Investigating,* to explore local resources and social innovation initiatives using ethnographic tools and user and community-centered design approaches to better understand problems and opportunities.
- *Facilitating,* to support the co-design processes using participative design tools to facilitate the interaction and convergence between the involved parties
- *Visioning* , to feed the specific co-design processes with *scenarios* and *proposals*. To do that at different scales: from the smallest ones (considering specific local problems), to the largest ones (aiming at building shared visions of the future).
- *Communicating,* to give the social innovation initiatives more visibility, to explain them and to create the preconditions to disseminate them thanks to specifically designed communication programs (websites, books, exhibitions, movies, ...).
- *Enabling,* to empower individuals and communities with dedicated solution (the *enabling solutions*), which permit to them to start and manage some new and promising collaborative organizations.
- *Replicating,* to scale-up promising collaborative organizations making them more replicable, thanks to *toolkits* and/or *specifically conceived products and services.*
- *Synergizing,* to promote large-scale systemic changes and regional programs with the development of *framework strategies*, specifically conceived to systemize, and synergize, a variety of local initiatives.

On-going projects

To better understand how design schools, via their Design Labs, can operate in the merging deisgn networks, we can consider the a concrete example, as the *Nutrire Milano* project in Milano. Nutrire Milano (http://www.nutriremilano.it) is an on-going initiative aiming at regenerating the Milanese rural-urban agriculture (i.e. agriculture near the city) and, at the same time, at offering organic and local food opportunities to the citizens. That is, aiming at creating brand-new networks of farmers and citizens based on direct relationships and mutual support.

This project is particularly meaningful to indicate what the role of Design Labs could be. In fact, in this case, DIS (a didactic and research unit of the Indaco Department-Politecnico di Milano) started years ago design classes and academic researches on this theme. On this basis, one year ago, in collaboration with Slow Food Association and several other partners, DIS

succeed in promoting a project, the Nutrire Milano project, founded by a bank foundation (the Fondazione Cariplo) and to be implemented in the next 5 years (Meroni, 2008). In this example, the design classes had the role of preparing the ground for the project concrete implementation. In fact, firsto of all, they facilitated the recognition of existing (social, cultural and economic) local resources and best practices. Moving from here, they outlined a strategy considering the emerging trends towards a new possible synergy between cities and their countryside (as the ones towards 0-mile food and proximity tourism). Finally, on this basis, they built a shared and socially recognized vision: the vision of a rural-urban area where agriculture flourishes feeding the city and, at the same time, offering citizens opportunities for a multiplicity of farming and nature related activities (Meroni, Someone, Trapani, 2009).

Now that the projects moved from design classes and academic research to a project destinated to be practically implemented, it is remarkable that in a large project like this (a 5 year project involving a very wide regional area), thanks to the work that had been previously done, a first concrete result has been obtained in less than one year since its starting-up (it has been a very successful Farmer Market initiative). It can be added that two new initiatives will be realized in the next two years and that several others are in program and will be implemented in the future (keeping in account the very concrete experiences of the first three ones).

Other initiatives, similar to the Nutrie Milano project, can be found worldwide: in several design schools teams of researchers, teachers and students are working on projects that increasingly involve other outside players and generate social consensus, political will and economic resources to become real-world, operative programs. Just to quote two well known cases, we can indicate the *Chongming Eco-community* project, in Shanghai (http://chongmingtao.blogspot.com), the *Amplify Project*, in New York (http://desis.parsons.edu). But, for sure, the list of cases could continue and expand in every regions of the world (for more examples, see http://www.desis-network.org and http://www.sustainable-everyday.net).

In conclusion of this part, we can say that these examples give clear indications on what has been, and what could be, the Design School Lab role in promoting sustainable changes, mixing didactic and research activities in the school, and collaborating with several stakeholders in real-world projects. In fact, looking at them, we can observe that, to start, develop and coordinate this kind of projects Design Labs operate in different ways and at different scales: from the local one (where they co-design with the involved local actors some specific initiatives) to the regional one (where they cooperate with other stakeholders in the definition and implementation of the large framework projects). To do that, specific strategic design capabilities are needed to recognize the existing resources and best practices, evaluate on-going influential trends, involve the stakeholders and facilitate their

convergence toward shared visions and common decisions on what to do and how. In parallel, when the local projects start to be defined, design experts must collaborate in synergizing them and coordinating with other on-going and/or future programs. Finally, but most importantly, the overall project and each one of the local ones must be effectively communicated. A communication that has to be articulated towards both the same involved (and potentially involved) actors and towards a larger audience, that has to be made aware of what the overall project will does and what is progressively (and very concretely) doing step by step (Jegou, Manzini, 2008; Jegou 2010).

Open Design Program

The previous examples are relevant because they demonstrate how some schools have become agents of (sustainable) change. At the same time, they show the possibilities connected to this way of working and the potential implicit in a diffused network of similar Labs in several Design Schools. In order to promote such approach, a wide and articulated design and research program must be conceived and developed (Manzini, 2009).

To be effective, this program should be unique in its concept and realization: a *design program* based on a peer-to-peer approach, including design schools from all over the world. The program should be both open and collaborative, and capable of self-regulation and self-management. We can name it *Open Design Program.*

The expression *Open Design Program* refers to a program of (didactic and research) initiatives where several design teams are challenged by relevant and complex problems and collaborate to produce shared visions and viable solutions. In order to do that, an appropriate communication and organisation platform has to be given. It must permit the Design Labs to operate adopting open source and peer-to-peer approaches to exchange experiences, mutually evaluate their projects and, finally, to collaborate in large and articulate programs.

The *Open Design Program* we are proposing here is characterized by these features and has three primary goals: (1) to define a shared framework for a multiplicity of research activities on design and sustainability; (2) to create a forum for ongoing discussion and outline design and research streams on well defined *crucial issues and emerging scenarios*; (3) to foster new autonomous research programs.

The Design Labs who join this Program agree to orient their on-going activities, or start new ones, in such a way that they can tackle these crucial issues and enrich these emerging scenarios. In doing this, these Labs offer their contribution to the realization of an articulated set of visions and proposals (as well as in the definition of the design tools necessary to better understand and implement them).

At the same time, the Program operates as a platform enabling each Design Lab to recognize emerging demands, exchange experiences with those working on similar topics, and have greater access to design tools and concepts developed and tested in other projects.

Distributed Design Agency

To enhance the Open Design Program, each Design Lab develops projects and research on the basis of its own resources and opportunities, but also acts as a node within a larger network of similar Labs. What results is a Design Lab Network which operates as an innovative *design agency*: both as an *open* agency (Mulgan, Steinberg, Salem, 2005), where complex, socially relevant topics can be tackled, scenarios developed, and solutions offered as contributions to larger innovation and co-design processes and as a *distributed* agency (Brigs, Ryan, Wisman, 2010), where many design teams work in parallel, are connected to each other and can function as a larger entity, while remaining sensitive to particular local cultural, social, and economic conditions. Given its particular system architecture this Design Labs Network offers the very unique possibility to integrate local and global points of view and to promote open design programs where a variety of projects converge, tackling complex problems and generating scenarios and solutions.

In other words, the Design Lab Network is, per se, a kind of social innovation where, as we wrote at the beginning, the existing (but under-valued) social resource of students' enthusiasm and teachers' experience is catalyzed and realized to generate a Distributed Design Agency where scenarios and solutions, conceptual frameworks and practical tools are generated and offered as a free and open contribution to the on-going co-design processes towards sustainability.

It must also be emphasized that this Distributed Design Agency is primarily and most importantly an *independent design agency*: one based in the design schools which can operate with greater degrees of freedom than commercial design agencies. We believe that the freedom to search for unconventional, critical, alternatives is the Design Labs Network and Open Design Program's major strength.

In acting as independent agents of change, design schools are doing precisely what they should do: operate as free cultural entities capable of using that freedom to promote the social good, even when this contradicts mainstream models.

References

Bauwens, M. (2006), *The Political Economy of Peer Production*. Post-autistic economics review

Bauwens, M. (2007), *Peer to Peer and Human Evolution,* Foundation for P2P Alternatives, p2pfoundation.net

Biggs C, Ryan C, Wiseman J, Larsen K (2009) *Distributed Water Systems: A networked and localised approach for sustainable water services*. Victorian Eco Innovation Lab, Melbourne.

Biggs, C., Ryan, C. Wisman, J. (2010), *Distributed Systems. A design model for sustainable and resilient infrastructure*, VEIL Distributed Systems Briefing Paper N3, University of Melbourne, Melbourne.

Brown, T., Wyatt, J. (2010) Design Thinking for Social Innovation, Stanford Social Innovation review, Winter, 2010

DESIS, 2010, http://www.desis-network.org

Green, J, (2009) *Democratizing the future. Towards a new era of creativity and growth*, Philips, Eindhoven

Halen, C., Vezzoli, C., & Wimmer, R. (2005). *Methodology for product service system innovation*. The Netherlands: Koninklijke Van Gorcum.

Jégou, F. (2010), *Social innovations and regional acupuncture towards sustainability*, in Zhuangshi, Beijing.

Jegou, F. Manzini, E., (2008), *Collaborative services Social Innovation and design for sustainability*, Polidesign. Milano

Leadbeater, C. (2008), We-Think, Profile Books, London

Manzini,E. (2009), *New Design Knowledge,* Design Studies,301

Manzini, E. (2010), "Small, Local, Open and Connected: Design Research Topics in the Age of Networks and Sustainability," in *Journal of Design Strategies*, Volume 4, No. 1, Spring.

Manzini, E., Collina, L, Evans, S, (Eds.) (2004) , *Solution oriented partnership. How to design industrialised sustainable solutions,* UK

Meroni, A. (2008). *Strategic Design to take care of the territory. Networking Creative Communities to link people and places in a scenario of sustainable development.* Paper presented at the P&D Design São Paulo, Brazil.

Meroni, A., Simeone, G. Trapani, P. (2009), *Envisioning sustainable urban countryside: Service Design as contribute to the rururban planning* in *Cumulus Working Papers – St. Etienne*, edited by Justyna Maciak, Camille Vilain and Josyane Franc, University of Art and Design Helsinki,.

Murray, R., Caulier-Grice, J., Mulgan, G. (2010), *The Open Book of Social Innovation*, NESTA Innovating Public Services, London

Pauli, G. (2010), *The Blue Economy*, Report to the Club of Rome

SEP, 2010, http://www.sustainable-everyday.net

Thackara, J. (2005), *In the bubble, Designing in a complex world,* The MIT Press, London, UK

Verganti, R. (2009), *Design-Driven Innovation*, Harward Business press,

von Hippel, E. (2004), *The Democratization of Innovation*, MIT Press, Cambridge, MA

CUMULUS // DRS SIG on Design Pedagogy
1st International Symposium for Design Education Researchers
La Bourse du Commerce, Paris 18–19 May 2011

Brigitte Borja De Mozota (2011). *Design Economics–Microeconomics and Macroeconomics: Exploring the Value of Designers' Skills in Our 21st Century Economy*. 17–39

Design Economics–Microeconomics and Macroeconomics: Exploring the Value of Designers' Skills in Our 21st Century Economy

Brigitte BORJA DE MOZOTA*

Parsons Paris College of Art & Design

Design activity is now integrated into society and organizations, and this implies the end of the independent "design planet." It is worthwhile to research how design relates to economics, on both the microeconomic and macroeconomic levels. This paper will first explore the significance of economics for design, and inquire into the economics of design, looking at design activity as a profession, as an industry, as employment statistics, as economic welfare. The paper will then explore how this economic point of view impacts design education, with a focus on the following two aspects:

–"Single loop design education" concerns how the design discipline responds to the demands arising from the accelerated changes in this transitional 21st century service economy. It seeks to change the context and preferred designer skill-set without changing design education.

–"Double loop design education" concerns the introduction of profound behavioral changes in both design education and business education. Design as defined through its specific skill-sets implies the invention of common learning spaces and the reorientation of organizational capital to integrate design as a resource

Keywords: Economics. Macroeconomics. Microeconomics. Veblen. Business Education. Design industry. Design career. Designer skills. Design profession. Design education

* *Corresponding author:* Director of Research, Parsons Paris College of Art and Design
14 rue Letellier | Paris 75015 | France
e-mail: b.borjademozota@parsons-paris.com

Introduction

"Le design pense sans cesse mais oublie de se penser"

"Design is always thinking but forgets to think about itself"

Stéphane Vial 2011 (translation by author)

Design thinks but forgets to think about itself; indeed, it should not forget to think about itself, and it ought to do so from many different viewpoints at once: philosophical, cultural, but also economic. Our concern in this paper is the economic viewpoint.

So, designers, be prepared as you read what follows to look at problems in the design profession from other viewpoints. This ability to vary viewpoints on a problem is in designers' DNA, and they frequently apply this ability to their clients' problems. Now we ask that designers apply this same ability to themselves and their profession as they read the text below, which we have written from the point of view of our own background in economics and managerial science.

Designers have consistently adapted their practices to changes in environmental contexts, always with the aim of inventing a better future through artifacts. And an education based on a critical attitude of questioning society and on inspiration from the "spirit of the times" has helped designers to transform their intuition into production and to impose their vision (Coeur, 2010: 7).

Historically, whenever the environmental contexts have changed, design activity has responded by inventing new design disciplines. The recent invention of design areas such as "web design or "service design," as well as the buzz about "design thinking" as a design process, are examples of the design profession's adaptive strategies. Such adaptive strategies have often resulted, on the one hand, in criticism of designers, who are said to promote mass consumption in our contemporary society dominated by branding and marketing (Flusser, 2002: 8), and on the other hand, in debate about the allegedly "schizophrenic" attitude of designers. Broadly speaking, the design profession has historically been defined by its different outputs.

Design is today understood and defined as an activity. Surveys are regularly conducted in all countries questioning how Design is perceived by CEOs, and how it is organized and integrated into organizations. The design profession now has specific rules and norms, syndicates and unions, and employment statistics. And even governments are integrating Design through initiatives such as national design policies and studies on the economy of Design that examine the competitive edge and quality that export products acquire through the value created by design industries.

Design is now mature enough to define itself both as a profession, and through the economic value that design activity acquires in virtue of its specific skills and its output. This newly acquired self-understanding has an impact on design education. The change from a "project view" of design to a "process and skills" view of the design activity implies that the "design planet" must now understand designers as economic agents participating in the general methods by which men and women co-operate to meet their material needs. And on some level, this is the very definition of economics (Rutherford, 1995).

It should not be forgotten that 20th-century economists have provided foundations for new issues in economic production, such as economic welfare, and these new issues are coherent with designers' DNA and design theory. Economic welfare moves beyond the statistics comprising the Gross National Product (GNP) to incorporate a wider range of social and economic indicators so that the subtleties of human taste can be taken into account. Design activity participates in this shift, either by lowering dissatisfaction or by increasing satisfaction.

This economic vision of design activity has implications, first, in the context of design understood as an industry, as a profession, as an economic actor, and as value in our newly intangible economy. All actors in the design industry need to think about the design activity collectively. Second, there are implications for the emergence of design as a "core competency," that is, the recognition of the value of designers' specific skills. When integrated into organizations, designers change the organization's "knowledge warehouse." Design education therefore becomes a "normal" part of the organization's capital, and this in turn has consequences in business education.

Design education had been linked to business education only through multidisciplinary brand and innovation teams. But it is now in relation with strategy education and organizational design education.

In our complex world, both designers and managers face common challenges, and from a purely economic point of view, the skills-driven definition of design is increasing the demand for designers and for design education.

An Economic View of Design

Economics analyzes the production, consumption, and distribution of products and services, and is articulated on both a micro- and a macro-economic level. Microeconomics is the study of behaviors in the market economy, of consumers, and of organizations. It explores how consumers and organizations make decisions and how these decisions affect the supply or demand of products and services: it concerns questions of price, and therefore of quantities sold. One of its goals is to study market mechanisms and the conditions of competition. Macroeconomics studies bigger issues

such as employment, economic growth, and inflation. This branch of economics deals with the performance, structure, behavior, and decision-making of the entire economy on both regional and national levels. Macroeconomists develops models to explain the relationship between national income, consumption, and international trade.

We already know that design is taken into consideration in macroeconomics: through national design policies, through the diverse direct contributions of design to national income (including the revenues of designers), through improving the performance of exports of manufactured goods, through design consultancies working for overseas clients, through better product quality and innovation (for a complete list**,** see Borja de Mozota, 2003: 52-59). Consequently, Design is now an economic agent, an industry which is an integrated part of a whole—whereas in the past it was seen as an elitist activity taking place on an independent "design planet" composed of design magazines, design schools, and design awards. It is now an industry.

Design has become an actor in society at large: quantitative data is gathered, statistics of the design profession are calculated, and research is developed in order to understand what is hidden behind the black box of the design activity and to measure its value. This new recognition of design as a unified profession existing within multiple industrial and service sectors, and as an industry, has resulted in major changes in designers' employment situations: designers have become "normal" economic agents in organizations or in regions, cities, and policies.

Even if our macroeconomic policy is increasingly monetary, economic science is centered on scarcity. And this is an excellent situation for design demand. The human desire for more products creates new techniques and new products, and whenever these emerge, scarcity actually increases rather than decreases (Albertini, 2008).

What about microeconomics? The emergence of microeconomics in design activity results from the development of design management. Design Management is design in management science. In the contemporary world, many designers still work as free-lancers or in design consultancies, but many others now work within organizations as "in-house designers " or entrepreneurs. Design is now embedded in organizations, institutions, and innovation teams in three ways. First, Design microeconomics developed as a result of the need to manage a design project. This has generated an opportunist behavior among designers, who search for and use management concepts relevant for their activity, such as project management, branding strategies, or strategic SWOT analysis (Best, 2006). Second, it developed with the study of Design valuation such as Design management as "design in the value chain" (Borja de Mozota, 1990) or as "managing as designing" using

Karl Weick's sense-building concept. (Bolland & Collopy, 2004). Finally, with the recent trend of "Design thinking," Design is now understood as a process-oriented activity. This "process view" of Design makes it easier to understand and appreciate for CEOs and decision-makers. And this new recognition of the value of design as process has long-term consequences. Let's now look at the development of the design function.

Table 1: Design in economics and its consequences: Single loop and double loop design education

	Single loop Design Education	Double loop Design Education
Changes	Design in society statistics. No behavioral change of agents	Design in organizational design and strategy. Changing agents' behaviors
Triggers	Design profession Design as creative industry Design Index: measuring design Holistic innovation ecosystem	Routes for innovation in education -Happiness route -Meta route - New Resource route

Design has become a function in organizations, which marks a fundamental shift towards Design in microeconomics and towards its introduction into the entire domain of managerial functions concerning utility. From an organizational and managerial point of view, an artistic director or a design director is no different from any other director in terms of utility. A manager tends to maximize his or her satisfaction in a firm. The utility and satisfaction of managers increase if their status improves when staff expenditures are increased, when their salaries are raised, or when profits are higher (Williamson, 1964).

This rise of the design function as design direction is a fundamental development in microeconomics. Design consultancies do not have the same power to change the view of design in the foundations of management science and organization theory. An outside designer is a consultant working within the budget and under the authority of another organizational function, most frequently R&D or communications or marketing.

Wherever the independence of the design function exists, it transforms the design activity. A designer is thus now seen as an economic agent motivated by self-interest who attempting to maximize total utility in consumption, work, or leisure. A design director is an economic agent who has the power to make decisions impacting the organization's output, investment, and price structures.

This paper will explain how this economic view of design as a profession and as a creative industry has various implications for design education. We will highlight the dual objective of design education as both "single loop" education (i.e., broadening design education's scope within the macroeconomic perspective without changing the design/business behavior) and as "double loop" activity (i.e., understanding that this broader context of design activity involves a microeconomic view in order to change both business and design education, as well as management theories) (see Table 1).

"Single loop" Design Profession and Education

Educating in a Design economy

The macroeconomics of design or the design industry is structured in multiple directions:

- The "Veblen effect" and the non-price quality factor: Design was first understood and studied as providing a national or regional competitive advantage through the "Veblen effect" or pricing premium, or the brand-premium that it conveys. Luxury goods, where design is embedded, are called "Veblen goods"—goods for which there will be a decrease in demand if the price drops because of the belief that the quality has fallen (which is in contradiction with the law of supply and demand for pricing decisions). Design is a "non-price quality factor" that is part of buyer and consumer preference in international exports (Cahn, 2010). The reputation-value or perception-value of this effect is central to building competitive advantage. The Interbrand index and other "best international brands" indices are being challenged by the question of the specific impact of design on brand-value.
- Design competitiveness is itself a competitive advantage: countries like South Korea have developed new city or country brand indexes in order to measure reputation-value or the quality-premium of design expertise. Cities all over the world compete on the quality of life they offer. See, for example, the UK Magazine *Monocle* and its best cities rankings.
- Creative and design cities: in this creative and experience-based economy, creative industries become a competitive advantage, and as one of these creative industries, design is infused by various practices from other creative industries. Creative industries are researched and creative employment measured by the "Trident concept" of creative employees. Consider as an example the study of the creative industries in the greater Paris region (Camors et. al., 2010).
- Innovation performance: innovation in macroeconomics is now understood as a holistic complex system (Morand and Manceau, 2009) wherein design plays a role at every level of innovation. There is a

similarity between, on the one hand, the concept of the three-tiered "design ladder" for measuring design position and knowledge in companies (from Design understood as style in the first level, to Design as process at the second level, to Design as strategy on the top level), and on the other, the three levels in the innovation eco system (innovation of product, process, and business model).

Table 2: Macroeconomics Role of the Design Profession as Competitive Edge

Design helps compete on perception-value, reputation-value, and brand value
Design in exports as a "non-price" factor and as a price-premium effect
Countries, corporations, and cities compete on design competitiveness
Design industry competes with other creative industries
Design as part of the complex system of innovation indicators
Cultural innovation helps technological innovation

The complex system of 21st-century innovation goes beyond the limited view of innovation as technological innovation in three way:

- The ecosystem of innovation requires innovation in three directions: portfolio (product and service) innovation, process innovation, and new business-model innovation.
- Semiotic and ergonomic inputs are understood as essential to innovation performance (Pignier and Drouillat, 2004).
- Cultural innovation is recognized, as is its correlation with technological innovation and also the impact of culture on creativity (Cox review 2005; KEA study for EU commission June 2009; Levy and Jouyet, 2006).

Design industry and competitiveness are now considered to be pertinent criteria to be managed and measured in national Innovation policy. Consider for example the UK's National Endowment for Science, Technology and the Arts (NESTA), whose aim is to transform the UK's capacity for innovation; consider also the pilot study of the Innovation index started in 2009, wherein we see that investment in innovation was divided into seven categories (research and development, Design, organizational improvement, workforce skills development, software development, Market research & advertising).

From these examples, we see that innovation is no longer limited simply to research and development. It is more like an ecosystem of innovation capacity within firms that are experimenting with and improving on their process and workforce capacities. Robust measures of innovation and its economic benefits are useful because they are linked to improvements in productivity. Like innovation policy, Design investment requires sound evidence. Consequently, the question of measuring design value at a macroeconomic level is important:

- Countries comparatively measure the value of their export products; Design factor (understood as aesthetics and ergonomics) is part of the "non-price" factors that define their competitive edge (Cahn 2010).
- Countries such as Korea have created a Design index called the National Design Competitiveness Power index. Design value is measured according to criteria including design competitiveness, design promotion performance, and the innovative capacities of companies.

These new challenges for Design activity call for more macroeconomic design research as well as innovation in design education, such as:

- Creating a Design Index or national observatory of design value in macroeconomic that aggregate statistics about the profession and measure National Design value.
- Researching and measuring design value and its role in the innovation index and the brand index.
- Developing benchmark studies comparing how creative industries (such as film, multimedia, publicity, or Design) manage creativity and deal with other issues that they share in common.
- Networking with researchers and auditors who are implementing the new accounting standards (IFRS) for the immaterial economy, with Design included in these intangible assets.
- Educating students in design about the importance of the final control phase of the design process, namely, measuring design impact, quality perceived, and design evaluation models.

As a consequence, we see why it becomes necessary to measure design value as a part of a macroeconomic whole, and as an actor in the more global context of innovation (see Table 3).

Table 3: Design as part of the complex global system of innovation indicators
(Translated & adapted from Morand and Manceau 2009)

Innovation	Input	Process	Output
Human capital	Education	Creativity Prospective	Intellectual property
Organizations	A culture of innovation Risk/entrepreneurship/ Optimism	Collaborative management project	New macroeconomic models number of new products, new profession, innovative firms
Performance	Investment R&D / GNP Number of research projects; Marketing investment/ GNP; **Design investment / GNP**	Capacity of anticipation and reactivity; Time to prototype; Number of new projects imitation or radical	New products and services

With reference to Michael Porter's strategic value-chain concept, and in coherence with this broader context of innovation, research on European design-driven SME's published in 2002 shows that the "Designence"™ model or design management value model supports a holistic view of design value. Design capital is first a substantial value; depending on the strategic route chosen, design capital may come from design value for products, process, and organizational business model (See Table 4).

Table 4: Design value model "Designence" / Design capital
(Borja de Mozota 2002, 2006)

Design capital as market capital, cultural and portfolio capital/brand The perception and differentiation of value	Design capital as organizational capital Inventing an innovation process that creates value
Design capital as human capital Empowering people through design as creativity in creative organizations	Design capital as financial capital, be it an economic or an intangible intellectual property value

Innovation driven by "form innovation" or "innovation formelle" (Vervaeke, 2003) is market value through brand perception value and through "front end" innovation in market research and market potential. But Design

also innovates in process optimization or in anticipating and inventing new business models. Design innovation is multiple and participates in building Design capital. Design capital comes from its capacity to create substantial value, that is, cultural, economic and social value. And this now is true not only for a company, but also for an institution, a city, a region, or a country. Finally, the Design industry creates measurable financial value (Hertenstein et. al., 2005; Aspara 2009).

In our immaterial economy, Design innovation is an actor that builds intangible assets. Intangible assets are no longer limited to intellectual property or patents. Financial value measures stock market value, market value, customer relationship value as well as IP. All of these innovation routes create models for measurement, and therefore for improvement, for companies and countries through self-assessment tools such as the Design Management Europe Award.

Design assessment tools measure design value through customer capital, brand capital, human capital, organizational capital, and technological capital (Borja de Mozota 2003). Companies participating in Design awards are asking for evidence with which to measure their design investment in comparison to their competitors in the same industry. The example of the Red Dot Institute in Zec and Burkhard, 2010, is interesting in this regard:

> *Companies investing for the long term in innovative and well-designed products that use Design as a strategic business tool and that are accordingly and consistently successful in the Red Dot award achieve distinct market advantages over their competition .... But the quantitative success of Designers' work is generally enjoyed by those who ordered the work to be done; those ordering the work must above all be strongly interested in its success.*

Such demand for Design and Design management evaluation will probably have an impact on Design education, as new approaches are required to educate designers to become "designpreneurs" or "intrapreneurs," or at least to understand the complex system of innovation and to go beyond education in communication and marketing skills.

Just as any created shape, a good design project has three effects (an aesthetic beauty effect, a social change effect, and the combination of both for an emotional user-experience effect), which enriches user empathy (Vial, 2010). Design-driven innovation as "empathy-driven" innovation challenges all three objectives of innovation in the economy: portfolio, process, and business model. The impact of Design on innovation should not been limited

to products only. This requires building a new shared mental image of designers' skills in innovation.

Educating in design skills value for 21st century economy

"Design: the history of ONE discipline" (Midal 2008; author's translation): the subtitle of this recently published book in France on Design history shows a change in Design activity—it is now united in "ONE " unique discipline, whereas traditionally it was divided in "MANY" Design disciplines.

Design activity is now challenging itself to find common ground for all of its disciplines after having traditionally developed itself through the creation of a new design discipline whenever the environment changed and warranted it. And this common ground is the designer's skill-set.

Design education in our present context has to give evidence of the success of Design Now through the pertinence of designers' skills to respond to our 21st-century needs and to ask which specific designers' skills will be most relevant today.

When the socio-technical system in society is stable, industry trajectories, infrastructures, institutions, culture, customers' preferences, scientific knowledge, and technology are all more or less coherently aligned. But we are living in a period of transition when these trajectories are lacking coherence. Through multiple niche innovations that are all experimentations and prototypes of the new world, the trajectories start to diverge. It will take a certain amount of time before all these experimentations generate a self-regulating system based on new patterns and directing diagrams.

Hence, we live in an economy of paradox wherein the new system coexists with the old one. A new form of hybrid democracy is building up. The service economy is helping the mutation towards an "economy of the individual" that is designed for individual persons rather than the industries. In this new world, it is "you" who has the power. Accordingly, old systems have to be reconsidered from "your viewpoint," and new interfaces have to be invented. Needs and desires are analyzed starting from the perspective of an individual, and economic and design actors are networking in order to satisfy that individual. The frontiers between industries are blurring because we are thinking more according to "activity" rather than "industry."

Companies are more process-driven, and design understood as process-skill is welcomed. Consider this example from Frog design consultancy:

> *At Frog, we try to learn and experiment on a constant basis; because it is used to adapting, Frog lives happily on the borderline between art and commerce ... For all those who struggle with conflicting notions of how design can live in a business model, here is a magic*

formula that might help resolve the conflict: Culture + Process = Profits ! (Esslinger, 2009: 4).

Based on Keen's 1997 book *The Process Edge*, Minvielle (2009) explains the value of the design process through the questions to be asked when a new process is implemented in a company:

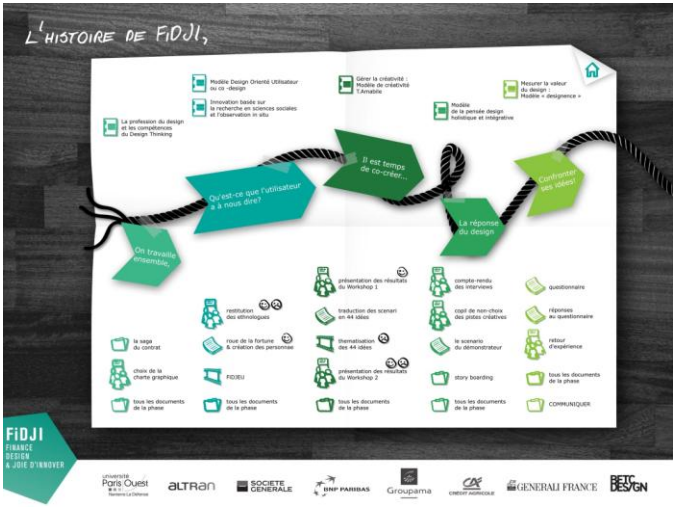
- Question 1: Is the process helping the company become distinctive? Is it directly linked with the firm's identity and helping to differentiate it?
- Question 2: Is the profit of this new process higher than its costs?

Obviously, the Design activity responds affirmatively to both objectives of identity and productivity.

Through holistic or systemic thinking, the Designer is able to analyze the aspirations of each individual actor deeply and with empathy. Such thinking can help invent "myths"—an ideal system for one activity or one actor. But this new customer's experience will be confronted by the institutions and the reality of existing networks.

An example, our research Project FIDJI (2010) with a consortium of French banks and insurance companies resulted in substantially increased user-oriented and co-design processes within these companies, which changed the whole vision of these industries with respect to customer relations.

Table 5: FIDJI project, 2010: Design Thinking for reinventing the customer experience in banks and insurance industries



In summary, this transition economy needs both global vision and an ability to manage the paradox, which are precisely designers' skills (see Table 6).

Table 6: Transition towards service integration in all industries.

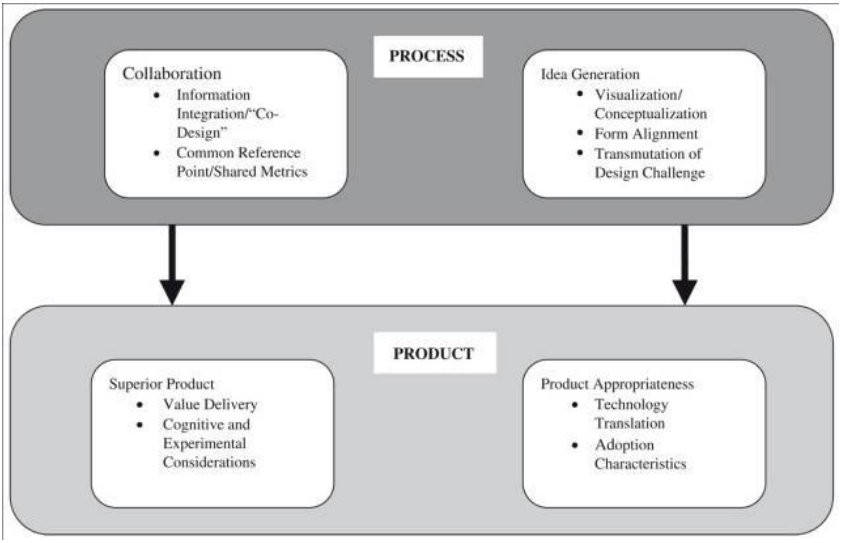
Traditional industries (e.g., automobile, consumer goods industries)	Services industries (e.g., hotels)	Public service and Government institutions (e.g., health sector)	New service industries (e.g., person to person services)
* Create empathy with the client * Think product and service	* Make the quality of service tangible * Differentiate through services	*Invert the pyramid	* Innovate by system thinking * Be user-oriented

It is not only the service industries but all companies that must think product and services in integration. Organizations are bound to augment their flexibility in customer relations and to empower the staff in direct contact with the clients. Similarly, public services, governments, and NGOs must invert the pyramid and provide service to the client. All public sectors are affected by this change towards user-oriented interfaces, including postal services, telecommunications, transportation, employment search, public health, and even prisons. New sectors are thus opened to design activity. Consider the example of the GLOBAL DESIGN VILLAGE initiative, an international design competition for UN disaster reduction department.

Designers' skills for multidisciplinary innovation management

Consequently, in management, this transition economy means inventing new ways to manage the transition, and to change the governance of innovation. It becomes necessary to experiment with an interactive "process-oriented approach" to management and innovation; this is consistent with the design profession and its thinking: User-oriented design (Veryzer and Borja de Mozota, 2005; see Table 7).

Table 7. User-Oriented Design innovation model
(Veryzer and Borja de Mozota, 2005)



By exploring the DNA of innovative companies, radical changes in innovation management have occurred: more network and partnership, the recognition of the importance of very small start-ups and a total change in innovation timeframes: time has "accelerated," and collaboration with creative inspirational people is valued for generating multiple ideas in a few weeks (Denervaud and Chatin 2009). An example of this is David Edwards' "le Laboratoire" in Paris, working with designer Mathieu Lehanneur on a purifying air product

Innovation follows user-oriented design that improves both the product and the process simultaneously (see Table 7). This user focus changes traditional "stop/go"-innovation models, because it requires the collaboration of multiple experts. And this thinking is a catalyst for change in organizations in terms of their innovation management. This is also acknowledged in some multidisciplinary education programs, such as IDBM in the Aalto University, or in the many partnerships between design and engineering schools.

Changes in design from single loop to double loop

Taking as a metaphor Chris Argyris' model of organizational learning and change, we can say that design education focuses either on incremental change or "single loop" actions, or on transformational change or "double loop" actions that question the status quo and are capable of explaining why alternative solutions should not to be taken.

We have explained the change necessary as "Single loop" design education and macroeconomics is introduced into design education, while taking into account the facts that design is an industry, that there are economic models in design, and that design is a profession with its five levels of career development, with designers' skills viewed as part of a career path (Borja de Mozota, 2010). It has an important value because it helps design students understand why design is important economically and why they are agents of accelerated change. Consequently, this means new course development focusing on skills (Holmlid et. al., 2007).

So, the macroeconomics of Design is an important change for the Design community, but it is an incremental change, as we saw in Chris Agyris' model.

"Double loop" Design education

Double loop design education goes beyond and questions the status quo, and opens new routes for education.

First let us underscore the gap between designers who develop design strategy and educators in design who do not know what corporate strategy is. Designers are seen as strategists because they are visionary and have prospective skills. Designers use the word strategy when what they actually mean is product strategy or design strategy, thus ignoring that there are development routes for corporate strategy other than product innovation or branding innovation, and missing the important issue of corporate strategy. Indeed, one of the major blind spots in the innovation management map of most companies concerns the invention of the conceptual aspect of company strategy. As Herrmann and Moeller (2009) report:

> The term conceptual is concerned less with merely developing abstract ideas for the future ... than with trying out abstract strategies by actually putting them into practice and translating them into tangible product and service concepts

Deciding a strategy route is thus a sticky problem. Decision-makers now have to face new specific challenges, such as managing complexity, globalization and innovation, process-oriented companies, socially responsible enterprises, etc. But designers' skills can help (Inns, 2007) as long as designers sell skills and not "outputs"! Our current macroeconomic situation requires design profession and design education to go further in innovation than simply having designers integrate multidisciplinary teams or hold normal corporate jobs.

This is no longer the industrial or service economy, this is also in parallel the individual or personal economy. "I"– as a person, an individual, a human being –"I" am changing and helping the reconstruction of many different industries and fostering alliances between traditionally competing actors. Consider all the Internet websites and their cascades of relations that allow

you to answer your individual question forms at your individual computer in your own time and by your own route. Consequently, in this individual "down-up" economy, the brand power of organizations is fundamental in shaping our mental images that this brand is better for me than some other, regardless of the product or services it offers. The power is in "ME" as a human being, with the power of individual choice for "my" brands.

Our "complexity economy" means adopting this "down-up" person-centric attitude. This is the reason for the emergence of design thinking and user-driven design success; their empathetic attitude gives designers new roles as inventors of "emotional" innovation. As Cuisinier (2010) highlights:

> The purpose of Design is to stimulate the encounter between the object (in its broader sense) and the individual. In this regard, the aim of the Design is to tempt users towards this encounter–in other words, to construct the conditions for a tendency approach, i.e., an emotion.

Consequently, designers and strategists share a similar entrepreneurial spirit. Designers' research skills and attitudes mean that the design profession can embrace larger issues of holistic innovation (technological, social, and cultural innovation) and then invent new business models.

Designers skills for the organization knowledge capital

The skills of designers change the skills framework in all organizations when integrated, and these skills help to change strategy formulation: "How passion can move an organization towards a cultural strategy is dependent on the education, on the creativity, and on the skills of the employees" (Gwee 2008: 125). Table 8 presents a synthesis of designer skills, indicating which the skills (in italics) are most relevant to our present context.

Table 8. Designers skills: in italics, the strategic skills for design now. (Borja de Mozota, 2010)

Knowledge	**Attitude Values**	**Applied skills**	**Understanding skills**
Design process	*Risk-taking* *Managing uncertainty*	Practical design skills *Prototyping* Drawing ability	*Observation*
Material	Originality	Creative techniques Lateral thinking	Researching
Market	Anticipating future trends Forward thinking	Commercial skills	Logical thinking *Integrative thinking*
Technology	Proactive in developing relationships	Communication skills (Presentation and report writing)	Analyzing Prioritizing Structuring problems
User awareness	Open-minded	Computer skills	*Scenario building* *Narrative*

Culture	Understanding multidisciplinary context	Design for manufacture	Synthesizing *Holistic thinking*
Aesthetic awareness	*Focusing on usability*	Project management	Intuitive thinking & action
Human factors	Attention to detail	Optimization	Consumer and stakeholder needs
Manufacturing process	*Learning from errors*	*Team work*	*Human empathy*

So the most important designers' skills for our present world include risk taking, experimentation, teamwork ability, narrative building, holistic thinking, and open-mindedness to transcend the existing barriers of industrial "silos." Because of contextual macroeconomic changes and the rise of the individual macroeconomy, the importance of understanding user insights is becoming even more strategic for the organization: User-oriented design and the "design for all" approach.

In this transitional economy, where any individual on the Internet is challenging the role of institutions to regulate the economy, new skills are needed to innovate in the organization's relationship to the world. Design activity becomes an agent of change for prototyping the new socio-technical system that has to be invented, as well as for helping companies manage the transition between the old and the emerging socio-technical systems.

Design in organizations is also shifting from merely designing the product portfolio or product strategy to both a holistic "design you can see" multidisciplinary process attitude (Michael Porter's competitive advantage) and a "design you can't see" attitude, based on a different route of strategic formulation of the "blue ocean" or "resource-based" view. In this view, design is a core competency for a company but also for country, city, and institution.

The shift creates challenges for design education and design research. Design management research should take part in and even lead the debates on "organization as design" launched by the journal *Organization Science* (Romme, 2003), and on organization studies as a "science for design" by the journal *Organization Studies* (Jelinek, et. al., 2008). Double loop design education starts with the understanding that since designers' skills are useful in organizations, the fundamentals of organization theory and knowledge management have to change in a retroactive loop in order to change the behaviors of people in business.

If business education does not integrate design, then there is no shared mental map, and consequently no organizational learning is possible. Just like

top management issuing memos and directives is not efficient to change employees behavior, so too does the introduction of design in the organization lead to defensive posturing, distancing, and even blaming and rivalry. If the organization has to change because of its understanding of the importance of design, then "double loop" innovative educative techniques are needed.

For example, the development of innovation in multidisciplinary courses with engineers, designers, and managers, or Design Thinking courses in MBA programs, are both encouraging first steps; other examples are innovative conception publications (e.g., Le Masson et. al., 2006) or the "D School" format spreading in Japan or France following the "buzz" of IDEO and Toronto's Rotman School of Management and its Dean Roger Martin.

But this buzz should not hide the hard facts that reference books in engineer and business schools are not mentioning design in their indexes (see as examples *Marketing Management* (Kotler et. al., 2009) or *Strategy* (Scholes et. al., 2008)). Inversely, design education is more and more frequently "smuggling" strategy concepts into its curriculum for improving designers' competencies (see the example of Michael Porter's five forces model to define a theoretical framework for design product strategy (Sun et. al., 2011)).

Academics in organization theory recognize that organizations have changed and that new theories of organizations are needed (Plane 2000), but how many academics in design are concerned with this "double loop" action of changing the classic models of organization theory in order to integrate design? This may be the only solution for simplifying the careers of all designers in the world.

So what can we do now in design schools in the short-term to move beyond multidisciplinary courses? Our suggestion is to educate designers in strategy models and in strategy intent while as the same time explaining that these new courses are based on specific skills being contextually important because of macroeconomic changes, and not because design is "per se" strategic. Design *becomes* strategic because designers' skills are useful to develop new strategy routes. And each strategy route has to respond to the new challenges business people are facing. Managers are not looking for Design as the "solution." Design is a competency, a tool in the knowledge system:

> *The problem is that even though designers have this potential to work at higher strategic levels of organizations, they are not trained to do so. This is a challenge for design education. (Borja de Mozota, 2010: 98).*

These changes in design education are therefore also relevant for changes in business education.

Double loop Design education can develop through three major routes for new business models pertinent to both design and business education: (1) the Happiness route; (2) the Meta route; (3) the New Resource route.

(1) The Happiness route. The concepts and values of creative designer skills understood as the application of a creative approach outside the traditional boundaries of idea-seeking in branding or in innovation. "Words make worlds"—a new vocabulary for management can emerge with design skills, as Bolland and Colopy (2004) point out:

> *Agonize, artifact, balance, borrow, boundary object, circulation, client, collaboration, constraint, crystallize, default, dialogue, drawing, emotion, experiment, fit, form, functional, gesture, goal, groundlessness, handrail, improvise, iteration, liquid, love, model, opportunistic, path-creating, path-dependent, place-holder, play, project, prototype, recycle, repertoire, space, study, tension, vocabulary.*

(2) The Meta route. Fundamentally, the conventional thinker welcomes the world as it is. The integrative thinker welcomes the challenge of shaping the world as it might be. This integrative thinker is a strategist. A "meta design" experience is needed: "design strategy as discourse" for corporate discourse. The "experience economy" is where new "Meta design" disciplines are needed, to give coherence and to navigate between existing design-discipline silos that are often also business units working in silos.

Strategy as language (which is known as interpretive strategy) provokes the formation of mental images and questions the boundaries of reality. In an uncertain environment, conversation becomes more important than closure. Conversation with the market and the consumer is needed, and a company needs to be both an effective listener and an active participant in the conversation (Borja de Mozota, 2003: 150).

The cognitive approach to strategy develops this idea that a company has access to its environment through a selection of representations or mental images of this environment. Postmodern organizations are collages that value creativity. Managers in postmodern organizations are reinventing a management that enhances autonomy and individual creativity. Design managers in postmodern organizations should enhance autonomy and individual creativity: co-design, user-centered design, inclusive design, etc. The postmodern design manager is seen as an artist or a theorist who focuses on creativity, freedom, and individual responsibility. For example, the design

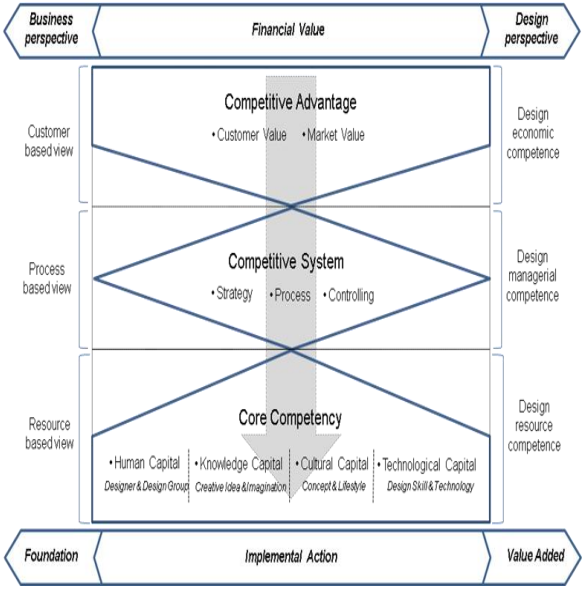
manager focuses on self-entrepreneurship and on deconstructing hierarchical power, through the galaxy of projects. Design is now valued as giving voice to silence, voice to previously overlooked minorities marked by gender, race, ethnicity, (dis)ability, and sexuality, and to young employees.

(3) The New Business model route. Emanating from a resource-based perspective, as well as a collective-learning objective, another view of strategy focuses on internal development, but also on pushing the traditional boundaries of organizations through network management (see figure 2). A resource refers an asset or input to production that an organization owns, controls, or has access to on a semi-permanent basis. Resource-based management highlights how the possession of internal, valuable, rare, inimitable, and non-substitutable resources may result in sustained superior performance.

The resource-based view emphasizes the importance of invisible internal assets such as skills and values, and consequently regards the design process as "design you can't see" (Table 9). Design skills are resources and core competencies for reinventing new business models. Rather than seeing the present system as more complex, it is the system that has to be reinvented (Osterwalder, 2010). New business models and new industries will emerge that will change the balance of our socio-technical system within the shift in strategy definition (Borja de Mozota and Kim, 2009).

What has changed in management is the emergence of a mental image of design as a horizontal function in organizations and institutions. Design management education should be based on skills, process, awareness, research, and knowledge for improving organizations' capital – whether human, knowledge, cultural, or technological (the S.P.A.R.K model of Design Management; see Borja de Mozota and Dong, 2009). Design management education is both business and design education.

Table 9. The resource-based view of design strategy (Borja de Mozota and Kim, 2009).



Conclusion

Managing design as a core competency is a high-risk venture and requires a long-term vision. Therefore, many companies have been reluctant to invest in building design capabilities. There exist, however, a number of companies that have understood that building a sustainable, competitive advantage requires adopting a long-term resource view of design management in order to improve the probability of success in the present chaotic business environment.

Managers have to integrate design theories into their organizational theories, and see "design science," design methods, and conceptual models as skills for designing their organizational platforms, structures, and systems. This is a challenge for design education. Designers have to reinvent the guilds, and to become more effective entrepreneurs in order to help society at large to face the changes in this transitional period between two socio-technical systems. They also have to design their profession as a part of the creative industries.

Finally, because of the last financial crisis and on-going environmental crisis, there is a feeling shared by many that economics itself needs to be reinvented, and we know now that economic science is not enough to make our 21st century comprehensible. Our situation requires a collective effort of

all persons conscious of this necessity to master economic force. This task cannot be done without the help of syndicates and unions, political parties, and activists. Behind finances, administrations, decision centers and "think tanks," we always find that human beings are the source of action. We believe that designers are acting for macroeconomic welfare. Economics is inseparable from a social project for humanity and for any person understood as a whole.

References

Albertini, J. M. (2008). *Les nouveaux rouages de l'économie*. Paris: Les éditions de l'Atelier.

Aspara, J. (2009). *Where Product Design Meets Investor Behavior*. Doctorate Thesis. Helsinki: University of Art and Design Helsinki, December 2009.

Best K. (2006). *Design Management*, Lausanne: Ava Books.

Boland R. and Collopy F. (2004). *Managing as Designing*. Palo Alto: Stanford University Press.

Borja de Mozota, B. (2003). *Design Management*. New York: Allworth Press.

Borja de Mozota, B. (2006). The Four Powers of Design: A Value Model in Design Management. *Design Management Review*, 17 (Spring, 2006): 42-53.

Borja de Mozota B. and Dong H. (2009). Towards a Theory of Design Management: Can Theoretical Models Define their Territory? A Transcultural Conversation Between Design and Business. *D2B2: Design to Business Conference*, 23-26 April 2011, Beijing, China.

Borja de Mozota B. & Kim, B.Y. 2009. Managing Design as a Core Competency: Lessons from Seven Korean companies. *Design Management Review*, Vol 20 ,No 2, pp. 66-76.

Borja de Mozota B. (2010a). Design Management as Core Competency: From Design "You Can See" to Design "You Can't See." *The Journal of design Strategies*, 4(1).

Borja de Mozota B. (2010a). The Brand Aesthetics Model: Reconciling Designers and Marketers on Brand Management. KEER: Kansei Engineering and Emotion Research International Conference. Paris: 2-4 March 2010.

Brown, T. (2008). Design Thinking. Harvard Business Review, 86(6), 84-92.

Damors, C., Soulard, O. (2010). Les industries créatives en Ile de France, un nouveau regard sur la métropole, *Institut architecture et d'urbanisme*, http://www.iau-idf.fr/fileadmin/Etudes/etude_671/Les_industries_creatives_en_IDF_avec_signets.pdf

Cahn, J.G. (2010). "Design et innovation technologique, quels avantages pour la France" (Etude ROE Rexecode), in The Friedland Papers, Chambre de Commerce de Paris.

Coeur, F. (2010) in M. Caraès and F. Coeur (eds.), *Enseigner le design: de l'idée à l'expérience* , Paris : Cité du Design.

Cox, G. (2005). The Cox Review of Creativity in *Business: Building on the UK's Strengths, HM Revenue, and Customs.*

Cuisinier, F. (2010). Emotions and Design: Between Feelings and Emotions. *Collection* 2 (Fall 2010), 49-60. Special Issue on Art + Design and Psychology. Paris: Parsons Paris School of Art + Design

Esslinger, H. (2009). *A Fine Line: How Design Strategies are Shaping the Future of Business*. New York: Jossey-Bass.

Flusser, V. (2002). *Petite philosophie du design* , tr. C. Maillard. Paris : Circé.

Guellerin, C., Minvielle, N., and De Jacquelot, M. (2010). *Designer : Carrières et professionnalisation / Designer : Careers and Profesionalizatio*n (bilingual edition). Bruxelles and Paris: de Boeck.

Gwee, J. (2008). *Art and Design for Strategic Management: Culture as Strategy*. Saarbrucken: VDM Verlag Dr Muller.

Herrmann, C. and Moeller, G. (2009). *Design Governance*. Hyderabad, India: Icfai University Press.

Hertenstein, J., Platt, M., and Veryzer R. (2005). The Impact of Industrial Design Effectiveness on Corporate Financial Performance. *Journal of Product Innovation Management* (22), 3-21.

Holmlid, S. and Arvola, M. (2007). Developing a Thematic Design Curriculum as a Bologna Master. International Conference on Engineering and Product Design Education. 13-14 September 2007: Northumbria University.

Inns T. (ed.) (2007). *Designing for the 21st century: Interdisciplinary Questions and insights*. Aldershot, UK: Gower Press.

Jelinek, M., Romme, G., and Boland, R. (2008). "Editors' Introduction." *Organization studies*, 29(3), 317-329. Special issue on "Science for Design: Creative Collaborative Artifacts and Research;

Kotler, P., Keller, K., Manceau, D., and Dubois, B. (2009). *Marketing Management* (13th edition). Paris : Pearson Education.

Le Masson, P., Weil, B., and Hatchuel, A. (2006) *Les processus d'innovation, conception innovante et croissance des entreprises*. Paris: Hermés

Levy, M. and Jouyet, J.-P. (2006). *L'économie de l'Immatériel: la croissance de demain*. Paris: La documentation française

Morand, P. and Manceau, D. (2009). *Pour une nouvelle vison de l'innovation*. Paris: La Documentation Française.

Midal, A. (2008). *Design : introduction à l'histoire d'une discipline*. Paris : Agora.

Minvielle, N. (2007). *Design et croissance*. Paris: Maxima.

Osterwalder, A. and Pigneur Y. (2010). *Business Model Generation*. New York: Wiley & Sons.

Romme, G**.** (2003). Making a Difference: Organization as Design. *Organization Science*, 14(5), 558-573.

Pignier, N. and Drouillat, B. (2004). *Penser le web design : modèles sémiotiques pour les projets multimédia.* Paris : L'Harmattan.

Plane, J.M. (2000). *Théorie des organisations*. Paris: Dunod.

Rutherford, D. (1995). *Dictionary of Economics*. New York: Routledge

Scholes K, Johnson G, Whittington, R., and Fréry F. (2008). *Stratégique*. Paris: Pearson.

Sun, Q., Williams, A., an Evans, M. (2011). A Theoretical Design Management Framework. *The Design Journal*, 14(1), 112-132.

Vervaeke, M. (2003). Le *design et les immatérialités de l'enteprise*. Paris: L'Harmattan.

Veryzer, R. and Borja de Mozota, B. (2005). The Impact of User-Oriented Design on New Product Development: An Examination of Fundamental Relationships. *Journal of Product Innovation Management* , 22 (March 2005), 128-143.

Vial, S. (2010). *Court traité du design*. Paris: Presses Universitaires de France.

Williamson, O. E. (1964). *The Economics ofDdiscretionary Behavior: Managerial Objectives in a Theory of the Firm*. Englewood Cliffs, NJ: Prentice Hall.

Zec, P. and Burkhard, J. (2010). *Design Value: A Strategy for Business Success*. Essen: Avedition (Red Dot Edition).

CUMULUS // DRS SIG on Design Pedagogy
1st International Symposium for Design Education Researchers
La Bourse du Commerce, Paris 18–19 May 2011

Andrew Polaine (2011). *Design Research - A Failure of Imagination?* 41–51

Design Research - A Failure of Imagination?

Andrew POLAINE*

Lucerne University of Applied Sciences & Arts

For a profession that claims imagination and divergent thinking to be among its key attributes, design research has failed to ignite public imagination. Despite efforts by the likes of John Maeda (2009), the rhetoric of STEM – science, technology, engineering, and mathematics – dominates the media. Science writers expound in newspaper columns, entire TV channels are devoted to the wonders of science. Science is, of course, important, but this one-sided view of research has not been counter-balanced by an equivalent, passionate exploration of the boundaries of design in the public sphere. Yet the potential is there – arguably, a handful of TED Talks have done more to raise the awareness of the importance of design than several decades of design research publication. Although there are exceptions, design research has failed to imagine and communicate an integrated vision of design comparable to that of science.

This paper argues that design has failed to integrate the nexus of theory, research and practice and is a call to arms for design researchers to bring their activities into a broader, public discourse. Despite the rhetoric of interdisciplinarity, design education research has become too convergent in its thinking and discipline specific. As practices such as service design engage in projects at the public policy level, it is essential for design to explicitly articulate the process of design synthesis (Kolko, 2011) in order to gain and maintain credibility, for such projects offers an opportunity to bring design's value and activities on par with the sciences in public discourse.

Keywords: design, research, synthesis, service design, education, science

A failure of imagination

I have an admission to make. Ninety-percent of the design and design education research that I read sends me to sleep. I am interested in design,

* *Corresponding author: Dr. Andrew Polaine: Design & Kunst | Lucerne School of Applied Arts & Sciences | Sentimatt 1 | CH-6003 Luzern | Switzerland*
e-mail: andrew.polaine@hslu.ch

education and research and the futures of all three, but while I am sure there are some inspiring research papers and presentations that I have not seen, the strike rate should surely be higher than this. For a discipline that claims creative thinking to be among its key attributes, design research has suffered a failure of imagination.

This is particularly noticeable in the lack of public discourse about design's value to society. The media regularly contains calls from scientists for more funding, more science to be taught in schools and claims for the enormous importance of science to the world. STEM subjects – science, technology, engineering, and mathematics – are the centrepiece of curriculum development and the associated funding (Higher Education Directorate, 2004). Newspaper columns and sections are devoted to science or, as in the case of Ben Goldacre's column in the Guardian (Goldacre, 2011), exposing Bad Science. Television channels and series, such as the BBC's highly successful *Wonders...* series featuring Professor Brian Cox (Cox, 2010), inspire and ignite the imaginations of schoolchildren and adults alike.

The purpose of this paper is not to bash science, however. Science *is* important as are technology, engineering, and mathematics, but this is just one side of the coin (and brain). Given that the world is not only filled with designed objects and media, but also suffering under the enormous weight and consumption of much of them, design clearly has a central role to play in society. Where are the impassioned calls for the role of design and for teaching design in public debates on curricula?

Some are there. Sir Ken Robinson (Robinson, 2005; Robinson, 2007; Robinson and Aronica, 2009) has argued the case for creativity in the curriculum from the perspectives of both personal fulfillment and economic value. Tim Brown (2009) contends that anyone, in any business, can and should become a design thinker. These two are perhaps best known through their TED Talk appearances, but their voices are missing from national newspaper columns, television series and government debates.

Don Norman (2010) has argued the case for a change in design education and was less polite than I when he wrote that he is "forced to read a lot of crap" (para. 1) when reviewing for conferences, journals and competitions. Provocative and insightful as Norman's article is, it was published on the design website, Core77, not in the national or international press, nor in conference proceedings or a journal. We are talking to ourselves and while it is important to talk amongst ourselves, it does not change the public agenda.

Professor Brian Cox's series had regular viewing figures of between three and four million when broadcast in the UK (Broadcasters' Audience Research Board, 2011), for example. Dan Brown's *The Da Vinci Code* (2003) is the UK's biggest selling book of the last decade with just over 4.5 million UK copies sold (Nielsen BookScan, 2011) and, while I have no sales figures for

the books of Tim Brown, Ken Robinson or Don Norman, it is reasonable to expect them to be significantly lower.

Apple sold 18.65 million iPhones alone in the first quarter of 2011 (Apple Inc., 2011), yet one might question the number of people who have heard of Jonathan Ive compared to Professor Cox, despite the far greater numbers of people owning the devices designed by Ive than the those that viewed Cox's TV series. Thanks to the efforts of broadcasters such as the BBC pushing the science agenda and through early contact with science in school, I would expect that many children and adults would have a better chance of describing the methods behind science than those behind design.

We only have ourselves to blame and it is a poor indictment of our imagination and communication abilities. Design education, design research and, by extension, design education research, have failed to imagine an integrated vision of design's role in society comparable to that of science. We have failed to make the case for and tell the stories of design and its processes in public discourse.

Design research and design education research should form the backbone of this message, but it needs to be communicated beyond the realms of conferences and journals. The skills of synthesis, of making connections between disparate fields and data points, of making intuitive leaps based on past experiences and insight are crucial to dealing with a world that is in constant flux and whose rate of continuous change is only going to increase (Johnson, 2010). Being able to take in and see the patterns in complex systems are essential to the future careers of designers as practices such as design thinking, social and service design start to engage in complex, global and political issues.

We should be making that case that these skills so central to design are also crucial skills for everyone. They should be central to discussions on curriculum where STEM is balanced by, as John Maeda put it, IDEA – Intuition, Design, Emotion, Art (Maeda, 2010, 2009). At the same time, we need to be as humble as we are bold and be aware of the history and practices of the areas design is making inroads into.

The mistaken divisions between theory, research and practice

Unpacking the comparison between science and design reveals a key to the problem. Design practice, design research and design theory have fractured apart from one another. When design research methods or theory are taught, they are frequently both taught and perceived by students as "not practice". Worse, theory and methods are often seen as a distraction from getting on with the "real work" of creative design *practice* in both senses of the word as commercial practice and the activity of designing.

I can't blame the students for taking this view. Some design theory and research reads as if it comes from another planet, totally divorced from the activity of designing (and by this I mean the thinking as much as the doing).

I believe there are two key reasons for the split between design research, theory and practice. The first has to do with the role that the arts have in schools. The division between the STEM subjects and the arts happens very early on. This tends to create an environment in which pupils with more visual or kinaesthetic learning styles begin to reject STEM subjects or, at least, find them difficult to engage with due to the way they are usually taught. Even if they do want to engage in both the sciences and arts, preference choices often force them to choose one path over the other. This initial experience taints later ones when design students are studying in higher education. Subjects to do with theory or research immediately smell of science and either fear or boredom set in (c.f. Robinson, 2009).

The second reason is that designers have for too long been complicit in perpetuating the myth of design ability stemming from talent and inspiration. Both of those may play a part in successful design activities, but they do in any discipline. To accept that creative thinking is just the result of a special gift is to deny the effort that goes into practice and experience. This is perhaps not surprising. Relegated to being "non-academic" in school early on, designers can fall back on the "magic" of how they come up with great ideas to restore their sense of self-worth. Later, in agency form, this mystery is sold to clients, perpetuating the mythology.

This has been an enormous mistake on the part of commercial design practice and has led to a backwash into education and, I suggest, design education research. We have sold what we do as magic at the cost of hiding our processes and when we hide our processes we can no longer articulate them, teach them or give them the value it deserves.

Design synthesis and the scientific method compared

The choice of the word "magic" is a deliberate reference to the title of Jon Kolko's recent book *Exposing the Magic of Design: A Practitioner's Guide to the Methods and Theory of Synthesis* (2011) in which he argues the case for designers to interrogate and explicitly articulate the process of design synthesis. In one of the ten percent of design research papers that did not send me to sleep, some of the origins of Kolko's book can be found in his 2010 Design Research Society paper, *Sensemaking and Framing: A Theoretical Reflection on Perspective in Design Synthesis (Kolko, 2010b)*.

Drawing upon the work of cognitive psychologists (Klein, Moon, & Hoffman, 2006) as well as communication (Dervin, 2003) and design theory (Schon, 1984; Coyne, 1988; Shedroff, 2000) among others, Kolko defines design synthesis as occurring during the "precarious moment between research and definition" (Kolko, 2010b). This "precarious moment" is the

intellectual leap that designers make as they move from research to insights to design and it is often poorly documented, if at all. This key part of the process is subsumed by the artefacts that usually follow – objects, images, diagrams – that are typically understood to be "design" by non-designers.

This stage is quite often left out of project planning or is often done on the designer's own time. It is, after all, hard to make the case for paying someone to stare at a wall of Post-It notes, but this is often where the actual design activity happens. In Kolko's definition of synthesis as distinct from sensemaking, the key attribute is externalising the process:

> *Sensemaking and framing can be enhanced and supported through externalization and through representations. Common to all methods of synthesis [...] is a "sense of getting it out" to identify and forge connections. This is an attempt to make obvious the sensemaking conditions described earlier. Emphasis is placed on finding relationships and patterns between elements and forcing an external view of things. In all of the methods, it is less important to be "accurate" and more important to give some tangible form to the ideas, thoughts, and reflections. Once externalized, the ideas become "real." They become something that can be discussed, defined, embraced, or rejected by any number of people, and the ideas become part of a larger process of synthesis. Essentially, sensemaking is an internal, personal process, whereas synthesis can be a collaborative, external process. (Kolko, 2011, pp 15-16).*

Kolko (2010a) uses Peirce's (1998) model of abductive thinking to describe hypothesis as a form of inference. "It is the hypothesis that makes the most sense given observed phenomenon or data and based on prior experience" (Kolko, 2011, p. 23). This is the kind of best guess or inference that designers make all the time, ideally based on combination of experience and research.

This is in stark opposition to the science's usual model of inductive reasoning, by which a structured experience (an experiment) has an intrinsic logic. "Each time I do A under the same conditions, B occurs. Inductively, the next time I do A under these conditions, B will occur" (Kolko, 2011, p. 24). The other keystone of scientific research, peer review, is what allows the testing and verification of those conditions by others. It is in this comparison of the two methods that we see the difference of attitude between design and science.

For science, the process and method are everything. Nothing is believed to be true until it is experimentally proven to be so and even then the door is always open for the discovery that experimental conditions, instruments or starting data were flawed. Arguably, method and process are more important than the actual end results – scientists remain skeptical until proven otherwise and rigour is paramount. Traditionally, however, design practice has taken the opposite approach. Results are what count and often speak for themselves in the designed artefacts, process is simply a means to an end.

Kolko argues that deductive and inductive reasoning are closed logical systems that "cannot offer any 'new findings' contained within the logic of the argument" (Kolko, 2011, p. 24). Design tends towards the intuitive leap or process of synthesis, which is essential for innovation. Designers in commercial practice (and many a design student) shy away from unpacking and making the case for their process of synthesis. It can feel like one is post-rationalising decisions, but this is largely due to a lack of vocabulary and practice in making this process explicit.

> *While designers have historically referenced a period of design synthesis in their process, little has been done within the community of design research and design practice to formalize methods of synthesis or to describe a cohesive theory of synthesis. Instead, designers commonly performed design synthesis in the due course of solving a design problem, and it was rarely explicitly separated from forms of ideation and the "raw creativity" commonly associated with form giving. Additionally, synthesis was rarely conducted overtly—instead, designers would synthesize research through casual conversation in the design studio or—more commonly— through personal reflection, and much of the synthesis process was conducted "in one's head." (Kolko, 2010b)*

Kolko is not entirely correct in arguing that little has been done within the community of design research in this area. Kolko himself builds upon the work of several authors already cited and several issues of *Design Issues* tackle the subject, for example. He is, however, right in his argument that this has not been terribly well formalized, especially outside the domain of journals and conferences.

While one might argue this is a failing of design educators to read and communicate this material, it is also a failing of commercial designers for not placing the requisite value on this part of the process and a failure of the design research community to properly publicise the value of synthesis.

There is, and will always be, a tension at the nexus of industry, students, faculty and research in terms of what is deemed a necessary understanding of the thinking processes behind design practice, but being more explicit about these processes is crucial in emerging design disciplines that deal with complex social problems and less with the individual artefacts of design. As Norman (2010) notes:

> *Service design, interaction design, and experience design are not about the design of physical objects: they require minimal skills in drawing, knowledge of materials, or manufacturing. In their place, they require knowledge of the social sciences, of story construction, of back-stage operations, and of interaction (para. 24).*

In failing to communicate design synthesis to a wider audience design research is easily challenged and dismissed by more rationalist science and business minds, leaving us wanting when it comes to winning research funding or, indeed, a prime place in the curriculum or at the boardroom table. Without this, designers remain regarded simply as stylists, design researchers are left to make sense of the chaos, and design education researchers have no agreed agenda.

One of the key differences between the sciences and design is in the relationship between research and practice. For most scientists, research is what they do. Research *is* science, scientific practice *is* research. A similar view of design is absent from most commercial design practice and design education. In many countries with a long tradition of design (such as Switzerland, where I am based), design research is a very young field. As design research has become more important both intellectually and financially to institutions, a false separation between theory, research and practice has been created. This has meant that design is seen what designers do, while theory and research are concerned with thinking *about* design in an academic context only.

For institutions and teachers that come from a history of design as craft (in which theory and research are present but often unarticulated), this separation gives rise to practical tensions concerning funding, positions and program design. In academia, at least, this often means lecturers and researchers are either part-time and have a day job as a “real” designer or they are not active in design practice any more at all. Students are acutely aware of this, but design education from undergraduate to postgraduate tends to take a trajectory from practice into the purely theoretical. The two are not integrated

It is essential that we teach students that theory *is* practice and practice *is* theory and that the same is true for research. To do this we need to be clearer about the value of research and synthesis to the practice of design. We also need argue for greater rigour in commercial design practice as designers start

to work in far more complex areas, such as those highlighted by Norman (2010), than their training has prepared them for.

Service Design and World Peace

We have seen the beginnings of this in the increased use of research methods borrowed from areas such as psychology and sociology in design projects. This has helped designers and researchers articulate their methods and process in the more rigorous terms that those disciplines use. There are still concerns with ethical standards and cross-cultural understanding in the use of ethnographic research by designers (Miller, 2010), but as interest from both sides gains momentum, a fertile cross-pollination may result (Miller et al., 2010).

Service design is a practice that actively sets out to uncover and design or redesign the relationships between multiple touchpoints and participants in services. It is defined by service design pioneers, live|work as, "design for experiences that reach people through many different touch-points, and that happen over time" (live|work, 2008). The discipline has emerged from a recognition that the complexity of services in a post-industrial economy requires a level of design engagement far further up the chain of events of project initiation and conception and that a different set of methods and tools are required to deal with the complexities that arise.

While at one level service design is about the design of experiences of and across touchpoints, it is largely about designing *with* people instead of *for* people (Løvlie, Polaine, & Reason, Forthcoming). This involves ethnographic field research, insight gathering and synthesis, as well as engaging in organisational change through co-design and connecting this to the customer, user or participant experience.

Many of the services that are valued in society are those that we expect to be around for a long time, such as healthcare, welfare, finances, mobility, communications and energy. For service designers engaging in these fields the design challenges become increasingly complex. A project aimed at helping the long-term unemployed get back to work (Sunderland City Council & live|work, 2008), for example, involved bringing together a number of different community organisations and specialist service providers ranging from mental health to drug rehabilitation and carers. In total, over 280 people contributed to the design of the pilot project.

More recently, service designers and researchers have been exploring the limits of design's ability to tackle one of the most complex, important and "wicked" problems of all – international peace, development and security (Miller et al., 2010). Derek B. Miller and Lisa Rudnick from the Security Needs Assessment Protocol (SNAP) team at the United Nations Institute for Disarmament Research (UNIDIR) have been exploring design's relationship with public policy in order to build an interdisciplinary research agenda.

Miller, however, strikes a note of caution regarding the danger of unintended long-term side effects of the design intervention.

> *Many designers today, especially the younger generation of designers, want to do some good in the world. They no longer seem satisfied simply creating objects of desire for profit. This is laudable. But for the good intentions of the design profession to actually result in some good, it is going to be necessary to carefully attend to how we design. Design is both a social process, with implications for others who are participants to that process, and also brings something new into the world that may have social force. Attending to both matters responsibly will be essential as the field moves forward.*
>
> *This is especially true as design steps into the wider world of international peace and security — given that the issue here is not consumer value but life and death.*
>
> *There is some limited discussion about ethics in design, but in comparison to codes of conduct in, say, anthropology, architecture, and medicine, one would be forgiven for finding them undeveloped. (Miller, 2010)*

Miller makes two key distinctions between design and policy making. The first is that policy making is usually carried out by democratically elected representatives. That is, the policy "design process" is done by people who have been elected and can be de-elected if the design outcome is not the one the citizens want.

Design, on the other hand, is more often about making decisions for people or, at best, on behalf of them, but not as their elected representatives, regardless of what we believe about how much we try to walk in their shoes. This important debate is outside the scope of this paper, but it is worth noting that the kind of participatory and co-design processes used in service design are intended to engage with this very issue.

The second point, in relation to the range of horrors and threats through armed conflict, is salient to the themes discussed here:

> *These are real, grown up issues that need real, grown up attention by people who are committed — professionally – to trying to figure out what is wrong with their own ideas, and not what is right about them.*

> *Designers are worryingly not involved in that process. Design is trying to prove itself, rather than disprove itself. It is the latter, though, that will serve the social good. (Miller, 2010)*

Despite the rhetoric of interdisciplinarity, design research and design education research have become too convergent and discipline specific. Much like the towers of medieval San Gimignano, academic careers are built by adding layers to one's own discipline tower while attempting to demolish those of others. Trying to prove ourselves wrong may seem counter-intuitive to a field that is trying to gain credibility outside of its usual place in the food-chain, but it is also the mark of self-confidence.

If design, as a broad field, really does want to start doing some good in the world, it is essential that design develops a clearer voice in public discourse. We need to argue the case for design's importance throughout education as an integrated practice and be rigorous in understanding the context in which we operate. That means looking outward, not naval gazing. A glance through the abstracts of a great deal of research journals and conferences points to the latter. This is a terrible irony given the fact that many of us practice human-centred design research that expressly aims to avoid the effects of designing from within ivory towers.

References

Apple Inc. (2010). Apple Reports Second Quarter Results. http://www.apple.com/pr/library/2011/04/20results.html.

Broadcasters' Audience Research Board. (2011). Weekly Top 30 Programmes. Retrieved 25th April, 2011, from http://www.barb.co.uk/report/weeklyTopProgrammesOverview?

Brown, D. (2003). *The Da Vinci Code.* London: Bantom Books.

Brown, T. (2009). *Change by Design: How Design Thinking Transforms Organizations and Inspires Innovation*. New York: HarperBusiness.

Cox, B. (2010). Wonders of the Solar System [Television Series]. London: BBC and Science Channel.

Coyne, R. (1988). *Logic models of design*. London: Pitman.

Dervin, B. (2003). Sense-Making's Journey from Metatheory to Methodology to Methods: An Example Using Information Seeking and Use as Research Focus. In B. Dervin & L. Foreman-Wernet (Eds.), *Sense-Making Methodology Reader: Selected Writings of Brenda Dervin* (pp. 141-146). Cresskill, NJ: Hampton Press, Inc.

Goldacre, B. (2011). Bad Science. Retrieved 28th March, 2011, from http://www.guardian.co.uk/science/series/badscience.

Higher Education Directorate. (2004). Report On The Science, Technology, Engineering & Maths (STEM) Mapping Review.

Johnson, S. (2010). *Where Good Ideas Come from: The Natural History of Innovation.* Riverhead Books.

Klein, G., Moon, B., & Hoffman, R. (2006). Making Sense of Sensemaking 1: Alternative Perspectives. *Intelligent Systems*, *21*(4), 71.

Kolko, J. (2010a). Abductive Thinking and Sensemaking: The Drivers of Design Synthesis. *Design Issues, 26*(1), 15-28.

Kolko, J. (2010b). *Sensemaking and Framing: A Theoretical Reflection on Perspective in Design Synthesis*. Proceedings from Design Research Society.

Kolko, J. (2011). *Exposing the Magic of Design: A Practitioner's Guide to the Methods and Theory of Synthesis.* New York: Oxford University Press.

live|work (2008). Service Design definition. Retrieved 11th May, 2009, from http://www.servicedesign.org/glossary/service_design/.

Løvlie, L., Polaine, A., & Reason, B. (Forthcoming). *Service Design: Designing Useful, Usable And Desirable Services.* New York: Rosenfeld Media.

Maeda, J. (2009). Stem of an Idea. Retrieved 28th March, 2011, from http://our.risd.edu/2009/08/20/stem-to-an-idea/.

Maeda, J. (2010). On Meaningful Observation. Retrieved 28th March, 2011, from http://seedmagazine.com/content/article/on_meaningful_observation1/.

Miller, D. B. (2010). Concerning Design Ethics for International Peace and Security [Lecture delivered to the University of Gothenburg, Business and Design Lab, 6 October 2010]. Geneva: UNIDIR.

Miller, D. B., Rudnick, L., Kimbell, L., & Philipsen, G. (2010). Conference Report. *The Glen Cove Conference on Strategic Design and Public Policy*.

Nielsen BookScan. (2011). Top-selling 100 books of all time. Retrieved 25th April, 2011, from http://www.guardian.co.uk/news/datablog/2011/jan/01/top-100-books-of-all-time#data.

Norman, D. (2010). Why Design Education Must Change. Retrieved 14th April, 2011, from http://core77.com/blog/columns/why_design_education_must_change_17993.asp.

Peirce, C. S. (1998). *The essential Peirce: selected philosophical writings, 1893-1913.* Bloomington: Indiana Univ Pr.

Robinson, K. (2007). *Out of our minds: Learning to be creative.* Wiley India Pvt. Ltd.

Robinson, K., & Aronica, L. (2009). *The Element: How Finding Your Passion Changes Everything.* Viking Books.

Robinson, K. (2005). How creativity, education and the arts shape a modern economy. *Education Commission of the States, April*.

Schon, D. A. (1984). Problems, frames and perspectives on designing. *Design Studies, 5*(3), 132-136.

Shedroff, N. (2000). An Overview to Understanding. In R. S. Wurman (Ed.), *Information Anxiety 2* (p. 27). Que.

Sunderland City Council, & live|work (2008). Make It Work: Northern Way Worklessness Pilot Project Review.

CUMULUS // DRS SIG on Design Pedagogy
1st International Symposium for Design Education Researchers
Paris Chamber of Commerce and Industry, Paris, France 18–19 May 2011

Eddie Norman (2011). *The Nature of Effective Research Contributions in Design Education*. 52–68

The Nature of Effective Research Contributions in Design Education

Eddie NORMAN*

Loughborough University

The paper begins by discussing the problematic nature of design education research: the essential requirement for continuous curriculum development and the difficulties of making effective research contributions in this context. It will then consider two particular case studies: the IDATER (International Design and Technology Education Research and Curriculum Development, 1988-2001) and the subsequent Design & Technology (D&T) Association Education and International Research Conferences (2002 onwards). The IDATER conferences were established in 1988 to develop a research foundation for the introduction of the National Curriculum in England in 1990. The D&T Association conferences continued these efforts, and also brought the research contributions into closer proximity with teachers.
Research published through these conferences ie contributions to IDATER and the D&T Association International Research Conferences), has been analysed in terms of their originators, their methods and intentions, and placed in the context of wider research contributions to design and technology education in this period. A sample of 3 IDATER conferences were selected and analysed: 1990, 1995 and 2000. These are representative of the conference's lifecycle. The 2005 D&T Association Conference was analysed for comparison
Some conclusions are then offered concerning the nature of effective research contributions and research infrastructure for these areas of design education.

Keywords: Design education; Effective research; Analysis; Conference contributions

* *Corresponding author:* Loughborough Design School | Loughborough University
Loughborough| LE11 3TU| UK
e-mail: E.W.Norman@lboro.ac.uk

Introduction

Perhaps the appropriate place to begin this paper is by noting recent views on the nature of effective research contributions in education. It is not possible to explore these positions extensively, but they place the discussion of effective research contributions in design education within one of their wider contexts.

> *Educational research has long been criticized for its weak link with practice. Those who view educational research as a vehicle to inform improvement tend to take such criticism more seriously than those who argue that studies in the field of education should strive for knowledge in and of itself. (van den Akker et al, 2006:4)*

This quotation is taken from the introduction to the book of edited contributions concerning 'design research'. So, it can be seen that mentioning this work introduces both context and the potential for confusion. However, this is their description of this research strategy.

> *... design research may be characterised as:*
> - *Interventionist: the research aims at designing an intervention in the real world;*
> - *Iterative: the research incorporates a cyclic approach of design, evaluation, and revision;*
> - *Process orientated: a black box model of input-output measurement is avoided, the focus is on understanding and improving interventions;*
> - *Utility orientated: the merit of a design is measured, in part, by its practicality for users in real contexts; and*
> - *Theory orientated: the design is (at least partly) based upon theoretical propositions, and field testing of the design contributes to theory building (ibid: 5)*

The authors of this book clearly believe that 'design research' offers an effective strategy towards meeting the criticisms of conventional educational research. So, perhaps the research question that this paper is ultimately addressing is this.

> *Are Effective Contributions In Design Education Research Significantly Different To Effective Research Contributions In General Education?*

And one approach to the analysis is to consider the similarities of contributions made to design education research to these characteristics.

Design Education Research

Contrary to occasional rumours, there are a substantial number of research contributions in the area of design education that can be mined for data to investigate this proposition. As Table 1 indicates, in relation to research concerning design in general education, which is the key context of the case studies presented, contributions are well documented back to around 1970. The online hub, www.dater.org.uk, was established in 2008 to provide a central access point to the archives of research outputs (estimated number of outputs in brackets) from *IDATER* (397), *D&T Association International Research Conferences* (178*), NADE (National Association for Design Education)* journals (90), Orange Series publications (10) and *Design and Technology Education: an international journal* (155) and its predecessors (1158)*. The hub facilitates a simultaneous online search of nearly 2000 research outputs. These are all open access, so that teachers have immediate access in support of practitioner research. The origins of these research outputs are highlighted in Table 1, and it can be observed that there are many other important sources (eg the *PATT* and *CRIPT* conferences and academic journals, such as the *International Journal of Technology and Design Education* and *The Journal of Technology Education).* Design education research is not a new area of activity, and there is a plausible case for considering its origins in the work of Pestalozzi (1746-1827), Fröbel (1781-1852), Cygnaeus (1810-1888) and Salomon (1849-1907), who developed the Sloyd approach (see Ólafsson and Thorsteinsson, 2009).

There will be debates about the rigour of the quality control procedures associated with some of these research outputs, but nearly all were peer reviewed. So academic colleagues at the time of their publication believed that were worthy of publication and for the purpose of this study, that is deemed to be sufficient in order to consider them to have made an effective contribution. The *IDATER* and *D&T Association* conference contributions were refereed by 2 members of an invited panel.

The essential difficulty with design education research is its breadth and this can be demonstrated through a discussion of the nature of effective research contributions in this area.

* *The Journal of Design and Technology Education (368 outputs, 1996-2004), Design and Technology Teaching (279 outputs, 1989-1995) and Studies in Design Education, Craft and Technology (511 outputs, 1968-1988)*

Table 1 Key research events 1968-2011 surrounding the emergence of design and technology in England[*]

Year	Research events
1967	• Project Technology started at Loughborough College of Education (ended 1972)
1967	• The Keele Project: Design and Craft Education started (ended 1973)
1968	• *Studies in Design Education and Craft (*later Studies in Design Education, Craft and Technology) launched
1969	• Art and Craft Education 8-13 project started at Goldsmiths' College (ended 1972)
1974	• Design in General Education project started at the Royal College of Art (ended 1975)
1973	• *International Perspectives of Design Education Conference*, University of Keele
1980	• Keith-Lucas report on Design Education at Secondary Level published by the Design Council
1982	• Understanding Design and Technology report by the Assessment of Performance Unit published
1984	• Graded Assessment Project - Kings College and ILEA: GAME, GAML, GACDT. Origin of 10 National Curriculum levels
1985	• First *Pupils Attitudes to Technology* Conference (*PATT*) • APU D&T Project National Survey launched (1985 – 1990)
1988	• **1st DATER (*Design and Technology Educational Research and Curriculum Development*) Conference at Loughborough University. One of a series of annual conferences.** • *Best of Studies in Design Education, Craft and Technology* published
1989	• *Studies in Design Education, Craft and Technology* relaunched as *Design and Technology Teaching: a journal of new approaches* • *The Journal of Technology Education* is launched by the ITEA
1990	• TERU (the Technology Education Research Unit) was founded at Goldsmiths, University of London
1991	• Final APU Report of The Assessment of Performance in Design and Technology published • *The International Journal of Technology and Design Education* is published by Trentham Books

[*] *Updated from (Norman et al, 2007:2). The author is grateful to colleagues for their comments and suggestions relating to a draft of this table, but of course accept full responsibility for any errors or omissions.*

1992	• ***DATER* relaunched as an international conference *IDATER*** • *Teaching Design and Technology* published • Loughborough University's Orange Series of publications is launched • 1st *PATT* Conference held in association with the ITEA • *Journal of the National Association for Design Education* launched (... published until 2002) • *INCOTE* (*International Conference on Technology Education*) Weimar, Germany
1994	• Nuffield Project, RCA Schools Technology Project and TEP launched
1996	• *Design and Technology Teaching: a journal of new approaches* is relaunched as *The Journal of Design and Technology Education* • *Understanding Practice in Design and Technology* published • *JISTEC* (*Jerusalem International Science and Technology Education Conference*)
1997	• Publication of *The International Journal of Technology and Design Education* transfers to Kluwer • 1st *CRIPT* (*Centre for Research in Primary Technology)* conference at Birmingham City University (formally the University of Central England). The first of a series of biennial conferences • 1st *TENZ* (*Technology Education New Zealand*) Conference • *Assessing Technology* published
2000	• *Design and Technology International Millennium Conference* in London • Publication of *Teaching and Learning Design and Technology: a guide to recent research and its applications* • Engineering Council publications launched *Interaction: the Relationship between Science and Design and Technology in the Secondary School Curriculum* (2000) *Design and Technology in a Knowledge Economy* (2001) *The Continuum of Design Education for Engineering* (2001) • *WOCATE* conference in Braunschweig, Germany •1st Biennial *Technology Education Research Conference* (*TERC)* in Australia organised by Griffith University. The first of a series of biennial conferences
2001	• **14th and final *IDATER* conference at Loughborough University**
2002	• ***1st Design and Technology Association Education and International Research Conference*. The first of a series of annual conferences**
2003	• Publication of *Designs on the Curriculum? A review of literature on the impact of design and technology in schools in England* • Strategy Group Report *The Unique Contribution of Design and Technology* published
2004	• Loughborough's Design Education Research Group and the D&T Association jointly publish *Designerly Activity and Higher Degrees* (2004), *A Framework for Design and Design Education* (2005) and *Design and Democracy* (2005)

2005	• *The Journal of Design and Technology Education* is relaunched as *Design and Technology Education: an international journal* • *PATT-15*, the 20th Anniversary Conference was held in Haarlem leading to the publication of the *International Handbook of Technology Education* by Sense Publishers • Project *e-scape* was founded at TERU
2006	• *Defining Technological Literacy: Towards an epistemological framework* published by Palgrave
2007	• *Researching Design Learning: Issues and findings from two decades of research and development* published by Springer • *Analysing Best Practices in Technology Education* published by Sense • First *IDATER Online* conference proceedings published *E-learning in Science and Design and Technology* • *Design & Technology – For the Next Generation* published by Cliffeco
2008	• *Researching Technology Education* and *The Cultural Transmission of Artefacts, Skills and Knowledge* published by Sense • The Online Hub www.dater.org.uk is launched and action research poster distributed • New MA in Design Education launched by Goldsmiths
2009	• Launch of 'Modelling' seminars and Orange Series publications • Launch of the DRS DESIG
2010	• Design education strand included in the DRS Conference in Montreal
2011	• 1st Cumulus/DRS Symposium in Paris • Design education strand included in the IASDR Conference in Delft

Nature of Research Contributions

Analysing research contributions in terms of their originators and the methods used is straightforward, but considering their intentions necessitates the development of an appropriate framework. A useful strategy is to consider research as targeted at one of three areas.

- The designer(s): the individual(s) their capabilities and their competences for designing
- The design context: the analysis of the knowledge, skills and values that they might possess
- The interface: tools for designing and organisational structures that enhance designer's capabilities, competences and access to their context.

Some discussion of each of these is necessary to explain their use.

The designer

Human capabilities are characteristics that can be developed and people are said to be competent when they have sufficient, knowledge, skills or values for a particular purpose. The relationships indicated in Figure 1 can be understood by asking:

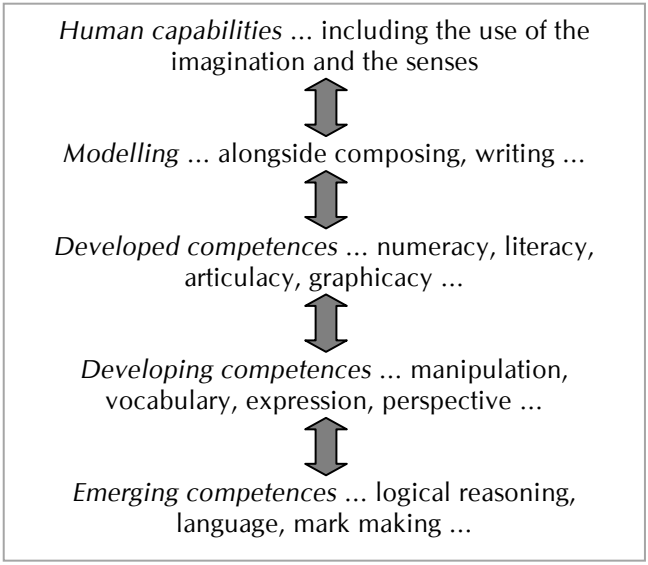


Figure 1. Human capabilities and a hierarchy of competences in the context of designing

- What makes using the imagination and the senses possible

One answer to this question would be modelling (Baynes, 2009a); capability in which would appear to be a fundamental human characteristic (Doyle, 2004). Modelling embodies the use of the imagination and senses in the context of designing.

- What makes modelling possible?

Developed competences in numeracy, literacy, articulacy, and graphicacy clearly play their part, and are what is immediately evident in an educational context. However, this question runs much deeper into areas of cognitive psychology. For example, how does the cognitive modelling that brings together the past, present and futures influences on a designing task within the human mind take place?

- And, for example, what makes graphicacy possible?

Developing competences in areas such as perspective would again be part of the unfolding story, but these will only be possibilities as competence in areas such a mark making emerge (Danos, 2011)

The way these capabilities and competences find expression changes. The use of the imagination and the senses is interwoven with the development of human societies and culture; modelling strategies are linked to economic development (Baynes 2009b) and technological change; and developed and emerging competences are linked to the consequences of such development and changes. For example, the place of drawing in children's upbringing and early approaches to numeracy are linked to the evolution of electronic products and communication technologies.

So, in relation to this consideration of the designer's capabilities and competences the inter-disciplinary nature of design research is apparent, as well as the associated potential for contributions from many areas. The need for continuous reappraisal of these matters and associated curriculum development is also evident.

The design context

Analysing the knowledge, skills and values that relate to the design field, or particular design areas is another possible strategy for seeking to contribute to design education research. There is, of course, no reason to assume correlation between the knowledge, skills and values that designers in a particular design area could possess and those that they do possess, but the gaps help to define targets for curriculum planners and policy makers, for the designers of 'tools for designing', and for continuous personal and professional development. It is possible to research these areas separately eg knowledge (de Vries 2003; Friedman, 2001), skills (Design Skills Advisory Panel, 2007) and values (Trimingham, 2007). It is also possible to research them together under headings such sustainable design and design for emotion.

When considering design education research relating to 'the design context', the inevitable overlaps with design research become apparent.

The interface

Design tools, such as computer-aided design and manufacture (CADCAM), the Cambridge Engineering Selector (CES) materials database, computer-aided ergonomic modelling (eg SAMMIE CAD[*]), Ardhuino[†] and web-based design

[*] *For information about SAMMIE CAD see http://www.sammiecad.com/*

[†] *For information about Arhuino, which is an open source electronic prototyping platform, see http://www.arduino.cc/*

guides (eg *Information-Inspiration*[*]) change the relationship between the designer(s) and their context. They provide access to 'capabilities and competences' that can far exceed those the designer(s) can possess without such technological enhancement.

If you accept a wide enough definition of technology that includes social and economic organisation, then sufficient has already been said, but it is worth noting that team or group work, a well-designed and resourced working environment, social networking and well-managed supply chains can also enhance designer's capabilities.

So with effective design education research contributions spanning the designer's changing capabilities and competences, the evolving contexts of their designing, together with tools and organisational structures developed to support their interface, the complexity of the research area is apparent.

IDATER and Design & Technology Association Conferences

The first Design & Technology Educational Research and Curriculum Development conference, *DATER88* was held at Loughborough University in 1988 and directed by John Smith, who continued in this role and established the conferences until 1998 (when the author became the Co-Director). The conference became 'international' in 1992 (ie *IDATER*) as it became clear that the growth of design and technology in schools' curriculum provision was a truly international phenomenon and delegates from all around the world attended the *IDATER* conferences. In 2002, the Design and Technology Association took over the mantle of running this series of conferences and the first of *The Design & Technology Education and International Research Conferences* took place. This development both ensured the continuation of the conferences and the continued proximity of research and practice (for more details see Norman et al, 2007) and *IDATER* moved online. *IDATER Online* targets specific issues such as Graphicacy and Modelling in 2010/11[†].

Four conferences at 5 yearly intervals have been selected for analysis as shown below. These case studies represent this series of conferences, which shared essentially the same purpose: namely supporting the development of design and technology in general education in the UK, and internationally. They have also been chosen as representing the 'high points' of the series and thus to avoid the inclusion of issues relating to establishing procedures and formats, or transferring the conference's governance in the data analysis.

- *DATER90:* two years after the first conference and it was still finding its feet

[*] For information about *Information-Inspiration* see http://www.informationinspiration.org.uk/

[†] *See http://idater.lboro.ac.uk/*

- *IDATER95:* at the peak of its influence
- *IDATER2000:* towards the end and the year in which the decision was taken to run 'just one more'
- *D&TA2005:* held at Sheffield Hallam University and one of the more influential of the new conference series

The papers contributed to these conferences have been analysed in terms of their originators, methods and intentions. It should be noted that *IDATER* always sought to support practitioner research, as illustrated by two key theoretical contributions to the understanding of action research as a designerly mode of enquiry. These were made in the Keynote Addresses by Professor Bruce Archer at *IDATER91* and Professor Phil Roberts at *IDATER2000*. Archer's Keynote was an early publication in the Orange Series, in which he considered a designerly approach to research.

> *A designerly approach, rather than a scholarly or scientific approach, can with advantage be made towards educational research and curriculum development. Design, in a certain sense, is research done backwards. Research starts with the particular, and moves towards the general. Design starts with the general and works towards the particular. Designers are told, or decide, at the outset, what their end product must be and do. They begin by conceiving of one or more broad configurations that seem likely to be, and to do, what is required. They then elaborate the structure of these configurations and develop the subsystems of one or more of the most promising proposals. They then detail the construction, working backwards to the particular, the bits and pieces, upon whose correct construction depends the efficacy of the whole. At various stages, the validity of assumptions is checked and performances are measured. (Archer, 1992:12)*

Archer's approach has clear similarities to 'design research' as conceived by its current advocates for general educational issues (op cit, 2006)

Among the objectives of Roberts' Keynote Address were the support of action research as a mode of inquiry and development that is especially appropriate to D&T educational practitioners; the support of the teacher-as-researcher (or practitioner-as-researcher); and the support of the position that action research within education (and D&T education) is intended to improve practice. He described action research as follows.

> *At its simplest, classroom action research relates to any teacher who is concerned with his/her own teaching: to the teacher who is prepared to question his/her own approaches in order to improve the quality of teaching and learning. Hence, the teacher/practitioner is involved in looking at what is actually going on in the classroom [or studio/workshop]. He/she seeks to improve his/her own understanding of a particular problem (or state of affairs) rather than to impose an instant 'solution' upon that unarticulated problem. It is crucial that time be taken for thought and reflection, and it is implicit in the idea of action research that there should be some practical effect of, or end product to, the research which would be based on a now increased awareness of what actually happens in the classroom. It is, as a consequence, towards the construction of a practitioners' theory, constructed from their experience; and it would intend to be useful.*
>
> *On this view, some of the characteristics of educational action research are that:*
> *1 its activities and objects are concerned with the deepening of understanding of the studio, workshop, classroom, and school situation by the teacher/researcher adopting a critical, questioning stance. Its starting points are the 'practical problems' experienced by teachers, rather than the problems found within the formal theories of the 'education disciplines'.*
> *2 The presentation of its reporting is in ordinary everyday language, and might well take the form of a case study or story. It adopts the action perspective of practitioners and employs their everyday language to describe and investigate its subject-matter states of affairs.*
> *3 Reflection on experience is part of its processes.*
>
> *Not all would agree with this, obviously simplified, characterisation of action research, and one of IDATER's functions should be to stimulate discussion about its nature and nuances. (Roberts, 2000:18)*

These quotations have been included to put the results of the analysis of the research outputs in an appropriate context.

Case study results

The results for the analysis of the research outputs reported at these conferences are shown below in terms of their originators (Table 2), research methods (Table 3) and intentions (Table 4).

In relation to Table 2, IDATER might be considered to be at its most successful at the point at which the decision was made to end the series (ie in 2000). The number of authors of research outputs from England had reduced to 14, but 43 of the 48 authors were from higher education. Hence the links to, and impacts on, practice could be considered to be at risk. However, the move to organise the research conference alongside the D&T Association's education conference in 2002 did not significantly alter this position, except in increasing the proportion of contributors from England.

Table 3 shows that the nature of the research methods being employed was changing. At *DATER90*, the dominant form of activity was document analysis; at *IDATER95* the use of empirical data and case studies to support the document analysis emerged; at *IDATER 2000* case studies had become the major research activity; and at *ID&TA2005* empirical data and its use in support of case studies were central.

Table 4 shows how the research intentions of the contributors switched over this 15 year period. At each conference there were research outputs focussing on the designer and the development of their capabilities. However, there was a clear movement away from outputs related to the design context and towards the interface between the designer and their context.

*Table 2 Originators of contributions to IDATER and D&T Association Conferences**

		1990 DATER	**1995 IDATER**	**2000 IDATER**	**2005 ID&TA**
Total number of papers		28	32	26	21
Total number of authors		37	43	48	34
Affiliations of authors	*Higher Education (academic)*	*21*	*37*	*41*	*31*
	Higher Education (research assistant/student)	*2*	*1*	*2*	*2*
	General Education	*6*	*1*	*3*	*0*
	Education other	*5*	*3*	*0*	*1*
	Design/Industry	*3*	*1*	*2*	*0*
Countries of origin		England (x36) USA	England (x29) Australia (x4) Botswana Bulgaria Germany Greece Hungary Scotland (x2) USA (x2) Zimbabwe	England (x14) Australia (x2) Canada (x3) Indonesia Israel (x2) New Zealand (x2) Northern Ireland (x3) Taiwan Wales (x8) Japan (x3)	England (x25) Australia (x3) Canada (x2) Cyprus (x2) Northern Ireland Sweden

* *Keynote speakers have been excluded and a maximum of 3 authors per paper recorded in order to avoid distorting the analysis.*

Table 3 Research approaches of contributors to IDATER and D&T Association Conferences

	1990 DATER	1995 IDATER	2000 IDATER	2005 ID&TA
Document analysis	12	9	2	1
Document analysis + case studies	4	7	5	0
Document analysis + empirical data	2	13	3	4
Case studies	5	0	9	0
Empirical data	4	3	2	6
Case study + empirical data	0	0	3	12
Literature review	1	0	0	0
Literature review + empirical data	0	0	2	0

Table 4 Research intentions of contributors to IDATER and D&T Association Conferences

	1990 DATER	1995 IDATER	2000 IDATER	2005 ID&TA
The designer	7	10	5	7
The design context	13	10	9	2
The interface	8	12	12	12

Discussion

It was not surprising to find that early research outputs were seeking to analyse documents that were defining the National Curriculum in Design and Technology, which was due to be implemented in 1990. In relation to van den Akker et al's characteristics of design research in general education (2006), these research outputs could be interpreted as 'interventionist': defining aims for real world interventions (ie within the educational practice).

The shift towards case study research and their evaluation as the *IDATER* conference series progressed also closely parallels the second and third characteristics: 'iterative' and 'process orientated'. The focus shifted towards designing interventions and gathering data, both qualitative and quantitative, in order to improve them.

The fourth and fifth characteristics, 'utility orientated' and 'theory orientated' both echo *IDATER's* underpinning philosophy as expressed by Roberts at *IDATER2000*. On-going conversations towards the development of a practitioner's theory were always the targets of this conference series. Improving practice in learning situations whether studios, workshops, or classrooms was the essential goal, so yes, utility and theory orientated. Theoretical propositions were being evaluated through case studies and typically adopting Archer's designerly methods in forms of action research.

So, what can be said of how these findings might relate to other aspects of the research context during this period. In 1989, *Studies in Design Education, Craft and Technology* was relaunched as *Design and Technology Teaching: a journal of new approaches*. This reflected the need for change and paralleled *IDATER's* emergence. In 1995, It was relaunched again as the *Journal of Design Education* and in his final Editorial John Eggleston wrote as follows.

> *The new feature will be a regular selection of the growing body of new research that is now available for the enlightenment of practitioners in the field – much of it being generated by practitioners themselves.*
> *(1995:3)*

By 1995, new research was being undertaken and reported in support of evolving practice, and in sufficient quantity to justify this relaunch with research as the focus of the change. By *IDATER 2000* international conferences had emerged around the world (eg the *TENZ* conferences in New Zealand (1997) and the *TERC* conferences in Australia (2000)). By 2005 the *PATT* conferences had grown strong enough for its 20th anniversary proceedings to be published by Sense as the *International Handbook of Technology Education,* and (design and) technology education had become a truly worldwide phenomenon.

The Design Research Society (DRS) had editorial control and directed strands of papers at both *IDATER 99* and *IDATER2000*, and the new Design Education Special Interest Group (DESIG) emerged in 2009. And in 2011, there is the 1st DRS/Cumulus Paris Symposium, perhaps marking a further milestone in the evolution of design education research.

Conclusions

It can be reasonably concluded that the analysis of the sample of 4 conferences spanning the period from 2000-2005 confirms the characteristics of effective research proposed by van der Akker et al in 2006 for general education. A model of research had evolved in relation to design education during 1990-2005 that supports these propositions, although there is no apparent indication than van der Akker, or his colleagues were aware of this or referred to it. The choice of 'design research' as a label for these approaches to research in general education reflects the recognition of the importance that designerly methods should be afforded. However, it is not clear that they are valued in this way, or perhaps even recognised as reflecting one of the higher order human capabilities; as they might be.

References

Archer, L. B. (1992). The Nature of Research into Design and Design Education. In B. Archer, K. Baynes and P.H. Roberts (Eds.) *The Nature of Research into Design and Technology Education* (pp 7-13). Loughborough University of Technology, UK: Department of Design and Technology.
Retrieved 25 March, 2011, from
http://magpie.lboro.ac.uk/dspace/bitstream/2134/1687/1/Archer_Baynes_Roberts.pdf

Baynes, K. (2009a). *Models of Change: the Impact of 'Designerly Thinking' on People's Lives and the Environment: Modelling and Design.* Loughborough University of Technology, UK: Department of Design and Technology.
Retrieved 25 March, 2011, from
https://dspace.lboro.ac.uk/dspace-jspui/handle/2134/5165

Baynes, K. (2009b). *Models of Change: the Impact of 'Designerly Thinking' on People's Lives and the Environment: Modelling and Society.* Loughborough University of Technology, UK: Department of Design and Technology.
Retrieved 25 March, 2011, from
https://dspace.lboro.ac.uk/dspace-jspui/handle/2134/6092

Danos, X., Norman, E., Storer, I. and Robson, J. (2010). Identifying Continuity and Progression in the Development of Graphicacy. In D. Spendlove and K. Stables (Eds.) *D&T – Ideas Worth Sharing: The Design and Technology Association Education & International Research Conference* (pp 33-52). Wellesbourne: The Design and Technology Association.
Retrieved 25 March, 2011, from
http://www.data.org.uk/index.php?option=com_content&view=article&id=637&Itemid=566#conference

Design Skills Advisory Panel (2007). *High-level Skills for Higher Value*, London: Design Council & Creative Cultural Skills.
Retrieved 25 March, 2011, from
http://www.ukdesignskills.com

de Vries, M. (2003). 'Design Matters, and So Does Philosophy of Design: John Eggleston Memorial Lecture', *Journal of Design and Technology Education*, 8(3), 150-153.
Retrieved 25 March, 2011, from
https://ojs.lboro.ac.uk/ojs/index.php/JDTE/article/view/648

Doyle, M. (2004). The Evolution of Technicity: Whence Creativity and Innovation? In E.W.L. Norman, D. Spendlove, P. Grover and A. Mitchell (Eds.), *Creativity and Innovation: DATA International Research Conference 2004* (pp 67-72). Wellesbourne: The Design and Technology Association.
Retrieved 25 March, 2011, from
https://dspace.lboro.ac.uk/dspace-jspui/handle/2134/2837

Eggleston, J. (1995). Editorial, *Design and Technology Teaching*, 1(1), 3-4
Retrieved 25 March, 2011, from
https://ojs.lboro.ac.uk/ojs/index.php/DTT/article/viewFile/1444/1401

Friedman, K. (2001). Creating Design Knowledge: from Research into Practice. In E W L Norman and P H Roberts (Eds.), *Design and Technology Educational research and Curriculum Development: The Emerging Research Agenda*. Loughborough University of Technology, UK: Department of Design and Technology.
Retrieved 25 March, 2011, from

https://dspace.lboro.ac.uk/dspace-jspui/handle/2134/953

Norman, E.W.L., Mitchell, A., Zanker, N. P. and Patterson, A. (2009). Developing the Research Infrastructure for Design and Technology Education in England (and Beyond). In *PATT2009*, M J de Vries (Ed.), September 2009, TUDelft University Retrieved 25 March, 2011, from http://www.iteaconnect.org/Conference/PATT/PATT22/Norman.pdf

Ólafsson, B. and Thorsteinsson, G. (2009). Design and Craft Education in Iceland, Pedagogical Background and Development: a Literature Review, *Design and technology Education: an international journal,* 14(3), 10-24. Retrieved 25 March, 2011, from http://ojs.lboro.ac.uk/ojs/index.php/DATE/article/view/246

Roberts, P. H. (2000). Aspects of Research Concerning Design Education. In E.W.L.Norman and P.H.Roberts (Eds.), *Design and Technology Educational Research and Curriculum Development: The Emerging International Research Agenda*. Loughborough University of Technology, UK: Department of Design and Technology. Retrieved 25 March, 2011, from http://magpie.lboro.ac.uk/dspace/bitstream/2134/953/1/norman-roberts2001.pdf

Trimingham, R. L.(2007). *An Exploration of the Roles Values Play in Design Decision-making*, PhD thesis. Loughborough University of Technology, UK: Department of Design and Technology. Retrieved 25 March, 2011, from https://dspace.lboro.ac.uk/dspace-jspui/handle/2134/7975

van den Akker, J., Gravemeijer, K., McKenney, S. and Nieveen, N. (2006). (eds), *Educational Design Research*, London and New York; Routledge.

CUMULUS // DRS SIG on Design Pedagogy
1st International Symposium for Design Education Researchers
Paris Chamber of Commerce and Industry, Paris, France 18–19 May 2011

Katrina Nordstrom (2011). *Retrofitting Science Education at Aalto University Design Factory: Conceptualizing Scientific Facts.* 69–83

Retrofitting Science Education at Aalto University Design Factory: Conceptualizing Scientific Facts

Katrina NORDSTROM*

Aalto University

Traditional engineering education in the European system continues to face many challenges. Classes are often large, topics are scientifically demanding and the curriculum is multidisciplinary, containing natural sciences, engineering and technology, including a significant mathematics-physics-information sciences requirement. Teaching scientific fact in the engineering curriculum is thus clearly a challenge. On one hand, mastering a scientific discipline or domains, and command of facts is an essential part of the learning process, whereas achieving a deep learning process, where knowledge is created or constructed by every learner is difficult to achieve in the traditional instruction and classroom setting. Accordingly, to develop every-day, real-life "classroom" tools for teaching of scientific fact in conjunction with development of social and team work skills, this communication presents the design and results of teaching science at Aalto University Design Factory with the aim of developing a concrete model of engagement through student commitment to shared tasks via problem solving. Deep learning of scientific fact can be facilitated by using non-conventional tools for teaching, learning and presentation such as drama, video, posters, model making and other similar means. It is also time to break free of the PowerPoint tradition in order to generate successful approaches for establishing student engagement and maintaining such engagement. The aim of this communication is to a) provide evidence-based assessment of learning for demonstrating that deep learning of scientific fact can be achieved and how the skills associated with scientific disciplines can most effectively be adopted into student learning processes, b) propose that focusing on group activities and development of the learning space, real-life and virtual, allows students more broader means for evidence based learning, and

* *Corresponding author:* Department of Biotechnology and Chemical Technology | University Kemistintie 1| PO 16100, 00076 Aalto | Finland
e-mail: katrina.nordstrom@tkk.fi

c) demonstrate the value of creativity as part of coaching novices into experts as part of a team via continuous engagement.

Keywords: Science, engineering, teaching, conceptualizing, learning spaces

Introduction

Engineering education in Europe continues to be dominated by an objectivist concept of learning. Even today it is widely assumed that passive listening to a lecture could somehow transmit knowledge from the teacher to the student. Learning is still also most commonly assessed by a written exam, which emphasizes the ability to memorize and recite details, rather than assessing the process of deep learning (Arbauch and Benbunnan-Fich, 2006). However, listening to and watching a lecturer and consequent recitation of detail and facts is clearly not the optimal avenue for students to absorb the skills that are necessary for sophisticated problem solving (Breslow, 2001), which is at the crux of the skills of the engineering profession.

Teaching scientific fact within the engineering curriculum is thus clearly a challenge. On one hand, mastering a scientific discipline or domain, and command of facts is an essential part of the learning process. On the other hand, achieving a deep learning process, where knowledge is created or constructed by every learner is difficult to achieve in the traditional instruction and classroom setting. According to Leidner and Järvenpaa (1995) students learn better when they are provided with the opportunity to discover concepts rather than being formally instructed. Moreover, participation in group work results in deeper learning as interaction with other students affects mechanisms of cognitive processes. Such mechanisms necessitate student participation in debate, resolution of conflicts or disagreement, as well as peer- and self-assessment (Benbunan-Fich and Hiltz, 2003; Arbauch and Benbunan-Fich, 2006). In such a learning environment, the instructor functions more as a consultant rather than as the conventional teacher (Johanssen et al. 1995) and a "cognitive apprenticeship" approach (Breslow, 2001) to instruction can be achieved. Genuine engagement can only be achieved by active collaboration in an environment, which fosters a shared, multidirectional process of teaching and learning (Rice, 2004).

New avenues for high engagement

Today, there are many options for promoting learning including verbal, digital, or visual tools or approaches, which draw on the emotional traits of the learner and increase personal and group commitment. Deep learning is supported by an environment that favours activity and experience as it fosters immediate engagement (Biggs, 1999; Holtham and Courtney, 2006).

However, maintaining engagement is also needed as it will ultimately reflect onto the fate of the learning process (Holtham and Courtney, 2006). The conclusions by Ramsden (1988) on the importance of viewing learning as a qualitative change in an individual, rather than as a quantitative change in the amount of knowledge someone possesses, are very poignant to engineering and science education.

Physiological aspects of learning have shown that active engagement with the learning object e.g. a lecture, laboratory assignment, text, or creative medium increases the likelihood that the learner will both retain and be able to use information and skills later (Zull, 2002; Grummon, 2009). Accordingly, inspiring learning spaces should be provided for students and teachers, where formal and informal activities meet. In line with such argumentation, the Aalto University Design Factory (ADF) is the symbiosis of the state-of-the-art conceptual thinking and cross-disciplinary hands-on doing http://www.aaltodesignfactory.fi/). The ADF learning space encourages integration of active learning tools to visualize, explore, and evaluate feasibilities of real-life challenges with scientific fact or theory/methodology. The informal nature of such learning spaces provide unofficial and unscheduled "learnscapes" (Cross, 2007; Aspden and Thorpe, 2009).

Enter a new dimension of space: the virtual world

Learning in the age of technology is, however, not restricted to the physical space, rather virtual spaces have also opened up new avenues for teaching and learning. Of the many virtual technologies, Second Life is currently used by thousands of educators around the world. It is evident that virtual worlds have many significant advantages (Gerald and Antonacci, 2009) compared to solely real-life learning spaces, namely 1) virtual spaces are extremely flexible, allowing learning spaces to be placed, modified, expanded, and moved as needed, 2) such learning spaces can be accessed by others at any time without real-life risks such as biological or chemical hazards to students, staff or facilities. In addition, the risks of failed experiments with expensive reagents and equipment is not an issue in the virtual world, and 3) Virtual world learning spaces are not restricted to the size of a class and can be used in conjunction with real-life laboratory experimentation, to repeat and rerun experiments which is an important part of the learning process.

Accordingly, the present paper discusses the use of novel learning spaces for teaching and learning science and technology in the Chemical engineering program of the Aalto University. First, two science courses are examined, which have been implemented at the Aalto Design Factory in 2009 and 2010. Second, the use of a virtual space for learning will be introduced. Third, views of a teacher on using the Aalto Design Factory as a "learnscape" (Cross, 2007) and virtual learning spaces will be discussed. The emphasis on all of these avenues is on finding a balance between the

everlasting dilemma of can scientific fact be learnt and taught by using non-conventional approaches and learning spaces? It is to be noted that a main goal for this communication is to highlight experiences of a science professor and views on using novel learning spaces, with perhaps a deliberately lighter emphasis on the experiences of the students.

Retrofitting teaching science to novel learning spaces: The Aalto Design Factory Section

Approach 1: Drama, videos, Lego's and cardboard prototypes – is this science?

The Aalto Design Factory is the current venue for the Health Technology Microbiology (5 ECTS) course in the M.Sc. degree program in Chemical technology. The course includes compulsory lecture attendance, group work assignments, a personal portfolio and a written exam (Nordström and Korpelainen, 2011). The assessment is based on three areas of course work, namely the scientific content of the group work (25% of final grade), group work activity as assessed via the portfolio (25%) and written exam (50%). The course is normally taken by some 25-30 students. At the time of the first implementation of the course in 2009 at ADF, the goals for learning outcomes were 1) scientific content of diagnostics and vaccine development and 2) development of skills for group work, problem-solving critical thinking and learning by experiencing. Every week there were lectures and a minimum of 3h of group work was required, although student feedback later indicated that they had spent 6-9h a week on the assignments. The students were divided into 6 groups and each group was given a specific topic and only one reference to current topics in health care and technology. The functioning of each group (i.e. roles of students, taking responsibility vs. "free-riding") was also monitored from feedback at the start, middle and end. However, very surprisingly, the students did not indicate that these typical problems in group work would have emerged, with one exception as addressed below. The group assignments were carried out at the Design Factory of Aalto University, http://aaltodesignfactory.fi/ where students could use tools, materials, dimensions for building and visualizing, such as drawing, Legos', modelling clay, videos, movies, welding, electronics, music etc. However, PowerPoint or written presentations were not allowed. It is important that science and engineering students begin to appreciate that there is frequently a need to be able to express oneself by other means that pre-rehearsed PowerPoint presentations. The goal of the course design was to explore how deep-learning of scientific fact can be promoted by allowing students to work on assignments without any specific pre-determined end-result in a non-conventional learning space and to present the results of their

work by non-conventional presentation tools (Nordström and Korpelainen, 2011).

At the end of the course, all six groups gave their presentations 45 minutes each. After each presentation, each student gave written feedback on every presentation for the following: 1) What was good about the presentation format from a scientific point of view? 2) Did the presentation help you to learn about the scientific aspects of the topic? 3) What specific scientific issues of the topic should have been addressed differently? The first group used drama for learning vaccine development and scientific challenges, and their original reference was http://www.accessexcellence.org./AE/AEC/CC/vaccines_how_why.php. Students presented the assignment by a short play (drama) of the history of vaccine development, followed by poster presentations. The second presentation gave an introduction of facts on Malaria, with short slogans, a 4-phase poster presentation and a video to summarize (http://www.rapid-diagnostics.org/index.htm.). SARS (Severe Acute Respiratory Syndrome) was approached via video with questionnaires to monitor individual learning before and after (http://www.sarsreference.com). Self-made prototypes for Influenza A virus function were used by the fourth group. The students presented the assignment via a prototype model, a short video and by drawing illustrations as the presentation proceeded (http://www.health-kiosk.ch.). The principles of rapid diagnostics were demonstrated by cardboard cut outs and Lego's and the interactions of the necessary biological molecules or reagents as well as technologies that most students were previously not familiar with (http://www.rapid-diagnostics.org/index.htm.). Colour and visualization for HIV immunobiology was the focus of the final presentation, which included a magnetic board where the invasion of the cell by a virus was demonstrated, a "home-made" prototype of the virus, banners and graphs (http://www.rapid-diagnostics.org/index.htm).

At the end of the course students were also asked to list three important themes, specific facts or working methods that they had learnt during the course. Learning was defined as a feeling of change in comparison to the knowledge possessed at the beginning of the course. The answers of the students, which reflect the learning process are presented as original quotes. Students stated that they had learned scientific content with reference to the immune system, immunology, vaccine development, health technology related microorganisms and epidemiology. Moreover, students stated that they had learnt group work skills and innovativeness, and that *"the group work motivated to study, to learn continuously and to question, it encouraged to discuss and ponder, it also generated a need to understand the course topics at a deeper level"*. Students also commented that conflicts and disagreement also emerged, but these could be resolved by compromising. Feedback at the end of the course was dominated by positive replies such as *"learning is deeper when you have to think about your topic in a group",*

"group assignments motivated to study and awakened an interest to study and learn", and *"group work allowed you to get to know other students, to be creative and it was a relief not to prepare PowerPoint presentations".*

Approach 2: Conceptualization of team work should not be pre-assigned

Based on the above experiences with the 2009 course, it was evident that student designed video presentations gave very good learning outcomes for both the group members as well as the audience. Consequently, in 2010, the students participating in another course on Process Industry Microbiology (5 ECTS) all produced only 10 min videos as a result of their teamwork for which the themes were Microbiological processing of radioactive waste, Use of algae in wastewater treatment, Use of aquatic plants in wastewater treatment, Microbial succession in composting, and Bioremediation.

The course was structured in a similar fashion as the preceding 2009 Health Technology Microbiology course. In addition, one lecture was given by a pedagogical expert on how to use video clips for demonstration of skills and knowledge, how to proceed with script writing and technicalities of filming and editing. Moreover, one aim was to evaluate how well the students would utilize the facilities and the equipment available at ADF both for their team meetings as well as for the actual production. After the presentation of the videos the students in the audience were asked to answer feedback questions and the students were also required to fill in self-assessment. When asked if making the video was useful from the point of view of learning the students replied that the videos did help to learn, but felt that the technicalities of making the video were very time consuming. Consequently, the concept of group work became dictated by technical details and students did not achieve the same sense of learning together as was evident during the preceding Health Technology Microbiology 2009 course described above. Overall, it may be concluded that is clearly beneficial for students to be allowed to choose their own modes of presentation. The attempt to standardize the format to videos only demonstrated that the technicalities involved with this type of presentation dominated the work of the students. Moreover, as all groups needed to film and edit at almost the same time, the students resorted to computer classrooms around campus, rather than working at a more relaxed pace at ADF. This also lead to less informal meetings and did not build the same sense of "us" as was evident, when students were free to choose their presentation formats. Clearly, students favour the kind of presentation, which matches their existing skills and pushing students to use other means of presentation may result in less effort being spent on learning the actual scientific content of the course.

Lessons learnt – views of the teacher

The learning outcomes were certainly achieved and exceeded all expectations for scientific content and development of skills for both courses. Student feedback for the first course in 2009 was dominated by statements on building an understanding, making connections, and storing into deeper memory and point towards an active process of constructing knowledge (Biggs 1999). Students stated that *"the theory behind vaccine development combined with the drama presentation gave a deeper understanding of the topic, which I will remember"*, *"modern vaccine development also became understandable due to the clear poster presentation"*, and *"the presentation was well in line with the topics covered by the lectures, the overlap was very good for learning purposes"*. The video presentation of Malaria and SARS were also praised as an excellent way of repeating what had been presented and *"the video helped me to correct my previous misunderstanding of Malaria"*. Moreover, the students who had enacted a video on SARS had devised also a questionnaire for fellow students' knowledge of SARS before and after the video. The students in the audience commented that *"the final questionnaire was an excellent idea, it was great to see what you had learnt during the presentation and it was also good to see how little you had known even at the start"*, *"the answers to the questions, were easy to retained in memory"*, *"the questionnaire attracted my attention and I became interested"*. Virus prototypes, which were very "home-made" and built by the students themselves from styrofoam, wiring, aluminium foil and wool yearn, clearly promoted learning. Students commented e.g. that they finally understood why H and N (= surface structures protruding from virus surface) are important for the virus, as well as the global classification of these infectious agents. Cardboard cut outs and building Lego models for immunodiagnostic kits was also thought to be useful as students could see how each test proceeds in reality, i.e. *"It was very useful to see how each test proceeds in reality"* and students commented that *"by demonstrating the tests in a simplified format it was easy to understand the function and the requirements for each test performance"*. Finally, although the immunobiology of HIV is scientifically a very challenging topic, students did feel that use *"of a magnetic board to demonstrate the invasion of the cell by the virus was very useful and made even this difficult topic understandable"*.

Interestingly, not only did the students feel that they had genuinely learnt about their own topic they also had learned significant scientific content from presentations given by other students. This, from a teacher's point of view is a major achievement, as when using the traditional PowerPoint presentations, student feedback usually comes back negative, i.e. they retain very little from oral presentations given by their peers and they tend to be so nervous that they claim they cannot even remember what they presented themselves. Notably, no student complained about being nervous, or seemed in any way uncomfortable during these presentations. On the other hand, there were

three students, who became frustrated during the team assignments and complained that the teacher should have divided the topics amongst the team members and given more information on what was the expected result of the task. All these students were individuals who tended to strategically aim at very high grade point averages and therefore demonstrates that such students may have difficulty to adjust to new learning technologies. Due to some overlapping courses, these high achievers ended up in the same group and this was clearly the only group, where feedback indicated that certain individuals were very strong personalities, which subdued some other members of this group.

For teachers the step from the lecture theatre or classroom to a space such ADF is not necessarily a challenge, but it does require a significant amount of preparation and a significant mastering of one's topic. More specifically, mastering your topic includes an ability to be able to admit when you don't know something and to be able to coach the students to logically evaluate where and how they should find the missing information they need. In other words, the teacher must become part of the learning process. Presented below (Table 1) are observations on teacher activities for implementing a course in a learning space such as ADF in comparison to a lecture course. Moreover, although the use of virtual space is discussed later in this paper, the teacher activities for such learning spaces are also summarized in Table 1. The most striking differences between traditional lecture courses and a course such as the ones presented above is the time spent by the teacher on planning of assignments, the selection of the most suitable space, and designing and collecting feedback.

Table 1. Teacher time estimate for implementation of teaching using different approaches and learning spaces.

Teacher Activity (1 teacher) Team time (Lablife3D, 9 individuals)	Health Technology Microbiology course at ADF (2009)	Health Technology Microbiology Traditional (lecture) Course (2009)	LabLife3D Laboratory
Designing PowerPoints Designing the virtual laboratory (drawing, encoding, design of equipment etc.)	50-60 h	70-80 h	4 working months (total 560 h)
IT issues			40 h
Applying for funding			80 h
Definition of learning outcomes, assignments, timetables- and	20 h	2 h	20 h

schedules, booking learning/lecture space/halls			
Lectures / presentations	14 h	28 h	10 h
Coaching and tutoring assignments, taking part in presentations	30 h	5 h	40 h
Collecting feedback	20* h	1** h	20 h
Assessment and grading	30 h	30 h	
Total teacher (=professor) time Total team time	164 – 174 h	136-146 h	180 h 770 h

* feedback collected by specially designed forms 4 times during the course,

** feedback via official on-line system

The amount of work in this type of course is typically high the first time a course is implemented, but will be less demanding as the course becomes part of the regular curriculum. Moreover, the teacher will need peer support and previous examples of how to implement courses in new teaching and learning spaces. Unfortunately, one of the major obstacles to be overcome is peer and faculty resistance, which typically stalls the implementation of new teaching methods in engineering and science education. Spaces such as ADF, are however extremely well suited for teaching science as they create a sense of working together with one's student, as both teacher and student need to retrofit their traditional roles and ways of learning.

Most importantly, the role of the teacher is that of change and as stated by Spence (2001) professors should not focus on being teachers, rather become designers of learning experiences. Moreover, the importance of the learning space in promoting student engagement is quite evident and emphasizes the need to align learning space design and student work as proposed also by Nixon (2009). Unfortunately, the learning experiences from the point of view of the students cannot be compared for the 2008 and the 2009 courses, as the feedback system for the university was changed at the time these course were implemented, and the feedback questions do not match. Most importantly, however, it is evident that students were highly engaged and motivated by the shared experiences and developed a "common language", which was ingrained into the pace of the presentations and the humour. The use of "normal language" instead of excessive terminology was a key to communication of results to peers and facilitated group discussions, internalizations and explanations and self-explanation effects as part of key to clarification of the students' own understanding (Nordström and Korpelainen, 2011). Tolhurst (2007) calls for all educators to consider the implicit message

that they convey to students via the design of the courses they teach and the learning environments they create. A good sense of humor, some imagination and an ability to listen to students rather than your own voice is certainly an asset! Perhaps the most rewarding experience of using ADF course was a comment of an interview of a student who had taken part in the 2009 course, and which appeared in the University Intranet as follows:

> *"The team work was demanding but fun. The environment of the Design Factory inspired one to commit oneself to the objectives of the course, and the teacher managed to create a relaxed work and study atmosphere. In the end, however, scientific facts had to be in place, and due to this it was challenging to think how to present the contents in formats other than PowerPoint slides"* (Nordström and Korpelainen, 2011)

Stepping into the virtual space: Second Life for engaged learning

Practical skills are one of the core competencies in technology, engineering and the natural sciences, where learning, experience and skills develop via extensive laboratory and similar hands-on experimentation. However, current laboratory courses in the engineering curriculum are burdened by heavy expenses for modern and safe equipment, facilities and reagents. Students and teachers suffer from large class sizes and overlapping schedules with other courses. Course sizes for e.g. chemistry range from 200-300 students, and in biotechnology students are often on a waiting list for laboratory courses, which causes delay and disrupts their studies. Consequently, although learning-by-doing is the ultimate goal of practical laboratory classes and hands-on experimentation, the current curriculum lacks space and time for the learning experience to mature. Many students pass classes with only surface-learning without developing deep learning where theory connects with practice. Accordingly, a virtual learning laboratory, LabLife3D (http://sites.google.com/site/lablife3d/) has been designed and is currently used to engage students to experiment and critically evaluate the inherent behavior of biological or chemical material in a shared local space and in a risk-free environment. Also non-engineering students across the University (e.g. students from the Aalto School of Economics and The School of Design) can participate in experimentation as of 2012. Moreover, LabLife3D can provide access to students from all over the world, which facilitates the internationalization of education via virtual worlds. However, it is important to recognize that LabLife3D is not meant to replace the real-world laboratory experimentation, rather to complement and offer added value to learning and teaching.

Two classes are currently in operation in LabLife3D namely working with viruses and safety procedures in the chemistry. Before entering the virtual laboratory students name their Avatars (Figure 1) and are designated into pairs, where an attempt is made to try to pair individuals with familiarity with virtual worlds (e.g. games, simulations) with less experienced students.

Figure 1 view from the Lab (left) Avatar investigating a sample by microscopy, the view of which is shown in the upper left corner as a view of a cell culture (right).

Prior to entering the LabLife3D laboratory an introductory tutorial session is mandatory in order to familiarize the students with technical details and the assignments to be done in the Second Life laboratory. To promote learning and give students real-time feedback, students also receive a list of points to remember whilst working in the laboratory environment, and a questionnaire is filled in at the beginning and the end of the virtual laboratory session (Figure 2). At the end of the session students can print out their actions in LabLife3D and this report can be used as self-assessment or assessment by the teacher. Moreover, students may use this as part of a larger project for which some parts may be carried out in real-world laboratories or the report may be used as a protocol for writing up reports or even filling-in or finalizing as take-home exams or other similar tasks, which promote continuous learning. The possibility of failed experiments and the different alternatives that students may choose are currently being encoded into the scenarios. This will also prepare students for the kinds of go/no-go decisions that will be required from them in their future positions in industry, corporate positions, science and society. Such learning goals are also in line with responsible use and implementation of technology and science overall.

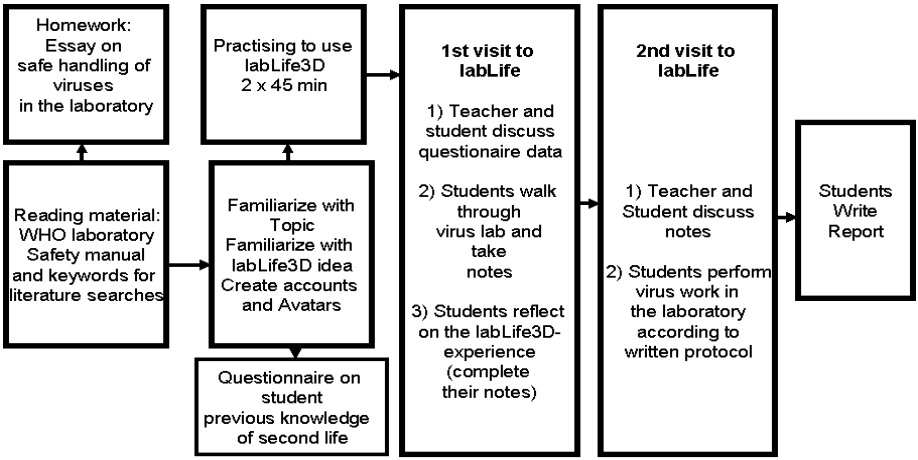


Figure 2. LabLife3D learning scenario outline (microbiology experiment)

Lessons learnt: The "digital native" student vs. the "digital confused" teacher

Engaged learning is an integral part of all learning tools, verbal, digital, visual or emotional, which are used to increase personal and group commitment, regardless of prior success or talent. In LabLife3D students learn in an environment that favors activity and experience and fosters immediate engagement (Ramsden, 1988). Virtual worlds in education lead to increased engagement (Palomäki, 2009) and brain activity has also been measured for tasks performed in real as well as in virtual reality environments (Micropoulos, 2001). Findings demonstrated that subject were more attentive, responsive, and utilized less mental effort in the virtual world, demonstrating that knowledge transfer of information gained in one world to the other world is possible. Moreover, students are more engaged in learning tasks and spend more time thinking and discussing the subject material (Mason, 2007). Immersion into another world have also been noted and engaging in learning in the first person, which is more interactive and experiential (Richter, 2007). As learners are allowed to interact with information in the first person, this facilitates constructivist-based learning activities (Dickey, 2005). Furthermore, the interaction with virtual objects can be helpful in developing a stronger conceptual understanding, depending on the content. It has also been documented that the 3D virtual worlds facilitate the visualization of difficult content and offer tools for learning challenging concepts (Barab, 2000). Moreover, the learner can execute many activities in 3D virtual worlds in a risk-free environment. Second Life also provides a social forum, and students

may engage in other activities in e.g. role playing and networking (Graves, 2008).

From a teachers view, spaces such as LabLife3D are, however, a significant technological challenge to those of us who received their education some 30 or even 20 years ago. So how should we go about mastering such novel learning spaces as Second Life? Moreover, what does ADF have to do with LabLife3D? The key to LabLife3D was successful team collaboration, which began at ADF via informal connections and chance meetings. Nine individuals became part of the group, which formed spontaneously via ADF. Three microbiology Ph.D. students wrote the learning scenarios together with the encoder and virtual world expert. A postdoctoral fellow and a chemistry professor collaborated on the chemistry laboratory scripts and two pedagogical experts gave input into all scenarios. A virtual world enthusiast 1st year student drew the original blueprints for the laboratory building. Consequently, virtual worlds for education clearly require a very multidisciplinary knowledge and are usually beyond the competencies of an academic teacher. As shown in Table 1, the estimated teacher or professor time for building the LabLife3D laboratory and generating the scenarios into the laboratory took some 180-200h. It is to be noted, that most of the work done by the professor involved obtaining the funding for the individuals working on the project (80h), as LabLife3D evolved via a teaching development project, which was not funded by the University budget.

Concluding remarks: Scientific content vs. learning to learn ?

Three issues arise as the most important experiences gained by the teacher from the activities as presented in the present paper. First, use of novel teaching and learning spaces initially require more time for preplanning and attention to course administrative details, than would a traditional lecture course. The teacher must also be actively present when students are working on their group assignments, as this makes it possible for the teacher to become part of the learning process. Second, shifting learning responsibility to students via active teaching methods necessitates more effort on selecting the core scientific content, cutting scientific content or reserving more time for implementation of individual courses, and perhaps even curriculum reform. This calls for a significant change in teaching philosophy, and Weimer (2002) argues that we should move beyond our existentialist role and view ourselves more as part of the process of providing tools for lifelong learning. However difficult it is for us to make the choice to cut some content, such a choice must be made if one is willing to even try moving into learning centered teaching as novel approaches to teaching and learning simply have a longer timeline. On the other hand, teachers should recognize that when they spend more time together with students on conceptualizing scientific fact, they are actually engaged at the heart of scientific exploration,

which is the ultimate goal of high quality science and engineering education. Third, new learning spaces, real-life or virtual, open up a new world for both students and teachers as they give a sense of endless possibilities and clearly motivate engaged and active learning and teaching.

Acknowledgements

The contribution of the following individuals to LabLife3D is gratefully acknowledged: Eero Palomäki, Pekka Qvist, Pekka Joensuu, Olli Natri, Marko Närhi, Elina Kähkönen, Päivi Korpelainen, Marianne Hemminki, Jari Vepsäläinen and Reija Jokela.

References

Arbauch, J.B. & Benbunan-Fich, R. (2006). An investigation of epistemiological and social dimensions of teaching in online learning environments. *Academy of Management Learning and Education*, 5 (4), 435-447.

Aspden, E.J. & Thorpe, L.P. (2009, 23 March 2011). "Where Do You Learn?": Tweeting to Inform Learning Space Development. *EDUCAUSE Quarterly* Retrieved 20 March, 2011, from http://www.educause.edu/EDUCAUSE%2BQuarterly/EDUCAUSEQuarterlyMagazineVolum/WhereDoYouLearnTweetingtoInfor/163852

Barab, S. A. , Hay, K.H., Squire, K., Barnett, M., Schmidt, R., Karrigan, K., Yamagata-Lynch, L., & Johnson, C. (2000). Virtual Solar System Project: Learning Through a Technology-Rich, Inquiry-Based, Participatory Learning Environment. *Journal of Science Education and Technology*, 9(1), 7–25.

Benbunan-Fich, R.& S.R. Hiltz. (2003). Mediators of the effectiveness of online courses. *IEEE Transactions on Professional Communication*, 46 (4), 298-312.

Biggs, J. (1999). What the student does for enhanced learning. *Higher Education Research and Development*, 18, 57-75.

Breslow, L. (2001, 20 March 2011). Transforming novice problem solvers into experts. Retrieved 20 March 2011 from http://web.mit.edu/tll/tll-library/teach-talk/transforming-novice.html

Cross, J. (2007). Informal Learning: Rediscovering the Natural Pathways That Inspire Innovation and Performance. San Francisco: Pfeiffer.

Dickey, M. D. (2005). Three-Dimensional Virtual Worlds and Distance Learning: Two Case Studies of Active Worlds as a Medium for Distance Education. *British Journal of Educational Technology*, 36 (3), 439-451.

Gerald, S. & Antonacci, D.M. (2009, 20 March 2011). Virtual world learning spaces: Developing a Second Life operating book simulation. *EDUCAUSE Quarterly* Retrieved 20 March, 2011, from http://www.educause.edu/EDUCAUSE%2BQuarterly/EDUCAUSEQuarterlyMagazineVolum/VirtualWorldLearningSpacesDeve/163851

Graves, L. A. (2008 21 February). Second Life for Higher Education. *US News & World Report*, 14 (2), 49–50.

Grunmon, P. (2009 23 March 2011). Best Practices in Learning Space Design: Engaging Users. *EDUCAUSE Quarterly* Retrieved 23 March, 2011, from http://www.educause.edu/EDUCAUSE%2BQuarterly/EDUCAUSEQuarterlyMagazineVolum/BestPracticesinLearningSpaceDe/163860

Holtham, C., & Courtney,N. (2006 20 Feb 2011). High-engagement learning for business education. Retrieved 20 Feb, 2011, from http://www.qube.ac.uk/QuBE/toolbox/think/think2/?searchterm=High-engagement for business education

Johanssen, D., Davidson, M., Collins, M., Campbell, J., & Haag, B.B. (1995). Constructivism and computer-mediated communication in distance education. *The American Journal of Distance Education*, 9 (2), 7-26.

Leidner, D.E. & Jarvenpaa, S.L. (1995). The use of information technology to enhance management school education: A theoretical view. *Management Information Systems Quarterly*, 19, 265-291.

Mason, H. (2007, 24 March 2011). Experiential Education in Second Life. *Proceedings of the Second Life Education Workshop 2007* Retrieved 24 March, 2011, from http://www.simteach.com/slccedu07proceedings.pdf

Mikropoulos, T. A. (2001). Brain Activity on Navigation in Virtual Environments. *Journal of Educational Computing Research*, 24 (1), 1-12.

Nixon, L. (2009, 23 Jan, 2011). Aligning learning space design and student work: Research implications for design processes and elements. EDUCAUSE Quarterly Retrieved 23 Jan 2011, from http://www.educause.edu/EDUCAUSE+Quarterly/EDUCAUSEQuarterlyMagazine Volum/AligningLearningSpaceDesignand/163859

Nordström, K. and Korpelainen P. (2011). Creativity and inspiration in engineering education. *Teaching in Higher Education*, in press.

Palomäki, E. (2009). Applying 3D Virtual Worlds to Higher Education. Espoo: Helsinki University of Technology, Industrial Engineering and Management.

Ramsden, P. (1988). Improving Learning: New perspectives. London: Kogan Page.

Rice, E. (2004). Rethinking scholarship and engagement: The struggle for new meanings. Research and Teaching International Colloquium, Winchester: Higher Education Academy.

Richter, J., Anderson-Inman, L., & Frisbee, M. (2007, 23 March , 2011). Critical Engagement of Teachers in Second Life: Progress in the SaLamander Project. *Proceedings of the Second Life Education Workshop 2007* Retrieved 23 March, 2011, from http://www.simteach.com/slccedu07proceedings.pdf

Spence, L. (2001) The case against teaching. *Change,* 33(6), 10-19.

Tolhurst, D. (2007). The influence of learning environments on student's epistemiological beliefs and learning outcomes. *Teaching in Higher Education,* 12 (2), 219-233.

Weimer, M. (2002). Learner-Centered Teaching. Five Key Changes to Practice. San Francisco: Jossey-Bass.

Zull, J. (2002). The Art of Changing the Brain: Enriching the Practice of Teaching by Exploring the Biology of Learning. Sterling, VA.: Stylus Publishing.

CUMULUS // DRS SIG on Design Pedagogy
1st International Symposium for Design Education Researchers
Paris Chamber of Commerce and Industry, Paris, France 18–19 May 2011

Frédérique Cuisinier & Elise Tornare (2011). *Why does designing a learning environment require a real collaboration between design and cognitive psychology?* 84–96

Why does designing a learning environment require a real collaboration between design and cognitive psychology?

Frédérique CUISINIER* and Elise TORNARE

University of Paris Ouest

This communication discusses the necessity of a effective collaboration between design and psychology (regarding particularly cognition, emotion and development) to enhance the design of learning environments. Knowledge building represents a major development at both the individual and societal level. Previously seen in terms of initial training, knowledge building now stresses learning throughout the individual's lifelong. The Information and Communication Technologies for Education (ICT-E) seem useful in this respect. But their really rapid development highlights new issues. Learning design is a new topic which aims to give some answers to those deep changes. The skills of the learning designers in the formalization of objects, tools and learning spaces are essential. How can designers create, maintain and focus people's attention on the learning content? How can they organize the space and shape the tools of knowledge building? How can we integrate the learner's perceptions and attitudes? What specifications are required according to the learner developmental level? Conceptual clarification and development of integrative models specifying the different layers of design (design of the program, the sequence, the activities, the objects and the content of learning) is essential. However, there is a risk of reductionism if these approaches are limited to a list of prescriptive steps without considering the learning situation as a psychological one. We claim that a cross-discussion between the psychologist and the designer would be a highly valuable dialogue. Psychology proposes analytical frameworks for these very complex processes involved in knowledge building. The researcher in psychology have an expertise about learning processes,

* *Corresponding author:* University of Paris Ouest
200 Avenue de la République | 92 001 Nanterre Cedex| France
e-mail: fcuisinier@free.fr

cognitive development, information processing, the effects of cognitive overload (when the information to be treated is excessive or too complex), the emotional and motivational factors in learning (which are beginning to be better identified and understood).The collaboration between psychology and professional designers is certain to provide a fruitful response.

Keywords: Learning processes, psychology, cognition, emotion, learning design

Learning Design as a response to the new educational need

Knowledge building represents a major development at both the individual and societal level. Previously seen in terms of initial training, knowledge building now stresses learning throughout the individual's life. Training is now not only restricted to academic learning, as prerequisite for professional life but has become fully integrated. Lifelong training is essential for anyone. For some European countries, it has become a right for companies' employees (Prokou, 2008). In a dynamic world, always in movement, it is imperative to solve problems in a flexible way that is to say, be able to learn all the time (Kolfschoten, Lukosch, Verbraeck, Valentin, & de Vreede 2010). The Information and Communication Technologies for Education (ICT-E) seem useful in this respect. But their really rapid development highlights new issues. Learning design is a new topic which aims to give some answers to those deep changes.

A cross-discussion between the psychologist in learning and the designer would be a highly valuable dialogue. Psychology offers analytical frameworks for these very complex processes involved in knowledge building. The researcher in cognitive psychology has knowledge about learning processes, cognitive development, information processing, the effects of cognitive overload (when the information to be treated is excessive or too complex) and emotional and motivational factors in learning (which are beginning to be better identified and understood). Collaboration between learning and emotion specialists and design professionals is certain to provide a fruitful response. The challenge will be to achieve the integration of scientific knowledge in the design of educational activities.

So, the needs for training increase drastically and it raises many questions about the principles and foundations to their design. These questions face two mains difficulties.

The first important issue is the diversity of learning contexts. Indeed, in what way is learning in childhood, adolescence or adulthood comparable? Is it comparable to learning in a company or professional training? Many learning activities, some on them more spectacular than others, are achieved in the family environment (with parents or siblings) through different ways as compared to the academic context. Educational activities about health, safety,

environment protection currently undergo a great development. However, this development raises many questions regarding the relevance and efficacy of these various educational activities. Cultural events and cultural institutions have to design expositions for a public always heterogeneous in terms of age, education, culture, etc., which does not fail to raise many questions for designers and project manager. Every one experienced satisfaction from an interesting and well-made exposition. Conversely, everyone could remember the deception from an inappropriate design without resonance.

The second important issue is raised by the diversity of actors, conceptual frames and disciplines concerned. Indeed, knowledge and learning interest numerous researchers of various disciplines as sociology, educational sciences, philosophy, information sciences or psychology. Obviously, they also interest the professionals of education, the teachers, but also the cultural mediators (in the scientific museums or in art galleries)**.** On the one hand, these researches aim at putting a scientific light on learning processes (what does « learn » mean? how can one learn?). On the other hand, they aim at building learning devices (design of a course or training). These researches differ according to their finalities (theoretical versus pragmatic issues) and consequently according to their designs (experimentation versus practice researches).

This communication discusses about the necessity of a real collaboration between design and cognitive psychology to enhance the design of the learning environment. The first point will concern the nature of learning. What we really know about learning today? The second point will concern the fundamental properties of learning situations. We will show that emotions are one of these fundamental properties. Finally, we will argue for an increased collaboration between every actor (designers, researchers, and teachers).

What does exactly mean «to learn»?

According Feyereisen (1999:8), "learning is what provokes a change in the behavior; a change does not result from maturation or age or tiredness, or disease, or food and drugs ingestion, or light variations or temperature, or atmospheric, climatic or seasonal fluctuations [...].This change results from the experience the individual acquires from his interactions with environment.". In other words, learning is an internal process based on the individual's activity, *w*hatever the theoretical frame (behaviorist, constructivist, cognitivist, or social interactionism). Actually, we can now say that learning definitely provokes more or less psychological change regarding knowledge, representations, thoughts, reasoning and high mental processes like attention, memory, language or perception. Every new knowledge modifies previous knowledge, and leads to the construction a new point of view on the world, in other words, a new representation. According to some

authors there is a strong link between learning and psychological development. For example, the Piagetian's theory considers that learning depends on the cognitive development (Piaget, 1947). On the contrary, Vygotski (1934) considers that the cognitive development depends on apprenticeships. Both of them argue that every opportunity to deal with a problem and to solve it actually is a major developmental opportunity because it implies actions (mental or concrete) which often require a shift in one's point of view.

The goal of the first scientific studies on learning by pioneers like Pavlov, Skinner, Thorndike, was to build a general and comprehensive theory, capable of explaining "learning". However, the most significant result of these researches is that no theory can completely explain what learning is. Each theory has to be considered as a local one. At the beginning of the 21th century, we now know that learning is driven by many different processes depending on the context, on the developmental level, on the domain and on the goal. For example, one can learn through instruction in class or by reading texts. One can learn through action, by concrete activities (manipulations, problem solving etc.). One can learn individually or with others through interactions (real or virtual interactions when they are computer-mediatized). Another way of learning is the imitation or the observation of a model. All these ways of learning are very different in respect to the psychological processes involved. Thus, learning through instructions implies understanding processes of both written and spoken language (Kintsch, 1978). Learning through human interactions implies understanding the processes of mental states, especially the ability to infer the mental states of others (Gauducheau & Cuisinier, 2005). Learning through problem solving implies several forms of reasoning (inductive or hypothetic-deductive) and many metacognitive regulation processes (Sternberg, 1998). Finally, learning through imitation or observation implies many attention processes, and a sometimes complex selection of actions having to be imitated (Winnykamen, 1990). All these types of learning are very different in respect to their outcome, in others words, in respect to the nature of the knowledge which stems from them. There is a current distinction between declarative knowledge (defined as conceptual or factual ones), procedural knowledge (defined as a sequence of actions) and metaknowledge (defined as knowledge about knowledge or one's psychological functioning). The 20th century highlighted that human beings are designed to learn; we are designed for giving and building new meaning to the world (and thus, thinking the world). Furthermore, human beings are designed for sharing meaning and teaching knowledge (Bruner, 1983).

Apprenticeship is a major factor of human development and is not a passive mechanism, as filling a container, but instead requires active and complex mental processes. So, a deep understanding of learning processes supposes to consider several dimensions simultaneously:

- The constraints and modalities of cognitive functioning as a complex system of information processing based on perception, on memory (especially working memory which is affected by the cognitive load), on speed of information processing and on attention processes, on language, and on the representational system in a large sense. Furthermore, learning often involves several components, and among others, a motor component which adds to the complexity (for example driving a car or write a text are partially motor).
- The goal of learning (learning to read; learning to use a software; learning to play trumpet; learning to conduct a meeting; learning to design a learning device). It is very important to specify the nature of the goal and the multiplicity of the underlying tasks.
- The issues or objects of learning (declarative/conceptual, procedural, sensory-motor or mental processes, metacognition)
- The context of learning (formal in academic or training context with a teacher or an expert, versus informal context (in family or while leisure activities with pairs)
- The main form of learning (through action, interactions, instructions...)
- The developmental issues (for example learning to read is a major change compared to learning to know the French kings) or prerequisite (to use a computer implicates reading skills);

These different dimensions of learning processes should be considered together because they all contribute to learning and do so through their interaction. For example, the main form of learning varies with age. Young children learn less by instruction than imitation; imitation is still even an important process for adults! In an instructional computer-based learning, the cognitive load varies according to the complexity and the nature of the presentation (text and/or picture, statics or animated) and according to age or computer skills (Artino, 2008; Paas, Renkl & Sweller, 2003).

Indeed, it is very important to be aware of the reality of all types of learning: they always are situated. This reality is one of the reasons to engage a real collaboration between designers and psychologists. The former and the latter could analyze these different dimensions together. An expertise in cognitive psychology is as important as an expertise in design. It seems a major mistake to believe that importing psychological concepts and data would be enough to make a good design. In this respect, psychology is one of the sciences of design applied on learning devices. How can we really design learning devices with such variability? According to the situated characteristic of learning, we have to research if there are some invariants. Let's now consider explicit learning in a formal context.

Formal learning situations: interrelated components.

Academic learning or training is situated in a frame defined with a triple relation, classically pictured with a triangle called « didactic triangle » (Houssaye, 2000). Each pole corresponds to an actor of the learning process: teacher, learner and knowledge. The sides of the triangle represent the specific relation between all three actors. Thus, the side linking teacher and learner defines the educative relation domain; the side linking teacher and knowledge defines the didactic domain (in other words, the manner of organizing knowledge to make it understandable by the learner). The side linking learner and knowledge defines the learning domain (i.e general and specific modalities). The characteristics of every actor significantly contribute to define all of these relations. For example, the age or developmental level of the learner and his previous knowledge are as important as teacher's professional experience or professional satisfaction. In a same way, the nature of knowledge (conceptual, practical) represents another important dimension of the learning situation. Consequently, designing a learning device without referring to the triple relation exposes to a high risk of neglecting one aspect or another of that context. The psychology of learning in every domain and referring to these scientific data is crucial. But that do not mean that a simple importation of psychological concepts is appropriate. This leads us to maintain the necessity of an integrative approach based on a psychological analysis of complex interactions occurring in the learning situation. Nobody can seriously claim to be at once a psychologist and for example an engineer, except in the case of a high-level training in both domains. This is all the more true as other parameters also interact, which confers to the situation of apprenticeship a very particular characteristic: it is a psychological situation built on human and physical components. The following section evokes some issues about some critical dimensions of the learning context and their impact on learners or teachers.

Learning situation as a psychological situation intertwining tools, perception and feelings.

Many parameters interact to define a learning device: tools (from pencil to computers and books), architecture and furniture (from spatial organization to acoustic quality). They influence teachers' and learners' attitude toward learning and their feelings.

Some studies investigated the impact of school characteristics on students' well-being and learning achievement. Subjective well-being is organized around three criteria: high positive affectivity, weak negative affectivity and perceived quality of life (Diener & Lucas, 2000).

Opdenakker and Van Damme (2000) examined the relation between the school frame and pupils' well-being, according to eight dimensions: total well-being at school, social integration in class, interest for learning activities,

motivation to learn, attitude displayed regarding work at home, attention in class and school self-esteem. These data were connected with the characteristics of the school frame (teaching practices, teaching staff co-operation in relation to teaching methods and pupil counseling, attention to pupils differences and development, orderly learning environment). Two significant insights emerged from this study. On one hand, the effect of school proves to be more significant on performance (mathematics and mother language) than on well-being. On the other hand, this effect on well-being seems to be mediated by the "co-operation between teachers" variable. The authors also noted an interaction between pupils' initial motivation (tracked down at the entrance of secondary school) and the orderly learning environment. The learning organization is beneficial in terms of well-being only for the strongly motivated pupils. In contrast, it is unfavorable to well-being for slightly motivated pupils. This research thus suggested that the pupils' point of view, their expectations, for themselves as pupils, their feeling to be able to answer or not the school requests contribute to their well-being. Engels, Aelterman, Van Petegem and Schepens (2004) showed that well-being is strongly determined by the perception and the satisfaction of the pupils on the class level and on the school level. These significant poles of satisfaction relate to the school infrastructures (architecture, maintenance), to the atmosphere, to the friend network, to the degree of participation in the class, to the active working methods and to the diversification of the media. Finally, well-being results from the integration of judgments on multiple facets of the school environment and the question of the direction of the relations of causality remains opened. But the impact of the architectural and space organization of the building on learning still has to be more precisely investigated. For example, Horen-Martin showed a strong link between the spatial environment of the classroom and teaching practices. Interestingly, the perceived impact by the teachers varies according to their pedagogical approaches. When they have centered-teacher practices, they consider the impact of the environment as real but it does not affect their planning or designing of class activities. In other words, they design their teaching activities the same way whatever the class environment. On the contrary, the centered-student teachers perceive and integrate the favorable or unfavorable impact of the environment in their school activity design. The acoustic comfort of schools seems to have an important impact on well-being as well as on specific cognitive processes like learning to read (Klatte & Hellbruck; Zannin & Zwirtes, 2009; Sutherland & Lubman, 2001). Perhaps others characteristics as light (natural versus artificial) and furniture contribute to the comfort and well-being. These results raise the question of the nature (direct or indirect) of the impact of the environment. Indeed the acoustic quality of the class is direct because it decreases the quality of voices perception and requires inhibiting the perception of the most interfering sounds (like human

speaking). An indirect effect would be driven, for example, from the feeling of comfort which raises a positive mood and a positive attitude towards the situation.

Learning device is also defined with the tools which are as different as pencils, notebooks or exercise books, computers, or handbooks. Some studies focus on evaluating the impact of computer use on cognitive processes, on students' beliefs or on the pedagogical activities. For example, computer use mobilizes a lot of information processing, both sequential and simultaneous, which raises a great cognitive load (Pass, Renkl and Sweller, 2003). Boond-Raacke and Raacke (2008) showed that students have a positive attitude toward tablet PCs implantation in their classroom. Nevertheless, the real impact on achievement isn't still known.

Emotion and feeling as the hidden face of the didactic triangle

Emotion, however deeply unrecognized is one of the major dimensions of learning. Although emotion is a very complex concept, it can be defined as a highly adaptive process because it signals to individual the relevance of the situation (regarding his safety, his security, his well-being or any threats). Fundamentally, emotions indicate what is good or what is bad for human beings. A century of researches intertwining several disciplines (especially psychology, neurobiology) demonstrated the implication of multicomponent processes in human emotion (appraisal, physiological and behavioral processes or action readiness and subjective feelings).

Many researches aim at exploring and understanding how emotions affect cognitive functioning, especially in learning contexts. In my opinion, emotions are the hidden face of the didactic triangle. Let now see some illustrations of the impact of emotions on learning or student activities.

Indeed, several studies showed the impact of computer use in the learning context on students' emotions. For example, anger and anxiety related to computer use dropped significantly over 8 month program. These decreases correlated with an increase of computer skills (Kay & Loverock, 2007; Kay 2008).The learning strategies were also correlated to students' emotions. Thus, in a recent study on second year College French students (Baduni and Cuisinier, in preparation) a weak but significant correlation (around .14) has been observed between the declared use of a surface strategy (repetition or memorization) and unpleasant emotions like shame or anxiety. On the contrary, there is a higher positive correlation (around .38) between deep strategies (i.e. reformulation of content, linking various knowledge) with pleasant emotions like pride, hope and satisfaction. Nijhuis, Segers & Gijselaers (2008) showed that College students' learning greatly vary as far as their perception of their different courses is concerned. Another study about related-emotions showed a developmental pattern from High school pupils to third year College students. Anxiety increases significantly from high school to the first year of college and regularly decreased after (Mendy, 2009).

Thus, the emotional state of the learner during learning seems a crucial dimension of learning situations. The few studies investigating the influence of emotions on children cognitive functioning revealed a facilitating effect of positive induced emotions on problem solving performance. These results are congruent with Isen, Daubman, and Nowicki (1987) concerning adults. Moreover, Efklides and Petkaki (2005) examined the influence of induced mood on children's representation (interest, liking) of maths and on their metacognitive experiences in maths (for example feeling of difficulty and competence). Whatever mood was induced (positive, negative, and neutral) negative mood increased after task completion and was linked to the feeling of difficulty experienced during the activity. Post-task positive mood explained post-task interest and liking of the task which increased with a positive mood induction. Other studies investigated the influence of the emotional content of written texts on memorisation, showing better recall of positive and negative emotional behaviours than non emotional behaviours (Davidson, Luo & Burden, 2001), and on reading comprehension, revealing that children (mean age 11 years old) have trouble understanding a text when it conveys positive emotions (Clavel & Cuisinier, 2008; Clavel, 2007). Conversely, a text with a negative emotional content is processed more deeply and therefore better understood. Knowledge of emotions also mediates understanding of texts with an emotional content (Clavel, Cuisinier, Pons & Garitte, in preparation). Similar results were found in a dictation tasks: orthographic performance increased when the text conveyed negative emotions (Cuisinier, Bruckert, Bruckert& Clavel, 2010). Furthermore, emotion regulation skills seem to be linked to kindergarteners' academic success (Graziano, Reavis, Keane & Calkins, 2007). According to Blair (2002), inefficient emotion regulation may physiologically inhibit children use of higher order cognitive processes such as working memory, attention and planning. All these studies contribute to sustain knowledge of the influence of mood on the cognitive processes involved in learning. The influence of emotions aroused by school activities on the processes involved is currently explored. Goetz, Preckel, Pekrun and Hall (2007) showed emotional variation before, during and after mathematical test according to students' reasoning ability. Some emotional variations appeared in children during a dictation activity (Cuisinier, Bruckert, Bruckert& Clavel, 2010).

From the silent psychology in learning design to a work in synergy.

The teacher plays a fundamental role in the building of knowledge, in particular because he intervenes at several levels, organizing information for transmission and building a context of appropriation for the learner; he does so through the use of tools and materials (books and other textual documents, graphics, sound, etc...) and in a dedicated space (the classroom, auditorium, or via hypermedia). In that respect, we can consider the teacher as a silent

designer in reference to the silent design concept suggested by Gorb and Dumas (1987, cited by Candi, 2010). Perhaps because contemporary education needs are drastically increasing, learning designers become necessary. The research in design education is rapidly growing.

Indeed, the skills of the designer in the formalization of objects, tools and learning spaces are essential when seeking the most favorable conditions for fostering the development of the action tendency to approach a situation. How can designers create, maintain and focus people's attention on the learning content? How can they organize the space and shape the tools of knowledge building? Conceptual clarification and development of integrative models specifying the different layers of design (design of the program, the sequence, the activities, the objects and the contents of learning) is essential (Boyle, 2010; Quintin &Depover, 2003; Conole, Dyke, Oliver & Seale, 2004). However, psychology seems to be a silent psychology for teachers and some of the designers. On the positive side it drives to the recognition of the relevance of psychological theories particularly about learning. Nonetheless, there is a risk of reductionism if these approaches are limited to a list of prescriptive steps not based on psychological analysis. We claim that the learning situation is a *psychological situation* in which every change are psychological change depending on the learning device but also on the perception and attitude of learners. Thus a deep analysis of the learner's point of view is as relevant as learning and tool analysis. A cross-discussion between the psychologist in learning and the designer would be a highly valuable dialogue. Psychology proposes analytical frameworks for these very complex processes involved in knowledge building. The researcher in cognitive psychology has knowledge about learning processes, cognitive development, information processing, the effects of cognitive overload (when the information to be treated is excessive or too complex) and emotional and motivational factors in learning (which are beginning to be better identified and understood).This psychological approach aims at articulating every dimensions of the learning situation. The learning situation definitively is an uncomfortable situation because it always provokes more or less unsteady cognition. Therefore, it becomes obvious to design a secure learning environment.

As Bachelard (1938:15) wrote "it is in the act of knowing, intimately, that rise, through a sort of functional necessity, slowness and troubles [...]. We build against prior knowledge, by destroying badly constructed knowledge; by overcoming what in the mind itself hinders spiritualization".

So, teaching like learning implies to create a specific context, which enables such epistemological obstacles to emerge as well as their integration by learners. The learners' orientation towards objects of knowledge (attraction or avoidance) is a determining factor which intervenes prior to the activity and evolves during it.

Two main properties would be appropriated for a Secure Learning Environment Design (SLED): cognitive secured processing (not exceeding the current cognitive capacities of the learner); and an emotional and affective envelop (regarding global affective climate of relationships, specific affective climate of teacher-learner relationship, environmental affective climate generated by sounds, lights, colors or textures and furniture). Collaboration between learning and emotion specialists and design professionals is certain to provide a fruitful response for SLED. So, we propose that psychologists (with a specialization regarding cognition and development) work in synergy with designers, teachers and learners in that perspective. The challenge will be to achieve the integration of scientific knowledge in the design of educational activities.

References

Artino, A.R., Jr. (2008). Cognitive load theory and the role of learner experience: An abbreviated review for educational practitioners. AACE, Journal, 16(4), 425-439.

Bachelard, G. (1938). La formation de l'esprit scientifique, Paris : Vrin.

Baduni, O. & Cuisinier, F. (in preparation), Emotions and learning strategies in College students.

Blair, C. (2002). School readiness integrating cognition and emotion in a neurobiological conceptualization of children's functioning at school entry. American Psychologist, 57, 111-127.

Boond-Raacke, J.M., & Raacke, J.D. (2008). Using Tablet PCs in the Classroom: An Investigation of Students' Expectations and Reactions, Journal of Instructional Psychology, 35, 3, 235-239.

Boyle, T. (2010). Layered learning design: Towards an integration of learning design and learning object perspectives, Computers & Education, 54, 661–668.

Bruner, J.S. (1983). Développement de l'enfant. Savoir faire, Savoir dire, Paris : PUF, 1983.

Candi, M. (2010). The sound of silence: Re-visiting silent design in the internet age, Design Studies 31, 187-202.

Clavel, C. (2007). Construction de sens dans les activités de lecture en contexte scolaire : le rôle de l'expérience émotionnelle et des interactions entre pairs. Thèse de Doctorat, Université Paris X, Nanterre.

Clavel, C., & Cuisinier, F. (2008). Compréhension de texte en cycle 3 : les compétences scolaires médiatisent-elles l'effet de la tonalité émotionnelle ? In Loarer, E., Mogenet, J-L., Cuisinier, F., Gottesdiener, H., Mallet, P., & Vrignaud, P., (Eds.), Perspectives différentielles en psychologie (pp. 441-445). Rennes : PUR.

Conole, G., Dyke, M., Oliver, M, & Seale, J. (2004). Mapping pedagogy and tools for elective learning design, Computers & Education, 43, 17–33.

Cuisinier, F., Sanguin-Bruckert, C., Bruckert, J.-P. & Clavel, C. (2010). Les émotions affectent-elles les performances orthographiques en dictée ? L'Année Psychologique, 110-1, pp.3-49.

Davidson, D., Luo, Z., & Burden, M. J. (2001). Children's recall of emotional behaviours, emotional labels, and non emotional behaviours: Does emotion enhance memory? Cognition and Emotion, 15, 1-26.

Diener, E., & Lucas, R.E. (2000). Subjective Emotional Well-Being, in M.Lewis, Haviland-Jones, J.M., (Eds). Handbook of emotions, second edition (pp 325-337), The Guilford Press.

Efklides, A., & Petkaki, C. (2005). Effects of mood on student metacognitive experiences. Learning and Instruction, 15, 415-431.

Engels, N., Aelterman, A., Van Petegem, K., & Schepens, A. (2004). Factors wich influence the well-being of pupils in Flemish secondary schools, Educational Studies, 30, 2, 127-143.

Feyerseisen, (1999), in J.-D. de Lannoy & P. Feyereisen, Qu'est-ce donc qu'apprendre?, Delachaux et Niestlé.

Gauducheau, N. & Cuisinier, F. (2005). Peer's mental states in a collaborative setting: Developmental perspective on children's inferential abilities. European Journal of Psychology of Education , 20 (4), pp. 389-407.

Goetz, T., Preckel, F., Pekrun, R., & Hall, N.C. (2007). Emotional experiences during test taking: Does cognitive ability make a difference? Learning and Individual Differences, 17, 3-16.

Graziano, P.A., Reavis, R. D., Keane, S. P., & Calkins, S. D (2007). The role of emotion regulation in children's early academic success. Journal of School Psychology, 45, 3-19.

Greene, T. R. & Noice, H. (1988). Influence of positive affect upon creative thinking and problem solving in children. Psychological Reports, 63, 895-898.

Horne-Martin, S. (2002). The classroom environment and its effects on the practice of teachers, Journal of Environmental Psychology, 22, 139-156.

Houssaye, J. (2000). Le triangle pédagogique. Berne: Peter Lang.

Isen, A. M., Daubman, K. A., & Nowicki, G. P. (1987). Positive affect facilitate creative problem solving. Journal of Personality and Social Psychology, 52, 1122-1131.

Kay, R.H. (2008). Exploring the relationship between emotions and the acquisition of computer knowledge, Computers & Education, 50, 1269–1283.

Kay, R.H., & Loverock, S. (2007). Assessing emotions related to learning new software: The computer emotion scale, Computers in Human Behavior, 24, 1605–1623.

Kintsch, W., & Van Dijk, T.A. (1978). Toward a model of text comprehension and production. Psychological Review, 85, 87-98.

Klatte, M., & Hellbruck, J. (2010). Effects of classroom acoustics on performance and well-being in elementary school children: A field study, Internoise, June 13-16, Lisbon, Portugal.

Kolfschoten, G. Lukosch, S. Verbraeck, A, Valentin, E., & de Vreede G-J. (2010). Cognitive learning efficiency through the use of design patterns in teaching, Computers & Education, 54, 652–660.

Nijhuis, J., Segers, M., & Gijselaers, W.(2008) The extent of variability in learning strategies and students'perceptions of the learning environment, Learning and Instruction, 18, 121-134.

Opdenakker, M.C., &Van Damme, J. (2000). Effects of Schools, Teaching Staff and Classes on Achievement and Well-Being in Secondary Education: Similarities and Differences Between School Outcomes. School Effectiveness & School Improvement, 11(2), 165-196

Piaget, J. (1947). La psychologie de l'intelligence, Armand Colin (The psychology of intelligence, first English translation, 1950; Routledge Classics Edition, 2001)

Paas, F. Renkl, A. & Sweller, J. (2003). Cognitive Load Theory and Instructional Design: Recent Developments, Educational Psychologist, 38(1), 1–4.

Prokou, E. (2008). A Comparative Approach to Lifelong Learning Policies in Europe: the cases of the UK, Sweden and Greece, European Journal of Education, 43, 123-140.

Quintin, J.J, & Depover, C. (2003). Design pédagogique d'un environnement de formation à distance, éléments méthodologiques, Lidil, 28, http://lidil.revues.org/index/603.html.

Rader, N., & Hughes, E. (2005). The influence of affective state on the performance of a block design task in 6- and 7-year old children. Cognition and Emotion, 19, 143-150.

Sternberg, R.J. (1998). Thinking and problem solving, Academic Press Inc.

Sutherland, L.C., & Lubman, D. (2001). The Impact of Classroom Acoustics on Scholastic Achievement, 17th Meeting of the International Commission for Acoustics, Rome, Italy, Sept. 2-7.

Vygotski, L.S. (1934/1947). Pensée et langage, Paris : La Dispute, 3ème édition.

Winykamen, F. (1990). Apprendre en imitant ?, Paris : PUF.

Zannin, P.H.T., & Zwirtes, C.R. (2009). Evaluation of the acoustic performance of classrooms in public schools, Applied Acoustics, 70, 626–635.

CUMULUS // DRS SIG on Design Pedagogy
1st International Symposium for Design Education Researchers
Paris Chamber of Commerce and Industry, Paris, France 18–19 May 2011

Alice D. Peinado & Sibylle Klose (2011). *Design Innovation: Research-Practice-Strategy.* 97–111

Design Innovation: Research-Practice-Strategy.

Alice D. PEINADO*[a] and Sibylle KLOSE[b]

[a]Design Management Department, L'Ecole Parsons à Paris/Paris College of Art; [b]Fashion Department, L'Ecole Parsons à Paris/Paris College of Art

This paper explores the development of two joined MA/MBA programmes sharing a research component. The aim will be to engage students with research problematics proper to design but which at the same time go to fuel a truly theoretical perspective as well as practical enactment of the design process. The paper begins by analyzing the current situation of educational programmes in business as well as design schools. It then proposes to look at design theory and research as new approaches to innovation in both design and management based disciplines. It addresses what lies behind such terms as "design thinking" or "abductive reasoning" to propose an educational programme geared towards making the design process explicit.

Keywords: Thinking; Research; Process; MA/MBA Programme

Introduction

This paper explores the development of two joined MA/MBA programmes sharing a research component. The aim will be to engage students with research problematics proper to design but which at the same time go to fuel a truly theoretical perspective as well as practical enactment of the design process. Design research declines itself through three sequential semester long modules that progressively have students engage in ever complex methods and research practices proper to design. Moving from the basics to intermediate and finally advanced approaches, students will gain a thorough understanding of how research informs the designer's problem solving skills and risk taking approaches. Simultaneously they will engage in theoretical and practical exercises aimed at pushing the frontiers of strategic innovation in their respective fields. At the end, we hope that innovation will result from the balance between research, practical application and strategic insight in a

* *Corresponding author:* Design Management Department | L'Ecole Parsons à Paris/Paris College of Art | 14 Rue Letellier | 75015 Paris | France
e-mail: alice.peinado@parsons-paris.com

holistic, systemic framework. Research emerges here as an intrinsic component of the design process.

Reinventing Business Models for Education

The impetus for the development of dual MA/MBA programmes with a high innovation focus comes from recent critiques of business education, as well as the rise in importance of educational models advocating a "design thinking" approach. According to MBA education critiques, there is a need today to move away from traditional function and discipline based models which do not foster a holistic, systemic approach to problem solving. Datar et al. write that:

> *The MBAs current repertoire of tools and techniques is inadequate. Instead, they must master a new set of skills: the ability to find and frame problems; collect, synthetise, and distill large volumes of data; exercise creativity and imagination; and develop, test, and revise ideas (Datar et al 2010:94).*

There is a need to focus on knowing, doing, and being, but also to develop new thinking models. Traditional knowledge imparted in the classroom must be completed with practical, hands-on training in project- bound or workshop-like settings. Moreover, students must become self-aware and develop empathy as a means to develop both their leadership skills and their understanding of the world at large.

> *Today's MBA students typically fail to process large volumes of information effectively. They feel uncomfortable when faced with ambiguous, open-ended problems. They lack knowledge of creative techniques that would enable them to think outside of the box. This is in part due to educational approaches that have privileged a quantitative, discipline based focus as opposed to a more qualitative, trans- or multi-disciplinary one. The importance given to finance in MBA curricula has played an important role in developing mathematical models that advocate highly structured but also highly abstract curricula. These have recently proven to be untrustworthy, unstable and ultimately out of sink with reality. Consequently, business education is currently looking to develop new methodologies to breach the gap with real-world situations.*

Reinventing the MBA

Reinventing the MBA today entails developing new curricula that focus on "Integrative Thinking" skills, "Experiential Learning" programmes and a "Leadership" focus (Ibid). The authors of this essay believe that this can be achieved by developing a "Design as Strategy" approach. This needs to be integrated at all levels of the MBA curriculum and alternate hands-on training in design practices with business knowledge and know-how. Research emerges as a key element of this approach. Students need to learn how to carry on research as a preliminary and in tandem to complex analysis of data. Indeed, educational programmes today often fail to teach students how to engage with research as a means to understand "wicked" problems and resolve them. MBA programmes have typically rested on the case-study approach as a problem solving method. However, while confronting students with a series of issues proper to everyday management, case-studies do not necessarily foster in-depth analysis towards the solution of problems. Rather, they call for immediate answers, often derived from theories learned in class, to what are often complex dilemmas that require hindsight, distance and new insights to resolve.

Design research methods demand a holistic approach to problems as well as an understanding of the complexity inherent to all human endeavors. Design research is by definition pluri-disciplinary. It involves an understanding of the multiple facets proper to human experience, from neurological insights to ergonomic understanding and ultimately anthropological appreciations. Obviously, this list is non exhaustive as the complexity inherent to each and every one among us, and to design itself, exceeds these disciplinary boundaries. However, proper to design is a holistic approach to the end user which neither engineering, with its focus on technological know-how, nor business, with its complex marketing approaches, can provide. While design also involves an understanding of materials and technology common to other disciplines involved in the production process, a user-centered approach is typical of design alone.

Interesting to design research is that this very peculiar trait to it exceeds disciplinary boundaries. Students need to engage with and learn to solve problems from a variety of point views. Moreover, problem solving can only be based on a careful understanding of the problematic at hand based on in-depth research. All design that does not engage in a real, holistic assessment of the problematic it seeks to resolve, might fail in its purpose. For this, however, design must be understood as being part of a creative process that accompanies the development of products or services from the beginning through a series of steps or project – and not as mere styling. Moreover, the design process encompasses research but goes beyond it by adopting specific thinking attitudes.

Design Thinking – What is it?

The term "design thinking" has gained momentum in both the more specialized literature on design as in business journals. We have taken design thinking to stand here for a method for innovating and creating value based on the way designers think as they work. As such it comprises a set of practices that designers engage in as well as cognitive approaches and a certain mindset. It is useful to understand what we mean by "design thinking" in order to understand our approach with respect to design research.

According to a recent article by Hassi and Laakso, design thinking practices are related to concrete activities or tangible ways of doing (Hassi and Laakso 2011). The term "Design Thinking" is itself unclear and hides a variety of practices more or less defined. From a business perspective, "design thinking is "a method for innovation and creating value" while for designers it's just a way of doing (Ibid:54). Neither definition is exclusive of the other – they are complementary. However, when taken separately, they both fail to elucidate what constitutes the underpinnings of the design process. For Hassi and Laakso, the design thinking approach is based on a three-dimensional framework where a set of practices interact with cognitive approaches and a specific mindset (Ibid: 57-59). These can be summarized in the table below.

Table 1. Common elements of Design Thinking as portrayed in management discourses

Adapted from Hassi and Laakso 2011:59

PRACTICES	COGNITIVE APPROACHES	MINDSET
• Human-Centered Approach • Thinking by Doing • Visualizing • Combination of Divergent and Convergent Approaches • Collaborative Work Style	• Abductive Reasoning • Reflective Reframing • Holistic View • Integrative Thinking	• Experimental & Explorative • Ambiguity Tolerant • Optimistic • Future-oriented

Hassi and Laakso are particularly interested in the way in which management has appropriated itself the design approach. However, they clearly indicate that such an approach has been written about and reflected upon at least since the 1960s and the ground-breaking works of thinkers like Herbert Simon and Donald Schön. As such, design processes and methods are very much part of a system thinking approach shared with other sciences such as

engineering or communication. What then differentiates a design approach from other ones?

If we are to follow Tim Brown's definition of design thinking, the difference here is the user centered focus and the reiterative process that characterizes design problem solving (Brown 2009). For Brown, design goes through three stages: inspiration, ideation and implementation (Ibid:16). Key here is design's character as "fundamentally an exploratory process" (Ibid). However, Brown's approach is essentially a management one axed on questions of desirability, viability and feasibility. Designers' skills are put to the service of business and asked to provide better and more pertinent solutions. Such skills include practices, cognitive approaches and a mindset that are not only proper to design, but which have come to define it lately.

Moving away from Brown by reflecting upon Herbert Simon's contribution to the science of management, Richard J. Boland Jr. argues that management itself should be considered from a design perspective (Boland 2004). He writes: "management is designing" in that it uses different levels of narrative as a means to act upon the world (Ibid:106). Language emerges as key here. How do we translate between different ways of knowing so as to clearly engage with the world through projects and methods? For Simon, Boland argues,

> *The way we narrate the story of our experience to ourselves and others as we engage in a sequence of events, gives meaning to the problem space we construct and the calculations we make of it (Ibid:107).*

We are essentially dealing here with a "sense-making" approach where, to use Simon's characterization of a manager's activities, we engage in "intelligence, design and choice" (Simon cited in ibid:108). Design for Simon is a holistic approach to problem solving, a methodological approach, not a specific discipline.

Boland identifies two narrative levels linked to Simon's characterization that can be of use to management. The former level conforms to the rational man of economic theory. In such an approach, "intelligence recognizes a need for intervention, design makes alternatives available for consideration, and choice select the best (satisficing) ones" (Ibid:109). The latter level is close to Karl Weick's theories on sense-making. Design here shapes "things while engaged with others in the flow of action and the producing of outcomes that are surprising" (Ibid: 111). For Boland this entails a cybernetic system based on "a phenomenological appreciation of human action" (Ibid).

Such an approach requires that one arrives at solutions only after having participated in and fully lived an experience. Thus no clear end-goal to the design process can be enunciated from the start, as the goal can only be

identified a posteriori. This requires incredible openness as well as alertness with respect to one's environment. It also requires an experiential and explorative mindset as well as tolerance for ambiguity as indicated above. This approach seems to us more pertinent when talking about design.

Design Thinking – How can we capitalise on it?

We believe that the term design thinking can be easily replaced by "design theory" and "design research". Unlike in more established disciplines, there is a tendency to diminish the theoretical underpinnings to design processes in design schools. Similarly, while a specific approach to research is currently taught, often research per se is not put forward as a discipline specific endeavor. This is even more so from the perspective of outside observers who do not recognize the theoretical and methodological approaches proper to design in general.

In a recent treatise on the philosophy of design, Stéphane Vial describes design methodology as encompassing five steps: analysis; problem formulation; conception; design; explanation (Vial 2010:72). As no formulation or identification of a problem without prior research is possible, analysis bases itself on research. For Vial, "to design is to engage in a project. To engage in a project implies pre-meditating something" (Ibid:73). Premeditation requires a constant engagement of the designer with his environment as a means to identify the salient problems he needs to address. Moreover, while design is always engaged with industry and the market, designers need to consider these as means towards developing value and not goals in themselves. Consequently, the designer constantly needs to assume "a moral position" (Ibid:51).

Vial is not alone in claiming that design is a project with a research component. Designer Gabriele Pezzini similarly defines the design process as one that ultimately requires formulating a project based on observation and analysis. In all production, he states,

> *we have … the process of a project. The process of a project means trying to unite or reunite distinct forces and combine their actions and qualities in order to discover another force, a force that can give each of them another form or another dimension within the single body resulting from their contact (Pezzini 2010).*

We are dealing here with a creative process embedded in a project and leading to the discovery of something new through the transformation of an existing reality. In his everyday practice, Pezzini re-transforms everyday objects through a reformulation of their functions and meanings borne out of research and analysis. His aim is not necessarily to produce, but to propose new ways of being.

Pezzini provides us with a basic "to-do list" on how to begin reformatting our approach to the world. A project, he argues, demands "observation, analysis, reflection, experiment, practice, intuition, manual skills, courage, magic" (Ibid). While the list might seem to imply a linear projection, in reality the process described should be understood as an iterative one whereby the designer constantly moves back and forward between reflection, experimentation, intuition and so forth until he reaches a final solution . Moreover, the items listed might seem obvious. However, the question is how to proceed, from an educational perspective, so as to create a new vision as well as a new practice in students.

Pezzini's approach echoes Bruno Munari's, a visionary in the field of design whose experience harkens back to the 1950s. For Munari, once again, design is a creative process, a problem solving endeavor and a project (Munari 2010). The steps involved in any creative process are various but always begin by identifying and circumscribing a problem, breaking it down into its constituent components, researching and analyzing the data pertinent to the issues at hand (Ibid:35-62). It is only at this stage that the designer can engage in creative thinking and practice, identify the materials and the technology adequate to the ideas that he/she is developing, experiment, develop new models, and test them in order to arrive at the most appropriate solution. Like for Pezzini, this is not a straightforward, linear endeavor, but an iterative one. The "methodological schema" provided by Munari is, as he states, "elastic" (Ibid: 60). Even if the schema has a progressive logic to it, it is up to the designer(s) to indicate the order of intervention and the iterative process proper to the various stages. Indeed, the designer(s) may continuously question the pertinence of the proposed solutions and hence move back and forth along Munari's ideal set of steps.

Vial, Pezzini or Munari are, each in their own way, describing both mental and practical processes that while complementary to them are quite different from standard educational models in business schools. The fact that they are becoming increasingly popular outside of design schools (as well as within them) signifies that we are facing a paradigm shift within business education. However, we could also be facing the development of a paradigm proper to design not merely as professional practice but more widely as a discipline with a theory and a methodology proper to itself. While design theory and research exist since a long time, the current interest in theoretical and methodological issues might be seen as a shift in the preoccupations facing designers as a community. These preoccupations are not only of a theoretical and methodological character, but also respond to questions proper to a real ethics and sustainability of production.

In the 1970s, Thomas Kuhn defined a paradigm as "some implicit body of intertwined theoretical and methodological belief that permits selection, evaluation and criticism" (Kuhn 1970:16-17). Accordingly, paradigm shifts occur when new models emerge to guide scientific research and hence

transform mainstream theoretical approaches or lead them unto new paths of inquiry. We believe that business education needs to identify and develop such a paradigm shift. The need to perceive concepts differently, to reframe our approach to complex systems, is a reality that we must reckon with and which requires new pedagogical methods. Rather than simply focus on passing on knowledge, then, it is necessary to develop thinking methods that will generate new knowledge. Moreover, these methods need to lead us to better solutions not only for business but for humanity and the planet as a whole.

Such an approach, however, is not only pertinent to business education. The recent appropriation by business of a "design thinking" model has simultaneously lead design educators to question what it is that design schools teach. Are we teaching students to make something or to develop a deep understanding about the very process of "making"? While mere aesthetic considerations when talking about design are surpassed since at least the Bauhaus movement, it is often the end product rather than the process leading to it that is talked about, fretted upon and ultimately displayed. The design process is still shrouded in a misty fog of subjectivity. It is here that an understanding of the research that goes into design might come in handy. Yet, research here cannot be divorced from the entire process leading to the creation of something new and/or innovative. Ultimately, the design process needs to be made explicit.

It might be pertinent at this point to briefly cite Charles S. Peirce and Michael Polanyi, two philosophers who both attempted to develop a non-Cartesian approach to knowledge. In a recent article, Phil Mullins argues for a link between Peirce's notion of "abduction" and Polanyi's idea of "tacit knowing" (Mullins 2002:198). For Peirce,

> *abduction... is any reasoning of a large class which the provisional adoption of an explanatory hypothesis is the type. But it includes processes of thought which lead only to the suggestions of questions to be considered, and includes much besides (Peirce cited in Mullins 2002:200-201).*

Abductive thinking which, as noted above, is a specific cognitive approach of designers, is largely instinctual as it rests on the "spontaneous conjectures of instinctive reason" (Peirce cited in Ibid:202) and is closely linked to man's deep seated beliefs and habits. Abductive thinking proceeds through "guessing" and "musing" to ultimately challenge our deepest convictions. While it is not possible here to engage in a full debate about the nature of abduction, may it suffice to link this to Polanyi's "logic of tacit knowing" whereby human knowledge proceeds by bringing together different elements via "a subsidiary awareness of them" (Polanyi cited Ibid:208). This is part,

Mullins argues, of "both ordinary perception and conception and the complex theoretical conception involved in scientific discovery" (Ibid:209).

Key for our argument is the transition from tacit to explicit knowledge and the underlying premises of abductive thinking as applied by designers in their everyday practices. It is by combining a set of distinct practices, cognitive approaches and a mindset that Hassi and Laakso were able to arrive at a coherent definition of "design thinking". We argue that, while concrete practices are easily observed and reproduced, it is the cognitive approaches that are at the core of the design process that need to be made explicit. An understanding of these approaches can help us develop coherent pedagogical programmes that change the mindset of participants at the same time that they instill a new way of looking at things.

Design – How can we integrate it?

How then can we use design's theory and research approaches as new pedagogical tools applicable across all disciplines? Following up on the above discussion, an understanding of design's cognitive approaches coupled with design's hands-on educational methods can begin to provide some answers. John Thackara writes that "formal education is already crippled by too much content and too little time to think"(Thackara 2005:135). He follows in this Ivan Illich's call for less schooling (Ibid:136). For Thackara,

> *The new mantra is learning to learn: a range of skills – and the capacity to use them effectively – that will equip us to understand abstract concepts and complex systems and how to live among them and improve them (Ibid:137).*

We believe that design is particularly well equipped with introducing students to a set of techniques on learning how to learn. These address, namely, the capacity to stop and think, play with ideas, before settling on a solution. A basic capacity to "play" is intrinsic to the design process. Play implies exploration and the reformulation of existing meaning. In Roger Caillois's terms, it requires a sense of freedom, uncertainty, lack of immediate productivity and fiction even though these need to be set in a given framework and follow at least a minimal set of rules (Caillois 1967:43). Obviously, however, play is not enough. The designer needs to engage with his/her environment in order to define the salient elements that need to be addressed. This requires the analytical capacity to identify and bring forth such elements to begin with.

When we look at design from close up, there is something of the *bricoleur* in designers. Recent views of design as a "tinkering" process seem to uphold

this view. The "tinkerer", like the *bricoleur*, plays with different - one could say disparate - elements in order to produce something new. For Claude Lévi Strauss, the *bricoleur* is the pre-scientific, one could almost say, the pre-Cartesian man who avails himself of everything at his disposal in order to make sense of the world. In The Savage Mind, he identified the *bricoleur* as

> *adept at performing large number of diverse tasks.... The set of the 'bricoleur's' means... is to be defined only by its potential use or, putting this another way and in the language of the 'bricoleur' himself, because the elements are collected or retained on the principle that they 'may come in always handy'.... They each represent a set of actual and possible relations; they are 'operators' but they can be used for any operations of the same type (Lévi-Strauss 1966:17-18).*

The image of the *bricoleur* conveys Pezzini's idea of the creative process: a remolding of what exists in order to create something new. At the same time, it renews with Peirce's discussion of abductive thinking and beliefs-habits. For Lévi-Strauss, the *bricoleur* begins by engaging in a retrospective reflection. He looks at what is in order to conceive possible, new assemblages. As a result, the *bricoleur* engages "in a sort of dialogue" with the materials at his disposal "to index the possible answers which [these) can offer to his problem" (Ibid:18). Furthermore, "he speaks not only with things... but through the medium of things" (Ibid: 21). This is akin to a form of poetry for Lévi-Strauss – and the design process for us.

To stop to think and play with concepts, ideas, material objects leads to the forming of new narratives. Through the design process, the designer aims at making sense, producing meaning. He does this by engaging with multiple intelligences, plural approaches that give him added insights into the environment he/she is exploring. However, once a narrative or a set of narratives begin to take shape, the need emerges to filter the data accumulated and the ideas that have been developed in order to assess what is pertinent and what isn't. It is at this point that a shift might and should occur, a turning around of what was into what might become.

Here, the idea of the *bricoleur* fits well with Carlo Ginzburg's outline of a research paradigm based on the decipherment of signs or clues – what Ginzburg terms "traces" (Ginzburg 2010). A narrative emerges always from a reading of the traces we observe in our environment. For Ginzburg, this capacity to infer the whole from a set of discrete signs is a fundamental characteristic of being human (Ibid:243). It is a qualitative approach based on a "subjective" reading of the data available. As such, it is not only characteristic of a designer's approach but proper to the social sciences and a number of disciplines privileging qualitative understanding. Such an

approach starts by an inquisitive look at what is, often from a micro standpoint, in order to decipher what might be at a macro level. Again, we fall within the ambit of Peirce's characterization of abductive reasoning. However, unlike in Peirce's formulation, we are able to describe in more concrete terms how this resembles the designer's approach. Like detectives, designers identify the salient elements of their quest for meaning in order to provide solutions to the problems at hand.

Therefore, teaching design theory and research implies leading students unto the path of discovery, on the one hand, and of rediscovery, on the other hand. By looking at things differently, learning to unlearn so to speak, students reach a different understanding of their environment. That is why the concept of play is key here: to play implies a level of freedom akin to the one children display when interacting together – freedom to move beyond known assumptions to imagine the (im)possible. As noted above, however, play must be accompanied by a strong analytical reflection about our environment and what we do, how we do it and why. Following Latour's understanding of technology's embeddedness in social practice, we believe this is valid for both inanimate as animate entities and requires an understanding of the way the inanimate and animate interact together[*]. The complexity inherent to these interactions can perhaps be made explicit through Deleuze and Guattari's idea of a rhizome and the inter-relationships implied thereby (Deleuze and Guattari 1980). Finally, reflection, exploration, understanding are all pathways to new ways of doing. Knowledge is gained not simply through passive learning but through practice. Experimenting, just like playing, is essential to this process as it contributes to developing a framework whereby to arrive at new knowledge.

The Dual MA/MBA Model

The difficulty of any educational programme lies precisely in how to instill in students the capacity to break free and invent new ways of doing. Perhaps, if we look at education not as something static but as an interactive form of apprenticeship whereby students integrate knowledge both explicitly through classical learning methods and implicitly by means of more experimental ones, we might develop new insights for pedagogical approaches. In this spirit, we have developed an educational programme that places students in situations where they need to simultaneously engage in knowing, doing and being via a heavy focus on experimenting, making sense and shifting/turning around their points of view. The set of dual MA/MBA programmes we present here operate on both a vertical and horizontal axis to integrate innovative business know-how, theoretical and hands on approaches in design, and

[*] *We are here referring to Bruno Latour's incorporation of technology and technological products as agency bearing elements within any social configuration (Latour 1991). We suggest to enlarge the concept of actant to any inanimate object interacting within a social configuration.*

design research methods. Students will be trained to comprehend and perceive abstract concepts and complex systems differently and to apply successfully advanced skills in, for example, meta-cognition, aesthetics and art, manual skills, personality and social theory, affect and emotion, to their projects. They will have to progress through several levels going from the exploration of an existing problematic to new solutions via special workshops integrated into their classes by cohorts. They will learn how to think differently, play, make sense of their experiences, filter ideas, shift their views and finally turn the problematic around to find innovative solutions together.

The table below exemplifies the various steps students will be helped through. Horizontally, they will attend management, design and research courses that will integrate process methodologies with new management models in order to understand "what is". Subsequently, students will look at process more closely by exploring how knowledge is produced and innovation managed. Here, they will engage in specific research techniques geared to design problematics. The focus is on "what could be". Finally, they will look at complexity theory and explore issues proper to strategy both in the management field and with respect to advanced planning and concept evaluation in design to identify "what should be". At the end, students should be able to develop new innovative products and services.

Table 2: Planned Dual MA/MBA Programme Structure for Design Theory and Research or Fashion Concepts with Design & Management (L'Ecole Parsons à Paris/Paris College of Art).

Management	Design	Research	Focus
New management Models	Process	Process Methodology	What is
Innovation & Process Management	Planning	Physical, Cognitive, Cultural HF, Ethnographic Research Methods	What could be
Complexity Management & Strategy	Strategy	Applied Research	What should be
Professional/Thesis/Degree Project			Product/Service

As students will progress from "what is" to "what could be" and to "what should be", they will go from an understanding of process to planning to strategy from both a business and a design perspective in a wholly integrated curriculum. The progression is meant to develop an understanding of design

as a holistic approach to problem solving through a project based and integrative thinking approach. The focus is on design first as process so as to develop an approach of design as strategy subsequently. Management is a key component of the programme as here design emerges at the end as a core competency to manage complexity; develop process-oriented problem solving approaches; focus on a user-centered model; and develop socially and environmentally responsible values in a truly collaborative effort.

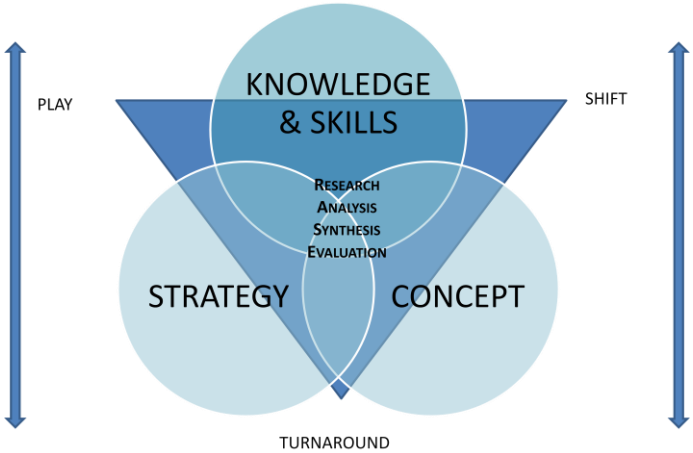


Table 3: Modelisation of Learning Processes for the Dual MA/MBA Programmes (L'Ecole Parsons à Paris/Paris College of Art).

At the same time that it seeks to have students progress from one stage to the other, the programme adopts an iterative approach whereby it asks students to question their thinking processes and their work, and to challenge themselves at any point in time by continuously testing the solutions they have arrived at. As indicated in the diagram above, the programme has students start by generating knowledge, move on to think strategically and plan accordingly, and finally develop new concepts. Throughout, research, analysis, synthesis and evaluation accompany the design process that leads to the emergence of new solutions in an iterative way. We find here Pezzini's and Munari's problem solving, project based design process coupled with Peirce's and Polanyi's thinking modalities. Students play with ideas, turn them around to ultimately shift both mindsets and viewpoints. The process, moreover, is group lead as creativity can emerge only through the constant challenging of ideas in a social context – hence the need to constantly check solutions against an existing reality.

Conclusion

Whether we look at business or design schools today, we observe that the term "Design Thinking" has been appropriated at various level without a real understanding of the underlying premises of design theory and research[i*]. From the vantage point of management, design still incarnates a subjective, undefined notion of creativity. Managers still experience difficulties, by and large, to apprehend design from more than a subjective "I like" standpoint. While this is not true of everyone, it is still sufficiently true to raise the issues of what do we mean by "design". Similarly, design schools still pay too little attention to the strategic power of design and focus more on the "doing" of design than the "thinking" about it. Moreover, designers shun management skills as not pertinent to their discipline and not valorizing for their know-how. The dual MA/MBA programmes we propose here want to break away from such stereotypical views to integrate fully a design based theoretical and research approach into management and vice versa. Design emerges as a full discipline worthy of contributing value to business and society just as much as engineering or management itself might. Finally, we believe that adopting a design theory and research approach can help business, engineering and art & design schools develop integrative curricula that address current problems with education in these fields.

Refences

Boland Jr,.Richard J. (2004) "Design in the Punctuation of Management Action" in Richard J. Boland Jr. and Fred Collopy (Eds)., *Managing as Designing*, (pp. 106-112). Stanford: Stanford Business Books.

Brown, Tim (2009) *Change by Design*. New York: Harper and Collins.

Caillois, Roger (1967) *Les Jeux et Les Hommes*. Paris :Gallimard.

Datar, Srikant M. and David A. Garvin, Patrick McCullen (2010) *Rethinking the MBA*. Boston: Harvard University Press.

Deleuze, Gilles and Félix Guattari (1980) *Milleplateaux*. Paris : Editions de Minuit.

Ginzburg, Carlo (2010) "Traces : Racines d'un paradigme indiciaire » in Carlo Ginzburg, *Mythes, Emblèmes, Traces* (218-294). Paris : Verdier Poche.

Hassi, Lotta and Miko Laakso (2011) "Making Sense of Design Thinking", *IDBM Papers* 1:50-63.

Latour, Bruno (1991- Fall) "On Technological Mediation: Philosophy, Sociology and Genealogy", *Common Knowledge* 3(2):29-64.

Lévi-Strauss, Claude (1966) *The Savage Mind*. Chicago: The University of Chicago Press.

Kuhn, Thomas (1970) *The Structure of Scientific Revolutions*, 2nd Ed. Chicago: The University of Chicago Press.

Munari, Bruno (2010) *Da Cosa Nasce Cosa*. Roma: Editori Laterza.

Pezzini,Gabriele (2010) *Meteorite: Looking Far, Watching Closely*. Paris: Thinker Ltd.

[i*] *A quick look at the most recent listings of Business Week relative to D-Schools shows the disparity in programmes and pedagogical approach of the various business and design schools cited.*

Thackara,John (2005) *In the Bubble: Designing in a Complex World*. London: The MIT Press.
Vial, Stéphane (2010) *Court Traité du Design*. Paris: PUF.

CUMULUS // DRS SIG on Design Pedagogy
1st International Symposium for Design Education Researchers
Paris Chamber of Commerce and Industry, Paris, France 18–19 May 2011

Alison Shreeve (2011). *The Way We Were? Signature pedagogies under threat.* 112–125

The Way We Were? Signature pedagogies under threat.

Alison SHREEVE*

Buckinghamshire New University

This paper identifies signature pedagogies which are common to creative art and design subjects across four main disciplinary areas. Based on a study of tutors' understanding of learning activities they create for their students in six London colleges, it explores the key characteristics which prepare students for professions in art and design. Signature pedagogies develop in students the disciplinary ways of thinking, being and acting in the discipline and vary between discipline areas. Having identified the pedagogic practices which are common to the four areas studied the paper then discusses the potential threats to maintaining these practices given the technological, social and economic pressures facing art and design higher education in England today. In concluding it suggests that signature pedagogies will be likely to change in the coming decade, although creative tutors are likely to develop innovative approaches to their teaching, which will in part circumvent the pressures facing the sector currently.

Keywords: Signature pedagogies; art; design; economy

Signature pedagogies

The idea that teaching and learning differs from discipline to discipline has been identified through notions of 'academic tribes and territories' (Becher 1989, Becher and Parry 2005) where different cultures have evolved for individual disciplines with distinct boundaries between the languages and social practices which each discipline espouses. Such definite distinctions have been softened by research suggesting that these boundaries are in practice more fluid and that metaphors such as rivers and landscapes are more appropriate means to conceive of disciplines and subjects. In such models different groups overlap or intermingle, or sometimes come together

* *Corresponding author:* School of Design, Craft and Visual Arts | Bucks New University
Queen Alexandra Road| High Wycombe HP11 2JZ | United Kingdom
e-mail: alison.shreeve@bucks.ac.uk

in joint activities (Brew 2008). Although debate about disciplinary difference has ebbed and flowed, much research suggests that there are differences between subject groups which are partly social, incorporating different language, concepts and practices. More recently the idea of 'signature pedagogies' (Shulman 2005b) has identified that not only are there differences in academic content and language, but in the ways that students learn the content of their disciplines, particularly where these are related to professions (Shulman 2005b). Signature pedagogies are those ways of teaching and learning which specifically prepare students for ways of thinking, being and acting in the professions. It is this 'specific external point of reference' (Squires 2005 p127) that distinguishes such disciplines as art and design, engineering, medicine, law and education within the university. There is therefore a close relationship between the practices beyond academia and the learning activities which students undertake. The pedagogies which help to create the links and prepare students for the professions are 'pervasive, routine and habitual' within the discipline (Shulman 2005b p3). In law Shulman identifies case teaching, in nursing there are simulated hospital wards, often referred to as learning laboratories and in design there have been classic studies of studio based learning observed by Schön and summarised by Waks (2001).

Signature Pedagogies in Art and Design

The influence of Schön's writings have become central to many practices in higher education in the UK, particularly the idea of reflection, or reflection in action. His analysis of learning through the design studio (1985) remains a classic work in the study of specific disciplinary practice in the arts. A more recent publication exploring signature pedagogies across disciplines however, specifically identified the critique as a particular form of learning which pervades the visual and performing arts (Klebsedel and Kornetsky 2009).The idea of signature pedagogies which are common to four disciplinary art and design subjects was an outcome from an investigation into teaching and learning practices at the University of the Arts London. Shreeve et al (2010) suggest that there are futrther characteristic ways of teaching and learning that contribute to 'disciplinary ways of knowing' in art and design, including the crit previously identified by Klebsedel and Kornetsky.

The 'Landscapes of Teaching' project was carried out at the University of the Arts London, across six colleges and four subject areas. Specifically the research questions were:

- What is distinctive in the teaching and learning practices in the disciplines of Fine Art, Graphic Design, Design for Performance and Fashion Product Design?

- What explanations are there for these distinctive characteristics?

- What is the significance of teaching and learning spaces in relation to these distinctive practices in the art and design disciplines studied?

The report of the project is available online (Sims, 2008) and sets out in more detail the methodology underlying the research. In brief, a team of teacher researchers interviewed colleagues across the colleges through a visual elicitation process which centred the interview discussion around a photograph of the tutor's teaching environment. A set of semi-structured interview questions was agreed by the team of researchers to provide some consistency to the process. The questions referred to the visual representation of the learning activity selected by the respondent which positioned the discussion in an actual teaching event which took place in order to avoid espoused theories of teaching, although we recognise that each individual will bring their own interpretations to the discussion. In addition to this an alternative image to that selected by the respondent was presented in order to raise further debate about learning activities in the particular subject area involved. All interviews were audio recorded and transcribed verbatim. The group of tutors came together to analyse transcripts thematically, agreeing the following overarching categories for analysis: student, tutor, space and discipline. There were differences within and between the different discipline groups and these have been explored elsewhere (see http://www.arts.ac.uk/clipcetl-landscapes for further information). In undertaking further analysis which looked for commonalities across the disciplines Shreeve et al (2010) proposed that these common pedagogies were the signature pedagogies for art and design disciplines.

The following section identifies these signature pedagogies in more detail, the claims being illustrated by quotations from interviews in the Landscapes of Teaching project. The fundamental idea of signature pedagogies supporting learners to develop disciplinary ways of thinking (Gurung et al 2009) are evidenced by the tutors' intentions for students in this study. Here they want students to learn to practice as a professional and to understand what it is to be a designer:

> *I think that there's all kinds of things about being an artist that are about the way in which you engage with the world.*

> *I think that you need to be very resilient to work in the industry that we work in. It's tiring, you work long hours. It's emotionally exhausting and all those things. In a way students need to be given a sense of what it actually means rather than it being a nice thing to do when you can't think of what else to do.*

This emphasis on understanding what it means to be a designer or an artist underpins the pedagogic practices described by the respondents in the research. There is less emphasis on the content of teaching and more in the development of identity as a practitioner. This approach to learning and teaching has been described by Dall Alba & Barnacle (2007) as an ontological approach, i.e. one that seeks to develop the whole person and their identity within the subject, not simply focusing on the epistemological aspects of the discipline or the content. In design terms Cross identifies that students need to learn '"designerly" ways of knowing, thinking and acting' (Cross, 2001 p53). This understanding of practice beyond the university is key to signature pedagogies in general and to art and design in particular, where 'real world' relations are characteristic of learning. These vary from learning activities determined through the project brief, which mirrors those used in industry and may indeed have been set by industry partners, to the use of part time faculty who are simultaneously practitioners and teachers (Shreeve 2009, 2010, 2011). The close relation between learning in university and the world of the designer has been tracked through the similarities of language used by both students and design companies (Logan 2006). This suggests that the pedagogies used help to prepare students for the professions they will enter on graduating and fulfil Shulman's criteria for signature pedagogies. Students may also spend periods of time in work related learning off campus in which they learn about the myriad variations and specific working practices of different companies (Shreeve & Smith forthcoming), situations in which their identities as designers are enabled to grow. The following pedagogies are common ways to develop such kinds of knowing, but these do not exclude other pedagogies employed by tutors in design disciplines

Working with ambiguity

Central to design learning is the development of creative thinking approaches and finding and exploring ways to create novel solutions to complex problems. Although informed by declarative knowledge such as historical information, materials science and technological processes, the design process is full of uncertainty and ambiguity, often dealing with 'wicked' problems. Similarly the learning environment is characterised by 'uncertainty' (Shulman 2005a), or a 'pedagogy of ambiguity' (Austerlitz et al, 2008) in which instruction by the tutor is seldom clear, as the tutor may also be in a position of uncertainty, also engaging with unknown outcomes alongside the student. This presents challenges for the tutor as well as the student.

> *...your relationship to students is different from student to student. There are some students that come to an idea which I just can't get my head around. But I trust them and I'll say go with your instinct because they're a strong student.*

> *Students will come up with ideas that you couldn't possibly have thought of yourself and it's really exciting, they're manipulating and changing materials and enquiring at it from a different direction and I find that very special.*

This sense of exploration and discovery is both exciting and challenging for students, who may be newly introduced to the idea of learning through discovery in higher education. If tutors are unable to provide clear instruction students who are unable to cope with ambiguity may find learning a challenge. Here a tutor attempts to describe this sense of the unknown journey that students, and to some extent tutors, embark on through the design process:

> *I'm not trying to get them to go 'there'. What I'm preparing them to do is to be better equipped to deal with it when they decide to go 'there'.*

Students who are less attuned to cues in the learning environment or perhaps ill prepared for ways of working and learning which require coping with ambiguous situations (Austerlitz et al 2008) struggle to maintain a foothold in their studies. The need to work through uncertainty has been described as a threshold concept for design students (Bull et al 2009). Such living with and through uncertainty and complexity has been identified by Barnett (2000) as a prerequisite for learning in the university of the 21st century. Design, it could be argued, has pedagogic models that may benefit other disciplines struggling to equip students for a future of chronic uncertainty. The places where students are taught help to counteract the challenges of ambiguity in the learning process, through encouraging social learning practices.

The Studio

Many exchanges take place in the studio, which has been identified by Schön (1985) as a particular culture, a mode of teaching and a location. Smith-Taylor (2009) claims that the studio helps to structure student centred learning, because there is no central point from which to lecture or instruct the student. However, this view has been counteracted by those who see poor teaching practice taking place where tutors simply 'cruise' through the studio dispensing wisdom and their own points of view, a tutor focused, transmission approach to teaching (Trigwell & Prosser, 1999). For many the idea of the studio is much more about location, a home base, a familiar territory. This is important, as the very act of learning to engage with ambiguity and the unknown requires courage and a safe place from which to venture forth into unknown territory. As one student said in a small scale (unpublished) study '*we don't have dedicated space where we can feel safe*

to leave things'. Students not only feel the need to 'leave things' such as ongoing work, but they require social spaces in which they develop peer learning, create course cultures which help people to develop an identity as a design novice and confidence that in the ambiguous territory of design pedagogy they have some stability and can feel 'safe'. This is summed up by a student who has these things:

> *They do make you work together and that's really good because I know people on different courses and they're in college for one day a week and they see for about 2 hours a day or something, and it doesn't seem to be the same thing, whereas we study together, we all go out together. I don't know if that's just our course or whatever but that way that it's set up is really good, it's really nice we've got a kind of little course family as it were.*

When students have a space, even if it is shared, it provides a mirror of professional practice and an opportunity to experience the kinds of working environments likely to be encountered on graduation, thus helping to create disciplinary ways of thinking (Gurung et al 2009). Where tutors no longer had access to a dedicated studio space in the Landscapes project they modified and adapted the environment to provide as much continuity or sense of belonging and ownership of the studio space as they could:

> *there's shared studio spaces so we tend to mix up second and third year, so in this space there would be about five students erm, placed erm, we try to place people together we may be have complimentary or different practices to make best use of the space. The space is used quite flexibly.*

Several tutors commented on the importance of planning or the need to be imaginative in the use of space in order to provide the studio experience that they valued:

> *it's quite complicated you have to, if you've got a full class which involves use of the stitch workshop in a formal way rather than just elective use of the workshop, one has to divide the group into half and have half in the studio and half in the workshop and then swap them over in the course of one day to get them all through that experience... So it's quite, it has to be organised but it's not that difficult, but it does*

have to be thought through and by arrangement with the technician.

Thus the studio as a learning environment remains a key component of pedagogies in art and design and a site where specific activities such as the critique (crit) take place.

The Crit

Critical thinking skills, which are an essential part of the learning process, are epitomised by the 'crit', identified as a signature pedagogy by Klebsedel and Kornetsky (2009). The crit may take many forms and in some cases is unlikely to be a constructive learning process (Blair 2007, Blythman et al 2007). However, the crit has become so embedded in the pedagogies of art and design that it constitutes the singular most recognisable form of pedagogy the disciplines have. This is perhaps surprising as the crit, in forms we experience in education, are unlikely to take place in the world beyond the university. Where it is most successful as a teaching method the crit will involve students in dialogue and discussion in smaller groups. It provides an opportunity to articulate the often tacit understanding and evaluation of design processes, enabling the development of critical thinking skills.

Dialogue

Central to the crit is the opportunity to talk, discuss, debate and explain ideas. The dialogue that takes place in the studio and in activities between peers and tutors in any learning environment is a significant component of signature pedagogies for design.

I think what maybe really helps is the constant discussion and talk, because that's part of the set up, it's part of the physical set up of any studio, you are learning, you are discussing, you are talking, you know whether it's to a peer or with me, you know, and that all builds; it is a continual learning curve, and you get something out of it at the end of the day, even if it's frustrating, and it hasn't turned out how you needed it to turn out, you know, there's just something tangible that you can hold.

The key characteristics of design pedagogies identified in the Landscapes of Teaching project were those that enabled dialogue, or a 'kind of exchange' (Shreeve et al 2010) to take place between tutors and students. The dialogic nature of teaching in design is critical and the forms this take are numerous, both one to one, in small groups, large groups and in formally structured and informal occasions in the studio or other situations both within and beyond the university. Dialogue was therefore identified as a signature pedagogy, because the exchange or discussions held enabled students and tutors to explore how a designer might think in practice. The exchange helped to elucidate the process of questioning, thinking about and evaluating potential

ideas and solutions, helping students to develop those kinds of ways to approach design. The complexities of dealing with the unknown and partly foreseen opportunities inherent in creative practice are explored obliquely through such exchanges.

Materiality

The dialogic nature of learning and teaching is not solely the province of verbal language. The physical and material aspects of learning are very palpable components of pedagogies in art and design where knowing is an embodied experience (Danvers 2006) and much learning remains an inculcation of tacit knowledge developed through practice (Dormer, 1998). In this example the tutor is explaining that students need to have a dialogue with the materials they use and the understanding of materials is an important part of the designer's practice.

> *this project is for those students who enjoy working purely speculatively in response to materials being handled using a mixture of experiments, chance and control so what's happening really is that they have to develop a dialogue between themselves and materials that are in front of them.*

For the tutor, the materiality of the learning process enables them to also centre a discussion of progress, learning and development around an artefact, not the student themselves.

> *So they do have these artefacts, which represent their learning. These sort of symbols of their learning which you can engage them with. Sit down with them and talk about this, this work that's outside of their head.*

Materiality is therefore central to the discipline, the learning activity and the dialogue that takes place in the studio. Having physical objects available for all to see enables discussion, participation and exchanges to take place between learners. It is through visual and material means that students begin to evolve potential outcomes in the research process, often through the use of sketchbooks, samples and prototypes. These material forms of thinking enable dialogue to take place and help to develop the kinds of embodied knowing that designers need. This 'material thinking' (Carter, quoted in Bolt 2006) supports learning about the design process through 'authentic' learning experiences. Within the university the use of sketchbooks, or other means of reflective drawing, thinking and evolution of design ideas is an important place of materiality. The evidence of thinking helps to develop the students' designerly knowledge and enables the tutors to question and prompt the

student, to challenge ideas, see potential and alternatives and so progress their ability to think in designerly ways.

This summary of pedagogic practices that help to develop students' ways of thinking, being and acting like a designer represent the core practices of the creative disciplines. Other forms of teaching and learning are obviously employed to good effect, but those described above may be threatened by changes to the education system in higher education to the extent that the discipline's signature pedagogies may change in the next decade.

Threats to Signature Pedagogies?

In the UK and much of the higher education sector based on British Educational practices, there has been an increase in numbers of students studying. The widening participation agenda has resulted in a broader range of students' previous experience and often an increase in international students. This broad range of student experience has also been accompanied by increases in class size, the modularization of the curriculum, managerialist approaches to education (Trowler 1998) and a regime of quality assurance which has introduced a set of general expectations about the nature of higher education learning and teaching (Strathern 2000). With larger groups of students there is less time to spend in the dialogic aspects of one to one tuition which enable individuals to be supported to develop their own questioning approaches to the discipline they are studying. With large groups (over 20 students) in a critique, there is less likelihood that students will find the crit a good learning experience (Blythman et al 2007) as opportunities for discussion or exchange of viewpoints are less likely to take place.

In an era of economic pressure on higher education there is a growing demand to be financially accountable. This manifests itself in changes to the funding councils' requirements of HE institutions, resulting in measurement of space usage, the costing of courses in relation to student numbers, contact teaching time and resource allocation, including technical support, studio and workshop spaces. Added to this in the UK, the introduction of full cost fees and the reduction of direct state support for any other subjects than those designated as STEM (science, technology, engineering and mathematics) will have an unknown impact on design courses. These funding changes, driven by worldwide economic downturn, are the latest in a series of changes to HE which threaten the traditional signature pedagogies of our disciplines.

The 'Tyranny of Transparency'

A term coined by Strathern in 2000 referred to a growing managerialist tendency in HE. This manifested itself largely as an increase in standardised practices and expectations, driven through quality assurance processes like review, the introduction of credit framework structures (Trowler 1998), modularisation of the curriculum and Subject Benchmark Statements. In the

Landscapes project a tutor identifies the unease with which certain kinds of standardised pedagogic practice have infiltrated learning in design disciplines:

> *...we are possibly dominated slightly by the assessment process...but it's not just in assessment that we are dominated by that process of standardisation, you know, attempts to make little containers for everything. I mean especially in design where things don't fit into containers...so I think we have a problem in design education particularly.*

Changes in academic practice have arguably altered the university from a culture of trust to one of accountability and transparency, with a visible increase in bureaucratic procedure (Strathern, 2000, Hussey and Smith 2010). Through the kinds of accounting and measuring of student progress that such changes demand, there is a danger that the kinds of learning that are difficult to measure, such as ontological approaches to learning, are likely to be replaced by those that are more directly measurable (Dineen and Collins, 2005). The signature pedagogies identified as common to art and design higher education may be subject to similar pressures as those that affect art education in schools (Atkinson 2002), where proscriptive and centrally generated demands have created particular 'pedagogised identities' in art. There is a danger that more pressure on academics to conform will lead to a reduction of autonomy and creativity in the pedagogies of our disciplines.

Space Pressures

The pressure of increased student numbers and less individual or studio spaces to work is already evidenced in the Landscapes of Learning project. Tutors in this study work hard to generate flexible use of space and recreate situations which the traditional studio provides. For example this tutor designs activities to develop social learning within the cohort through trips:

> *...our students live all over London and they don't really socialise. We take them on trips and do things to try and get them to meet each other and know each other in a social context.*

A similar social learning approach is achieved through devising team projects:

> *If you can encourage each student to work as a team then I think it it's really vital for their learning and I think once they get to know each other and they have put down their barriers they find it rewarding... it builds*

> *their confidence and their self esteem being in a group working together and actually learning from each other.*

However, the studio provides an opportunity to create the 'kind of exchange', the dialogue, which we identified as a key signature pedagogy. If fewer physical places exist to support opportunities to practice and create dialogue we are concerned that this will impact learning the 'overlapping circles of language' (Logan 2006) which characterise the relationship between the academic and professional worlds of design. Less studio space also means less space to produce visible (material) work and students who have to share spaces take away ongoing work so that the richness of the material world of the studio is diminished.

Pressures on studio space also extend to workshops and making spaces. As new technologies become increasingly dependent on digital environments and processes this removes opportunities for students to learn the embodied meanings of design. A tutor in graphics, no longer able to access letterpress and other physical printing processes, takes his students out to a private workshop to learn and invents ways to improvise printing, in order that students do not rely totally on their computers. He believes that this hands-on process provides a better understanding of form, space and proportion than simply working on a computer.

The pressure for academic managers to maintain outdated, material and physical resources, because they provide a different and arguably better learning experience are hard to defend economically given the cuts to specialist teaching provision looming in the UK and beyond (e.g., Clarke & Budge 2010). More worryingly, expensive material processes such as glass making, ceramics and metal workshops in the current economic environment are likely to disappear in favour of cleaner, smaller, less resource intensive digital media based subjects. Without the embodied understanding of materials and processes our students will be less likely to succeed and to understand the manufacturing aspects of the design process.

A different kind of threat is presented by the idea of the student as consumer. As fees increase and the size of the debt with which students will graduate also increases the demands of parents and students are likely to become more stringent. The idea of ambiguity and threshold concepts (Bull et al 2009) which require students to be able to deal with ambiguous situations does not sit well with notions of transparency and knowing exactly what your money will buy. Parental expectations of creative industries professions are generally negative and poorly informed and although many students receive financial support from their families there is a limit to how much they can expect from relatives (Taylor and Littleton 2006). With increased costs and rising unemployment the pressures on students to follow more traditional career routes may well impact the current numbers of applicants to courses. This, in conjunction with expectations about precisely what a fee of £9,000

per annum will buy does present higher education with new challenges and may force out the more expensive practical design subjects altogether. Publishing employability statistics in the form of first destination returns, part of the drive for transparency, is also unlikely to support parental investment in their children's futures through art and design, although research indicates that art and design careers take longer to establish but are more rewarding than other discipline areas (Ball et al 2010).

Conclusion

The signature pedagogies identified here depend on places to learn which provide a material experience, a secure space to develop peer learning, a social network centred on becoming a designer and identifying with design practice. Dialogue, an opportunity to engage in a 'kind of exchange' with tutors who are practitioners, as well as with peers, remains an important and key aspect of design pedagogy. As economic pressures constrain both the facilities and resources available for higher education it is likely that the opportunities to engage in dialogue will continue to be challenged by increased student numbers and decreased opportunities to develop the language, concepts and skills required to become a practising designer. Although this presents a gloomy picture for the future, design tutors are creative practitioners and will adapt within the constraints that are presented to them. However, in adapting it is likely that the key signature pedagogies of design and the visual arts will be modified and changed in response to continued technological, social and economic pressure. In ten years time it will be interested to see how the signature pedagogies of design have changed, or how creative tutors have circumvented the challenges to create and maintain an education through design which helps to develop the creative thinkers of the future.

References

Atkinson, D. (2002). *Art in Education: identity and practice*. Dordrecht/ Boston/ London: Kluwer Academic Publishers.

Austerlitz, N., Blythman, M., Grove-White, A., Jones, B.A., Jones, C.A., Morgan, S., Orr, S., Shreeve, A., Vaughan, S. (2008). Mind the Gap: Expectations, Ambiguity and Pedagogy Within Art and Design Higher Education. In L. Drew (Ed), *The Student Experience in Art and Design Higher Education: Drivers for Change*. Cambridge: JRA Publishing.

Ball, L. Pollard, E. Stanley, N. (2010). *Creative Graduates Creative Futures.* Report Retrieved from http://www.employment-studies.co.uk/pdflibrary/471.sum.pdf April 26 2011

Barnett, R. (2000). *Realizing the University in an Age of Supercomplexity*. Philadelphia: SRHE/ Open University Press

Becher, T. (1989) Academic Tribes and Territories: intellectual enquiry and the culture of disciplines. Milton Keynes SRHE/Open University Press.

Becher, T. & Parry, S. (2005) The Endurance of the Disciplines. In Bleikle, I., & Henkel, M. (Eds) Governing Knowledge: a study of continuity and change in higher education. Dordrecht, Springer pp 133-143

Blair, B. (2007). 'At the End of a Huge Crit in The Summer, It Was Crap - I'd Worked Really Hard But All She Said Was "Fine" and I Was Gutted.' *Art, Design and Communication in Higher Education*. 5(2), 83-95.

Blythman, M., Orr, S. & Blair, B. (2007). *The Strengths and Weaknesses of the Crit – A Discussion Paper.* Retrieved September 29, 2010, from: http://www.adm.heacademy.ac.uk/projects/adm-hea-projects/learning-and-teaching-projects/critiquing-the-crit

Bolt, B. (2006). Materializing pedagogies. *Working papers in Art and Design* 4. Retrieved March 2011 from http://sitem.herts.ac.uk/artdes_research/papers/wpades/vol4/bbfull.html

Brew, A. (2008) Disciplinary and Interdisciplinary Affiliations of Experienced Researchers. *Higher Education*, 56(4), 423-438.

Bull, K., Tovey, M. & Osmond, J. (2009). Threshold Concepts and the Transport and Product Design Curriculum: reports of research in progress. *Art, Design and Communication in Higher Education.* 8(2), 169-175

Clarke, A. and Budge, K. (2010). Listening for Creative Voices amid the Cacophony of Fiscal Complaint About Art and Design Education. *International Journal of Art and Design Education*. 29(2), 153-162.

Cross, N. Designerly Ways of Knowing: Design Discipline versus Design Science. *Design Issues* 17(3), 49-55.

Dall'Alba, G. & Barnacle, R. (2007). An ontological turn for higher education. *Studies in Higher Education* 32(6): 679-692.

Danvers, J (2006). The Knowing Body: Art as an integrative system of knowledge. In Hardy, Tom (Ed) Art Education in a Postmodern World: Collected Essays. Bristol, Portland OR, Intellect, 77-90.

Dormer, P. (1994). *The Art of the Maker.* London: Thames and Hudson.

Hussey, T. & Smith, P. (2010). The Trouble with Higher Education: a critical examination of our universities. New York and Abingdon: Routledge

Klebsedel, H. & Kornetsky, L. (2009). Critique as Signature Pedagogy in the Arts. In Gurung, R.A. R., Chick, N. L. and Haynie, A. (Eds). *Exploring Signature Pedagogies: Approaches to Teaching Disciplinary Habits of Mind.* Sterling VA: Stylus.

Logan, C., D (2006). Circles of Practice: educational and professional grpahic design. *Journal of Workplace Learning* 18(6): 331-343.

Schön, D. A. (1985). *The Design Studio: An Exploration of Its Traditions and Potentials.* London: RIBA Publications Ltd.

Shreeve, A. (2009). 'I'd rather be seen as a practitioner, come in to teach my subject': Identity Work in Part -time Art and Design Tutors. *International Journal of Art and Design Education.* 28(2), 151-159.

Shreeve, A. (2010). A Phenomenographic Study of the Relationship Between Professional Practice and Teaching Your Practice to Others. *Studies in Higher Education*, 35(6), 691-703.

Shreeve, A. (2011). Being in Two Camps: Conflicting Experiences for Practice-Based Academics. *Studies in Continuing Education*, 33(1), 79-91.

Shreeve, A., Sims, E. & Trowler, P. (2010). 'A kind of exchange': Learning From Art and Design Teaching. *Higher Education Research and Development.* 29 (2), 125-138.

Shreeve, A. & Smith, C. (forthcoming) Multi-directional Creative Transfer Between Education and Work. *British Educational Research Journal.*

Shulman, L. S. (2005a). Pedagogies of Uncertainty. *Liberal Education*. 91, 18-25.

Shulman, L. S. (2005b). Signature pedagogies in the professions. *Daedalus* 134(3): 52-59.

Sims, E. (2008). Teaching Landscapes in Creative Arts Subjects. Report on the CLIP CETL Funded UAL Research Project. Retrieved on September 29, 2010, from: http://www.arts.ac.uk/docs/Landscapes-final-report.pdf

Smith Taylor, S. (2009). Effects of Studio Space on Teaching and Learning: Preliminary Findings From Two Case Studies. *Innovative Higher Education*. 33(4), 217-228.

Squires, G. (2005). Art, Science and the Professions. *Studies in Higher Education*, 30(2) 127-136.

Strathern, M. (2000). The Tyranny of Transparency. *British Educational Research Journal* 26(3): 309 - 321.

Trowler, P. (1998) Academics Responding to Change: New Higher Education Frameworks and Academic Cultures. Buckingham: Open University Press.

Waks, L.J. (2001) Donald Schon's philosophy of design and design education. *International Journal of Technology and Design Education*. 11(1) 37-5.1

CUMULUS // DRS SIG on Design Pedagogy
1st International Symposium for Design Education Researchers
Paris Chamber of Commerce and Industry, Paris, France 18–19 May 2011

Elvin Karana (2011). *Materials Selection in Design: From Research to Education*. 126–140

Materials Selection in Design: From Research to Education

Elvin KARANA*

Delft University of Technology

The selection of a material is a process that is common to a number of disciplines including materials science, mechanical engineering, civil engineering, architecture and industrial design, among others. The nature of materials can encompass nano particles to giant concrete pieces and applications can span products as diverse as telephones to bridges. The approach to the selection of an appropriate material within these disciplines varies. However common fundamental questions remain the same, namely: how do we select a right material for a particular application; and what are the main requirements and constraints?

Requirements and constraints are usually technical which can be numerically expressed in dimensions, such as strength, thermal conductivity, elasticity and other physical descriptors. However, when it comes to design related disciplines, requirements and constraints also include intangible aspects whose description is more difficult; such as meanings we attribute to materials (e.g. modern, feminine, aloof, etc.) or emotions elicited by materials (e.g. surprise, hate, love, etc.). In addition, in different stages of a design process, the broadness of the required materials information can differ tremendously. While a rough overview about a material family might be sufficient in a concept-creation phase, much more detailed information regarding technical properties of a material might be needed in an embodiment design. Considering these points, it is appropriate to say that design related disciplines require different materials selection tools and methods (than those used in engineering and materials science) which can be used in different phases of a design process and support designers in understanding both tangible and intangible aspects of a material.

These contrasting needs in other disciplines lead to discussions over 'materials training' in industrial design programmes. Formal and

* *Corresponding author:* Industrial Design Engineering | Delft University of Technology
Landbergstraat 15 | Delft 2628 CE | The Netherlands
e-mail: e.karana@tudelft.nl

informal discussions with design students and professional designers over a number of years and the partial reanalysis of the author's doctoral data have been used for: (1) creating material-driven design projects; (2) developing a new 'materials' course; and (3) creating a material library to support material education in design. In this paper, the reflection of the research on design education regarding those three aspirations will be discussed.

Keywords: Materials Selection; Meanings of Materials; Materials Education

Background

> *Once we begin to listen to what designers like Teague and Mies van der Rohe were trying to tell us- that materials are not just a 'given' to be incorporated in the designer's calculation but are part of the design problem- then the need to articulate a critical framework for the discussion of materials becomes obvious.* (Doordan, 2003)

The focus of designers differs from that of engineers and scientists who deal with materials principally to obtain product utility. For example, does a material conduct heat and does it resist to high impact forces? Designers do not only consider materials as physical entities to fulfil physical functions but also as a medium to affect people's experiences of products: materials gratify senses (i.e. aesthetic experience), convey meanings (i.e. experience of meaning) and elicit emotions (i.e. emotional experience). An experienced designer is expected to integrate these considerations in materials selection to ensure a positive user experience (Hekkert & Schifferstein, 2008; Karana, 2009; Rognoli, 2010; H. Zuo, 2010). Conversely, designers tend to invent their own ways (or just use their own intuitions) in putting these concerns into practice since there exists no common systematic approach for supporting designers in the incorporation of tangible and intangible aspects into their selection processes (Arabe, 2004; Hodgson & Harper, 2004; Ljungberg & Edwards, 2003; MacDonald, 2001; Sapuan, 2001; Van Kesteren, 2008).

There has been an important body of research in recent years that underlines the role of intangible considerations of materials on designers' material decisions (O Pedgley, 2009; V Rognoli & M Levi, 2004; Van Kesteren, 2008). For instance, the author in her PhD research Meanings of Materials (Karana, 2009) explores the factors influencing materials experience with a particular emphasis on understanding how materials are assigned meanings. She proposes a new method, Meaning Driven Materials Selection (MDMS), which encourages designers to systematically include meaning

considerations in their materials-selection processes (Karana, Hekkert, & Kandachar, 2010).

Despite the body of research emphasising the increasing value of intangible concerns and their integration to a tangible material selection process, the focus of materials training in design programmes has remained dominated by engineering content. The scholars in the domain also conjoin at a point that in design education students are mainly taught on technical characteristics of materials and not so many courses are dedicated specifically to materials experience (Rognoli, 2010; Karana, 2010; Rognoli and Levi, 2004; Pedgley, 2010). Instead, experiential aspects are presented randomly and in an unstructured way in other 'design' courses (V Rognoli & M Levi, 2004). Students often express their frustration since they find it difficult to select materials based particularly on the technical requirements. As a result, they usually postpone materials selection to the very last phase of the design process. In his recent article Pedgley (2010), demonstrates how to invigorate industrial design materials education and emphasises understanding of materials experience in design-materials education in parallel with the changes and concerns in the contemporary professional design practices. He states that young designers should be nurtured accordingly and adds "*For the industrial design student's experience in materials and manufacturing to be at its most relevant and enriching, it is considered vital that good correspondence is made between degree course content and contemporary professional practices*" (Pedgley, 2010: 342). Undoubtedly, adapting materials education in design by integrating different tools and methods for understanding both tangible and intangible aspects of materials is a vital need when current practices in design are considered.

In this paper, materials selection in product design is firstly explained with particular emphasis on the designers' needs and expectations from materials selection sources. Secondly, the Meaning Driven Materials Selection (MDMS) Method is discussed with respect to its usefulness for design students. In the last section, three initiatives are proposed to teach materials in design education to achieve better balance with current practices in the domain of design. These are: (1) material driven design projects; (2) a new 'materials and design' course which integrates both utilitarian and experiential concerns in materials selection; and (3) a materials library, implemented to the materials course.

Materials Selection in Product Design

Materials selection in product design is part of the design process that determines appropriate material(s) for designed products by considering related design criteria such as manufacturing processes, availability, environment, cost, function, shape, context of use, as well as meanings, associations, emotions, characteristics of users, and cultural aspects (Karana, 2009). The results of the conducted studies (Karana, Hekkert, & Kandachar,

2008; Van Kesteren, 2008) and the findings from literature provided us with a number of common approaches, needs and expectations among designers regarding materials selection in design.

Approaches, needs and expectations

Inspiration in Materials Selection

Traditional approaches to materials selection often rely on previously used materials, which results in safe however limited solutions. Inspiration in materials selection plays an important role on the innovative and effective use of materials in different applications. Selection by Inspiration is indeed emphasised as one of the main approaches followed by designers in selecting materials (Ashby & Johnson, 2002). Designers visit stores, viewing products and materials to seek ideas in a serendipitous way, until one or more are found appropriate for the project at hand (Ashby & Johnson, 2002). In addition, designers prevailingly use design fairs and conferences as inspirational sources for new material ideas (Karana, et al., 2008). Material libraries provide designers with new and traditional material samples and some application examples presented at an exhibition space. Visiting material libraries, designers become more familiar with current trends in materials, innovations, alternative manufacturing processes, and material suppliers.

Variety of Information in different design stages

In a majority of situations, designers commence the materials selection process with a definition of a product category such as, a medical product, equipment for military or a bathroom accessory. A preliminary set of material requirements is usually listed based on the defined product category. For instance, if it is a military product and the user is determined as soldiers, the candidate materials are expected to be light, matte, resistant to the environment and fluctuations in temperature. These material properties mainly respond to issues of utility and the physical function of the material. Each functional need can be readily translated into a technical requirement. However, unless technical requirements are defined at the outset of the project, product designers consider technical properties at an overview level and not in detail at the conceptual design stage (Ashby & Johnson, 2002; Karana, et al., 2008; Van Kesteren, 2008). At the concept creation, the designer requires preliminary data for selection of the widest possible range of materials (Ashby, 1999; Mangonon, 1999). All options are considered. A polymer may be the best choice for one concept, a metal for another, even though the function is the same and both are plausible concepts. At this point, it is crucial to inform designers in a systematic way of their pre-selections while, at the same time, providing them greater freedom in considering alternatives (Ashby, 1992, p. 8). Seeking alternatives in a conceptual design phase leads designers to more inspirational sources (Ramalhete, Senos, &

Aguiar, 2010) such as fairs, conferences and material exhibitions. In these inspirational sources, materials and products are presented as tangible samples which are also used as crucial references for ideas in the early design phases (Pasman & Stappers, 2001) particularly in presenting preliminary ideas to clients (Van Kesteren, 2008). Material samples also provide designers with the opportunity of experiencing the sensorial properties of materials which are considered one of the most vital aspects designers can harness for expressing certain ideas and notions through the materials of products (Karana & Van Kesteren, 2008).

The intangible characteristics of materials, for example, involving the perceived values and cultural meanings, trends, associations and emotions evoked by materials (Karana, 2006) play an important role in the product designers' decisions on materials. Designers use their own intuition and instincts to select the best material(s) fulfilling the intangible characteristics of their products. The final materials decision is essentially the best match the designer can propose to achieve a certain product character. Product designers also gather information about their target group while establishing criteria for materials selection (Karana, et al., 2008; Van Kesteren, 2008), which is an activity not usually incorporated into existing methodologies (Karana, 2009).

When designers complete the conceptual period and proceed to the 'embodiment' and 'detailed design' phases, they explore in more detail if the candidate materials perform appropriately in the areas of stress, temperature and environment as required in the analysis (Ashby, 2005). They, for instance, seek to determine if the selected material's service temperature is appropriate for the existing manufacturing processes or if the selected material has a high tensile strength. It should be remembered that although it is more critically analysed in the last phases of a design process, the critical data regarding manufacturability, accessibility and cost can be determinants of materials selection at a very early phase of a design process. In the detailed design stage, one of the selected materials may be subjected to precise mechanical or thermal analysis; the production methods are analyzed and the design is costed. If the selected material does not perform as required or if it costs more than expected, other candidates are subjected to the same analysis to compare the results. This iterative process goes on till the optimal solution is found.

Combinations of different materials sources

In a materials selection process, an optimal approach can be assured with combinations of different materials sources in different phases of the design process. The existing databases usually lack the inspiration designers need at the conceptual design phase (Ramalhete et al., 2010); nevertheless they are convenient for the embodiment and detailed design phases. Designers mostly prefer images (of sample materials and example products), supported with

minimal text-based information from a source to support the preliminary selection (Karana, et al., 2008; Van Kesteren, 2008) where the materials' names disappear; instead their sensorial properties, their expressive meanings dominate the ideas. Scholars in the design domain have recently developed new methods and tools that guide designers particularly in creating sensorial experiences through material choices (Zuo, 2010; Rognoli, 2010; Sonneveld, 2008). Integrating these kind of tools and methods into the materials selection process, undoubtedly, provide designers with appropriate material choices.

Time matters

Product designers expect materials selection to occur expeditiously in comparison to the entire design process (Ashby & Johnson, 2002; Karana, et al., 2008; O. F. Pedgley & Norman, 2007; Van Kesteren, 2008). Designers believe that, in a limited project time span, they cannot spend excessive time in the selection of new materials. As a consequence, they select traditional materials, which can be an obstacle to achieving a more innovative design. Therefore, designers would benefit from a source that provides new material ideas promptly. Existing case studies and other designers' experiences are important inputs in the selection processes. A material platform where designers can discuss new materials and share their experiences on material choices, for certain cases, might also provide designers with condensed, secure information which can be achieved in a rather short period of time.

Moreover, designers require materials data that can be readily and easily updated. The renewal of data in a given materials source is a very significant issue allowing designers to follow improvements and trends regarding target markets. Accordingly, most of the designers use the Internet as a source in their material searches (Karana, et al., 2008). The two major motives for opting to consult Internet sources are (1) up-to-date information can be found, especially on new production technologies and material innovations, and (2) accessibility of the source is easy and it does not take too much time.

Meaning Driven Materials Selection (MDMS)

We attribute meanings to materials around us. Meanings of materials are what we think about materials, what kind of values we attribute after the initial sensorial input in a particular context (Karana, 2009). The preliminary ideas in materials selection in design are determined by considerations regarding what kinds of meanings are conveyed through the selected material(s), how they are perceived by a particular user group, or how certain material and/or product aspects can be manipulated to convey the aimed meanings (such as modern, feminine, sportive, etc.).

After a number of conducted studies engaging different experiential methods, Karana (2009) explains the dynamic action between a user and a material in which the material obtains its meaning. A user with his/her particular characteristics interacts with a material of a product, appraises it

and attributes a meaning (or meanings) to it. The attributed meaning will be (partly) based on the material's technical and sensorial properties and is affected by aspects of the product in which the material is embodied. A material's meaning can change, depending on the user-material interaction, which is affected by use and time. Each main factor (i.e. user, product material) has a number of aspects (e.g. shape, manufacturing process, gender, expertise, etc.) that can influence the meaning attribution to materials. In addition, the context in which the material of the product is appraised may have a considerable effect on meanings attributed to materials, and is therefore shown as enclosing the entire process of user attribution of meanings to materials (Karana 2009). We assume that designers who can understand these relationships (which we may call 'meaning evoking patterns') between the user, product, material and contextual aspect, can more deliberately (or systematically) manipulate meaning creation in their materials selection processes and ensure effective user experiences.

The developed Meaning Driven Materials Selection (MDMS) method focuses on the systematic manipulation of meaning creation in materials selection process in design. In this method designers are expected to have in mind the meaning(s) such as, modern, sportive and feminine they would like to create through the material(s) of their designs. Data are proposed to be generated through the results of different studies conducted online with groups of people (target group) who are asked to select materials expressing the aimed meaning. People who participate in the data collection study are given the following three tasks, namely: (1) select a material that you think is 'X' (such as sexy, feminine, modern); (2) provide a picture of the material you selected; and (3) explain your choice and evaluate the material on the given sensorial scales (see Karana 2009 for more detailed information on the created sensorial scales). The open explanations are analyzed to find out commonalities among the selected materials in terms of their use and function, color, their context, form and manufacturing processes, etc. The sensorial scales are also evaluated to see which sensorial properties have significant effects on the creation of the aimed meaning. Designers browse through the selected materials, and try to find the meaning evoking patterns in that particular meaning-material relationship.

A dummy tool (Meanings of Materials- MoM- Tool) was created in order to test if MDMS can be used effectively in design education (main collection page and sensorial properties page of the dummy tool can be seen in Figure 1 and 2). The tool was tested with 20 Dutch master design students and a workshop was conducted with 140 Greek 4th year undergraduate design students. Students were given a design task and asked to incorporate the meaning driven materials selection in their design process via the provided 'dummy tool'. The data for the tool was created through a number of studies conducted with Dutch and Turkish participants on their appraisals of 'elegant' and 'sexy' materials (see Karana 2010a for further information). We aimed to

explore if the proposed method: (1) encourages students to systematically think about materials in concept creation; (2) inspires them to consider various candidates for a specific application; and (3) stimulates them to look for detailed information in other materials sources. The main findings are as follows:

- Wright (1998) explains that students tend to stick to one solution due to limited knowledge about materials, especially in the first years of their education. The MDMS method helped students to think about a number of material options instead of sticking to traditional materials.
- Van Kesteren (2008) emphasises that students need to be actively involved in looking for information. The MDMS method successfully invoked curiosity about selected materials and it encouraged students to look for further information in online material databases such as MatWeb (www.matweb.com).
- The method also encouraged them to make a systematic selection starting from the concept creation. They first roughly analysed the candidate materials based on their expressive meanings, sensorial properties, and physical performances. Then they selected 2-3 candidates to explore further in technical databases.
- The method stimulated the students to look for other materials (not presented in the collection) which fulfil the sensorial requirements such as 'smoothness' and 'transparency'. They were able to think more broadly and consider sensorial properties as tips for further exploration in databases.
- The method familiarized them with the variety of aspects that might play an important role in creating meanings. They, for instance, considered their user group's approach in that particular meaning-material relationship, or they mentioned manufacturing processes as one of the aspects to express different meanings.
- They found the method enjoyable and inspiring. Some of the students emphasized that they had enjoyed selecting materials for the first time.

The method was successful to realise our main aims. However, there were some drawbacks that encouraged us to think about alternative solutions for a complete material education. For instance, MDMS does not consider touch and feel of materials. Furthermore, the new material information it provided was limited and it was not able to provide deep understanding of a certain material family (or type). A complete material education should certainly involve different sources and methods focusing both on tangible and intangible qualities of materials. It should stimulate students to look for the most appropriate material(s) for an application given as a design project implemented in a longer period of time within a materials and design course.

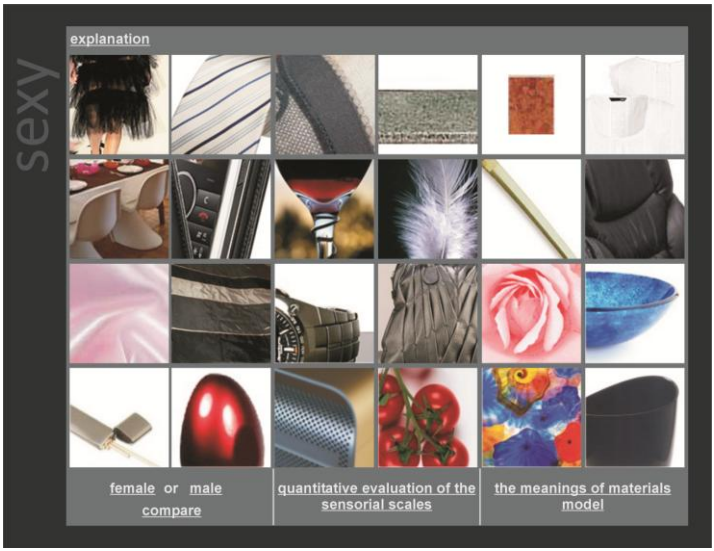


Figure 1. Meanings of Materials Tool, dummy application interface for the meaning sexy.

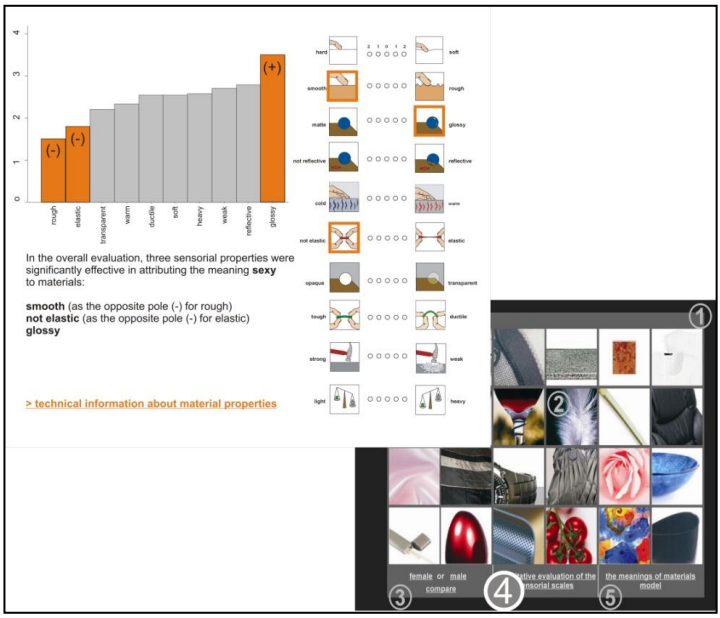


Figure 2. Quantitative evaluation of the sensorial scales page in the dummy application.

Teaching Materials in Design

How could we transfer accumulated knowledge of materials and design research and the method (MDMS) that presents a new approach in materials selection in design to design education? Three directions have been followed to develop an effective way of teaching materials in design: (1) material driven design projects; (2) a materials and design course; and (3) a materials library. These three directions are explained in the following section.

Material Driven Design Projects

The first attempt was to develop material driven design projects which mainly support the idea of 'multiple detailed levels' in a materials selection process and provides students with a deep understanding of a certain material over a longer period of time (for instance 6-month graduation projects). The Meaning Driven Material Selection (MDMS) Method is implemented as the main approach to be followed by the students at the conceptual-design phase and the other material selection tools and methods (such as Cambridge Engineering Selector) are involved in different phases of the design process. One of these projects is shortly explained below:

Exploring Meanings of Bio-Plastics

With the emergence of bio-plastics, in many cultures the earlier image of plastics has changed from being a material that is 'harmful and toxic' for people and the environment to a material that might come from nature and returns to nature. The first bio-plastic was discovered more than a hundred years ago. Application of bio-plastics and acceptance in the market, however, happened only around the late 1980s. As expected it is not easy to change an existing image of a material or to commercialize a new material in a society. The core idea of this research stems from the following question. How can we commercialize bio-plastics in consumer products as an 'environmentally sensitive' material? This question brings a number of questions along with it: When do people think that a certain material is sustainable/environmentally sensitive? How do other design elements (such as form and function) contribute to the creation of this meaning? How can we support designers in the expression of 'environmentally-sensitive meaning' through material properties? How can we improve/modify the sensorial properties of bio-plastics in order to emphasise/create this meaning?

Currently a graduation student works on this project. The questions have stimulated the use of MDMS method as a starting point in order to understand when people appraise materials as 'natural'. In this ongoing project, the graduation student is exploring the expressive characteristics of the materials as well as its technical properties and related manufacturing processes. The main findings of the research are aimed to be implemented in a design of a product made of bio-plastics which expresses the image aimed for, and shows the potential of the material.

Materials and Design Course

The second attempt was to develop a course to incorporate different activities focusing on different materials, material properties, and material selection tools and methods. The course consists of a number of projects which encourage students to explore materials, to create particular experiences with materials and to design for materials. In these projects, students are encouraged to integrate both technical and experiential aspects of materials in their designs. Supportive lectures and workshops by experts and by the course coordinator are involved in the course. The course is structured as follows:

Exploring Materials: Industrial Design Classics, New Materials and Technologies

The first projects in the course aim to stimulate students to understand (1) commonly used materials in design (industrial design classics), and (2) new materials and technologies in design. In the first project, they are asked to explore frequently used materials in the domain of design (such as aluminium, PP, silicon, etc.) or a material family in general (such as plastics, metal, wood, ceramics, etc.) and prepare a 'story' showing the selected material's role in design from different perspectives. For example, while one group might approach to the topic from 'an environmental point of view' and show how the image of plastics changed in time from being an environmentally suspect to an environmentally sensitive material; another group might focus on how the improvements in manufacturing technologies have affected the form of wooden products. The aim is to explore the possibilities in the world of well-known materials, and also to see the novelties and new applications regarding these materials. In this project the students work in groups. Each group focuses on a different material - and prepares a presentation for other participating groups. Their exploration is expected to include technical and sensorial properties, possible manufacturing processes, and existing applications; and supported by material samples and example products. In the second project, students get a similar assignment, yet this time for 'new' materials which are not well-known in the domain of design though they have great potential for new applications. The students are asked to present a 'future scenario' considering potential applications of the material. They estimate a future image for the material and define the role of the material in a particular society.

Creating Experiences with Materials

Follow-up projects aim to stimulate students to create certain experiences through materials. Each project starts with a supportive lecture regarding the three main components of a material experience: aesthetic experience, experience of meaning, and emotional experience. Lectures focus on different tools and methods referring to one of these experiential components (such as

MoM Tool, expressive semantic atlas developed by Rognoli, etc.). In each project, students are asked to design a 'simple object' (such as a bowl, a plate, a coffee table, etc.) to emphasize the specific experiential component they focus on. An example project for a group can be 'creating a fruit bowl which elicits surprise through its material'. Each group is expected to create a number of bowls that differ in the way their materials are embodied and the way the surprise is elicited. Students are expected to make physical models for an exhibition.

Designing for Materials

The last project in the course is rather a long-termed project. Students work as individuals on projects given by material suppliers, who look for new applications for their materials. Example topics for the project might be bio-plastics, natural fiber composites, smart textiles, etc. Students explore the material properties and design new products considering technical and experiential aspects of materials. The project ends with final presentations which show the process followed, the ideas and concepts developed. The project is supported by an introductory lecture and a workshop given by the course instructors and guest specialists from material suppliers.

A Material Library to Support Design Education

The third initiative was to develop a material library that will be incorporated to the materials and design course. There are a number of material-consulting companies (such as Material Connexion, Materia, etc.) offering physical material libraries for material browsing. In these libraries, material samples are presented with a basic technical, manufacturing, environmental (which has especially gained importance in the last few years) and supplier information. However, they do not provide a systematic way of browsing through the collection. Moreover, the library materials are mainly selected on the basis of their opportunities for innovation and creativity, and thus they do not offer a general overview on materials in design (Wastiels, 2010). Considering the expectations of design students, a material library in a design faculty should be different than one that mainly provides an innovative sample collection. The starting point for developing a material library is to explore the existing libraries in order to understand the main advantages and disadvantages. After visiting 6 material libraries (including Material Connexion in Milan, and Material Matters in Eindhoven), a proposal has been written to be submitted to the Executive Board (Board of Directors) of TU Delft. The proposal of developing a material library at the Faculty of Industrial Design Engineering TU Delft has been accepted. This ongoing project is planned to be completed by the end of 2011.

In the proposed project, the material library is structured based on the materials and design course in order to promote the active use of the library as well as to update library materials with the involvement of students who

take the course. Accordingly, it consists of four main components which are actively used in different stages of the course: (1) industrial design (ID) classics, (2) new arrivals, (3) material exhibitions, and (4) student platform. In ID Classics, commonly used materials in design (such as metal, ceramics, etc.) are presented with a story behind (as explained in the previous section). Students get familiar with the different applications, manufacturing processes, different sensorial aspects regarding these materials.

In the new arrivals collection, relatively unknown, innovative and/or rarely used materials are presented in the form of material samples provided by material suppliers. Students can get more information about a specific material by scanning the barcode on the material sample, which causes an automated e-mail with a technical data-sheet to be sent to the students' email accounts. In addition, material samples in the new arrivals collection are grouped based on the three keywords often emphasized in the design domain and in current material databases: environmentally sensitive, smart and lightweight. In this way, students can get a quick overview regarding the materials of the library grouped under these keywords.

In the materials exhibitions component, every four months a particular material or a relevant topic is elaborately exhibited. For example, 'cork' can be an exhibition material. A company who produces a variety of cork products is asked to provide a collection to express the character of the material's potentials in design. Or in another exhibition, 'surprise' can be selected as the exhibition topic and a variety of materials that elicit surprise in different ways can be exhibited. Different tools and methods for selecting materials in design are also aimed to be introduced through the exhibition unit. The Materials and Design Course is again incorporated in organising these exhibitions in the library.

In the last component of the library (student platform), students share their material experiences with each other through exhibited student projects. Different courses in design education are incorporated in this component of the library. All material-related projects are presented in the form of posters and physical models.

Conclusion

This paper presents a new approach to teach materials in design education. Across several years the approach has been developed through a number of studies conducted with design professionals and students in order to understand their materials selection processes, their needs and expectations. In this paper it is concluded that a comprehensive education regarding materials in design is possible by incorporating various activities, tools and methods that encourage students to touch and feel materials, to get inspired by materials, to consider both tangible and intangible aspects of materials in a selection process, and to further explore materials. Material driven design

projects, a new course for materials and design, as well as a physical material library have been proposed as three different, but complementary strands to support this approach. We aim to present the first fruits of these ongoing projects in the near future.

References

Arabe, K. C. (2004). Materials' central role in product personality. Industrial Market Trends, March. Retrieved from http://news.thomasnet.com/IMT/archives/2004/03/materials_centr.html

Ashby, M. F. (1992). Materials selection in Mechanical Design. Oxford: Butterworth-Heinemann.

Ashby, M. F. (1999). Materials Selection in Mechanical Design (2nd ed.). UK: Butterworth-Heinemann.

Ashby, M. F. (2005). Materials Selection in Mechanical Design (3rd ed.). Oxford: Butterworth- Heinemann.

Ashby, M. F., & Johnson, K. (2002). Materials and Design: The Art and Science of Material Selection in Product Design. Oxford: Butterworth- Heinemann.

Hekkert, P., & Schifferstein, H. N. J. (2008). Introducing product experience. In H. N. J. Schifferstein & P. Hekkert (Eds.), Product experience (pp. 1-8). Amsterdam: Elsevier.

Hodgson, S. N. B., & Harper, J. F. (2004). Effective use of materials in the design process- more than a selection problem. Paper presented at the International engineering and product design education conference.

Karana, E. (2006, 27-29 September). Intangible Characteristics of Materials in Industrial Design. Paper presented at the 5th International Conference on Design and Emotion, Goteborg, Sweden.

Karana, E. (2009). Meanings of Materials, PhD Thesis. Delft, ISBN 9789051550559: TU Delft.

Karana, E., Hekkert, P., & Kandachar, P. (2008). Material considerations in product design: A survey on crucial material aspects used by product designers. Materials and Design, 29, 1081-1089.

Karana, E., Hekkert, P., & Kandachar, P. (2010). A Tool for Meaning Driven Materials Selection Materials and Design, 31, 2932–2941.

Karana, E., & Van Kesteren, I. (2008). Materials affect: The role of materials in product experience In P. Desmet, J. Van Erp & M. A. Karlsson (Eds.), Design and Emotion Moves. UK: Cambridge Scholars Publishing.

Ljungberg, L. Y., & Edwards, K. L. (2003). Design, materials selection and marketing of successful products. Materials and Design, 24, 519-529.

MacDonald, A. S. (2001). Aesthetic intelligence: optimizing user- centered design Journal of Engineering Design 12 (1), 37- 45.

Mangonon, P. L. (1999). The Principles of Material Selection for Engineering Design. New Jersey Prentice- Hall.

Pasman, G., & Stappers, P. J. (2001). Product World, An Interactive Environment for Classifying and Retrieving Product Samples. Paper presented at the 5th Asian Design Conference, Seoul, Korea.

Pedgley, O. (2009). Influence of Stakeholders on Industrial Design Materials and Manufacturing Selection. International Journal of Design, 3(1), 1-15.

Pedgley, O. (2010). Invigorating industrial design materials and manufacturing education METU Journal of Faculty of Architecture 27(2), 339-360.

Pedgley, O. F., & Norman, E. W. (2007). A Synopsis of Materials and Manufacturing Expertise for Trainee Industrial Designers. Paper presented at the Shaping the Future: 9th International Conference on Engineering & Product Design Education, Northumbria University, Newcastle.

Ramalhete, P. S., Senos, A. M. R., & Aguiar, C. (2010). Digital tools for material selection in product design. Materials and Design, 31, 2275–2287.

Rognoli, V. (2010). A broad survey on expressive-sensorial chracterization of materials for design education. METU Journal of Faculty of Architecture, 27(2), 287-300.

Rognoli, V., & Levi, M. (2004). Emotions in Design through Materials: An Expressive-Sensorial Atlas as a Project Tool for Design of Materials Turkey. Paper presented at the 4th International Conference on Design and Emotion.

Rognoli, V., & Levi, M. (2004). How, what and where is possible to learn design materials? . Paper presented at the International engineering and product design education conference.

Sapuan, S. M. (2001). A knowledge-based system for materials selection in mechanical engineering design. Materials and Design 22, 687- 695.

Van Kesteren, I. (2008). Selecting materials in product design. Delft University of Technology, Delft, The Netherlands.

Wastiels, L. (2010). Mapping material experience in architecture. Brussels, Belgium.

Wright, I. C. (1998). Design Methods in Engineering and Product Design. Cambridge: The McGraw-Hill Publishing Company.

Zuo, H. (2010). The selection of materials to match human sensory adaptation and aesthetic expectation in industrial design. METU Journal of Faculty of Architecture 27(2), 301-319.

CUMULUS // DRS SIG on Design Pedagogy
1st International Symposium for Design Education Researchers
La Bourse du Commerce, Paris 18–19 May 2011

Jane Osmond (2011). *Researching Design Education a 'Wicked' Problem for a 'Wicked' Discipline*. 141–155

Researching Design Education a 'Wicked' Problem for a 'Wicked' Discipline

Jane OSMOND*

Coventry University

This position paper extrapolates the experience of researching the ways of thinking and practicing in an UK industrial design course into the wider context of the recent UK government announcement that the Higher Educational teaching budget will no longer exist from 2012 for Humanities subjects, within which the creative disciplines sit.
The paper argues that this decision could be seen a direct consequence of a lack of published educational research within the creative disciplines, a situation that is due to creative arts subjects historically being vocational in nature and delivered by practitioners, rather than academics.
As such an educational research culture has been slow to evolve and is concomitantly patchily resourced, with creative arts disciplines still, in some cases, positioning themselves 'outside' the academy, operating within a lack of a widely agreed boundary of knowledge, passing on knowledge via tacit agendas and thus resisting 'easy' measurement.
The author argues that the consequences of not having a firm baseline of published educational research has left creative arts disciplines undefended against government cuts which have privileged the 'less messy' or more easily measurable sciences, and this in turn has also left them undefended against their internal institutional marketplaces.
The paper concludes that against the current economic backdrop the role of groups such as the Design Research Society will be crucial in offering a legitimate space for the building of a solid body of educational research that demonstrates the importance of creativity in underpinning a vibrant, critically minded society that does not depend on a science/humanities divide.

Keywords: art and design; creativity; threshold concepts; UK spending review; educational research

* *Corresponding author:* Centre for Excellence for Product and Automotive Design | Coventry University | Coventry |UK
e-mail: arx162@coventry.ac.uk

Introduction

From 2005-2010 the author was involved in identifying threshold concepts in industrial design for the Centre of Excellence for Product and Automotive Design (CEPAD) at Coventry University. The research gathered qualitative data from 90 design student interviews and a series of focus groups. Two whole-staff meetings were also held, alongside one-to-one interviews with nine members of staff.

The results of the research to date has been published as a series of papers and book chapters (Osmond et al 2010; Osmond and Turner 2010; Osmond 2009; Osmond and Turner 2008; Osmond et al 2008). In addition, an overall view of the journey and subsequent identification of the threshold concept entitled 'the toleration of design uncertainty', is also outlined in a paper presented at the 2010 Design Research Society Conference held in Montreal (Tovey et al 2010).

However, this position paper focuses on a theme that emerged from the research, which then found echoes in anecdotal discussions at creative arts conferences during the five-year period of research: namely what appeared to be the lack of a fully supported culture of educational research into teaching and learning practices within the creative arts disciplines[*] [†]. The paper then considers the consequences of this in the current economic climate, and the concomitant role of groups such as Design Research Society in increasing the range of published materials available.

Background: tacit teaching and learning practices

The Centre of Excellence for Product and Automotive Design (CEPAD) research took place as a result of a successful bid to the Higher Educational Funding Council for England (HEFCE) in 2005 under the Centre for Excellence in Teaching and Learning Initiative (CETL). The research, carried out with Industrial Design staff and students, concentrated on three particular strands – student development of spatial awareness skills, identification of threshold concepts in design and internationalisation of the design curriculum.

The initial research concentrated on student spatial awareness development; however very early on, it became apparent that the teaching and learning practices within the industrial design department at Coventry

[*] *The term creative arts used in this paper is meant to denote the full range of creative disciplines within the Art & Design domain; in addition the use of the term 'educational research' is defined, after Meyer and Land (2003) as research that takes into account 'the ways of thinking and practising within a discipline'. This is distinct then from research that examines the design process, for example, or research that is carried out by practitioners in order to inform the development of a new artefact or 'a description of practices' (Shreeve 2009:126).*

University were, in the main, informed by a tacit, 'underlying agenda of things students needed to have', rather than being grounded in an established working body of knowledge.

This was reflected in the early finding that spatial awareness development, initially seen as a threshold concept by the staff, was in fact, not specifically explored during the first year of the course. Further, a definitive staff view of the meaning of the term 'spatial awareness' did not emerge within the context of the course, which led to a debate over meaning during a whole-staff meeting, and individual staff interviews. A search of the literature underlined this lack of common agreement in that a number of terms are offered, including Spatial Awareness (Karnath et al. 2001), Spatial Functioning (Temple and Carney, 1995), Spatial Ability (Garg et al. 1999), Spatial Orientation (Bodner and Guay, 1997), Spatial Visualisation Ability (McGee, 1979 cited in Alias et al., 2002) and Spatial Intelligence (Eliot 2002; Gardner 1983; Shearer 2004).

This lack of clarity in relation to a definitive meaning of spatial awareness development in this context is perhaps because spatial awareness is, in the words of one teacher on the programme, 'Not something that designers acknowledge or talk about because it is the natural world they inhabit.' Another commented that 'it is an intuitive skill you develop, especially through experience.' Because of this lack of agreement, and a concomitant finding during the second year of research that the results of both a conventional and specifically designed spatial awareness test bore no correlation to students' end of year assessments results, this particular aspect of the research subsequently changed focus to notions of visual creativity.

By the second year then, the research had established that one of the cornerstones of the industrial design course – spatial awareness development, which was looked for in entry portfolios and considered a crucial component for students in becoming successful designers - did not have a commonly agreed definition within the course, and could not be correlated with concomitant meanings of spatial awareness in the literature.

This author argues therefore, that carrying out research into the teaching and learning practices within a hugely successful course was beginning to pay dividends in terms of what was, and what was not, a cornerstone of the course. This reshaping of thinking continued throughout the research period and ended with a complete redesign of the curriculum, which was based on a clearly articulated and agreed threshold concept.

Details of the journey towards the identification of the threshold concept has been published as a series of book chapters and papers (Tovey et al 2010, Osmond et al 2010; Osmond and Turner 2010; Osmond 2009; Osmond and Turner 2008; Osmond et al 2008), but in essence the threshold concept identified has been labelled as 'the toleration of design uncertainty'.

This uncertainty relates to Tovey's (1984) notion of a 'dual processing' strategy that is routinely employed by designers, akin to a 'conversation' between the left-brain (convergent, reflective, field dependent, serialistic) and the right-brain (divergent, impulsive, field independent, holistic). The result of this 'conversation', or what Tovey describes as an 'incubation period', is the arrival by the designer at a solution.

However, the research showed that some students, presented with typical 'wicked' design problems may get stuck in this 'conversation' and those who do can remain in what Meyer and Land describe as a 'liminal state'. In this context a liminal state relates to the notion of a threshold concept, which Meyer and Land define as:

> *... akin to a portal, opening up a new and previously inaccessible way of thinking about something. It represents a transformed way of understanding, or interpreting, or viewing something without which the learner cannot progress. (2003:1)*

As such then, some students can be stranded within a liminal space and experience a period of intense uncertainty, and it is the toleration of this uncertainty that facilitates creative breakthroughs during the design process. Thus the threshold concept was labelled as 'the toleration of design uncertainty' which is defined as:

> *...the moment when a student recognises that the uncertainty present when approaching a design brief is an essential, but at the same time routine, part of the design process.*

From this analysis came the notion of providing a safe 'creative space' in which the students could experiment and experience intense uncertainty within a supportive environment, and this represented a key change for the design curriculum.

The point to be made here though, is that the identification of threshold concept was not a 'bolt out of the blue' realisation; rather it was a culmination of all the data gathered from two whole-staff meetings, one-to-one interviews with members of staff and 90 student interviews. Therefore, using the threshold concept framework as a research method allowed the emergence of the hitherto hidden 'episteme' of the course. Perkins defines an episteme as 'a system of ideas or way of understanding that allows us to establish knowledge' (2006: 41-42), and argues that all disciplines have their own characteristic epistemes, which are often hidden, but can shape people's sense of whole disciplines. Perkins goes on to argue that a tacit episteme,

when not surfaced, can be problematic for students in that 'many students never get the hang of it, or only slowly'. (IBID: 43)

Bearing in mind the experience of this educational research process at Coventry University, the author began to speculate as to how much educational research was taking place elsewhere in the creative disciplines. Attendance at several conferences indicated that, anecdotally, there were barriers to this, and an example was found during a session presenting the threshold concepts research at the Teacher's Academy Conference run by the European League of Institutes of the Arts (ELIA) in 2007. When asked about research into their teaching and learning practices, the overwhelming reaction from the audience was 'how lucky [the course was] to have the funding to carry out such research'. Also, when asked if they would consider writing up their own teaching interventions in the classroom as research, the majority of the audience felt this was 'too scary' as 'they had no idea how the publishing system works', and' wouldn't know where to start'.

This was also the case at the Group for Learning in Art and Design (GLAD) conference in 2009: again the lack of a educational research was reflected in similar remarks, epitomised a paper by Alison Shreeve (2009) which outlined the importance of educational research into art and design outlasting the CETL closures. However, Shreeve acknowledges that one of the barriers to this type of research was the sheer workload expected of tutors:

> *The emphasis on a quality learning experience for students, the quest for excellence and striving for recognition and status, the expectation that they will be involved in research and/or consultancy in their creative practice, and the constant challenges of budgetary constraints, pressures of time, space and new technology all add an almost impossible burden for the full-time tutor.' (2009:126)*

Another barrier articulated by a conference attendee was 'assumed knowledge'. 'Assumed knowledge' in this context relates to the fact that design lecturers are assumed to know '...the ins and outs of conducting research and where to publish'. This attendee felt that she '...did not have any of this assumed knowledge on starting [the job] and have had to learn by asking others for advice.' These comments were echoed by another design lecturer who said, that up until very recently, there was no real expectation that design staff had to carry out and publish research, indeed, in this particular institution, specialised researchers were employed to do this to 'satisfy the RAE requirements'.

At a different institution, staff were exhorted to research and publish in their yearly appraisals, but they felt they were not given the resources or knowledge to do so. Others confirmed that they were allowed one day per week as a designated 'research day' but this often got overtaken by events. Further, even if the research day could be used to gather evidence and do the required reading, there was not then a concomitant block of time provided to write up the research. This situation is compounded by a lack of research and/or teaching assistant support; however, this could also prove problematic because of the need for particular specialisms within the field.

Educational research in creative arts disciplines

Therefore, for this author, there was, and is, a general sense that although creative arts disciplines are successful in facilitating creative and critically minded practitioners, there is a paucity of published educational research into the teaching and learning methods that underpin this success, and this is often underlined by the lack of an established educational research culture within institutions.

That an established educational research culture is hard to identify within the creative arts is not surprising when, in comparison with more established higher education disciplines such as science, history, and economics, creative arts disciplines are a relative youngster, with, for example, Art and Design courses only gaining degree status in the late 1960s (Bird 2000).

Before this, courses were firmly located away from the academy in independent Art and Design Schools, first set up in 1837. Ritterman argues that a lot of specialist art institutions still feel that they don't 'naturally belong' in the higher education sector, and that the pressures of externally-and internally imposed demands, which Watson (quoted in Ritterman 2010) refers to as the three 'alternative macrocosms' – the immediate environment, the higher education mainstream and the global higher education system - gets in the way of their 'core business'. Ritterman goes further and states that 'it is not unknown for specialist arts institutions to seek to promote their attractions through reference to an 'anti-academic' approach'. (2010: 34).

In addition, Art and Design schools were originally set up to train people to serve industry (Bird 2000) and so were historically seen as vocational, and indeed, the Coventry School of Art & Design is of this ilk, being established in the 19th Century with a remit of educating 'people to be designers'. (Tovey 2011)

Cross posits that this 'vocational sensibility' is still to be found today when he states that design teachers have '...traditionally...been practicing designers who pass on their knowledge, skills and values through a process of apprenticeship...These design teachers tend to be firstly designers, and only secondly and incidentally teachers.' (2006: 3) This practitioner focus is evidenced by Doy (2008) who found that there was a lack of scholarly

activity surrounding RAE returns in that 'it emerged that some designers and other practitioners were not accustomed to writing in a theoretical, scholarly way about their work or presenting it as research'.

Alongside both this 'outsider' identity and vocational sensibility, Joseph (2008) suggests that within the domain of Design, 'the contradictions and tensions that exist between various theories, practices and cultures of Design, and the lack of any widely agreed to formal knowledge framework suggest that, as well an ill-structured and undisciplined domain'. Poggenhol (2004) echoes this in that he argues there is a lack of consistency on 'key terms and their meaning, on what constitutes core knowledge' and for Buchanan (2001) the literature surrounding the domain is ' filled with contrasting and sometimes contradictory definitions of design'.

Further, within this 'ill-structured' domain, the teaching and learning practices can be based upon tacit knowledge, which concurs with the findings of the CEPAD research that identified an 'underlying agenda of things the students need to have' that informed the Industrial Design course, and is also echoed in a study by Cowdroy and Williams (2006) which found that design teaching tended to be based on 'what the teachers liked'.

And this is the crux of the matter – creative arts disciplines sometimes position themselves 'outside' the academy, can still retain a vocational sensibility, do not tend to operate within a widely agreed boundary of knowledge, are inclined to pass on knowledge via tacit agendas and thus can be considered to resist 'easy' measurement. This being the case, researching the ways of thinking and practising within the creative domain could be considered somewhat problematic. Any attempt to pinpoint the crucial and important learning themes within a domain that is characterised by a focus on creativity, itself a shifting, evolving and contradictory terms with many definitions, seems doomed to failure. Indeed, Nigel Cross (quoted in Sonalkar 2008), perhaps one of the most recognised design researchers, argued that a 'new paradigm for design research' was needed: one that allows the discipline to be studied in a way that does not strip it of its spirit, and its complexity.

Meanwhile, Hatton, in order to address the 'little available material of more recent design education based research...whilst at the same time knowing that there must be many kinds of research going on in the various institutions involving local action research and case studies of pedagogic practices.' (2008: Forward) instigated a conference in 2007 specifically to address the paucity of published educational research data within the domain.

This paucity of published material is especially ironic given that some of the teaching and learning practices employed within the creative arts disciplines are already used within other, more established, disciplines. A prime example of this is studio-based learning which privileges 'learning by

doing'. Gosling, as far back at 1985, argued that medical students, engineers and social workers in the clinic, lab or field are, in fact, practising the kind of 'learning by doing' that is common in studio-based architectural teaching (quoted in Schon 1985: Foreword). This cross-disciplinary approach is echoed by Wilson (1997) who writes about the development of a 'Studio Model' for a variety of courses at the Rensselaer Polytechnic Institute in New York. First introduced as a model to cope with large enrolment on undergraduate courses in Maths and Physics, the Studio Model '...has since been adapted to Chemistry, Biology, Engineering and Computer Science.' At the same time, a Kansas State University undergraduate biology course demonstrated 'that the studio format is as effective as or more effective (for some measures) than the A-T approach and traditional approaches in providing an effective learning environment' (Montelone et al 1997).

More recently, Foulds et al (2003) see studio learning in bio-medical engineering 'as an alternative to the conventional lecture/ recitation/laboratory format, and it is shown to encourage student inquiry and foster faculty and peer mentoring.' Further, Barak describes how a shift in teaching and learning practices in delivery of a java programming course 'to collaborative studio- based learning, via mobile devices, may be an important trend in the way learning is perceived and knowledge is constructed' (2007:27).

However, as both Hatton's conference proceedings and the Design Research Society can attest, educational research in design is taking place, and indeed the latter has seen the coming into being of the Design Pedagogy Special Interest Group. This perhaps reflects the recognition that since the 1990s there has been a 'growing awareness' of the importance of the designer within a global environment and how design pedagogy 'may prepare the undergraduate and postgraduate student for global and sustainable design development.' (Hatton 2008: viii) In this vein, the author believes that using the threshold concept framework within the industrial design programme at Coventry University has added to the educational research data available.

Consequences

Given that creative arts courses are generally very good at producing creative graduates, does it really matter that there is a lack of published materials relating to teaching and learning practice within higher education? This question is all the more pertinent, given that the recent REF guidelines privilege research that has an impact OUTSIDE the academy:

> *Case studies may include any social, economic or cultural impact or benefit beyond academia* that has*

> *taken place during the assessment period, and was underpinned by excellent research produced by the submitting institution within a given timeframe.(HEFCE 2011).*

Therefore, if creative arts courses are successful and educational research is not being given a particularly high rating in research terms in the REF, it is the case that the expenditure of effort and resources will be disproportionate to the level of reward?

This author argues that the consequences of not having a firm baseline of published educational research in this area has left creative arts disciplines as whole undefended against government cuts, and in turn undefended against the internal pressures within the institutions within which they sit. This is echoed by Shreeve who stated in 2009 that:

> *If we do not articulate and develop awareness and knowledge based on research we are unlikely to be able to defend our beliefs about art and design education in the university in the light of the growing demands for uniformity and conformity, usually originating in sectors outside our own disciplinary context. How are we to argue for what we believe and develop learning in creative arts if we do not base our arguments on sound research and enquiry methods? (2009:128)*

Writing in 2011, the lack of defence is evidenced by the UK Comprehensive Spending Review in October 2010, which demonstrated, at the very least, that the government does not see the humanities, within which most creative arts courses fall, as crucial to the country's success. The Review cut the teaching grant for Band D subjects by 100%, but is to 'continue to fund teaching for science, technology, engineering and mathematics (STEM) subjects.' At the same time, George Osborne, the Chancellor of the Exchequer announced that 'scientific research was being protected because it was 'vital to our future economic success'. (Morgan 2010)

This dismissal of humanities as not being as important as STEM subjects is possibly because the government cannot easily measure their impact as, according to Eyre '...they're wayward and ambiguous and because they deal with feelings rather than facts.' (2011). This is reflected by Ransome in terms of the differing teaching styles within Higher Education: either academic 'the abstract and esoteric process in which knowledge is problematised as a social construction (broadly the arts, humanities and social sciences)' or instrumental '...those that instruct students in a body of technical information generally oriented towards clear practical application (broadly the natural and

physical sciences and disciplines characterised by technical knowledge)' (2011: 209)

The new regime will see the teaching budget for the humanities funded by (higher) fees, and thus each course will be funded by students, who either pay the fees themselves, or through student loans. This means that humanities courses from 2012 will now be dependent on the ability to 'persuade students to pay £7000 to £8000 a year, a task that may be beyond many of them.' (Cohen 2011) The question is whether the worthiness of humanities subjects is going to be negatively affected by the disdain that the government has shown towards those very subjects, epiomised by a another quote from Cohen, 'It tells you all you need to know about the political class's commitment to culture that the Department for Business rather than the Department for Education is in charge of universities.' (IBID)

There is some hope that students will choose humanities subjects as figures from the Higher Education Statistics Agency show that EU student figures climbed to 40% and non EU figures to 78% in these subjects between 2001-2010 (Roberts 2011). However, this hope may lose currency if students choose courses that are going to result in perceived higher pay upon graduation. It is probable that being an artist, or a designer, in a world where these occupations are seen as not only NOT essential to the economy, but as actually an 'add-on' soft subject, could see creative arts courses going to the back of the desirable course queue.

In terms of internal pressures, this need to self-fund courses will also have a knock-on effect on the internal market within universities which manifests itself as in a culture of 'new managerialism' defined by Deem as:

> *...the use of internal cost centres, the fostering of competition between employees, the marketisation of public sector services and the monitoring of efficiency and effectiveness through measurement of outcomes and individual staff performances. (1998:50)*

In this culture, university management is obviously going to make decisions based on how much money courses can attract, and those decisions will be based on how measurable the outcomes of courses are. Therefore it is essential that creative arts disciplines continue to research their teaching and learning practices and make explicit the benefits of such an educational route.

As mentioned earlier this is not straightforward as they can resist easy measurement and this problem is epistomised by a paper written by Cowdroy and Willams (2006) from the University of Newcastle in Australia. In the paper the authors outline the process a creative design course had to undertake in response to a student appeal against a 'fail' mark for a particular module. This appeal brought the course to the attention of the university

hierarchy who subsequently demanded that the course be re-written with outcomes that clearly distinguished between a pass and a fail, instead of being based 'largely on established best practice'; without a defined criteria for creative ability.

Acknowledging that the current assessment criteria was based on tacit knowledge - 'what the teachers liked' – and was therefore difficult to explain to students, the course team went on retreat and consulted the literature in order to define what they meant by creativity, how this linked the concept of an 'ideal graduate' and then examined how to integrate both into desired curriculum outcomes. Using the literature, the team consulted across the faculty and undertook a root and branch consideration of notions of creativity in order to assess how these fitted into design education, how they could be taught and how they could be explained in order to satisfy the quality assurance agenda. The conclusion was that as a result of this process, the rewritten course satisfied three particular stakeholder pressure points: from external reviewers by adding new relevant content, from the university by increasing cost effectiveness including adopting the use of more lectures and online courses, and from government in terms of accountability by adopting clearly defined and appropriate assessment methods.

Conclusion

Despite the current government rhetoric which privileges the sciences over humanities, it is acknowledged everywhere (apart from the government departments which make the funding decisions, is seems) that competitive advantage is strengthened by creative input as outlined by Peattie:

> *Sustainable competitive advantage is very rarely generated from technological excellence alone. Today, in markets which many people might assume to be dominated by technological issues, including cars, home computers and mobile phones, it is actually 'soft and subjective' factors like design, branding or customer service that are ultimately crucial in delivering and sustaining competitive advantage. These factors are very strongly rooted in the arts, humanities and social sciences. (quoted in British Academy 2010: 19)*

As this paper has discussed, this message is not getting across to the policymakers and the argument this author is developing is that one of the reasons for this is that creative arts disciplines are not encouraged and supported in publishing enough good quality educational research about teaching and learning practices. Thus the link between the plethora of creative and critically minded practitioners who graduate from creative arts

courses and the teaching and learning practices that facilitated this is not made clear enough.

Further, the lack of published material is historically due to a vocational sensibility developed when creative arts disciplined were 'outside' the academy coupled with an ever-shifting domain knowledgebase. This has resulted in an established educational research culture not being fully supported within institutions and as a consequence creative arts staff can be somewhat unused to writing about their teaching and learning practices in a scholarly way.

Therefore, this author argues that without initiatives such as the CETL, which enabled the Coventry University research, groups such as the Group for Learning in Art and Design (GLAD), the International Council of Graphic Design Associations (Icograda), the European League of Institutes of the Arts (ELIA), and, of course, the Design Research Society (DRS) are crucial in bringing together educational researchers within the creative arts. These groups have a vital role in encouraging and showcasing research on teaching and learning practices within what could be considered 'wicked disciplines' in that they, like the 'wicked problems' they privilege, contain Gordon's (2004: 61) 'wow' factor: 'creativity, originality, inventiveness...' and, as such, resist easy categorisation or definition.

That these research papers will be in narrative rather than scientific is something that the Professor Sir Adam Roberts, President of the British Academy commented upon:

> *There is no simple way of demonstrating the subtle and unexpected ways in which academic disciplines "contribute to the vitality of society". Research and teaching often has effects in ways which may be captured in narratives as much as in statistics. (British Academy 2010: 5)*

Given that the world is full of what Schon (1985: 15) calls 'real world problems' that are 'messy, indeterminate, problematic', or indeed wicked', the need to build up a viable, solid body of educational research that can be used to defend creative arts disciplines against attack - and also to demonstrate the importance of creativity in underpinning a vibrant, critically minded society that does not depend on a science/humanities divide - is as important now as it ever was if 'wicked disciplines' are to survive.

References

Alias, M., Black, T., Gray, D. (2002) 'Effects of Instructions on Spatial Visualisation ability in Civil Engineering Students.' in *International Education Journal* Vol. 3, No. 1

Barak, M. (2007) 'Studio-based learning via wireless notebooks: a case of a Java programming course'. Int. J. Mobile Learning and Organisation, Vol. 1, No. 1,.

Bird, E. (2000) Research in Art and Design: the first decade. *Working Papers in Art and Design* 1, Retrieved < 26.3.11 > from < http://sitem.herts.ac.uk/artdes_research/papers/wpades/vol1/bird2full.html > ISSN 1466-4917

British Academy (2010) *Past, present, and future the public value of the humanities & social sciences.* Available*:* http://www.britac.ac.uk/policy/pastpresentandfuture.cfm, [Accessed 22.3.11)

Bodner, G. and Guay, R. (1997) 'The Purdue Visualisation of Rotations Test'. *The Chemical Educator*, 2(4): 1-17.

Buchanan, R. (2001) Design Research and the New Learning'. *Design Issues*. V17.4.

Cohen, N. (2011) 'Academia plays into the hands of the right'. *The Guardian*. Available: http://www.guardian.co.uk/commentisfree/2011/jan/30/nick-cohen-higher-education-cuts

30 January. [Accessed 23.3.11]

Cowdroy, R., Williams, A. (2006) 'Assessing creativity in the creative arts' in *Art, Design & Communication in Higher Education.* V5, N2. Intellect Ltd 2006

Cross, N. (2006) *Designerly Ways of Knowing*. Springer-Verlag. London

Deem, R. (1998) 'New Managerialism' and Higher Education: the management of performances and cultures in universities in the United Kingdom' in *International Studies in Sociology of Education*, Vol. 8, No. 1.

Doy, G. (2008) "Let's all go shoplifting: Culture, Consumerism and Education' in Hatton, K. ed. (2008) *Design Pedagogy Research*. Leeds

Eliot, J. (2002) 'About Spatial Intelligence'. *Perceptual and Motor Skills*, 94, 479-186.

Eyre, R. (2011) 'Arts cuts will result in cultural apartheid' *The Guardian*. Available: http://www.guardian.co.uk/culture/culture-cuts-blog/2011/feb/15/arts-funding-arts-policy [Accessed 26.3.11]

Foulds, R., Bergen, M., Mantilla, B. (2003) Integrated biomedical engineering education using studio-based learning.' Engineering in Medicine and Biology Magazine, IEEE Volume: 22 Issue: 4. 92 - 100

Garg, A., Norman, G., Spero, L., Taylor, I. (1999) 'Learning anatomy: do new computer models improve spatial understanding?' in *Medical Teacher*, Vol. 21, No. 5

Gardner, H. (1983) *Frames of mind: the theory of multiple intelligences*. New York: Basic Books

Shearer, B. (2004) 'Multiple Intelligences Theory after 20 Years.' in *Teachers College Record*. Vol. 106, no. 1 pp2-16

Hatton, K. ed. (2008) *Design Pedagogy Research*. Leeds.

HEFCE (2011) *Decisions on assessing research impact*. Available http://www.hefce.ac.uk/research/ref/pubs/2011/01_11/ [Acessed 22.3.11]

Joseph, F. (2008) 'Design Research and Domain Representation' Proceedings of *DRS2008, Design Research Society Biennial Conference*. Sheffield, UK. 16-19 July

Karnath, H., Ferber, S., and Himmelbach, M. (2001). 'Spatial awareness is a function of the temporal not the posterior parietal lobe.' *Nature*, Volume 411(6840): pages 950-953

Meyer, R. Land & C. Baillie, eds (2010). *Threshold Concepts and Transformational Learning*. Sense Publishers. Rotterdam.

Montelone, B., Rintoul, D., and Williams, L. (2008) *Assessment of the Effectiveness of the Studio Format in Introductory Undergraduate Biology.* CBE Life Sci Educ 2008: 234–242. Availbel online http://www.lifescied.org/cgi/content/full/7/2/234. Accessed 27.4.11

Morgan, J. (2010) 'Fears made flesh: only STEM teaching grants spared CSR scythe'. *THES*. 20 October. Available: http://www.timeshighereducation.co.uk/story.asp?storycode=413956 [Accessed 24.3.11]

Osmond, J., Turner A. (2010) 'The Threshold Concept Journey: from identification to application'. In JHF Meyer, R. Land & C. Baillie, eds. Threshold Concepts and Transformational Learning. Sense Publishers. Rotterdam.

Osmond, J., Bull, K., Tovey, M. (2010) Threshold concepts and the transport and product design curriculum: reports of research in progress. In *Art, Design and Communication in Higher Education*. Special edition 8.3

Osmond, J. (2009) 'Stuck in the Bubble': Identifying Threshold Concepts in Design' in *Dialogues in Art and Design: Promoting and Sharing Excellence, Proceedings of the 2009 GLAD Conference*, held at York St John University, York. ADM

Osmond, J. and Turner, A. (2008), 'Measuring the creative baseline in transport design education', In Rust, C (ed) *Improving Student Learning – For What? Proceedings of the 2007 15th International Symposium*, Trinity College, Dublin. p.87-101. The Oxford Centre for staff and learning development. Oxford Brookes University. Oxford.

Osmond, J., Turner, A. & Land, R. (2008) 'Threshold Concepts and Spatial Awareness in Automotive Design.' In Land, R., and Meyer, JHF. (eds) *Threshold Concepts within the Disciplines*. Sense Publishers. Rotterdam

Perkins, D. (2006) Constructivism and Troublesome Knowledge in Meyer, J.H.F. and Land R. (Eds.) *Overcoming Barriers to Student Understanding: Threshold concepts and troublesome knowledge*. London and New York: Routledge. pp 33-47.

Poggenhol, S. (2004) 'Language definition and its role in developing design discourse'. *Design Studies*. 25.6. November.. p. 579-606

Ransome, P. (2011) 'Qualitative Pedagogy versus Instrumentalism: the Antinomies of Higher Education Learning and Teaching in the United Kingdom'. *Higher Education Quarterly*, Volume 65, No. 2, April 2011, pp 206–223. 0951–5224 DOI: 10.1111/j.1468-2273.2010.00478.x

Ritterman, J. (2010) 'Riding the Tiger: Leading institutions for higher education and the arts at the beginning of the twenty-first century' in Corcoran, K., Delfos, C, Solleveld, F. (eds) (2010) *ArtFutures Current issues in higher arts education*. Amsterdam. December. Available: http://www.elia-artschools.org/News%2B/ArtFutures+-+Current+issues+in+higher+arts+education. [Accessed 28.3.11]

Roberts, A. (2011) 'The end is not nigh.' *The Guardian*. Available: http://www.timeshighereducation.co.uk/story.asp?storycode=415349 [accessed 22.3.11)

Schon, D. (1985) *The Design Studio An Exploration of its Traditions and Potentials.* RIBA Publications. London

Shearer, B. (2004) 'Multiple Intelligences Theory after 20 Years.' in *Teachers College Record*. Vol. 106, no. 1 pp2-16

Sonalkar, N. (2008) 'Interview with Nigel Cross'. *Ambidextrous*, Issue 9. Spring.

Shreeve, A. (2009) 'Why bother with research in Learning and Teaching in Art and Design?' in *Dialogues in Art and Design: Promoting and Sharing Excellence, Proceedings of the 2009 GLAD Conference*, held at York St John University, York. ADM

Temple. C., Carney, R. (1995) 'Patterns of spatial functioning in Turner's syndrome.' *Cortex*. 31(1):109-18.

Tovey, M. (2011) 'Researching Design Education'. Keynote for *CUMULUS DRG SIG on Design Pedagogy. 1st International Symposium for Design Education Researchers*. Paris 18-19 May.

Tovey, M., Bull, K., Osmond, J. (2010) 'Developing a Pedagogic Framework for Product and Automotive Design'. *Design & Complexity Conference*. Université de Montréal. July

Tovey, M. (1984) 'Designing with both halves of the brain' in *Design Studies*, Volume 5, Number 4. October. pp 219-228. Elsevier.

Wilson, J. (1997) *'Studio Teaching: When the Future Becomes the Present'.* UniServe Science News Volume 7 July 1997. Available online: http://sydney.edu.au/science/uniserve_science/newsletter/vol7/wilson.html. Accessed 26.4.11)

CUMULUS // DRS SIG on Design Pedagogy
1st International Symposium for Design Education Researchers
Paris Chamber of Commerce and Industry, Paris, France 18–19 May 2011

Luisa Collina (2011). *New postgraduate educational models between globalization and local culture*. 156–167

New postgraduate educational models between globalization and local culture

Luisa COLLINA*

Politecnico di Milano

How has the design profession been changing over recent decades and what are the new challenges for design education?
What is the cultural heritage of Italian design and what are the lessons that can still be learnt by future designers?
Focusing on a specific case, namely the Product Service System Design MSc. taught in English to both Italian and international students at the Design School of the Politecnico di Milano, the author reflects on how contemporary design education can face the new challenges and counterbalance current mainstreampractice :
_*globalization,* which means addressing contemporary tracks of innovation in design education and the job market;
_*contextualisation* in terms of valorisation of the local Italian design culture.
Based on these reflexions the author identifies some main principles that have driven the design of the new study course.

Keywords: design education, product service system design, made in Italy tradition, global trends in design education.

Introduction

In 2005 the Design School of the Politecnico di Milano inaugurated a new postgraduate course, taught in English and aimed at international students, entitled Product Service System Design.

It is the first course at university level to be offered in English in Italy, in the hope of welcoming and training talented young people in Milan, both from Italy and from other countries, overcoming the language barrier. The

* *Corresponding author:* INDACO Department/School of Design | Politecnico di Milano
via Durando 10 | 20158 | Milano - Italy
e-mail: luisa.collina@polimi.it

two year study course, initially limited to 40 students per year, has now doubled to 80 students annually, divided into two classes. Looking to the cultural and geographical background of the enrolled students, the course can be considered a multicultural and multidisciplinary space.

The starting point for the course design (in 2004) and redesign (due to the new national accreditation system set up by the Italian Ministry for University and Research, starting in the academic year 2010-2011) of this Master of Science were two main principles:

_*globalization,* which means addressing the contemporary tracks of innovation in design education at international level as well as the expectations of the local and international design job market in the most advanced realities;

_*contextualisation* in terms of valorising the local design culture, its location in Milan and, more in general, the so called tradition of "made in Italy" with its unique approach to design.

A deep understanding of these two main pillars and at the same time their search for the right balance between global perspectives and a 'made in Italy' identity has continuously stimulated the discussion of the scientific course committee* finalized in the definition of the main characteristics of the academic programme of the course.

The most relevant outcomes of this discussion have been summarized in the following paragraphs.

A Broader Perspective within the Field of Design

The first consideration derives from the roots of Italian design and its 'anomalies' as regards the international scene. The first School of Design in an Italian university has only been established recently, in 1993.

Indeed Italian design was born at the heart of Italian architectural culture. The fathers of Italian design, such as Giò Ponti and Franco Albini, Achille Castiglioni and Vico Magistretti, Ettore Sottsass and Marco Zanuso, to name but a few (and it is no coincidence that Tomás Maldonado, who trained as an artist, is not Italian by birth), were for the most part architects working on all scales—from the architectural project to the house object, from interior decoration to light fittings or the latest knobs, handles or communication appliances.

* The scientific committee of the Product Service Systems Design course has been made up of Norman McNally, Anna Meroni, Giuliano Simonelli and Cabirio Cautela (Politecnico di Milano), Fabio Di Liberto (Continuum, Milan), Fabrizio Pierandrei (Pierandrei Associati, Milan) and the undersigned Gianluca Brugnoli, Ezio Manzini and Valentina Auricchio (Politecnico di Milano), Cindy Coleman (The School of the Art Institute of Chicago), Peter Di Sabatino (School of Architecture and Design, American University in the Emirates, Sharjah) and Neil Frankel (University of Wisconsin, Milwaukee, School of Architecture and Urban Planning) have fruitfully collaborated in the project.

Such a broad scope for action is inextricable from the leading role these figures have played, from 'advisor to the Prince' or 'strategic assessor' to 'art director': a new term coined for those in earlier times known simply as designers. As a result of their close ties of deep respect, trust and often even affection and friendship with visionaries in the business world, they tackle projects on several fronts, a range of fields and different levels of responsibility in Italian companies.

Just to give an example: the success of Kartell in the sector of plastic products is due, among other things, to the important collaboration between Giulio Castelli, chemical engineer educated at the school of Giulio Natta in the Politecnico di Milano, and Anna Castelli Ferrieri, architect and designer. Together they gave birth to new typologies of plastic products considered not only as functional items but also able to express aesthetic values.

This non specialized and multidisciplinary origin of Italian design is entirely in tune with today's global context characterized by a progressive widening of the focus of design that calls for broad views and multidisciplinary knowledge.

The widening object of design and the increasing complexity of the context

Looking both on a national and an international level, it is easy to recognize that it is no longer possible to establish limits between single products: a washing machine turns into an "on demand" laundry service; the paper pages of a newspaper become the shiny screen of an I-pad, a gin and tonic cocktail becomes an alcoholic "fog party" (Martì Guixé, *GAT FOG in CASCO*, 2004); the design of a piece of furniture designed in the Netherlands can be sold through a digital platform and produced by a carpenter in any local neighbourhood (Droog, Design for download, Milan Design Week 2011); furthermore a retail space, formerly considered as a typology of interior space, is considered today in terms of 'hyper-medial site', 'communicative artefact', 'relationship platform', 'brand stage', 'experiential touch-point' or 'service evidence'.

These are just a few recent examples able to show how services, interaction, communication elements and environments are increasingly interlinked, and how the capabilities of visioning, of combining different elements and of strategic thinking assume increasing relevance in the difficult activity of trying to design possible, attractive, innovative and sustainable solutions.

In other words, the object of the design project embraces artefacts in which the material, communicational and strategic dimensions, as well as that of service and interaction with users and their surroundings, become more and more interrelated and convergent: thanks to advanced digital technologies, products are becoming progressively intangible and

environments increasingly intelligent; the surfaces between spaces (both internal and of buildings as a whole) do not only adopt the shape but also the role of interactive communication screens; ever-more 'intelligent' materials become mutable and dynamic, etc. Similarly, increasing awareness of the sustainability of products, environments and services demands the use of 'holistic' design methods; new ways of design thinking able to understand continuously changing contexts; to observe a design question in a broad way and from different perspectives; to analyse and design systemic solutions with great attention not only to the single components but also to the interactions between them.

Given this situation, design disciplines adapt and reconfigure themselves: service design, life-cycle design, experience design, interaction design, environmental design, brand design or strategic design represent diverse points of view and ways of addressing design projects that share a systemic vision transcending the limits of traditional disciplines.

As Richard Buchanan reminds us (2001: 11-12): "Of course, systems thinking is nothing new today. (...) What has changed today is what we mean by a system. The focus is no longer on material systems—systems of "things"—but on human systems, the integration of information, physical artifacts, and interactions in environments of living, working, playing, and learning."

A Multidisciplinary approach

The broadening 'object' of design and rising complexity of contexts requires new multidisciplinary knowledge.

Thus the advanced profile of the professional designer is moving from being highly specialised (with a prevailing, well-defined field of discipline equipped with its own tools) to become increasingly multidisciplinary. For some time now, multidisciplinary teams have co-existed in important international design firms such as IDEO, Philips Design or Continuum, whose designers do not focus exclusively on product design and are characterised by strategic vision and the use of tools and methodologies from other fields such as anthropology, sociology and marketing.

However, this big change is no longer limited to the big design firms.

A survey on the designer profile for 2015, based on interviews, focal groups, workshops and questionnaires, carried out in 2006 by AIGA, the professional association for design in the United States, , shows us that this phenomena does not affect only the big international design firms. The general outcome describes a professional characterized by certain main capabilities including 'wide & deep' (or multidisciplinarity, capacity for analysis and broad vision), 'expanded scope' (the need to systemically confront wide and complex scales, to foresee problems, opportunities and solutions and not merely solve specific problems in isolation), 'shared experiences' (and therefore the ability

to work in groups and co-create) and 'responsible outcomes' (seeking sustainable solutions and adopting a human-centred approach).

Master of Science in Product-Service-System Design at Politecnico di Milano

Based on these reflections, the unspecialised nature of the contemporary professional designer, endowed with the capacity for global, sustainable and strategic vision, has formed the basis of the new academic programme. The name of the degree, "Product Service System Design", however difficult to understand, makes this systemic quality perfectly clear, for the term refers to the combination of communicative and interactive products, services, spaces and artefacts that provide comprehensive solutions to our present and future demands.

A Multidisciplinary class

The students selected to enter the program are a mixture both from a geographical and cultural point of view.

Regarding their cultural background, during the selection phase, students have to demonstrate capabilities and experiences in any area of design study (graphic, product, interior, fashion, interaction, architecture, multimedia etc.): a balanced mixture of these different competences is considered to be a common asset, able to simulate professional team work and cross fertilization processes.

An even higher mixture of backgrounds characterizes the faculty members: in-house professors work together with professional lecturers; Italian teachers run the class together with international guests professors; and finally, professors from a wide range of disciplines such as management, psychology, technology, history, photography and movies are part of the academic staff.

A Multidisciplinary and a Tailor-Made approach

In the dilemma between specialization and multi-disciplinarity the scientific board of the PSSD study course shaped the following hypothesis, by virtue of which first degrees (bachelors' degree) provide students with a clear, solid, professional identity- and equip them with cultural knowledge and skills so as to be able to produce consolidated tools. Postgraduate courses (masters' degrees), on the other hand, are required to construct more complex, hybrid professional profiles characterised by a broader vision of the problems and their possible solutions and equipped with a global vision of the 'project network' (or of some 'significant nodes' of that network), capable of building the position they intend to occupy in the design process in the future.

From this point of view, the objective of first level academic education, complemented by subsequent integrated academic programmes such as

specialisation and refresher courses, is to train specialists for contemporary designing processes, while the second level shifts interest from *knowing how* to *being* a professional; from *savoir-faire* to *savoir-être*.

Hence the creation of postgraduate programmes that impose high levels of awareness and motivation and involve the student in the construction of his own professional profile in a mature and independent way.

Carla Milani, IBM Italy's Director of Relations with Universities, identifies the figure of the service project designer by introducing the metaphor of a professional profile characterised by a *T shape*, which presents a vertical axis that moves towards the acquisition and application of specialised abilities in specific fields, and a horizontal axis that refers to the acquisition and use of tools and cultural matrices taken from other disciplines (Carla Milani, "Service Science and Smarter Planet", speech, Milan Triennial, 14 May 2009).

Similarly, for the product-service-system designer the vertical axis of the "T" represents the knowledge acquired during the bachelor degree in a specific design area (product, interior, graphic, multimedia, fashion, furniture, etc.) while the horizontal axis represents training in interpersonal skills as well as the learning and experimentation of tools, methods and approaches borrowed from other cultural areas.

More in detail, the horizontal axis represents the capacity for relations, for listening and working in teams, and the high degrees of flexibility and adaptability to contexts in constant mutation, as well as the individual's leadership qualities. In addition to these interpersonal qualities, increasing importance is attached to acquiring systemic vision, user-centred perspective, design thinking capabilities, ability to analyse local and global contexts from an economical, technical, social and cultural point of view and design capabilities at a system level, focalized both on material and immaterial components as well as on the interfaces between them.

Following the T concept an interesting debate has emerged in connection with the contents of the stem of the T and the width of the transversal line, replacing the idea of a standardised T with that of different versions, in different sizes and typographic fonts. Ultimately a T can be written by a single hand, becoming unique. Similarly the PSSD study course pursues the goal of assuring each student the possibility to personalize (as for a hand-tailored suit) his or her own study course through their choice of certain elective courses, their internship and the topic of their final thesis, according to their specific background, the tools and experiences they have acquired, their future skills and abilities, and their own personal way of 'being designers'.

The identification of three main "innovation streams" (business-, technology- and social innovation) helps the students in prioritizing their choices and defining their own personal "educational mix".

An Experimental and Research approach

Starting from the reflections introduced at the beginning of this paper, another issue arises based on the links between Italian design, research and industry.

Andrea Branzi, scientific curator of the first two editions of the *Design Museum*, set up in the framework of the Milan Triennial (*Le Sette Ossessioni del design Italiano,* opened on the 7th of December 2007; and *Serie Fuori Serie*, opened on the 21st of March 2009), postulates that Italian design did not emerge as a result of the Industrial Revolution but has its origin in artists' workshops (as in Futurism and Metaphysical Painting). It is not, therefore, a mere expression of productive and market options but the expression of theoretical research hypotheses. Its roots do not only lie in industry, for it preserves elements of the artistic culture that has generated it and of former ages. What emerges is a genetic heritage of 'anomalous' Italian design, a mutable, contradictory, unstable and complex sort of design capable of enhancing the prevailing visions of design on the international stage.

In the case of Italy in particular, as a result of the lack of a strong model of welfare and of residence other than that of the aristocracy (such as the Victorian style, or that of the Second Empire), even today "the mechanisms defining a domestic space and the objects that form a part of it are open-ended, an area of research that is always starting from zero" (BRANZI, 2009:34),a field of continuous experimentation.

In fact, the deep connection between design and research, the idea that it is possible to do research designing new visions and scenarios is a typical characteristic of Italian design.

This strikes us clearly if we look back a little to our past, at the end of the 60's, to the work of Ettore Sottsass and to the Italian Radical Design. This was a design and architectural movement that was extremely active between 1966 and the early 70's thanks to two major cultural groups: Archizoom Associates (Andrea Branzi, Gilberto Corretti, Paolo Deganello, Massimo Morozzi, Dario Bartolini and Lucia Morozzi) active from 1966 to 1974 and Superstudio (Adolfo Natalini and Cristiano Toraldo di Francia) active from 1966 to 1973.

Radical design brings the role of the designer into the discussion, with his relationship towards industrial production and his clients. Their design is no longer pure functionalism, subjected to industrial production, nor (or not only) pure answer to the expectations of the client: radical design is a critical design. The radical design groups were active both as professional designers (Sottsass was art director of Poltronova; he was designer at Olivetti etc.) as well as design researchers: designing visions for possible futures able to feed, in concrete, their future projects.

Archizoom associates developed for example *No-Stop city* in 1969; Superstudio, *The twelve ideal cities (Le dodici città ideali)* in 1971: two different but extremely interesting cases. *The twelve ideal cities* was a research of 12 visions, 12 dreams independent from the consumer culture. In

1971 the twelve ideal cities were abstract visions of fantasy feasible worlds, they were considered as an anticipation of a re-birth of urbanism. They were published in a magazine directed by Italo Calvino (*Il Mondo*), who at that time was writing the *Invisibile Cities* (*Le Città Invisibili*) published one year later.

The Italian magazines *Domus* and *Casabella* as well (the latter directed by Alessandro Mendini from 1970 to 1977) were the media for disseminating radical design projects and essays. However, the most powerful moment for the presentation of radical design was the Italian exhibition: *The new domestic landscape*, in 1972, organized at MoMa in New York with Emilio Ambasz as curator.

In the same years the radical design groups were also involved in didactic activity. Ettore Sottsass, together with Archizoom, for example, organized some didactic design studios called *Global Tools* with the aim of disseminating their ideas to future generations. These design studios were not very successful, but some years later some of the same people were involved in a new didactic and research project: the foundation of Domus Academy Research Center in Milan in 1982, which is both a private design school and, or mainly, a cultural laboratory. They went on to collaborate in the start up of the first Italian design degree at university level, at the Politecnico di Milano in 1993. Ezio Manzini, Andrea Branzi, Michele De Lucchi, just to mention a few names, have constantly given birth to research through the development of projects in connection with companies, but not directly answering to specific company demands, as well as independently in the form of scenarios and visions, handicraft and limited series of products.

More recently, the emphasis on the experimental and research nature of Italian design and its connections with industry was the object of the second edition of the *Design Museum*, opened in 2009. Andrea Branzi sees design and production as two activities that have never merged into a unique logic or reality, thereby creating a circuit which, like a voltaic pile, takes advantage of the potential difference between materials in order to create an active magnetic field. The result is a circuit based on two poles, "in which industrial production receives energy from spontaneous experimentation which, in turn, is fed by a productive open territory that makes available everything from the experimental prototype to mass production, and in which the rule always foresees the exception (BRANZI, 2009:30)."The energy released by this circuit generates a high productive flexibility and a continuous renewal of languages: In the age of market niches and globalised competition, these two factors are an important developmental feature of the projection of Italian design." (BRANZI, 2009:30)

Hence the intention of returning to a design education approach:

- that is highly linked to practice based research, characterised by a great capacity for criticism and reflection;

- that is not only meant to respond to the demands of industry and the market but also to generate alternative visions of territories, urban environments, domestic spaces and lifestyles in general;

- that does not only take into account innovative productive processes of an industrial nature but also appraises the capacity of Italian handicrafts and art. The values of criticism, anticipation, constant interconnection between professional activity and research, intervention not only in form and/or function but also in the constitutive structure of products and environments in cultural, environmental, technical-constructive, commercial, distribution and socioeconomic terms, represent a vision of design that is still highly contemporary, valid for Italy and for the rest of the world.

This cultural approach also has significant consequences for the educational model.

Research that is able "to feed" design education and to become a driving force for creativity and talent is very often non-theoretical and clearly project-orientated, meant not only to *solve problems* but above all to *raise problems.* It is grounded in the recognition that we do not know the correct answer and must therefore create hypotheses and repeatedly construct prototypes in order to come up with possible solutions and verify their impact; it is based on consolidated tools but also on the conviction that tools must be continuously reinvented, borrowed from a range of disciplines (social, artistic and scientific) in an ongoing dialogue.

The logical result is highly experimental, an ability to 'make' and not only conceive, to test and verify projects through more or less successful prototypes without losing sight of the fact that if they appear on the market they must adapt to the methods of industrial productions. This approach, therefore, moves away from the idea of an 'arts & crafts' design and is much more in keeping with the 'poly-technicality' of the postgraduate course environment.

The Entrepreneurial Capacity of Designers

Finally we could say that the DNA of Italian design—the origins of which, as we have seen, lie in the anomalies of the industrialisation process in Italy—has strong connections with small and medium-sized companies set up spontaneously and dotted throughout the country, and with a weak entrepreneurial class on which it centres both its production and its projection. The recent history of Italian design has been enhanced by the presence of significant entrepreneurial designers, who have succeeded in combining creativity and technical knowledge with a strategic vision and a talent for articulating around the product-system a business system meant to last.

Similarly the easy access of designers to self-production or small scale production as well as the possibility to "de-intermediate" the distribution system through the web or through international fairs has increased the number of designers that play the role of entrepreneurs. A number of these were on display during the recent Design Week in Milan: such as Tom Dixon and Michele De Lucchi (Produzione Privata); Droog and Markus Benesch; as well as Autoproduzioni Italiane (curator: Stefano Maffei) or the design self-production market organized by the *esterni* association.

This feature is the new and, in the context, the latest identifying element of the postgraduate profile in Product Service Systems Design: designers capable of promoting their resources for producing projects and of understanding the entrepreneurial dynamics involved. In their turn, these resources are further developed thanks to the contribution of professors in the field of economics and management, and to the experience accumulated in the Concept Design Studio. At the end of the semester this gave rise to a 'market' at which students could sell the products they themselves had devised and created in limited series or, more recently, to an exhibition where the outcomes of the studio were presented to potentially interested companies. The final *Talent Trade Show,* which enlivens the Design campus at the Politecnico di Milano every year, is a particularly effective way of stimulating and testing the ability of students in Product and Service Systems Design to 'set up businesses', although that is not all. The event is also a means of putting into practice knowledge, tools and creative talent, of simultaneously developing ideas for producing projects, of materialising those very ideas, and finally, of acquiring new knowledge through experience.

Alta Scuola Politecnica - ASP

The best students of PSSD, as well as of all the other MSc. courses in engineering, architecture and design enrolled at the Politecnico di Milano and Politecnico di Torino, are admitted to Alta Scuola Politecnica

The Alta Scuola Politecnica (ASP) is a school for 150 young talents who wish to develop their innovation potential in a multidisciplinary community. The mission of ASP is to provide high profile graduates, combining in-depth disciplinary knowledge with the interdisciplinary skills that are needed to work and contribute leadership in a truly multidisciplinary environment.

Alta Scuola Politecnica is a sort of "metaschool" (with a program taught in English that runs parallel to the MSc programs of the two institutions) where the most talented students receive additional lectures, seminars and courses on interdisciplinary issues, methods and models of innovation and have access to two years of additional multidisciplinary project work, where they practice and experience the development of complex innovations.

More in detail, in multidisciplinary projects students may practice the process of envisioning, framing, planning and implementing innovation.

Projects are proposed by firms, public bodies and research institutions and are carried out by teams of 3/6 students, coming from the various Schools of both Politecnico di Milano and Politecnico di Torino, and are therefore intrinsically multidisciplinary.

The problems proposed are complex and systemic in nature and require the integration of competences from different disciplines. The main drivers of these projects are either technology or design.

These projects are conducted with the help and supervision of a team of tutors.

During the conference a project of the PSSD Concept Design Studio and of the ASP multidisciplinary project work will be presented.

References

ANNICHIARICO, Silvana and Andrea Branzi (2008). Che cosa è il Design Italiano? / Le sette ossessioni. What is Italian Design? / The seven obsessions. Milano: Electa.

ANNICHIARICO Silvana and Andrea Branzi (2009). Serie Fuori Serie. Series off series. Milano: Electa.

AIGA in collaboration with Adobe (2006). Defining the Designers of 2015, from http://www.aiga.org/content.cfm/designer-of-2015.

BROWN, Tim (2009). Change By Design, New York: Harper Collins.

BROWN, Tim and Jocelyn Wyatt (2010). Design Thinking for Social Innovation, Stanford Social Innovation review, Winter, 31-35.

BUCHANAN, Richard & Victor Margolin (1995). Discovering Design: Explorations in Design Studies, Chicago: University of Chicago Press.

BUCHANAN, Richard (Autumn 2001). Design Research and the New Learning, Design Issues, Vol.17, 3-23.

COLLINA, Luisa (2009). Training Designers of the Future, in Elisava TdD, n.26.

COLLINA, Luisa (2008). Changing the change: an European perspective. In which way in EUROPE design research is, or is not, an agent for sustainability?. In CIPOLLA Carla, Pier Paolo Peruccio, Changing the Change proceedings, Allemandi Conference Press, Torino, ISBN 88-422-1670.4, 98-107.

DEWEY, John (1991). Logic: The Theory of Inquiry, in The Later Works, 1925-1953, Vol. 12, Southern Illinois University. (Original edition, 1938).

DEWEY, John (2005). Art as Experience. New York: The Berkeley Publishing Group. (Original edition, 1934).

GARGIANI, Roberto (2007). Dall'onda pop alla superficie neutral. Archizoom Associati 1966-1974, Milano: Electa.

GOMBRICH, Ernst H. (1979). Research in the Humanities. Ideals and Idols, Daedalus 102 (Spring 1973): 1-10. Reprinted in Ideals and Idols. Essays on Values in History and in Art. Oxford: Phaidon.

JACOB, François. "Evolution and Tinkering", Science, New Series, Vol. 196, No. 4295, 10 June 1977, pp. 1161-1166.

LÉVI-STRAUSS, Claude (1966). The Savage Mind. Chicago: The University of Chicago Press. (Original edition, 1962).

LOCKWOOD Thomas (2010), Design Thinking: Integrating Innovation, Customer Experience, and Brand Value. New York: Allworth Press.

MANZINI, Ezio and Francois Jegou (2008), Collaborative services Social innovation and design for sustainability, Milano: Polidesign.
MARTIN, Roger (2009), Design of Business: Why Design Thinking is the Next Competitive Advantage, United States: Harvard Business Press.
MARTIN, Roger (2009), The opposable mind. Winning Through integrative Thinking, United States: Harvard Business Press.
MILANI, Carla (2009) "Service Science and Smarter Planet", Milan Triennial, 14 May 2009.
OSTERWALDER Alexander and Yves Pigneur (2010), Business Model Generation. New Jersey: Wiley.
SCHOEN, Donald A. (1983) The Reflective Practitioner. How Professionals Think in Action, Basic Books, New York.
SCHOEN, Donald A. (1987) Educating the Reflective Practitioner: Toward a New Design for Teaching and Learning in the Professions. San Francisco: Jossey-Bass.
VERGANTI, Roberto (2009) Design-Driven Innovation, Harvard Business Press, Boston
VISOCKY O'Grady, Jennifer, Kenneth Visocky O'Grady (2006), A Designer's Research Manual, Rockport Publishers, Glouchester, MA

Acknowledgement

Part of this contribution has been published in: Luisa Collina, "Training Designers of the Future", in *Elisava TdD*, n.26, 2009

Most of the content of this paper has been discussed together with the scientific committee of the Product Service Systems Design course comprising Norman McNally (UK), Cabirio Cautela, Ezio Manzini, Anna Meroni and Giuliano Simonelli (Politecnico di Milano), Fabio Di Liberto (Continuum, Milan), Fabrizio Pierandrei (Pierandrei Associati, Milan).

CUMULUS // DRS SIG on Design Pedagogy
1st International Symposium for Design Education Researchers
La Bourse du Commerce, Paris 18–19 May 2011

Mark Evans (2011). *Case Studies in the Evaluation and Evolution of Tools to Support Design Education.* 168–186

Case Studies in the Evaluation and Evolution of Tools to Support Design Education

Mark EVANS*

Loughborough University

The use of design tools forms a central component of academic study in the creative disciplines, with applications ranging from 3D modelling software to colour specification. The vocational nature of design requires educators to expose students to tools that have been validated through use by designers during professional practice, although an opportunity also exists for academic research to be more pro-active in both the evaluation of emerging tools and development of new resources. This approach enables educational institutions to be at the forefront in the selection and development of new techniques that support teaching and learning. This paper explores this approach through descriptions of two case studies in which PhD research was used to inform educational practice in industrial design education. The first case study, supported by Hewlett Packard USA, evaluated the use of the Tablet PC as a mobile design studio that could integrate sketching with other core design activities, such as computer aided design and data collection via web browsing. The second case study, supported by the Industrial Designers Society of America, developed a compact card-based tool (iD Cards) to support understanding and communication in the use of design representations during new product development. Whilst these studies have contrasting aims, they are linked through the use of substantive academic research to support design education. The paper discusses the methods used in the research and identifies the positive outcomes in the contribution to student learning.

Keywords: Design tools, PhD, industrial design, product design, Tablet PC, taxonomy, iD Cards

* *Corresponding author:* Loughborough Design School | Loughborough University
Loughborough | LE11 3TU | UK
e-mail: M.A.Evans@lboro.ac.uk

Introduction

The vocational nature of design education requires universities and colleges to equip students with the knowledge and skills required to engage in professional practice. At undergraduate and taught masters level, there is a fundamental need to identify how designers practice and to translate this into an appropriate curriculum for student designers. This reactive approach is typical of taught courses, with pro-active opportunities to explore future curriculum content being more appropriate for investigation through academic research and, in particular, research degrees.

This paper explores the capacity of PhD research to inform design education through the evaluation and evolution of tools that are central to industrial design practice. Case study methods (Birley and Moreland, 1998; Moore 1983) are used to describe two projects that received the support of a technology developer and a professional body that resulted in valuable insights and material for curriculum development. The methodologies for each case study will now be discussed.

Case Study 1: The Tablet PC as a Mobile Design Studio

The tower and lap-top PC play a central role in industrial design activity during New Product Development (NPD), having particular relevance during the phases of design activity that require greater control over form and detail such as design development and specification. However, the creative generation of ideas at the front end of industrial design practice is particularly well suited to manual sketching which facilitates the required level of spontaneity and ambiguity. Whilst it is possible to employ sketching hardware for this activity, such as an interactive tablet (e.g. Wacom Cintiq), these are relatively large and when combined with the required PC lack the portability and spontaneity afforded by a sketch pad.

Comparative studies of digital and paper-based sketching studies are limited, with Faber's small-scale comparison on the experiences of students in creative disciplines other than industrial design being an exception (Faber 2009). In 2009, the author received an Innovation in Education Grant from Hewlett Packard USA. The aim of this three year research project was to explore the capabilities of the Tablet PC to facilitate a totally digital strategy for New Product Development (NPD), with a specific focus on the inclusion of creative concept generation through sketching. The distinctive feature of the Tablet PC is its ability to reverse the position of the screen so that it can be viewed in what would normally be the closed lap-top position. The screen can be used with a dedicated pen-type stylus which has the capacity for freehand sketching. This sketching functionality is additional to the other computer-based activities that are central to industrial design practice, such as 3D Computer Aided Design (CAD) and image manipulation.

Research Methods

The application for the Grant utilised findings from an on-going PhD and when awarded, it enabled the researcher to exploit the resource within their methodology. The first phase of the research, that took place over one year, was to gather feedback on the capability of the Tablet PC to be used by final year industrial/product design students as a highly portable yet capable digital design studio. Sixteen finalist students were provided with a Tablet PC and, in addition to MS Office, received software to support industrial design activity, i.e. high-end CAD (Pro-Engineer), sketching (SketchBook Pro) and image manipulation (Photoshop). From the 16 students that participated in the study, 7 were studying for a BA in Industrial Design, 7 for a BSc in Product Design and 2 were studying for a B/Eng in Product Design and Manufacture. During their studies, all students had been taught how to sketch 3D product form to support industrial design activity.

The students received the Tablet PCs in the October of the 2009/10 academic year and had full use whilst undertaking design activity for their major projects and supporting modules. On-going support was provided by the author (responsible for teaching design sketching) plus a research assistant and in November 2009, the students participated in a two hour 'Shared Experiences' session during which they were able to discuss the benefits and challenges afforded by the Tablet PC and problems they were having were addressed.

After using the Tablet PCs for design activity for four months, data collection commenced through the following activities:

- Design Exercise and Product Sketching Exercise (January 2010)
- Expert Opinion on Sketching Questionnaire (February 2010)
- Focus Groups (February 2010)
- Closing Session (June 2010)

The specific data collection activities will now be discussed.

The Design Exercise and Product Sketching Exercise were undertaken to collect data on student attitudes towards the use of the Tablet PC, with expert opinion being collected on the sketched output. The design exercise allocated 2 hours for the design of a new product (a pepper mill) using the Tablet PC only. During the design exercise, students employed the full functionality of the Tablet PC's interactive screen during sketching activity, including use of the virtual keyboard when the physical keyboard was hidden under the screen (see Figure 1) and capacity to loosely apply tone and colour (see Figure 2).

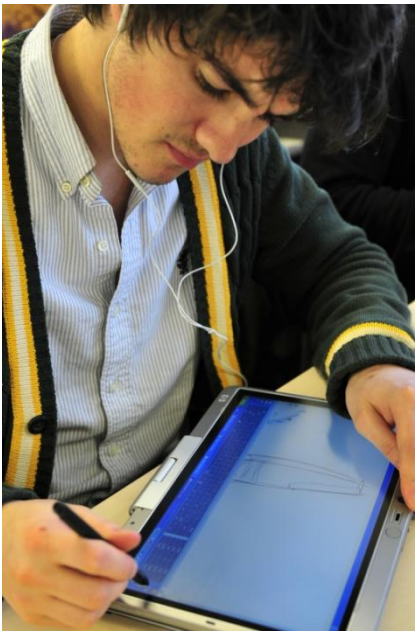


Figure 1. Use of the virtual keyboard whilst sketching

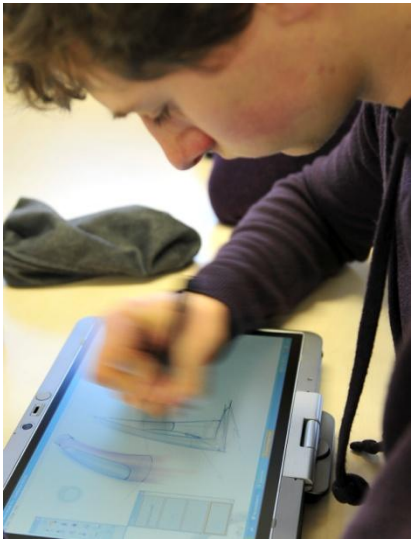


Figure 2. Loose application of colour whilst sketching

The students were given a detailed briefing on what was required for the pepper mill design which was supported by 50 examples of existing products as photographs. The format required for the outcome of this exercise was typical of that for the concept generation stage of new product development i.e. a single perspective view of the proposal plus elevational views. The application of colour/shade was optional and the use of 3D computer aided design software was not allowed i.e. it had to be sketched using the interactive tablet only. At the end of the design exercise, the proposals were collected using a memory stick for future analysis. An example of a design proposal completed in 90 minutes of design activity can be seen in Figure 3.

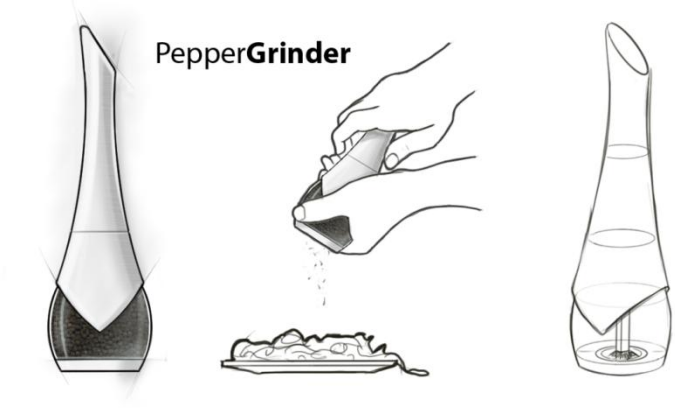


Figure 3. Sketch rendered output from design exercise

During observations, it was noted that students were rapidly switching between design sketching and accessing supporting material on the internet. Whilst such activity would be possible when using a computer and paper-based techniques, it was apparent that the Tablet PC facilitated a seamless transition between sketching and access to on-line images to support design activity. This went beyond the more typical searches for examples of related products and stylistic direction, as was the case with the proposal illustrated in Figure 3 where the student accessed an image of hands in the pose required for the visualisation. This was imported into the image manipulation software and traced for use in the proposal.

The pepper mill design exercise was undertaken to help develop capability in use of the interactive screen. The exercise was supported by the author and researcher assistant and was an opportunity for the students to address problems and share expertise. It also provided an indication of progress in the development of design capability as the students had previously provided examples of their work before being given a Tablet PC.

On completion of the pepper mill design exercise, the students completed a Design Exercise Questionnaire that required them to list three strengths and three weaknesses in using the Tablet PC for the task. Results from the design exercise questionnaire indicated that the Tablet PC supported improvements in sketching capability through the capacity to delete unwanted line/colour and then redo it. This enabled the students to be more fluid in the way that they worked due to the potential for immediate corrections. Although the students did not move around the room with the Tablet PC during the pepper mill design exercise, having been using it for over four months, they noted its portability and capacity for them to undertake digital sketching 'on the move' e.g. on trains or during visits to friends/relatives. In contrast, the key negative response was that the digital sketching techniques were more difficult to learn than non-digital techniques. This response had significant implications for learning support if the Tablet PC was to be introduced into the industrial design curriculum.

In addition to the design exercise, a product sketching exercise was undertaken to identify changes in sketching capability arising from the use of the Tablet PC. This required students to sketch contrasting products using both paper-based methods and the Tablet PC, with the process being recorded on video for future analysis (see Figure 4).

Figure 4. Use of video to capture sketching activity

Product sketching typically employs techniques that are appropriate to the required 3D form, with crating and ellipses being used for forms with a high degree of primitive geometry; and contour lines and bulkheads for those with more organic form. For this reason, the students were required to sketch from

observation, a battery operated torch that was based entirely on primitives (see Figure 5) and a child's spoon that had organic form (see Figure 6).

Figure 5 . Geometric torch used for product sketching exercise

Figure 6. Organic form of spoon used for product sketching exercise

By requiring students to sketch the two very different forms, differences in outcomes from use of the Tablet PC and paper-based methods would be evident. Five minutes was allowed for each product sketch with each being undertaken using digital and paper-based methods. This resulted in the production of four sketches for each student: 2 x torch sketches (one using the Tablet PC and the other paper-based techniques); 2 x spoon sketches (one using the Tablet PC and the other paper-based techniques). The sequence of undertaking the sketch exercises was randomised to avoid order effects.

On completion of the sketching exercises, students were asked to complete a Product Sketching Questionnaire that focused on the contrasting experiences afforded through use of the two media. The first question explored the students' perception of their sketching capability when using the two media. The second question requested open-ended responses to ways in

which the product sketching strategies differed between paper-based techniques and the Tablet PC by requiring a list in rank order with a maximum of 5 responses. The final question sought opinion on a series of statements that might apply to either product sketching using paper-based techniques or the Tablet PC. The results from the sketching exercise indicated that students felt that their ability to sketch using non-digital methods was greater than when using digital methods, although it was acknowledged that they had been using non-digital methods since their first year of studies. During the sketching exercise, students identified the capability of the software to allow them to work on layers as a significant advantage, especially when employing colour and tone.

In addition to feedback from the students on their experience of using the Tablet PC and paper-based sketching during the product sketching exercise, expert opinion was gathered on the effectiveness of the students' sketches to represent product form. An Expert Opinion on Sketching Questionnaire utilised the sketches produced by individual students, pairing them for each product and presenting them as full size images on an A4 sheet. Tick boxes were added to enable an expert on sketching to indicate which of the two sketches most accurately represented product form or if no difference in the two could not be identified. An example of the A4 questionnaire sheet for the spoon can be seen in Figure 7.

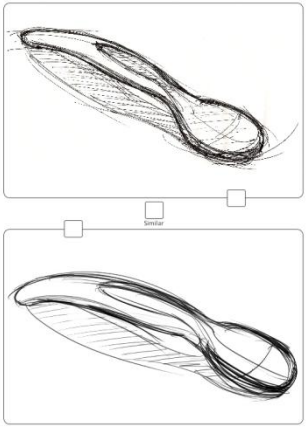


Figure 7. *Sample questions from the Expert Opinion Questionnaire for the digital and non-digital spoon sketches*

The questionnaire was completed by eight academics with responsibility for teaching product sketching to undergraduate students. They were also

qualified industrial/product designers with a minimum of ten year's commercial experience. The academics were provided with photographs of the torch and spoon and asked to complete the questionnaire by making a judgement on which was the most successful sketch in terms of line and perspective for the spoon and torch, although they were unaware of the specific media used. If no clear difference between the two sketches could be identified, the respondents had the option of ticking a "similar" box. The students were not required to apply colour or tone and if used this was ignored in the judgement.

The number of questionnaire responses was relatively low but, as experts in sketching, there was a high degree of reliability in the responses. The results from the academics indicated that the non-digital sketches were superior to the digital sketches which confirmed the student perception from the Student Sketching Questionnaire.

After using the Tablet PCs for four months, the students participated in a focus group during which seven semi-structured questions were used to elicit open-ended feedback on their general experience of sketching with the Tablet PC; its impact on sketching, creativity and productivity; what skills the students thought were required to teach the use of the Tablet PC; if they felt that the Tablet PC should be introduced to all industrial/product design students; and any other comments on the use of the Tablet PC. The two focus groups of 8 students each were facilitated by the author who had experience of professional practice, teaching product sketching and digital design methods.

72 distinctive responses were recorded and translated into a final questionnaire for use when the students returned the computers at the end of the academic year. The open nature of the focus groups provided a forum in which the widest possible range of issues could be elicited. This supported the aim of the final Use of Tablet PC Questionnaire which was to identify the significance of the wide range of issues raised in the focus group. The results indicated that the students had an overwhelmingly positive attitude to the role of the Tablet PC to support their development as industrial designers, even though they appeared to be more capable at sketching when using paper-based techniques. Key reasons for the more general positive response to the Tablet PC were its portability; capacity to effectively explore alternative solutions; its contribution to collaboration (sharing digital images); and that it increased the potential to design products entirely digitally. The key negative feature of the Tablet PC was that digital sketching was more difficult to learn than paper-based techniques.

The research provided valuable insights that are being used to inform decision-making, not only in the relevance of the Tablet PC to industrial design education, but also more generic products such as the stand-alone interactive tablet.

Case Study 2: Supporting Understanding and Communication in the Use of Design Representations

The use of representations for the communication of design intent are central to industrial design practice, but the development of skills and knowledge to enable students to produce the representations comprise a significant component of the undergraduate curriculum. This is very much the case for the core activities of paper-based sketching, the use of 3D CAD, digital image manipulation and model making/prototyping; where students are required to develop capability to the standard required for professional practice. Whilst there is extensive published material to support the development of specific techniques and, in particular, sketching and drawing, information on the full range of representations and context of use remains limited. This shortfall in teaching material was addressed using a combination of data collected during a Loughborough Design School PhD and post-doctoral development to produce a card-based design tool (iD Cards) that was designed and then distributed to students, educators and novice practitioners around the world. However, the research that led to this outcome commenced with a somewhat different aim; to enhance the collaboration between industrial designers and engineering designers.

Research Methods

The starting point for the development of the iD Cards was a Loughborough Design School PhD that was supervised by the author and awarded to Eujin Pei in 2009 (Pei, 2009). The PhD investigated the barriers to effective collaboration between industrial designers and engineering designers, with problems in the use and knowledge of design representations being identified as a significant issue and one that had the potential to be addressed through doctoral research.

The literature review for the PhD indicated that, in an increasingly competitive commercial environment, organisations were under constant pressure to identify and implement efficiency gains. In terms of the interaction between industrial designers and engineering designers, the problematic nature of the collaboration between the two disciplines is acknowledged (Jevnaker, 1998; Persson and Warell 2003). The Loughborough Design School PhD identified three distinct problem categories: conflicts in values and principles; differences in design representation; and education differences.

The research established that industrial designers tended to operate with open-ended, ill-defined problems; while engineering designers had a much more focused and objective approach. These dissimilar approaches could, at times, generate conflict (Persson and Warell, 2003). In addition to fundamental differences in approaches (Cross, 1985), another key barrier was that industrial designers focused on appearance and user-interface, whereas

engineering designers focused on functionality and manufacturing detail (Kim, et al., 2006). The engineering designer produced detail drawings and CAD geometry for the manufacture of a working product based on quality, performance and cost (Flurscheim, 1983). In contrast, industrial designers produced representations such as rendered sketches and appearance models.

Effective communication is essential when undertaking new product development and Clark and Wheelwright (1993) note the importance of this in achieving cohesion and efficiency. Studies indicated that engineering designers struggled to fully understand the vocabulary used by industrial designers but, in contrast, Fiske (1998) identified that industrial designers found it difficult to understand engineering design-related issues such as technical specifications. In addition, words may not have the same meaning for all members of a design team, with Persson and Warell (2003) acknowledging that communication becomes more effective once the team develops a common vocabulary through and understanding of communicative codes and language, e.g. symbols, product reproductions and message content.

Erhorn and Stark (1994) note that because the various participants in new product development have their own vocabulary that is suited to specific activities, there can be difficulty in communicating and understanding amongst those outside the specific professional group. Although the language may be similar, identical words have been found to have different meanings (Ashford 1969).

As part of the PhD, an empirical study was undertaken with the aim of identifying and resolving barriers to effective collaborative between industrial designers and engineering designers during new product development. The first data collection event involved a ten week study that was undertaken with 17 design consultancies specialising in electronic consumer products. The subjects were qualified industrial designers and engineering designers with varying levels of experience. The fieldwork consisted of 45 hours of in-depth interviews and 80 hours of observations. The empirical studies utilised a qualitative research methodology, incorporating semi-structured interviews and the observation of participants during a commercial project.

The interviews allowed respondents to fully describe their personal experiences relating to group interaction; reasons for project success and failure; and methods used during the project. To increase reliability, a mix of large, medium and small companies with an equal number of industrial designers and engineering designers participated in the survey. The data was coded into a spreadsheet which identified 61 problem categories. A coding and clustering technique was then used to condense the results into a matrix using recurrence and importance.

The matrix highlighted the 19 most frequently occurring problems (occurring 3 or more times) which were then categorised under the following headings:

- **Problem Category A - Conflict in values and principles**
  Engineering designers tend to work with quantified solutions with a focus on efficiency. Industrial designers favoured an open-ended approach with less constrained solutions
- **Problem Category B - Differences in design representation**
  A lack of a common understanding/language for both disciplines represented a significant obstacle to effective collaboration
- **Problem Category C - Education differences**
  Differences in education resulted in different capabilities, approaches and expectations

Observations were used to obtain detailed information during a 2 week case study that involved the commercial design of an electronic communication device that required collaboration between industrial designers and engineering designers within a design consultancy. Analysis of the results identified that a lack of a common language in design representations made it more difficult for industrial designers and engineering designers to understand and empathise with each other.

A representation is defined as a model of the object it symbolises (Palmer, 1987). Internal representations encompass imagery and cognitive activity, with external representations being visual or verbal (Goel, 1995) and expressed through language, graphics or actual objects. The research project had a focus on external representations that included physical and digital formats. In the early stages of design activity, when a solution is ill defined, more unstructured representations, such as sketches, are employed. According to Tang (1991), sketching allows visualisation, communication and information storage; while Larkin and Simon (1987) point out that representations can externalise and visualise problems as they emerge. Other studies highlight the importance of product representations in enhancing team communication (Ulrich and Eppinger 1995) and as a thinking tool (Ferguson, 1992). Suwa et al (1998) note that sketches provide visual cues for further work and for the construction of 'functional thoughts'.

The potentially ill defined nature of sketches can lead to them being interpreted differently by industrial designers and engineering designers, but this ambiguity also enables industrial designers to re-interpret them and gain new insights (Goel, 1995). While engineering designers employ formal systems, such as ISO standards, industrial designers have been cited as using less established representation types and ones that are ill-defined and imprecise (Saddler, 2001). In highlighting the differences in the vocabulary of

each discipline, Smith (1997) suggests the use of a common understanding of shared definitions.

In developing a tool to promote shared understanding, the PhD research sought to provide definitions for the key design representations used by industrial designers and engineering designers; when they were used; and to identify the key types of design and technical information that they were used to communicate. Numerous formats for the emerging tool were evaluated and a physical card format was selected on the basis of portability and convenience.

The cards were developed as sets of red cards for industrial designers and blue cards for engineering designers, with the content for each set being divided into 3 sections. The red and blue sets differed in the fact that the popularity of use for the design representations was not the same for industrial designers and engineering designers as evident through the data on use that was collected via the interviews. Section 1 of the cards identified the key design stages of the new product development process (concept design, design development, embodiment design, specification). The front face provided a definition of a specific design stage, with 4 cards being used to indicate the popularity of use of representations during each of 4 stages with the most popular appearing at the top. Section 2 described the key design and technical information used by industrial designers and engineering designers in the design process. The front face had a definition of the type of design or technical information, with the reverse showing the popularity of specific representations to communicate the design or technical information. Section 3 identified the 34 most significant design 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 specific design stage. An example of a card from the information section for industrial designers can be seen in Figure 8 and for engineering designers in Figure 9.

The card-based tool, called “CoLab”, was validated through semi-structured interviews with participants from 15 design companies and academic institutions. The results indicated that most respondents felt that the tool would provide a common ground in design representations that would contribute to enhanced collaboration. There was also a 3-week case study during which the cards were used for a live, client-based project. The case study approach allowed data to be collected within a real-life context (Yin, 1989) with observations being conducted in a natural work environment. A design diary captured the activities, enabling later analysis.

Figure 8. Front and reverse of design information card for design intent in industrial designers (red) set

Figure 9. Front and reverse of design information card for design intent in engineering designers (blue) set

The case study confirmed the relevance of the design representations used on the cards along with the use of the design/technical information. It was noted

that both industrial designers and engineering designers used identical keywords picked up from the cards during discussions which helped reduce the potential for misunderstanding. The case study provided further positive feedback which reinforced the capacity of the cards to facilitate collaboration in a multi-disciplinary environment.

Having received significant support for the CoLab design tool from participants in the data collection process, on completion of the PhD, attempts were made to put the product into production. Despite meetings with several major stakeholders in new product development, the cost of the 114 full colour double sided cards was identified as a significant obstacle to commercialisation. Whilst the potential existed to convert the physical CoLab system into a web-based tool, this was resisted on the grounds of an overwhelmingly positive response to the convenience and portability of physical cards. During a search for viable alternatives to a playing card-type product, the commercially available 'Z-Card' fold-out printing format was identified as a potential solution as it was available in a variety of sizes and aspect ratios. Unfortunately, although the Z-Card product was cost effective, the format was not suitable for the creation of 114 double-sided as used on the CoLab tool.

During a review of the potential for the Z-Card format to be used as an alternative to the 114 double-sided cards, considerable interest in the CoLab tool was shown following a presentation at the 2009 Industrial Designers Society of America International Conference in Miami. Its contribution to support student and novice designers was particularly well received. Ensuing discussions resulted in the potential to produce a design tool that included the full range of design representations but also employed empirical data on their use by industrial designers in terms of when they were used during product development and for what types of information. Significant development work was undertaken to redesign the CoLab tool for the Z-Card format which was re-branded 'iD Cards'. The iD Cards had credit card-size front and rear covers that were printed on card, with the fold-out panels being on paper. Yellow tabs indicated at which stage of product development the design representations were used, with tabs to indicate if they were used to communicate design information (red tabs) of engineering information (blue tabs). The front sheet of the iD Cards can be seen in Figure 10 and reverse in Figure 11. The folded-up iD Card is shown in Figure 12.

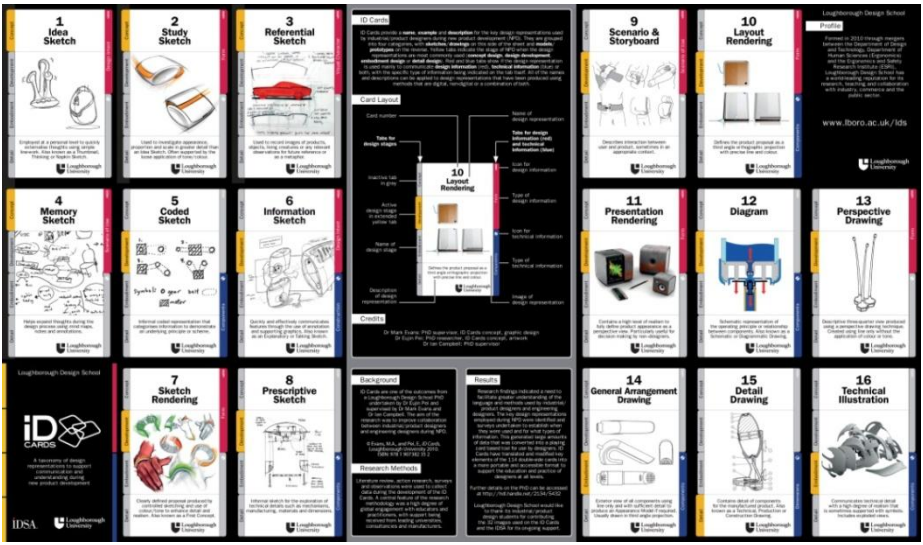


Figure 10. Front sheet for iD Cards

Figure 11. Rear sheet for iD Cards

Figure 12. Folded iD Cards

The collaboration with the Industrial Designers Society of America (IDSA) facilitated the printing and distribution of the iD Cards in the UK and USA, with the potential to access a modified PDF via a link on the web site for the Design Practice Research Group at Loughborough University (www.lboro.ac.uk/departments/lds/research/groups/design-practice/). To support design education in the UK, an iD Card was sent to the Design and Technology department of every secondary school in the UK (total 5002) and 5000 were distributed to students and practitioners in the USA by the IDSA in April 2011. The iD Cards were also selected by the IDSA as a finalist in the 2011 International Design Excellence Awards (IDEA).

Conclusions

The two case studies have discussed contrasting strategies in which academic design research can inform design education. Manufacturers can make significant claims about the contribution of their products to design practice, but objective evaluation using academic research has the capacity to provide impartial feedback. Whist it must be acknowledged that there is significant cost associated with the Tablet PC, it has been identified as an effective means of integrating sketching with the more established digital design techniques of 3D CAD and web browsing. It was of some significance that the methods used during sketching with the Tablet PC were above and beyond those available through non-digital techniques, such as the ability to edit. What might appear as a relatively simple functionality for software such as a word processing package, when integrated into sketching activity, the

capacity to edit made a significant contribution to the development of capability.

In contrast to the use of design research to evaluate an emerging technology, the development of the iD Cards demonstrated how such methods can be employed to address a need for information that supports practice. The development of the tool to provide information on the use of design representations lasted for over four years, but it indicates how the original aims for research can evolve, through need and opportunity, to produce a tool that is of relevance to a related but different group, i.e. instead of focusing on the needs of practicing industrial designers and engineering designers, it was used to support design students and novice designers.

The key feature of both case studies has been the contribution of key stakeholders in both activities where Hewlett Packard and the IDSA were central to the research. In fact, the research would not have been viable without their support. It must be acknowledged that the availability of such support to evaluate and develop design tools is relatively rare, with research funding, particularly in the UK, focusing on multi-disciplinary activity for more topical issues. However, the development of core capability in design disciplines remains of considerable significance to academics in the field and these case studies demonstrate the value and impact of research to education and, ultimately, commercial effectiveness.

References

Ashford, F. (1969). *The Aesthetics of Engineering Design*. London, Business Books Ltd.

Birley, G, and Moreland, N. (1998) *A Practical Guide to Academic Research.* London. (p36)

Clark, K. B. and Wheelwright, S. C. (1993). Managing New Product and Process Development in *The Organization of Integrated Product Development*. V. Paashuis. Berlin, Springer-Verlag.

Cross, N. (1985). *Styles of learning, designing and computing*. Design Studies (12)

Erhorn, C. and Stark, J. (1994). Competing by Design - Creating Value and Market Advantage in New Product Development. USA, Oliver Wight Publications.

Faber, C. H. (2009). *Digital Drawing Tablet to Traditional Drawing on Paper: A Teaching Studio Comparison.* Proceedings of the International Association of Societies of Design Research Conference 2009. Retrieved 16 May 2006 from: http://www.iasdr2009.org/ap/navigation/byauthorname.html#f

Ferguson, E. S. (1992). *Engineering and the mind's eye.* Cambridge, MIT Press.

Fiske, J. (1998). Kommunikationsteorier: en introduktion. Wahlström och Widstrand. Relational Modes between Industrial Design and Engineering Design – a Conceptual Model for Interdisciplinary Design Work. Göteborg, Chalmers University.

Flurscheim, C. H. (1983). *Industrial Design in Engineering*. London, The Design Council.

Goel, V. (1995) *Sketches of thought.* USA, MIT Press.

Jevanker, B. H. (1998). Building Up Organizational Capabilities in Design, *Management of Design Alliances*. UK, Wiley.

Kim, Y. S. *Interdisciplinary Research: Integrated Engineering and Industrial Design*. Retrieved 16 May 2006 from: http://www.engr.uiuc.edu/communications/engineering_research/1996/gen1/gen1-9.html

Larkin, J. H. and Simon, H. A. (1987) *Why a Diagram is (sometimes) Worth Ten Thousand Words.* Cognitive Science Journal (11). pp65-99.

Moore, N. (1983). *How to do Research.* London, Library Association Publishing

Palmer, S. E. (1987). *Fundamental Aspects of Cognitive Representation, in: Cognition and Categorization.* Hillsdale, Lawrence Erlbaum Associates.

Pei, E (2009). *Building a Common Language of Design Representations for Industrial Designers and Engineering Designers. Loughborough University PhD Thesis*

Persson, S. and Warrell, A. (2003). *Relational Modes between Industrial Design and Engineering Design - a Conceptual Model for Interdisciplinary Design Work*. Proceedings of the 6th Asian Design International Conference. Tsukuba, Chalmers University.

Saddler, H. J. (2001). Understanding Design Representations. *Interactions* July – August 2001.

Smith, M. B. (1997). Are Traditional Management Tools Sufficient for Diverse Teams? *Team Performance Management* 3(1) pp3-11.

Suwa, M. Purcell, T. and Gero, J. (1992). Macroscopic Analysis of Design Processes Based on a Scheme for Coding Designer's Cognitive Actions. *Design Studies* Volume 19(4) pp455–483.

Tang, J. C. (1991). Findings from observational studies of collaborative work. *International Journal of Man-Machine Studies* (34):143-160.

Ulrich, K.T. and Eppinger, S.D. (1995) *Product Design and Development.* USA, McGraw-Hill

CUMULUS // DRS SIG on Design Pedagogy
1st International Symposium for Design Education Researchers
La Bourse du Commerce, Paris 18–19 May 2011

Kath McKelvey (2011). *Turning an idea into a valuable teaching resource and research output!* 187–200

Turning an idea into a valuable teaching resource and research output!

Kathryn MCKELVEY*

Northumbria University

This paper describes the journey of a teacher who became an author in Higher Education. The journey began with a simple idea about a fundamental resource book, designed to improve teaching in design and illustration classes with ever increasing numbers of novice fashion students, back in 1991. This resource was a taxonomy of fashion, designed to increase the awareness of garment shapes, context, proportion, terminology, construction, production and finish with a view to improving student knowledge, design and visual communication skills.

The paper reflects upon the subsequent publications that built on the previous resource, as outputs of rigour, significance and integrity in shaping the author's approaches to teaching and research in fashion and other disciplines. It describes the development of the original idea and the subsequent acceptance of this for publication and illustrates how this one idea allowed for further opportunities for publications in a partnership with a global publisher.

There are resource issues around gathering content for publications of rigour and originality and there have been challenges around communicating in the publications themselves due to technological and economical constraints.

There are also practical resource issues around creating and designing the publications as well as the need for the development of personal skills when keeping up with changes in technology and the fashion industry.

Each publication requires careful planning and needs to have unique 'reasons for being' that make it different to the competition. It describes the positive aspects of working with a colleague who brings similar skills and understanding, but a different handwriting and point of view to the publications. It looks at the impact of updating original editions and keeping the works contemporary. It also looks at personal and

* *Corresponding author:* School of Design | Northumbria University
City Campus East 2 | NE1 8ST | United Kingdom
e-mail: Kathryn.mckelvey@northumbria.ac.uk

practical insights learned across almost 20 years of being an author with the same publisher.

Keywords: author, teaching resource, design process, communication, publication

Introduction

This paper strives to explain what it is like to be an author of fashion design publications and a Reader in Higher Education. It describes the value of the publications as a Reader and teacher and the philosophy that binds them together in the 'Research Profile'. Becoming an author was not part of the career plan, but it was about having a timely idea, many years ago, and then taking an opportunity when it was offered, this is described in 'Developing the Initial Idea'. 'Taking Opportunities' explains how this idea allowed for more opportunities to be realised.

One of the key drivers of this success was my ability to draw, research, design, organize, plan, work in a team and hit deadlines. These skills became key to the publication design process and a 'degree of flexibility' meant that the inevitable design constraints were seen as a positive challenge explored in 'The Publication Design Process and Constraints.'

Each publication needs to be carefully planned and have its unique reasons for being, this is explored in 'Unique Selling Points and Content Resources'. The final consideration is the actual creation of the publications and what it takes to realise these in practical terms and with insights described in 'Designing the Publications and Practical Resources'. The paper concludes with personal reflection on the authoring process and the fulfilling of the original aim to improve teaching in design classes.

Research Profile

There is pressure, as a Reader, to have a strong research profile within Higher Education so these fashion design publications have to fulfill the need for measurable 'outputs' which means that as well as informing the target market there has to be consideration of originality, significance and rigour in their execution.

The research lies in the field of fashion design practice, which is an esoteric, volatile and dynamic field. The prevailing teaching/learning process of fashion designers is studio/workshop, project-based, where tacit knowledge and skills are acquired by osmosis (Schön, 1991).

The growing number of undergraduate fashion students needing to attain contemporary knowledge, skills and techniques that will effectively allow them to proceed to the design innovation stage and focus on idea generation, development and prototyping, are difficult to manage, so the traditional

studio/workshop is no longer sufficient for this osmosis of skills and dialogue to take place.

So, this research is manifested in a series of design pedagogy publications that are intended to inform and progress through the novice stage of the skills acquisition process (Dreyfus & Dreyfus 1980) and build on knowledge and experience in the subject area of fashion design. These are; the Fashion Source Book (FSB), Illustrating Fashion (IF), Fashion Design: Process, Innovation & Practice (FD:PIP) and Fashion Forecasting (FF), all published by Wiley.

The contribution to knowledge here is in articulating the heuristics of fashion design in a constantly dynamic industry to create a 'sense making' (Gladwell 2005, Owens 2007) relationship through skill gathering, but in a visual, non-verbal way.

The scholarship is in converting tacit, esoteric and volatile knowledge into explicit materials suitable for pedagogic reference; and in the sense-making approaches employed to do this, i.e. visual documentation, layout and annotation.

Developing the Initial Idea

This all started around 1991, with an idea, to try and encourage novice fashion students to use the correct fashion terminology in their design projects.

I worked on the Fashion Marketing degree at Newcastle Polytechnic, teaching fashion design, illustration and conceptual thinking by combining skills in design and illustration 'holistically' through a fashion forecasting project (fashion forecasting being my background and requiring illustration and design skills).

Research revealed that there was a lack of well-drawn fashion dictionaries and a complete lack of focused practical fashion books in 1991 – mostly promotional fashion illustration books or pattern cutting books were available.

Novice fashion students needed to learn so many skills to be proficient designers, how do you do this effectively when there is pressure to be more efficient with teaching contact time?

Further investigation revealed the need for a fundamental reference combining this with knowledge of construction and production and so aid awareness of potential when designing. Imparting this knowledge with traditional one-to-one teaching was becoming difficult primarily because there was a rapid increase in student numbers.

Fashion design traditionally takes a 'problem-based learning approach', but if a novice designer is not well informed and the lecturer cannot instruct till there is some designing in evidence, then the student needs to 'jump in

without knowing' (Schon 1987:93). The FSB was intended to provide support at this point.

The FSB, needed to be a 'visual' fashion dictionary. This is supported by Sennett's view of the limits of language, by substituting the 'image for the word'. He emphasises this by suggesting the 'showing rather than telling' approach of Henri Cartier-Bresson's 'decisive moments' series of photographs (Sennett 2008:95).

The FSB was created and used when teaching fashion design fundamentals. The idea was to include clothing items that were of historical, classical or ethnic interest in each garment category. It included a comprehensive range of templates of figures for men, women, children and babies and a chapter on how to adapt these figures for fashion use. It included flat drawings of childrenswear, mens and womenswear clothing such as; outerwear, jackets, waistcoats, trousers, suits, skirts, swimwear, dresses, shirts, tops, loungewear, nightwear, knitwear, underwear.

It also included flat drawings of accessories; bags, gloves, hats, belts, neckwear, boots, shoes, sports shoes, hosiery.

Production techniques were illustrated, such as; seams and finishes, fullness, pockets and fastenings. Varied construction elements were included such as sleeves, cuffs, collars, necklines, waist and hemlines. All items had full explanations in the glossary.

Some figures, garments, accessories, production and construction elements had to be painstakingly researched, described and then illustrated as sometimes drawings and photographs were difficult to find for reference.

What made the book unique was the pulling together of all of these elements, elements that were necessary to teach in design class, but pre FSB this was undertaken in a much more ad-hoc way without the comprehensive resource.

Taking Opportunities

The publisher from Blackwell Publishing, visited the University around this time looking for modern pattern cutting books to publish, he saw the prototype of FSB and immediately negotiated a contract to publish it (he didn't pursue the pattern cutting book).

The contract was for two years to produce the book.

Blackwell were seen as 'one of the world's foremost academic and professional publishers' (Wiley 2011) and this fitted perfectly with the change of status from Newcastle Polytechnic to University of Northumbria in 1992 and the beginnings of developing research in Higher Education.

The continuing relationship with Blackwell in 2007, allowed for a broader distribution to Australia, China, USA, UK and Greece when John Wiley & Sons bought Blackwell Publishing, they stated that, 'for our customers, we

provide more access to more content to more people than ever before in the history of the two companies'(Wiley 2011).

Blackwell were interested in other publication ideas. There was a need to produce a resource on fashion illustration as this was a subject taught alongside design studies.

The Illustrating Fashion (IF) publication was created and used when teaching modules on illustration fundamentals, there were many books on promotional illustration but very few that analysed the different types of drawing taught in class and more importantly required by the fashion industry.

There was a need to provide a comprehensive resource offering as much information and explanation about this area. So, the book began with an historical contextual review of drawing for fashion dating back to the 1900's with a brief indication of the influences that affected the style. These drawings were all re-interpreted and illustrated, as permission to use existing imagery was going to be costly, also this allowed us to gain better knowledge and understanding of historical stylisation.

The book then explored figure construction, drawing from life, balance, including proportion and the drawing of clothes. Particular emphasis was placed on drawing heads, hands, feet and footwear as students struggled with these areas. Drawing exercises (from contemporary life drawing classes) were included to build on the independent learner's understanding.

Media Techniques were included, that is, hand drawing and digital techniques – utilising digital tools in a common workflow situation using Adobe Illustrator and Photoshop. Part of the success of an illustration is in the presentation, so layout & typography, normally belonging in the graphic design discipline, were researched. This chapter proved itself to be of value when teaching other disciplines, such as animation and interactive media, as knowledge of the Adobe suite of software is essential in today's digital world (hand drawing techniques are valuable also). The level of the digital tutorials proved to be pitched correctly for these students also as they have been used for a number of years with great success.

A chapter on Fabric Representation, exploring printed textiles, depth and shine, highlights and pleats, textured fabrics, drape and transparency, knitwear, volume and gather, wool and faux fur, folds and fringing, denim, specialist fabrics, lace and embroidery was also included along with composition, cropping, viewpoints, graphic application, promotional drawing and illustrating detail.

Drawing for Manufacture explored the working/technical drawing which was a fundamental method of communicating design ideas for all types of fashion personnel involved in the industry. Accessory drawings were also included as this was becoming a developing market area. Examples of each

type of drawing were provided to show as much variation in style and approach as possible.

The Publication Design Process and Constraints

Publications take a lot of planning and of course producing the content, especially when they are an original set of drawings as in the source book. A new contract was being negotiated to produce the book on fashion illustration, half way through the production of the FSB. This looked like a lot of work for one person to undertake, so my colleague, Janine Munslow, offered to help with IF. This proved to be an ongoing working relationship.

The idea was made explicit in a 'publication proposal' that was essential to the process and the publishers used this to gauge interest, in terms of sales, in the idea, and whether the proposed content was right for the target market. The proposal was refereed by 'experts in the fashion field' and the publisher fed back findings to us.

There weren't a lot of competitors in the early years, from 1993, and they didn't seem to have the complete overview of industry requirements that we did, dealing primarily with the more promotional aspects of fashion illustration. Janine and I happened to work closely together as Industrial Placement tutors also, so feedback from industry here was important in terms of teaching students the right skills at the right time for their 2nd and 3rd year placements. We were in a position to influence what was included in the curriculum because we taught on the novice/fundamental early years of the fashion courses. Later, around 1997, at the implementation of 'modularisation' in Higher Education, the books helped us to clearly articulate new modules in the curriculum as we had already separated design processes and illustration processes through the books. Design is a holistic skill though (Schön 1987:158) and novice designers need to understand the whole in order to synthesise the parts, consequently the two books (resource and illustration) worked together but there was another opportunity presenting itself that would take advantage of the 'whole' design experience and would utilise the industrial intelligence that we gathered as well as explain the design process; this was Fashion Design: Process, Innovation and Practice (FD:PIP).

FD:PIP explored the design process and after creation worked in tandem with the FSB in fashion design classes.

The book began by; analyzing the brief, discussing the place of innovation - including exercises to promote innovation, research inspiration, research direction including fashion forecasting, the fashion cycle, fashion and art, the place of sub cultures and street style (the analysis of fashion design research into inspiration and direction helped to clarify the process).

After the design research element the book explored the development process by looking at the use of colour, silhouette, proportion, understanding fabric

and new fabric innovations, construction, that is; basic skirts, bodices, panels, pleats, dresses, sleeves, trousers, collars, prototypes and embellishment.

In keeping with the previous two books, a comprehensive approach was desired to have a self-contained teaching resource that aided design understanding, so chapters on designing for specialist markets, designing ranges and collections, design using the computer and promotional graphics and styling were also included. These latter subjects were taught on the Fashion Marketing degree, which philosophically is about taking a product from concept to market. The Fashion Design degree works towards a final catwalk collection and it was important that the publications were relevant to these students also. The two different approaches to fashion allowed for a number of vocations, requiring slightly different skillsets, so the Fashion Careers chapter aimed at articulating these possibilities. As placement tutors, liaising regularly with industrial partners, we knew what was required by industry and utilized this information by reflecting on the job of press assistant, public relations officer, assistant buyer, assistant designer, visual merchandiser, costume designer, assistant on a magazine, fashion forecaster, product developer, textile agent, recruitment consultant and supplier.

The book concluded with case studies elaborating upon the design principles explored.

This book pulled together a lot of tacit design and education experience and captured material that, on reflection, was often overlooked but proved incredibly important.

The design process here was also applicable in other disciplines perhaps with a change of terminology, for example, in Fashion Marketing the focus is the 'target market', in Interactive Media (IMD) it is the 'User'. I now teach on programmes like Motion Graphics and Animation Design (MGAD) and IMD, and have found, as Schön (1991) suggests 'simply shifting between domains of activity stimulates fresh thinking about problems'.

For example, IMD students explore 'scenarios' (invented consumer profiles) in product development, this resides in a design process document called 'Information Architecture'. MGAD students use graphic design as a basis for their character design, where the character is a 'brand' and apply 'Style Guide' principles (rules of the brand) to this type of work (also the brand is explained in the Fashion Forecasting publication). Both of these approaches have been used in the second edition of FD:PIP.

The publication design process, in terms of structuring the books, consisted initially of a holistic mind map of what Janine and I thought we needed to do; then we would talk through each area about the why and how, audience and message, process and materials, ways of thinking and synthesis (Noble & Bestley 2005), elaborating on which areas we needed to research in more detail, the type of content that required development and whether we would illustrate these principles ourselves or use 'case studies' to make a

point. We split the chapters up between us as to which areas we felt we could best handle individually.

On reflection, we learned also that we used visual representations and graphic organisers to communicate abstract concepts and content as Petty (2006:113) suggests: 'indeed the more abstract the topic, the more important it is to represent it visually'. We used some principles of design such as 'mnemonic devices' and 'picture superiority effects' by choosing memorable visual examples, 'progressive disclosure' in digital tutorials, 'storytelling' in audience scenario development, the 'Von Restorff effect' where noticeably different things are likely to be recalled such as, the innovation examples in FD:PIP and the 'ways of seeing' in Fashion Forecasting (Lidwell, Holden & Butler 2003).

Three 'second editions' have been completed now, allowing us to implement any reflection and new material.

There were opportunities to seek feedback, which affected our design decisions, such as looking at Amazon for 'pointers' from purchaser's reviews, we would also consult with the fashion student body and check out any citations of our work on Google Scholar to see what information was being used.

We went from working in 'black and white' on the first three publications (colour was not in common use as content tended to be text heavy and technical with diagrams and the odd photograph,) to years later, being able to explore the 'impact' of and 'designing' with colour. We learned a great deal from doing the IF first edition - that line quality needed to vary, that texture and pattern were critical and that composition was an important consideration.

As the relationship with the publisher developed and the books sustained strong sales, Janine and I continued to work together as we discovered that 'two hands' and two different but complimentary approaches really helped to make the publications unique in the field. We described FD:PIP as the third in a 'trilogy' of essential books for the novice fashion designer.

The fourth book was more specialist in the world of fashion and would appeal to a slightly different market, not the novice but the more competent designer and professional; this was Fashion Forecasting (FF).

With more specialist books the publisher needed to be sure there was a market and so they tested the idea on a number of fashion experts. Usually 2000 sales in the life of a single book edition is considered successful!

FF grew from the research direction part of FD:PIP, from a level 4 module that synthesized illustration and design and from personal industrial experience.

The fashion forecasting industry sells design intelligence material to the fashion design and manufacture industry, usually two years ahead of a season.

FF began by explaining about fashion design intelligence, which looks at general trends such as social, political, economic and cultural influences and included the power of the fashion brand. Key companies in the forecasting industry were interviewed and profiled, such as, Carlin and Here & There, with their limited edition hard copy publications and Worth Global Style Network, who publish online; more accessible fashion forecasting magazines, such as, the View series, were also profiled.

The fashion forecasting process was briefly outlined in FD:PIP, but here was elaborated upon, with a view to students creating their own intelligence material and included the development of new textiles, mood boards, colour and 'seeing' an important contribution that was about getting more out of visual inspiration (from the work of a PhD student, Emma Jefferies, who was exploring visual literacy in visual communication) and case studies to explain the esoteric principles of forecasting and how to communicate ideas.

As forecasting is communicated via the Internet or in book form, a further chapter on communication was included, which expanded upon the work in IF on type and layout application. The colour work here has proved invaluable in animation design classes as well as in fashion teaching.

Unique Selling Points and Content Resources

Each publication had a number of unique selling points.

The second editions (FSB 2006, IF 2007 and FD:PIP 2011) needed to not only be updated but also allowed the introduction of FULL colour which meant that the impact on the audience would be greater and finally we could really explain about designing with colour.

We updated all content in each second edition, especially case studies and other illustrative examples to keep them contemporary.

FSB offered copyright free illustrations for use by students.

The case studies in each publication re-inforce the idea that an individual approach is expected, they also help to show someone else's design process and decision making when working with a complex problem. They are really about 'sense-making' (Gladwell 2005, Owens 2007:31) in complex problem solving.

Where necessary we introduced relevant current digital tools and how to use them by designing easy to use tutorials (IF and FF).

The addition of the 'innovation' chapter in FD:PIP came from a product design oriented project, written specifically, by a colleague, Dr. Kevin Hilton from his research. This was updated, in the second edition, by adding a conceptual exercise derived from a MGAD project. The chapter on 'seeing' in FF by Dr.Emma Jefferies, was unique in attempting to utilise the visual more thoroughly. The contribution from experts from other disciplines makes the books unusual in the field, as they offer different ways of problem solving.

As fashion students try and make sense of their world, I would suggest that these publications support a move towards independent learning and a student centred approach (Owens 2007:33).

A designer makes things. . .He works in particular situations, uses particular materials and employs a distinctive medium and language. Typically his making process is complex. There are more variables – kinds of possible moves, norms and interrelationships of these – than can be presented in a finite model. (Schön 2007:78)

Designing the Publications and Practical Resources

We started out in 1993, using traditional skills such as cutting and pasting drawings and word processing text.

As the books and technology have progressed, we have been given the responsibility for producing the layout of the manuscript as we became skilled enough to do our own typesetting. It was important to consider the content retrieval element of each book so the information design had to be clear. Designing the contents page became an increasingly more visual and informative exercise. The publisher lets us design the covers now also, we originally provided ideas only, this is exciting as it re-inforces the idea of it being our design, our practice! The books 'hang together' and have our stamp on them, as they are completely conceived by us.

Our skills at graphics and layout design improved and each publication became more contemporary in feel.

We did apply for small research grants from our Design School to support the production of the publications. We needed equipment such as laptops, a scanner, an external hard drive to back up and store files and access to printing facilities. A personal camera was useful to capture interesting and inspiring imagery. We needed the Adobe CS software Suite as we regularly used Illustrator and Photoshop in image production and InDesign to create the pages. We now export chapters as PDF's. These are used to proof read and produce the final printed publication. We started out, in the early years, saving word files on floppy discs, then we used zip drives, CD's and DVD's, posting a printed version to the publisher, we now upload the PDF files to the publisher's server.

The problem with technology changing so rapidly is that often our 1st edition files will have become out-of-date and in-accessable due to changes and upgrades in computer equipment over the duration of the life of a book (we re-do most content in any case though). We always produce a printed version throughout the process, for checking purposes, updating pages as we create them, as it is important to understand how the pages are going to work, they are re-worked if the layout doesn't communicate well enough.

In terms of the FF publication, the fashion forecasting industry is based in key fashion capitals like London, New York and Paris. How do you profile and interview companies situated across the world with no budget?

We had to plan well ahead to gather the necessary information, up to two years before the delivery of the publication. Opportunities like field study visits, to New York, with student groups to arrange meetings, interview personnel and take photographs with companies and to get permission to publish, were invaluable. I put in bids at the university for side projects like 'Applauding Teaching & Learning' initiatives with ideas like 'assessment feedback by MP3', the £1000 award allowed for travel to Paris to interview key companies and also visit Premiere Vision, the trade show, where the main players exhibited to the fashion industry. I was always planning and thinking ahead as to how I could do visits. We visited companies in London with money left over from the award. We were surprised to find that everyone wanted to be part of the publication, this meant that we got some excellent material to publish. We were privileged to be given passwords to access online content and were sent limited edition publications to scan.

Reflecting on the publication process in this way, over the years, has revealed some interesting insights and practicalities about the process, such as:

It is not ethical to publish with a number of publisher's on similar subjects. In fact, you do become very loyal to your publisher and build the relationship over a number of years.

The more ideas for publication that you have, the more updating to 2nd and 3rd editions is required! This means that there always seems to be a book in the background!

When you work with a colleague any royalties are split between you, which is fair, because your time commitment is halved.

When royalties are 10% of any sales this does not mean that you make a lot of money, you do not publish for the money.

You have to estimate how long a publication will be, this used to be by the number of words used in the very early days, but now we commit ourselves to a great number of images per publication.

It is expensive to use other people's imagery and photographs so it becomes essential to observe and record interesting subject matter wherever you are in the world. These images could also be subjects for illustration in the publications. Building resource libraries of photographic images has become very important.

In terms of research outputs and the Research Excellence Framework (REF) in Britain, if publications are your key outputs it becomes very difficult to generate and publish four in the given time period, so other outputs have to

be considered. When this is your passion, as practice-based research, it is difficult to diversify meaningfully.

In the production of these publications a number of research methodologies have been employed, mostly this is practice-based research using action research and experimentation when creating visuals to explain principles. Also, qualitative methods were used by interviewing key players in FF and fashion careers in FDIP. Not only did content and relevant techniques require research but the actual design of the content/the information design required research and experimentation to find the best ways to communicate. The books also work in different disciplines in terms of fundamental principles of design.

Publications require long term planning, so you have to be well organized and always looking at opportunities for gathering content.

Conclusion

The original aim behind producing the publications was to improve teaching in fashion design and illustration classes (as well as to get published), the books became invaluable resources here. The principles illustrated were broken down into weekly classes and design and illustration, taught by us, was cross-referenced to help to 'sense make', to have a more holistic approach, with the students. Contemporary examples of design and illustration were shown that were wholly appropriate to any fashion design principle.

Design and visual communication skills were tangibly improved, both by students who had no prior knowledge of fashion design and illustration, before entering the university, but also by those who understood the fundamentals, this was especially visible when students undertook the design and illustration synthesis module that was concerned with fashion forecasting. What was harder to gauge was the effect on independent learners!

The modules taught in the fashion degrees were often starting points for what needed to be included in the publications and the publications became key texts in the module reading lists.

The fashion books sell consistently well in the fashion market and are core texts in a number of institutions, even though there is greater competition in the field of fashion publications now, twenty years on.

I believe we have achieved the original aim to improve the teaching of fashion design and illustration skills to novice fashion students and have found broader uses for the publications than was originally intended in other design disciplines.

I have not taught in fashion related disciplines for a number of years but have succeeded in applying the design and illustration process (FD:PIP and IF) to the disciplines that I now teach, such as, IMD (with some of the 'user'

approaches cross fertilising back into the fashion publications) and MGAD which is very much based on drawing and then moves into using digital tools.

I am very interested in the 'design process' and how it can be applied to other subjects (the design process in fashion, interactive media and animation starts out with many similarities from a design research point of view).

I can use the FF book to explain colour concepts to MGAD students. I can explore illustration examples and media techniques from IF with MGAD students. I can then use animation design processes, such as storyboarding and graphic novel approaches to further my fashion illustration skills. I can apply my knowledge of drawing, design, colour and media use to teach illustration, storyboarding, character design and use my developing digital skills in teaching matte painting in animation classes.

I can collaborate with IMD students to develop websites for fashion forecasting material. This crossing over of disciplines provides a consistently rich supply of potential ideas for publication development or research projects. The only problem with this approach is that perhaps the publisher does not always publish in these new areas and may not yet be interested as they do not have an established market!

There is always a desire to strive to make the most recent publication better than the last, this can be fun but does create personal pressure.

Being an author is exciting, especially when you see your books in stores or online, it is even better when you see students using them in their studies.

This journey started with a very simple idea in 1991, followed closely by an opportunity to become a published author in 1993. I have 'written' books ever since!

New technological developments have not diminished the desire to own books whether digital or printed. So far we have sold around 15,000 publications with Wiley.

References

Dewey, J. (1910). How We Think. Milton Keynes: Lightning Source UK Ltd.

Gladwell, M. (2005). Blink: The Power of Thinking Without Thinking. London: Penguin Books.

Dreyfus, H. L. & Dreyfus, S.E. (1980). A Five-Stage Model of the Mental Activities involved in Directed Skill Acquisition. Berkeley: University of California.Lidwell, W., Holden, K. & Butler, J. (2003). Universal

Principles of Design: 100 Ways to Enhance Usability, Influence Perception, Increase Appeal, Make Better Design Decisions and Teach through Design. Massachusettes: Rockport Publishers, Inc.

Noble, I. & Betsley, R. (2005). Visual Research: An Introduction to Research Methodologies in Graphic Design. Switzerland: AVA Publishing SA.

Owens, T. (2007). Problem-Based Learning in Higher

Education. In Campbell, A & Norton, L. (Eds.), Learning, Teaching & Assessing in Higher Education (pp. 31-41). Exeter: Learning Matters Ltd.
Petty, G. (2006). Evidence-Based Teaching. Cheltenham: Nelson Thornes Ltd.
Sennett, R. (2008). The Craftsman. New Haven & London: Yale University Press.
Schön, D. (1987). Educating the Reflective Practitioner. San Francisco: Jossey-Bass.
Schön, D.A. (1991). The Reflective Practitioner: How Professionals Reflect in Action. Aldershot: Ashgate Publishing Ltd.
Wiley. Narrative History. Retrieved 18 March 2011 from http://eu.wiley.com/WileyCDA/Section/id-301697.html
Wiley. About Wiley-Blackwell. Retrieved 18 March 2011 from http://eu.wiley.com/WileyCDA/Brand/id-35.html

Author's Publications:

McKelvey, K. (1996). *Fashion Source Book.* Oxford:
Blackwell Publishing Ltd.
McKelvey, K., & Munslow, J. (1997). *Illustrating*
Fashion. Oxford: Blackwell Publishing Ltd.
McKelvey, K., and Munslow, J. (2003*). Fashion Design: Process, Innovation and Practice.* Oxford: Blackwell
Science Ltd.
McKelvey, K. (2006). *Fashion Source Book. 2nd Edition.*
Oxford: Blackwell Publishing Ltd.
McKelvey, K., and Munslow, J. (2007). *Illustrating*
Fashion. 2nd Edition. West Sussex: Wiley-Blackwell.
McKelvey, K., and Munslow, J. (2008). *Fashion*
Forecasting. West Sussex*:* Wiley-Blackwell.
McKelvey, K., and Munslow, J. (2011). *Fashion Design:*
Process, Innovation and Practice. Wiley-
Blackwell, West Sussex.

CUMULUS // DRS SIG on Design Pedagogy
1st International Symposium for Design Education Researchers
La Bourse du Commerce, Paris 18–19 May 2011

Linda Drew (2011). *Using design thinking and co-creation to re-imagine curriculum.* 201–209

Using design thinking and co-creation to re-imagine curriculum

Linda DREW*

Vice Chair DRS Council and independent researcher

This paper begins with a discussion of approaches to co-creation and the application of design thinking (Sanders and Stappers, 2008). In this discussion, examples of co-creation approaches include Open Space Technology (Owen, 1997) a model of collaborative, research-informed facilitation and writing mostly used in higher education settings. The discussion reveals aspects of these approaches which enhance co-creation and peer to peer facilitation as well as high quality research-informed writing and curriculum development using the cognitive characteristics of design thinking (Oxman, 1999 & 2004). Significant features of the OST model are assessed to understand relevance for educators and practitioners in design as an anti-hierarchical approach to research-informed writing and curriculum development. The paper goes on to analyse two case studies of different stages in the experience of a group of art and design educators brought together to re-imagine a research-informed curriculum after an institutional merger. The group uses co-creation and OST informed approaches such as World Café and Bar Camps to co-create a blueprint for a research-informed curriculum. This analysis draws on evaluation reports. The paper concludes with suggestions for further development in design Higher Education contexts.

Keywords: Co-creation, design thinking, participation, curriculum design, open space technology

Introduction

Co-creation strategies

It is often the case that the terms co-design and co-creation are conflated or even deemed to be synonymous. Definitions of co-creation and co-design are

* *Corresponding author:* Vice Chair DRS Council and independent researcher | UK
e-mail: l.drew4@btinternet.com

mostly limited to design research publications and only exist as outlines in Wikipedia for example.

Sanders and Stappers (2008) in their article on uses of co-creation and co-design in multiple contexts refer to these activities as;

> *'...any act of collective creativity, i.e. creativity that is shared by two or more people. Co-creation is a very broad term with applications ranging from the physical to the metaphysical and from the material to the spiritual, as can be seen by the output of search engines. By co-design we indicate collective creativity as it is applied across the whole span of a design process(...) Thus, co-design is a specific instance of co-creation. Co-design refers, for some people, to the collective creativity of collaborating designers. We use co-design in a broader sense to refer to the creativity of designers and people not trained in design working together in the design development process.' (Sanders and Stappers, 2008, p 6)*

In the examples I wish to discuss, I have focused on the use of co-creation strategies in an education setting at the *fuzzy front end* of the problem phase of idea generation. The use of such processes is well understood in business and marketing situations as well as in co-creation approaches to participatory design. In design education however, the teacher or researcher is often required to produce course designs (modules, courses, learning outcomes etc) in less than participatory circumstances. How might co-creation be applied to the design of our own education contexts? Or at least in the idea generation phase.

> *'Co-creation practiced at the early front end of the design development process can have an impact with positive, long-range consequences (...) The application of participatory design practices (both at the moment of idea generation and continuing throughout the design process at all key moments of decision) to very large scale problems will change design and may change the world.' (Sanders and Stappers, 2008, p 9)*

In these situations, I have used co-creation strategies as models of facilitation and expression as well as a peer to peer approach which is less hierarchical and enables my role as both an educational manager and thought leader to be included in the participatory design rather than fore fronted. The tools used will be discussed in the next section.

> *'In generating insights, the researcher supports the 'expert of his/her experience' by providing tools for ideation and expression. The designer and the researcher collaborate on the tools for ideation because design skills are very important in the development of the tools. The designer and researcher may, in fact, be the same person.' (Sanders and Stappers, 2008, p 12)*

Design Thinking

In co-creation strategies we can identify the cognitive characteristics of design thinking, a process which uses both visual and conceptual knowledge as well as the dialectic process of design thinking. Schön's process of 'reflection in action' (1987) describes dialectical phenomenon in cognitive design processes.

> *'The primacy of this unique cognitive characteristic demands cognitive models of design thinking which reflect both the duality of the visual and the conceptual and their dialectical interaction in design thinking.' (Oxman, 1999)*

It is therefore entirely appropriate to consider both co-creation strategies and how to develop design thinking in those strategies in order to fully develop the idea generation phase of curriculum design or system design in an educational setting (Oxman, 2003). I shall exemplify this with a later description of open space technology and other approaches used in the case study.

What is Open Space Technology?

Open Space Technology (OST) is essentially a methodology or 'tool', which can be adapted to a range of contexts, for example, meetings, conferences, staff development events. It encourages participants to engage actively and take responsibility for the process, hence drawing comparisons with 'student-centred' and 'deep' approaches to learning (MacDonald, 2007). Feedback and reflection from participants generally references the importance and quality of 'personal learning' as an outcome. OST can be used to address complex and wide ranging issues and achieve meaningful outcomes. It can be particularly successful where the people involved and ideas are diverse, and traditional facilitator-led approaches may be less productive. The focus, assimilating individuals' expert knowledge and experiences creates a greater understanding of issues and realistic practical solutions.

The OST concept in educational settings

I hadn't realised till I attended an OST conference in 2003 that the idea of co-created or participative event is not new. A well established conference in Medical Education has been running for more than twenty years (Wakeford, 1985) and has remained momentum by identifying new themes whilst retaining a 'think-tank', presentation-free format. The significant features of this model are:

1. Choose a topic of high importance.
2. Invite a small, preferably research orientated, group of people knowledgeable about this topic.
3. Add a group of `users'.
4. Supplement them with good facilitation and working conditions.
5. Add a sprinkling of what might be described as `new researchers' or `young blood' in the field, to keep more esoteric delegates' feet on the ground.
6. Set the participants some specific goals. These usually include reviewing the `state of the art' of a particular area (in medical education), commenting on what research might collectively say about these issues, generating further questions for investigation and encouraging the delegates to publish their findings. (Hays, *et al*, 2000, p. 783)

OST demands you structure participation: Case Study of the Graduate School model at Camberwell, Chelsea and Wimbledon Colleges

The Graduate School planning group agreed the principles for the invitation process, we knew we wanted to invite a range of academics, senior managers, researchers, students and other stakeholders (e.g. technicians) with the ability to write, work as part of a team or complete projects was deemed essential. The invitation was clearly targeted and we had a clear aim. The aim was to create a model for a Graduate School at the newly merged Camberwell, Chelsea and Wibledon Colleges of the University of the Arts London. The final plan was to make a collaborative approach to a graduate curriculum for both taught and research postgraduate activity spanning nearly 500 full time equivalent taught masters students and over 80 PhD students.

The participative process began with a project initiation document in January 2008 which basically described the management parameters and purpose of the project. There was a two day 'Purpose and Visions' workshop in February 2008 using OST approaches to co-create the basis for the structure and visions of the school. This was swiftly followed by drafting of a strategy and planning for wider consultations with University stakeholders in March 2008. The final OST sessions were in April 2008 to design an implementation plan.

These workshops identified the CCW Graduate School context, research question, purpose and Vision:

CCW Context: Considering the river; Embracing uncertainty; Our complex network of flows

CCW question: What if we can illuminate the space between knowing and doing?

Purpose: To enable you to enact our futures

Vision: to be the brightest art and design graduate school in the world

The key factors in this mix were determined by the group as:

- Global best people
- Intellectual space
- Communication
- Environment structure
- Unlock potential
- Brilliant courses

A Project Timeline for 2008-09 was then completed which included milestones for further co-creation activities in order to create a communications strategy and budget model. Based on these deliberations, the Graduate School was launched in September of 2009.

The key part of re-imagining the curriculum for the Graduate School was a course portfolio analysis and structure working group which used OST strategies again to come up with ideas to formulate a postgraduate timetable which worked across three colleges and co-ordinated marketing and admissions strategy . This two day OST workshop used the following aims:

- Create a shared understanding of our research and practice
- Potential for collaboration
- Identify interdisciplinary directions
- Visualise new spaces for research
- International dimensions

The groups invited included all researchers and teaching academics as well as technical and support staff. In groups across the college boundaries, they were asked to identify curriculum projects which would exemplify the above aims. These outcomes provided enough activity to sustain development through to the first academic year, one year later, in 2010, the groups were reconfigured to further re-examine the practicalities of further development of a collaborative research-informed curriculum.

Developing the research-informed curriculum: using BarCamps and World Café

As by now my colleagues were becoming comfortable with OST principles, we moved to use other complementary co-creation approaches. We developed a BarCamp session to further contribute to ideas already in progress and designed a framework consisting of sessions proposed by participants.

BarCamps are based on simplified variations of Open Space Technology (OST), building on colleagues passion and responsibility in participation. While loosely structured, there are some rules at BarCamp. Participants are encouraged to present facilitate and contribute to a session. Everyone is also asked to share information and experiences of the event, both live and after the fact, via public web channels including (but not limited to) blogging, wiki-ing, and photo-sharing. BarCamping facilities include; network access i.e. WiFi, food and drink but no sleepovers were planned at this event (although many seasoned BarCamp practitioners stay as long as it takes to develop a project, see for example barcamplondon.org)!

BarCamp rules include the standard OST 'Rule of two feet' where participants can move around to listen and contribute to one or more presentation. All ideas generated can be shared and recorded, whether on post-its, flip chart, laptops or through other digital devices. The BarCamps start with ideas and then make plans to realise those ideas. Each presenter/group has an outline which is roughly 'advertised' to others. They then collaborate to realise those ideas

World Café

The critiquing and refining process was designed by using a World Café format in order to create the conditions for thinking ahead beyond our first year and to consider how we integrated both internally and with external organisations.

World Café uses a cyclical process to Use the outlines and build, enhance, refine the ideas developed collectively. Further sharing and refining occurs as the groups change and rotate through three cycles of World Café discussions. In the first round of discussion the Café table hosts are drawn from the course directors and research leaders and encourage each café table to write, doodle and draw key ideas on their tablecloths or on post-its, flip chart paper etc. Table hosts can photograph for ease of recording, as they are not chairing the conversations. Table hosts can encourage conversation and take note of key ideas on large post-its or index cards. After the First Round one person is asked to remain at the table as the 'keeper of the conversation', while the others serve as travellers or "ambassadors of meaning." The travellers carry key ideas, themes and questions into their new café conversations.

In the Second Round the table host welcomes the new guests and they briefly share the main ideas, themes and questions of the first café conversation. They encourage guests to link and connect ideas coming from their previous table conversations—listening carefully and building on each other's contributions. By providing opportunities for people to move in several rounds of conversation, ideas, questions, and themes begin to link and connect. At the end of the second round, all of the tables in the room will be cross-pollinated with insights from prior café conversations.

In the final and Third Round (in our World Café, several more rounds can occur according to circumstances and outcomes required). People can return to their home (original) tables to synthesize their discoveries, or they may continue travelling to new tables, leaving the same or a new 'conversation keeper' at the table. After these three rounds of conversation, the facilitator will lead a period of sharing discoveries and insights in a whole group conversation where patterns can be identified, collective knowledge can grow, and possibilities for research-informed curriculum emerges. A large whiteboard or several flipcharts may be used to distil the main points from each café table. These insights form the basis for the curriculum plan, a product of collective knowledge production or co-designing. All of the photographs, flip-charts etc. need to be analysed swiftly and can be fed back as a proposal to participants soon after the event.

Evaluation of the experience of OST strategies for re-imagining the curriculum

Often the most important learning we experience is in reflection on our practice, made even more powerful by sharing that experience with others (Schön, 1987). We learnt a lot about the OST process, about working with each other and particularly how our experiences may help others, either in contemplating using OST as a workshop or conference model or in considering social aspects of informal learning.

Do OST models work?

The Graduate School project team concluded that this model could be used by other practitioners (not just in an educational context) with another theme or goal. For the model to prove a success we have also observed that a number of key variables need to be maintained. Some of these follow:

1. **Project Board**. The board contributed to the planning and facilitation of the events, each member leading on different aspects and during the events contributed to facilitation of sessions either in pairs or individually. Together, they represented a range of experience, both within the colleges and in the subject disciplines which was complementary to the collaborative nature of the planning exercise. Each of them brought a high level of professionalism to the project, both in planning and in

execution but also in following up on actions to resolve operational and implementation aspects. Commitment to attend meetings of the group was vital, so a lot of advance planning of meeting schedules was required. A small group could be risky if one person fails to attend, and a larger group may not actually progress tasks efficiently and also becomes more difficult to coordinate and manage.

2. **Plan of events**. As discussed earlier, it had been our intention to maximise process and discussion but to make sure that there were concrete outcomes in time for implementation as courses.

3. **Ethos and guidelines for working**. We talked about the process and overarching ethos of the events right at the beginning, and we talked specifically about how things would be managed. There were a number of non-negotiable rules, for example the objective was to work towards collectively designing the Graduate School model but individuals could move between groups over time. Debate and non-consensus was to be positively encouraged and participation in cross group critiquing was essential. All other aspects were however negotiable including where groups met, size of group, themes to be debated, how and who did the writing, note-taking and reporting.

4. **Participants**. Having a mix of participants from across the Colleges and some from outside was essential. Many different career stages and types were represented, researchers, academics, academic developers and senior staff as well as students (mostly doctoral students) and technicians. This mix was important as was the ability of the invited participants to act as team players with a proven ability to take part in high level debate, write and also finish projects.

The Working Process.

The format for the events received incredibly positive feedback, the few comments to the contrary referred to minor changes to the process in the future. The 'free and open ethos', as well as the non-hierarchical, collegial nature of the events created an inclusive environment where all participants felt able to contribute to the process and this was recognised. The most frequently remarked upon feature was the opportunity for collaborative activity and teamwork. This came out as the most rewarding aspect for participants. For some it was the opportunity to work with a variety of staff from across the Colleges, from which they felt they learnt a lot. Some colleagues drew comparisons on how this differed from the surface approach they were often required to use to develop curriculum as just one of the many aspects of multi-tasking that made up much of their daily routine.

Conclusion

It has been interesting to reflect on this process, and I believe this approach could be used again in another context or with different themes if the opportunity arose. My reflection has led to my thinking that this process could be used with student groups seeking to build on projects beyond the initial ideation phases or with colleagues when addressing collaborative writing tasks, for example vision and strategy documents. Bearing these future directions in mind, what can we learn which could be transferable to a new situation?

Making sure that plenary or feedback sessions are not all the same in process and format reduces the risk of these being perceived as 'set pieces'. In removing the ritual of reporting back sessions in plenary this avoids overload and running over time for participants and enables reporting to become a peer to peer and group to group imperative, much more can be gained through smaller focused critiquing sessions and through informal social exchange.

I have learnt that this process is paramount and that these processes can be used for collaborative research informed writing in other OST conference settings (Drew, 2008)

OST guidelines say that 'whoever comes is the right people' and I really like that principle. But of course I am aware that it is absolutely vital to invite the right people to attend and participate and those people are they who can contribute to learning, research and curriculum design, together.

References

Drew, L. (Ed) (2008) The student experience in art and design higher education: drivers for change. Cambridge: Jill Rogers Associates

Hays, R., Jolly, B., Newble, D., Gupta, T.S., Spencer, J., & Wakeford, R. (2000) The Cambridge Conference: background. Medical Education 34 (10), pp. 782–784.

MacDonald, R. (2007) Online forum for SEDA 1/3/2007 http://www.jiscmail.ac.uk/cgi-bin/webadmin?A2=ind0703&L=seda&T=0&P=47 accessed 04/04/11

Schön, D. (1987) Educating the Reflective Practitioner. Jossey- Bass, San Francisco, CA

Wakeford, R.E., (ed) (1985) Directions in Clinical Assessment. Cambridge: Cambridge University Medical School

Owen, H. (1997) Open Space Technology: A User's Guide. San Francisco, Berrett-Kohler

Oxman, R. (1999) Educating the designerly thinker Design Studies 20: 2, 105 - 122

Oxman, R. (2004) Think-maps: teaching design thinking in design education. Design Studies 25: 1, 63 – 91

Sanders, E. B. N. and Stappers, P. J. (2008) Co-creation and the new landscapes of design, CoDesign, 4: 1, 5–18

CUMULUS // DRS SIG on Design Pedagogy
1st International Symposium for Design Education Researchers
La Bourse du Commerce, Paris 18–19 May 2011

Peter Lloyd (2011). *Does Design Education Always Produce Designers?* 210–227

Does Design Education Always Produce Designers?

Peter LLOYD*

The Open University

By questioning what we mean by the term 'designer' this paper describes the ideas behind a new Open University course in Design Thinking. The paper shows how the creative skills of students can be consciously developed, and deliberately applied outside of the creative industries in what are termed 'embedded' contexts. The distance learning model of education pioneered by The Open University is briefly sketched before the developments and ideas behind the new course in Design Thinking, in particular the concept of 'social practice' are explained in detail. The paper presents the results of an extensive student and tutor survey regarding the course before concluding that, although it is possible to teach design practice by distance, practice-based expertise for tutors remains a critical success factor.

Keywords: Design Thinking; Design Education.

Introduction

One of the main findings of a 2008 National Endowment for Science, Technology, and the Arts report on the UK creative economy was that: "more people work outside the creative industries than inside them" (Higgs, Cunningham, Bahkshi, 2008). Based on census data collected in 2001 the report identified 1.9 million people (7.1% of the UK population) in 'creative employment'. This figure breaks down to the number of people in the creative industries being 552,170, the number indirectly employed by the creative industries – for example in accountancy or business – 690,641, and the number outside of the creative industries, 'embedded' in other industries being 645,067.

This general picture provides an interesting context for UK design education. HESA, the UK Higher Education Statistics Agency, which provides

* *Corresponding author:* Department/School | The Open University
PO Box 197 | Milton Keynes MK7 6BJ | United Kingdom
e-mail: p.lloyd@open.ac.uk

data online for subject areas and students in UK universities, shows that in the academic year 2009-2010 there were 173,825 students studying 'Creative Arts and Design' subjects, with 63,325 classified under 'Design Studies'. Of these 2570 (4%) obtained a higher degree that year.

Where might these 2570 graduates find employment? In the trade journal *Design Week* on 3rd March 2011 there were 11 design job advertisements which, totalled over a year, makes 572 available jobs. Assuming these positions would 1) be filled by graduates and 2) form most of the positions available in the design industry – two very big assumptions – that would leave 2000 students graduating without an obvious job in the design industry. As the first paragraph showed, the market for 'embedded' creativity outside of the creative industries is equally as big as the market within the creative industries so we might speculate that an equal proportion go on to work in this 'embedded' mode. This, however, raises the question as to why we primarily educate designers in specialist areas – product design, graphic design, interactive design – when it appears many will not go on to practice in those areas.

The argument for the productive application of design and creativity methods to a wider range of work-based situations has found traction in both business schools and forward thinking design schools through the area of 'design thinking'. The main thrust of this approach is to show how using methods of design can add value to a business (Brown, 2008; Brown, 2009; Lockwood, 2009; Martin, 2009). There is, however, an alternative approach to design thinking that places less emphasis on the benefit to business and more on designing as a way of empowering a wider range of 'non-designing' people that goes beyond business (Ambrose and Harris, 2009). This distinction could be crudely characterised as the difference between indirect change – design and business encouraging people to consume in order to enhance their lives, and direct change – empowering people to enhance their lives through designing. This is the approach that The Open University has adopted in a new course titled 'Design Thinking: Creativity for the 21st Century' (U101).

This paper describes the ideas underlying U101 and brings together research showing the impact it has had on students and staff. The paper is framed as an experiment where the experiment is a new type of learning, the results showing the effect that that learning has had. The paper starts by giving a brief overview of the unique way in which The Open University teaches its courses. It then goes on to describe how the distance learning model has been adapted to teach the practice of design thinking, following recent developments in the internet. The concept of 'the social practitioner' is introduced, before a consideration of evidence about the impact that the course has had. The paper ends by concluding that although it is possible to teach design practice by distance, practice-based expertise for tutors remains a critical success factor.

The Open University Educational Model

The Open University came into existence in 1969 as the 'University of the Air', using radio, television, and printed materials to deliver course material to students studying at a distance. The model of distance learning adopted by the Open University, and still in current practice, has two major features. The first is that the collection of course materials given to students need to be sufficient for 'self-study'. That is to say that the student is able to learn simply by following the learning materials. Significantly this means that although every student is allocated to a regional tutor, the role of the tutor is to *support* the student in their study, not teach the course material.

The second feature is that the production of all course materials – for example audio, video, printed materials, timetables, assignments, marking guides, multi-media, online material, etc. – is completed before any students study the course. There is thus a *production* process, typically lasting three years, during which a course team made up of academics and support staff produce the course materials. This is followed by a *presentation* process, typically lasting eight years, where the students study the course materials in regular cohorts. During this eight years changes to the course materials are minimal.

Although this process is analogous to any product development process the closest analogy is perhaps to that of film, with a clear division between production – where the narrative of the film is crafted and fixed – and viewing – where an audience is able to watch, experience, and criticise the film.

Two aspects of higher education at The Open University deserve further mention. The first is that there is open access to everyone, regardless of prior qualification, for entry to first year ('level 1') courses. This means that course materials have to be crafted for a very wide range of student abilities and over the years the university has built up considerable expertise in pedagogy. The second is that the diversity of students is matched by the diversity of the regionally-based part-time tutors the university employs. Sometimes tutors are already teaching in other universities or educational establishments, a few come from business, sometimes they are retired academics, and often they are people that have completed Open University degrees themselves.

Teaching Design at a Distance

Design as a subject area has long been taught at The Open University. The first course – *Man-Made Futures: Design and Technology* – appeared in 1975 and this has been followed by many other courses leading up to the present day. However, in contrast to how design is taught at 'traditional' universities, as a practice-based education, Open University design courses have concentrated on teaching that considers design as a general phenomena; for example about how design takes place in different disciplines, or the impact

and influence that design can have. So rather than teaching students *to* design, as a traditional design education does, Open University design courses have tended to teach students *about* design, producing students knowledgeable about design and the design process, but not necessarily accomplished as designers.

Three recent developments, all dependent on the ubiquity of the internet and increased broadband speeds, have made a different kind of design course possible, allowing the Open University orthodoxy of simply teaching students *about* design to be challenged. The first development is of a more social creativity. Web 2.0 has brought together people in ways amenable to demonstrating creativity through 'usable', configurable and media rich websites. For example, the photo-sharing website Flickr reveals a huge range of approaches to photography, from the amateur to the professional, that combine and influence each other in a creative social network.

The second development is that the distinct disciplines of design have become more ambiguous, blurring boundaries that were once distinct. Presenting product portfolios online, for example, now means that an understanding of graphic and interaction design is necessary. This means that design has become more oriented towards communicating design possibilities rather than producing objects that fit into well-defined categories, be they buildings, vehicles, products, sounds, or fonts.

The third development is that conventional design education has become more 'distanced'. Students are spending more time working at home, sending in their work electronically, and communicating online with fellow students and staff. The studio-based educational model of the past is slowly being eroded as design education progressively becomes more of a virtual activity.

These developments present problems for a design education premised on the transmission of expertise through face-to-face discussion between teacher and student over a progressing design – an approach beautifully described in Donald Schön's seminal book The Reflective Practitioner (1983). At the heart of reflective practice, Schön suggests, and arguably at the heart of creative practice, is the process of framing and re-framing; being able to see one thing as another. An expert practitioner is able to 're-frame' a problem so a student can both move forwards in the process of reaching a solution *and* understand the importance of framing and reframing itself. How can these two forms of learning still take place when the amount of face-to-face discussion time is diminishing?

A possible answer to the question, and one that builds on the three developments outlined above, comes with the new course in Design Thinking offered by the Open University. Rather than adopting a reflective practitioner model of design education, a one-to-one transmission of expertise or knowledge, the course adopts something that we might refer to as a *social* practitioner model, where expertise comes from a diverse peer-group of

students working in online environments. The word 'diverse' is important here in that it suggests a wide range of expertise and experience that can potentially feed into the design process. This aspect of the new course, combined with the traditional features of an Open University education – self-study course materials and support from a regional tutor – provide the basis for a different kind of practice-based design education.

U101 Design Thinking: Creativity for the 21st Century

Overview

In February 2010 The Open University launched 'Design Thinking: Creativity for the 21st Century' (U101), a 60 credit level 1 module ('course' in Open University parlance). During the first presentation 355 students, 18 based outside the UK, studied part-time for 36 weeks, sending in a portfolio of their design work for their final grading. These students were supported by 16 regional tutors. For the second presentation in 2011 the number of students had increased to 555, with an additional 8 tutors recruited.

At the beginning of the course students receive a creative welcome pack through the post (figure 1). This is designed both to provoke creativity, by asking students to play creatively with familiar objects, and to promote early engagement with other students doing the course.

The educational environment of U101 consists of three tailored elements; online self-study materials, an online design studio called OpenDesignStudio, and software for completing design assignments called CompendiumDS. These elements, detailed below, are closely integrated to provide a coherent and complete learning experience for the student.

Figure 1. Creative Welcome Pack

Self-Study Materials

The online self-study materials are presented within the Open University's Virtual Learning Environment (VLE). This is essentially a website that brings together different kinds of learning material for students to study on a week by week basis, for example academic concepts, practical skill development, activities for students to do, and course assignments. Figure 2 shows a screenshot of the course home page where the course content is structured in a prescribed order. This roughly equates to 15 hours of study per week for students.

There are four key concepts underpinning design thinking that are taught to students, both in theory and in practice, as they complete the course:

1. Problem-framing. This is the idea that problems have to be defined at the correct 'level', independent of design discipline, before appropriate means of solving the problem can be identified. This is perhaps equivalent to saying that the solution to a product design problem isn't necessarily a product. The idea of problem-framing at different scales is reinforced by the four-block structure of the course which looks at themes of self, others, society, and world.

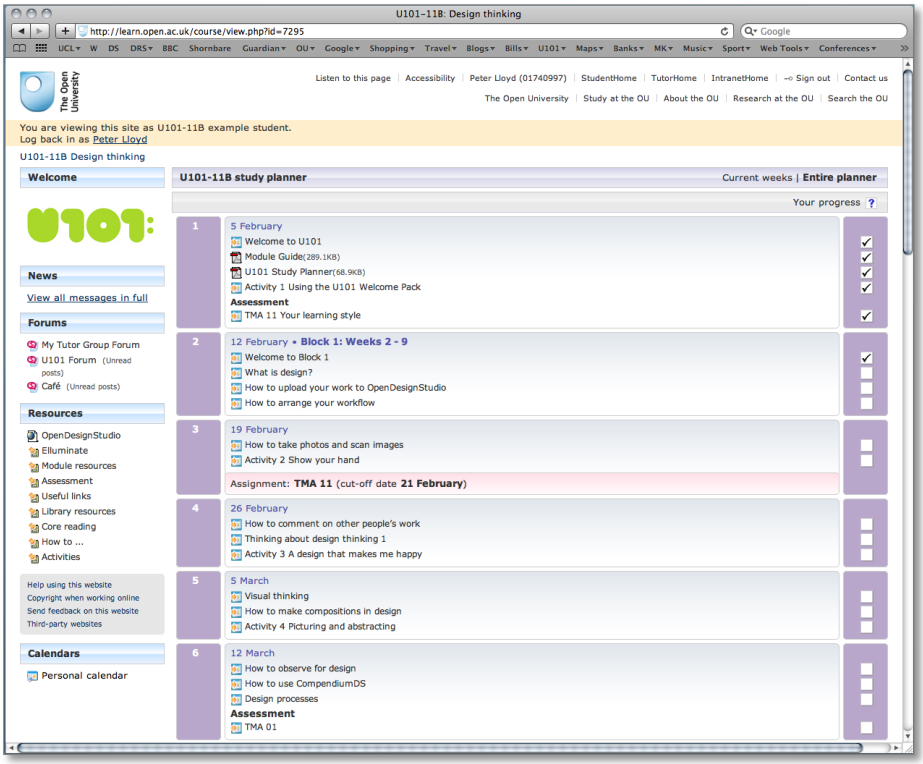


Figure 2. Screenshot of the U101 self-study homepage

2. Productive dialogue. Perhaps the most important aspect of design thinking is engaging in a *productive* dialogue as a way of progressing towards a design proposal ('proposal' is used here very deliberately in place of 'solution', as it suggests something incomplete, and open to further dialogue and development). Productive dialogues, for example over sketches and prototypes, are essentially a way of learning through doing. They naturally take place between people, but one can also think of a dialogue occurring with the self or, as Schön (1983) terms it in 'a reflective conversation with the materials of the situation'. A further aspect of a productive dialogue is the idea of 'play'; proposing something simply for the sake of finding out where it will lead.

3. Quiet design. It is continually emphasised to students that design thinking is something that is all around them, in the many objects, environments, and organisations that Rich Gold refers to as 'the plenitude' (2007). Quiet design refers to the tangible and intangible things that don't

stand out as being 'designed' at all. Indeed, it also suggests that design can be about taking away things, rather than producing more things.

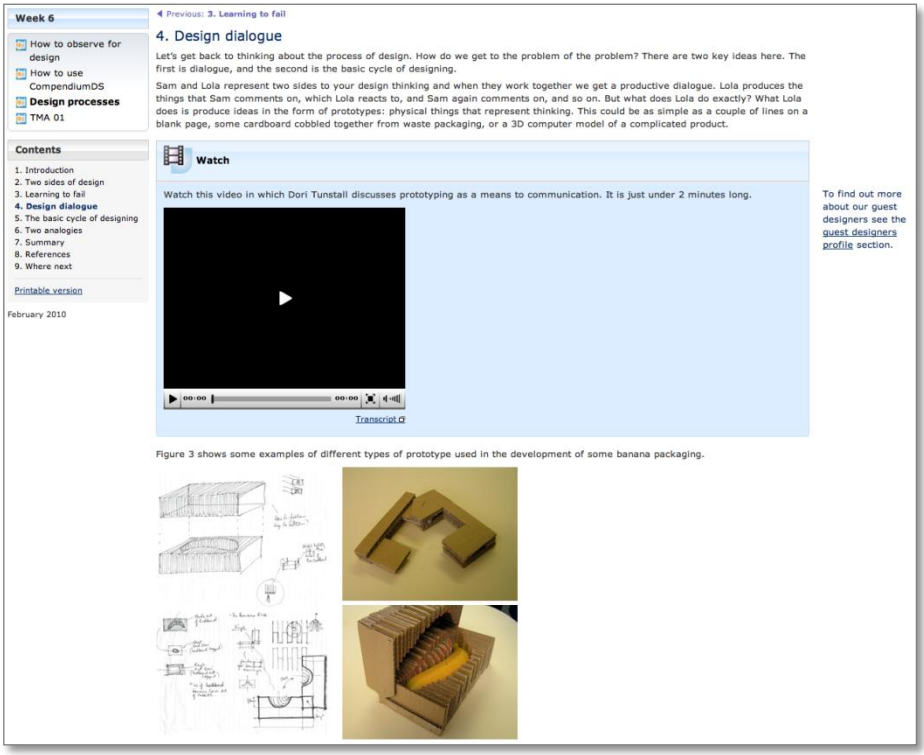


Figure 3. Screenshot of U101 study material

4. Using expertise. The collaborative aspects of design thinking are emphasised by considering the overall role of a designer as someone who can utilise the expertise of others in solving problems; someone who can marshal and manage resources, not necessarily someone who has a wide range of particular technical abilities or familiarity with a certain piece of software.

All four concepts focus on the more general aspects of designing, drawing on a number of different design disciplines for examples. Figure 3 shows a screenshot from a particular piece of learning material, showing how video, image, and text are combined.

OpenDesignStudio

The second key element of U101 is an environment within which students can upload and discuss their work. OpenDesignStudio combines elements of

Flickr and Facebook in a social networking environment structured in a way that students can follow a sequence of practical activities to produce a portfolio. Figure 4 shows a typical student's homepage while figure 5 shows an example portfolio.

Figure 4. An OpenDesignStudio homepage

OpenDesignStudio embodies the social nature of creativity by allowing the sharing of expertise through discussion about particular things. These 'things' can be sketches, prototypes, or examples uploaded via photos, video, or other embedded web-objects. During the course this uploading and discussion becomes second nature to the students, and is often extremely sophisticated. The social glue for OpenDesignStudio, however, comes from the diversity in the student cohort allied with the expertise of their tutors. As

an example of this diversity table 1 shows the age profile of students completing the course in 2010.

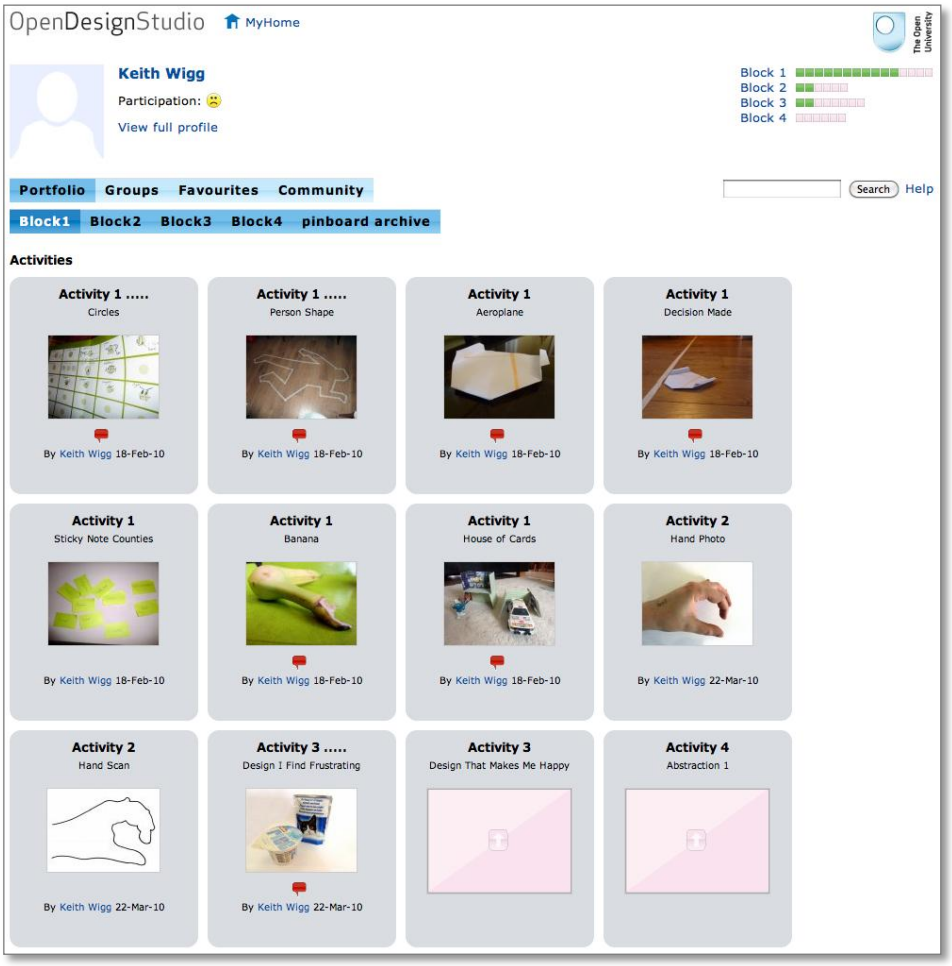


Figure 5. An OpenDesignStudio portfolio page

As students study part-time they are able to contribute their experience from their everyday and working lives to many areas of design activity. For example, one student, working on a problem that they'd framed as 'book storage and retrieval', proceeded to produce a prototype and uploaded an animation of that prototype to OpenDesignStudio. On coming across this prototype, another student, who worked as a librarian, was able to provide detailed information about her experience in helping to develop the prototype. That discussion, available for all to see and typical of many other discussions, has valuable consequences: it provides an opportunity for the

tutor to emphasise a learning point, it provides an opportunity for other students to contribute, and of course it provides an opportunity for the first student to develop their design prototype.

Table 1. Age Profile of students completing U101

Age Range	Number of Students	%
Under 25	76	21
25—29	63	18
30—39	100	28
40—49	82	23
50—59	27	8
60—64	4	1
Over 65	3	1
Total	350	100

OpenDesignStudio also provides an opportunity for students to use other students' work as inspiration. Indeed, students are actively encouraged to build on the work and ideas of others as this is considered to be another essential aspect to design thinking. This results in pathways of connected creativity, where students have taken on an idea, developed it, and that development, in turn, has been taken on by someone else. The environment can also be used to illustrate a learning point. Figure 6 shows how different students responded to the challenge of sketching a 'hair dryer' in 30 seconds. The results visually illustrate the idea of design fixation; how framing a problem in a particular way can lead to having a pre-conceived idea about a solution.

What figure 6 illustrates is that, consonant with running this exercise in a classroom, about 5% of people identify the sun or a towel as a 'hair dryer'. This change of frame is an important learning experience for students wedded to the idea of a hair dryer as basically a gun-shaped object. OpenDesignStudio provides an excellent way of showing how many people have similar fixations.

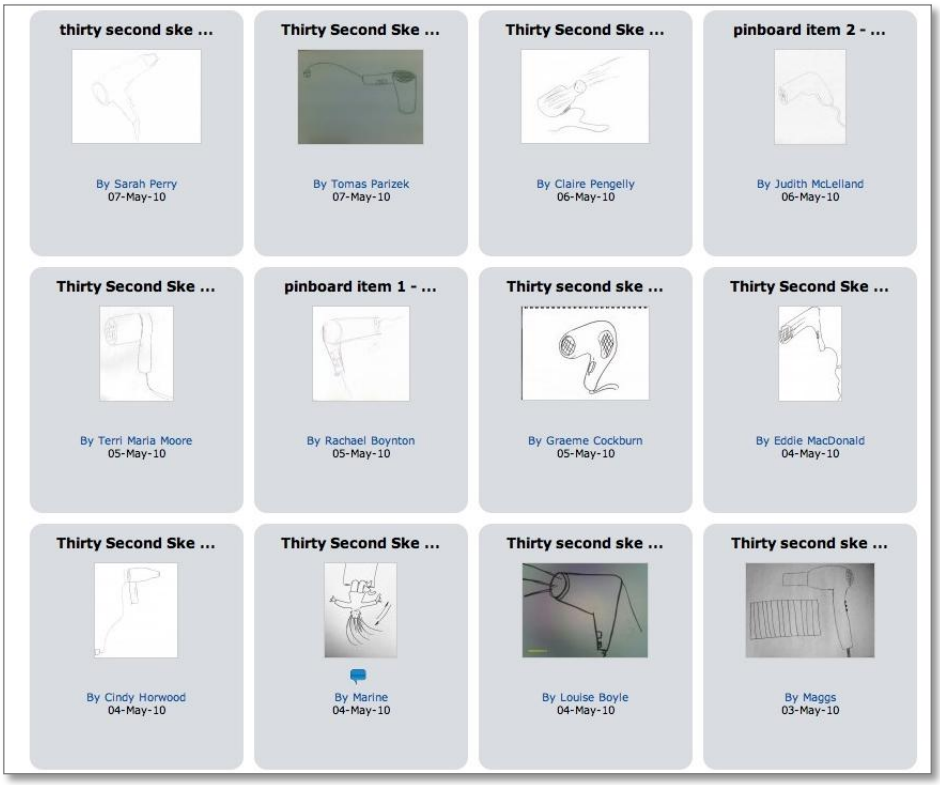


Figure 6. Students responses when asked to sketch a 'hair dryer'.

OpenDesignStudio is an asynchronous communication environment but students and tutors also meet online synchronously using the conferencing application Elluminate. Elluminate can be used both to present and discuss examples through it's whiteboard facility and to hold creative sessions – again drawing significantly on the experience of students. Furthermore, sessions can be recorded for later playback by students unable to attend 'in person'.

CompendiumDS

In seeking to teach a general ability like design thinking one of the most difficult issues is how to assess a *thinking* process rather than the product or outcome of that process. How can one see evidence that a thinking process is improving over the 36 weeks of the course? The third key element of U101 is an application called CompendiumDS, a knowledge mapping environment where different types of 'nodes' can be linked together. Within CompendiumDS a design thinking process can be represented in a node

structure and hence assessed. Figure 7 shows a screenshot of the CompendiumDS interface, with an example node structure.

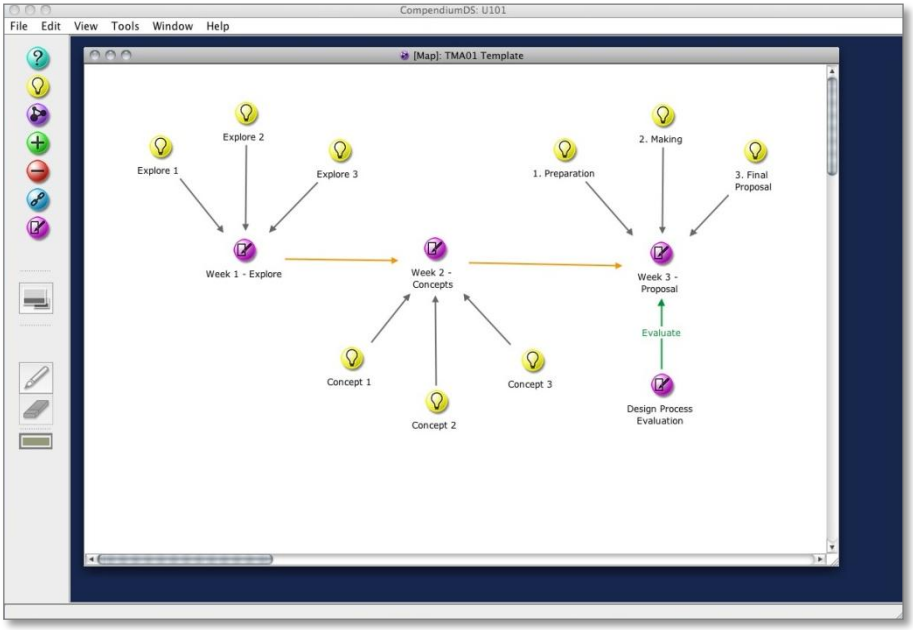


Figure 7. The Compendium Interface. The menu on the left of the window contains different types of nodes that can be connected together to form linked structures.

The CompendiumDS environment is tailored for U101 in that the different nodes form an iconography of the design process, for example there are nodes for 'ideas', 'questions', 'decision points', 'links', and a 'diary' node. Each node can have resources associated with it, for example images, or web-links, as well as notes. By combining nodes a design process can be constructed that contains the reasoning for making decisions at regular points. A tutor assessing the design process can thus access and assess the individual 'moves' that were made in a design process.

One of the major learning outcomes for students completing the course is to understand the components of the design process and how design processes might themselves be 'designed'. For its assignments the course gives students a number of design process templates to follow. For the first assignment this just requires information and images to be added, but progressively, over four assignments, more flexibility is given for students to construct their own design processes. Figure 8 shows the template for the second course assignment.

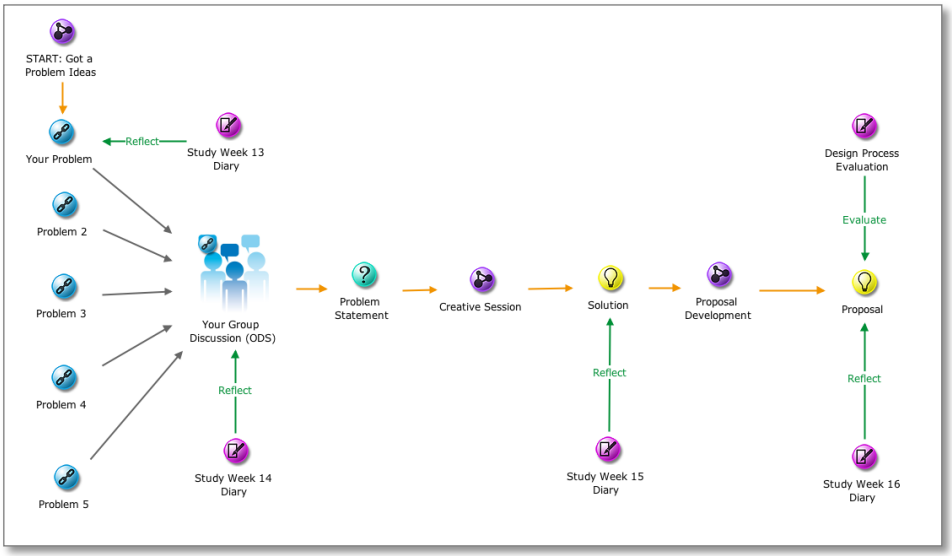


Figure 8. Design process template for assignment 2.

The assignments themselves are general enough to complete in a range of ways, and without specialist knowledge: the first assignment is to produce a T-shirt, the second to frame and solve a self-defined problem, the third to design a game, and the forth to communicate a story about a design prototype.

As mentioned earlier, the three key elements of U101 are closely integrated. The course materials require regular uploads to OpenDesignStudio as do key pieces of work during the design assignments. There is thus an intentional overlapping between theory, practice, and discussion, with a strong emphasis on using social expertise to generate individual design proposals.

Results

Following the first presentation of U101 189 students were surveyed about their experience of the course. 64 (33.9%) students responded and the results are shown in table 2.

Additionally, the tutors that taught on U101 were surveyed about the quality of various aspects of the course. Of the 16 tutors invited to respond, 11 (69%) did. The results are shown in table 3.

Table 2. Student satisfaction survey: % of students answering that they definitely or mostly agreed with the relevant statement. Notes: the 'OU average' figure combines the results from 45 level one courses (a total of 4083 students), which includes U101.
**The cost of studying U101 in 2010 was £635.*

Statement Responded to	U101	OU Average
Overall, I am satisfied with the quality of the course	70.7	90.0
Overall, I am satisfied with my study experience	72.4	89.0
The course provided good value for money*	63.2	79.1
I was satisfied with the support provided by my tutor on this course.	82.1	85.5
Overall, I was satisfied with the teaching materials provided on the course	69.0	89.6
The workload on this course was higher than I expected	37.9	34.1
The course met its stated learning outcomes	80.7	90.2
I would recommend this course to other students	69.0	84.4
The course met my expectations	65.5	83.8
I enjoyed studying this course	79.3	86.1

The results of the student survey show satisfaction with U101 generally lower than satisfaction on other Open University level one courses. The Open University, it should be noted, generally finishes in the top two of all UK universities for student satisfaction, so the U101 results might appear poor in that context. Taken on their own, however, the results seem quite presentable, particularly student satisfaction with tutor support.

Issues relating to the delivery of the course might also explain a lower than average result for student satisfaction. There were some technical problems with CompendiumDS that proved frustrating for many students, but which were rectified during the course. Some of the students also found the group work difficult to organise and contribute to, which resulted in dissatisfaction. It should also be borne in mind that U101 has broken new ground for the Open University, both in teaching a practice-based subject, and in delivering the course entirely online. With 229 students (65%) having already studied other Open University courses – what are termed 'continuing students' – expectations were confounded by U101 with some students enjoying online study, while others missed having printed materials.

Table 3. Tutor course-content survey. Responses were on a 10 point scale with 1=poor, 10=outstanding.

How would you rate the following aspects of U101?	%
Overall structure of the course	85.5
Academic content of the course	80.0
Practical content of the course	86.4
Video and multi-media content of the course	84.5
CompendiumDS	67.3
OpenDesignStudio	72.7
Online Self-study Materials	81.8
Course Assignments	79.1

The results in table 3 indicate that, in general, the tutors supporting the students were very positive about the various features of the course. Of note are high responses for the course structure, academic content and practical content, indicating that the course is both coherent and balanced. The lowest grade was given to CompendiumDS. This is the environment that the tutors had to engage with most as all design assignments were completed using the software. Several found the assessment process both different from what they were used to, as existing Open University tutors, and difficult to manage in terms of collecting, marking, and returning assignments.

Of the sixteen regional tutors employed to tutor U101 ten (63%) were entirely new to the Open University. What is remarkable is that eight of the top ten tutors, measured in terms of student retention, were all 'new' tutors. Table 4 shows the average retention rate achieved by 'new' tutors and 'old' tutors. It should be noted that, with part-time study and no prior qualification required, student retention on first level courses at The Open University is low when compared to other Universities. U101 achieved an overall retention rate of 65% (230 students), which is about average.

Table 4. Average student retention rate by tutor experience

Tutor Experience	Retention Rate (%)
'New' Tutor	70.5%
'Old' Tutor	55.5%

Table 4 provides further evidence of the ground-breaking nature of U101 for The Open University, with the 'old' tutors tending to find adapting to the needs of a quite different course more difficult than starting afresh. Table 4 also raises a further question related to design expertise. Seven of the ten new tutors were practising designers, from a range of disciplines, and this seems to have played a factor in keeping students interested in the course. Indeed many of the 'new' tutors were recruited following an advertisement in the trade journal *Design Week*, which may go a small way to explaining where professional designers find jobs embedded in organisations outside the creative industries.

Discussion

In the introduction we discussed the main approach to making the subject area of design more widely applicable to areas outside the creative industries. This approach adopts more of a business focus to the design curriculum, emphasising, for example, how design can be used to solve management problems as well as improving product and service delivery. The paper also outlined a second approach, which was to give a more diverse group of people the tools to think creatively, developing their confidence and helping them to engage with the world around them in a productive discourse. Crudely put, the first approach emphasises design as a way of increasing profit for business, while the latter emphasises design as a way of empowering people more generally.

The new Open University course in Design Thinking described in this paper has followed the second approach, drawing out the natural creativity of a diverse range of individuals and helping them to shape and sharpen their ideas in the world around them. This approach exploits the unique diversity of the part-time Open University student population. With many students already employed in the workplace, the design thinking skills that they have learned in doing the course can be directly applied to a business context, lessening the need to become qualified to design before practicing as designers, or the need to consume some product or service to fix a solvable problem.

This model of design education is perhaps not suitable for many academic schools of design, with more homogenous cohorts of students, but it could point the way for possible change. Accepting students from a wider range of backgrounds and, importantly, drawing on those backgrounds directly in teaching, could lead to designers having a more fundamental impact on society outside the creative industries. Design education is a curious mix though. On the one hand a subject that fosters and demands creativity and innovation from students, while on the other resistant to the very creativity and innovation espoused. Traditional design courses still hold at their heart a discipline-based, master-apprentice approach to learning with any radical deviation from this viewed as a debasement of design values. Design education is largely still the final stage in a development process whereby creativity is encouraged in young children, repressed in teenage years, and then professionalised in higher education, a process made explicit by Ken Robinson (2001). Which brings us back to the original question: does design education always produce designers?

The title of this paper was motivated by a comment from U101's external examiner who, although impressed by the quality of the student work produced, was keen to emphasise that the students passing the course shouldn't think of themselves as designers. The external examiner was right, although their claim as to what exactly constitutes a fully educated 'designer'

remained unarticulated at the time. Design Thinking is a first level course and no programme in design education would claim to have produced a 'designer', whatever we mean by that term, after only one year of part-time study. However, it does raise an interesting issue about courses teaching design subjects in what we might term 'non-traditional' ways; outside of studios, with little face-to-face contact between students, and with a tutor at one removed from the work of the student. Could students graduating after a design education on this basis be termed 'designers'?

The question, of course, depends on what we mean by the term 'designer'. Do we mean someone who is steeped in a traditional design discipline or do we mean someone who is able to solve problems in particular way? Traditional design education, I suspect, produces more of the latter than might be admitted. Adding more business-based elements to traditional design courses, or conversely adding more design-based elements to business courses, is a way of making the skills of designing more generally applicable but U101 has sought to go much wider in teaching and applying the skills of designing. This, naturally, challenges what we mean by the term 'designer'. Perhaps the biggest contribution of U101 is in demonstrating that students can be taught skills of design thinking online, independent of design discipline, and with little prior qualification.

References

Higgs, P., Cunningham, S., Bakhshi, H. (2008) *Beyond the Creative Industries: Mapping the Creative Economy in the United Kingdom*, NESTA Technical Report.

Robinson, K. (2001) *Out of Our Minds: Learning to be Creative*, Capstone.

Ambrose, G. & Harris, P. (2009) *Design Thinking*, Ava Publishing.

Brown, T. (2008) *Design Thinking*, Harvard Business Review, June, pp 85-92.

Brown, T. (2009) *Change by Design: How Design Thinking Transforms Organizations and Inspires Innovation*, Collins Business.

Gold, R. (2007) *The Plenitude: Creativity, Innovation, and Making Stuff*, MIT Press

Lockwood, T. (2009) *Design Thinking: Integrating Innovation, Customer Experience, and Brand Value*, Allworth Press, US.

Martin, R. (2009) *Design of Business: Why Design Thinking is the Next Competitive Advantage*, Harvard Business School Press.

Schön, D. (1983) *The Reflective Practitioner*, Basic Books.

Author Index

Symposium Proceedings

The 1st International Symposium for Design Education Researchers took place in Paris, France on 18–19 May 2011. The Symposium was held under the auspices of the CUMULUS Association and the Design Research Society's Design Pedagogy Special Interest Group. We would like to thank to Paris Chamber of Commerce and Industry for their kind support to host this important event.

The symposium's overarching aim was to explore how innovation in education is informed by and is informing design research. In order to do this the symposium convenors invited a diverse mix of speakers to explore the symposium's theme. The 1st International Symposium for Design Education Researchers provided a space for design educators to continue to review their educational practices and the assumptions underpinning these practices.

ISBN 978-952-60-0042-8 (print)
ISBN 978-952-60-0043-5 (electronic)

The Symposium Proceedings are available online from the following websites

DRS http://www.designresearchsociety.org
Cumulus http://www.cumulusassociation.org
Symposium http://collab.northumbria.ac.uk/2011paris/