DRS CUMULUS Oslo 2013

Design Learning for Tomorrow

Design Education from Kindergarten to PhD

Proceedings from the 2nd International Conference for Design Education Researchers, 14-17 May 2013, Oslo, Norway

Vol. 1-4

Reds.: Janne Beate Reitan, Peter Lloyd, Erik Bohemia, Liv Merete Nielsen Ingvild Digranes and Eva Lutnæs

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Volume 4

Editors

Janne Beate Reitan
Peter Lloyd
Erik Bohemia
Liv Merete Nielsen
Ingvild Digranes
Eva Lutnæs

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DRS Secretariat
email: admin@designresearchsociety.org
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CUMULUS the International Association of Universities and Colleges of Art, Design and Media
Cumulus Secretariat
Aalto University School of Arts, Design and Architecture
PL 31000, 00076 Aalto, Finland
Secretary General Eija Salmi
Tel: +358 505 927060
email: eija.salmi@aalto.fi
www.cumulusassociation.org

Oslo and Akershus University College of Applied Sciences
Faculty of Technology, Art and Design
PO Box 4 St Olavs plass, 0130 Oslo, Norway
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Introductions

Design Learning for Tomorrow
– Design Education from Kindergarten to PhD

Many thanks to the Design Research Society (DRS) and Cumulus for giving the Oslo and Akershus University College of Applied Sciences the confidence to chair and organise this 2nd international conference for design education researchers in Oslo May 14–17, 2013. Researchers from more than 74 universities have undertaken a rigorous double blind review process used to select papers for inclusion in these conference proceedings. We received 225 full papers and of these 165 were selected and included in the conference proceedings and presented at the conference. Thanks to all, and a special thank to professor Peter Lloyd of the Open University, who served as chair of the scientific review committee and to dr. Janne Reitan of the Oslo and Akershus University College of Applied Sciences who chaired the committee with him.

The 2nd international conference for design education researchers in Oslo May 14–17, 2013 on the theme of ‘Design learning for tomorrow – Design education from Kindergarten to PhD’ received an overwhelming response. This is gratifying for us, the organisers, as we see design in a broad interdisciplinary perspective in support for a *better tomorrow*. For years we have promoted the idea that sustainable design solutions should include more than ‘professional’ designers; they should also include a general public as ‘conscious’ consumers and decision makers with responsibility for quality and longevity, as opposed to a “throw-away” society.

This is also the reason why we as the conference hosts have chosen to focus on design education from Kindergarten to PhD. This perspective was put forward as a contrast to most design education conferences where there is either a focus on design education for professionals or general education for children and non-designers. In the call the conference papers we have argued for a longitudinal perspective on design education where the education of professional designers is seen in *relation* to general education of a people. This is becoming increasingly relevant as more and more decisions are being made on the basis of visual representation. With this conference we have the ambition to see education at many different levels in securing a sustainable future for the design of everyday life solutions. For that we need qualified and reflective decision makers with a consciousness for quality of design and solutions.

Why are these issues of concern for Norwegian researchers in this field? The answer goes back to the 1960 National Curriculum for primary and lower secondary schools in Norway, when art and crafts were merged into one subject. Currently this subject includes art, architecture, design and visual communication. No other Nordic–or European–country seems to have developed a model similar to this and today we see the benefit of this merger where design is at the core of the subject for youngsters – building upon the best from art and the best from craft to become creative problem solvers and critical consumers. I am looking forward to the day when UNESCO, or other organisations with responsibility for funding research, recognise that we need more research and knowledge on what impact design education from Kindergarten to PhD have on consumer habits and sustainable development at large. I hope that such projects are not far away. Politicians have far too long been told that advanced mathematics is the main way to stimulate youngsters to abstract thinking. The designerly way of solving problems can be even more suitable in training abstract thinking, and it will also include ethical aspects of sustainable development and ecology. A design literate general public would therefore be a step forward in supporting the statement of commitment by the members of Cumulus; the 'Kyoto Design Declaration 2008'.

For this DRS//cumulus Oslo 2013 conference we are happy to continue our international cooperation for design education research. In advance of the conference we have cooperated on editing the conference proceedings at level 1 in the Norwegian system. After the conference we will cooperate for special issues of the following academic journals; *Art, Design & Communication in Higher Education*, *TechneA*, *Design and Technology Education*, *Studies in Material Thinking* and *FORMakademisk*. The role of journals as an arena for design education research is essential for the advancement of knowledge production within the field. For the Nordic design and design education research field, *FORMakademisk* has played a crucial role in its five years of existence, as a digital open-access journal for both design and design education research. Its first editorial wrote that:

> The aim of the journal is to provide a venue for research in design and design education, and thereby develop an interest and working community of scholars in the field. The editorial team perceives design as a generic term that includes creative and performing activities in the great span of the artefacts 'from the spoon to the city'. The editorial team relates to design education as a field that includes the dissemination of design in society and the teaching of design at all levels general education, vocational preparation, professional education and research education - from kindergarten to doctorate.(www.formakademisk.org)

The Norwegian design education community includes design education for professional designers and teacher training for design educators. The teacher training is mainly developed through two master programmes–one in Oslo (Institute of Art, Design and Drama, Faculty of Technology, Art and Design, Oslo and Akershus University College of Applied Sciences - HiOA) and one in Notodden (Department of Art Education, Telemark University College - HiT). Two PhD-programmes; Oslo School of Architecture and Design (AHO) and Cultural Studies at the Telemark University College, have a focus on both design and design education. The AHO programme was chaired by professor Halina Dunin-Woyseth, who has played a key role in developing research within the 'making disciplines'. From the AHO programme the research network *DesignDialog* was established in 2002 with research focus on three themes; 1) Studies of dialogues of design in context, 2) Studies of design education, and 3) Studies of public dialogues on design.

I see this conference as a further step to international collaboration in design education research. Thanks to all those at HiOA, Faculty of Technology, art and design, who have supported this conference; Dean Petter Øyan and institute leaders Åshild

Vethal – Institute of Art, Design and Drama, Gunnar H. Gundersen – Institute of Product Design, and Laurence Habib – Institute of Computer Science. Without their support this conference would not have been possible. Thanks are also due to the leaders of Oslo and Akershus University College of Applied Sciences, rector Kari Toverud Jensen and head of research Frode Eika Sandnes, for general support to the internationalisation of design education research at HiOA, including this conference.

It is an honour for us that the DRS-Cumulus partnership will be signed in Oslo by DRS chair professor Seymour Roworth-Stokes and Cumulus vice-president professor Luisa Collina. Professor Michael Tovey and co-chair of this conference Erik Bohemia have played a central role in preparing for this partnership and this 2nd conference for design education researchers.

Warm thanks to the Scientific review committee, the Scientific review panel, the Programme Committee, the Organising committee, and the rest of the Editorial team; Janne Beate Reitan, Peter Lloyd, Erik Bohemia, Ingvild Digranes and Eva Lutnæs. Thanks also to colleagues and students for valuable contributions.

We are also grateful to our supporters and sponsors; the National Museum, the Research Council of Norway, the musicians and designers Peter Opsvik and Svein Gusrud, the furniture companies SAVO, HÅG, STOKKE and Variér for generously providing display chairs for the exhibition, and all the other supporters and cooperation partners.

We hope, as the organizers, that the conference will promote design and design education as a field of practice and inquiry. We hope that it will create a fertile context for establishing new networks of future co-operation, nationally and internationally, and that design education research in its broad context will be recognized both inside and outside the design research community. The general public's interest for design and quality is developed from the kindergarten, through primary and secondary education and the public's attitude is central for professional activities and a broad democratic design participation.

Liv Merete NIELSEN
Professor, designer
Chair of the conference

Design Pedagogy Special Interest Group of DRS

This is the second symposium organised jointly by the Design Research Society and CUMULUS. The two organizations complement each other. 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.

The Design Research Society has three main aims. It focuses on recognising design as a creative act, common to many disciplines. It has the intention of understanding research and its relationship with education and practice. Then there is the overall aim of advancing the theory and practice of design. The membership of DRS is international.

The Society's Special Interest Group in Design Pedagogy is one of five in the society. It aims to bring together design researchers, teachers and practitioners, and others responsible for the delivery of design education, and to clarify and develop the role of design research in providing the theoretical underpinning for design education. These aims are not directed simply at one type of design education, but are intended to include all ages. However as the current membership of DRS is predominantly from universities inevitably the conference stream has concentrated on design education at that level.

The first DRS/CUMULUS Symposium was held in Paris in 2011. Its overarching aim 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. It was successful and it marked the point at which the Design Pedagogy Special Interest Group became could be said to be established as an effective force in design research.

This was consolidated at the DRS Biennial Conference in July 2012 in Bangkok. Papers aligned with SIGs were streamed through the conference programme. The Design Pedagogy stream consisted of 24 papers which was a strong representation within the conference. They focused on teaching and assessment, education and learning, design methods and processes, design approaches, cognition and creativity, and design culture, with papers grouped accordingly. Attendance at the sessions was good with informed and lively discussion.

In recognition of the strength of the papers at the conference, 8 of them were selected to form the basis of a special issue of the Design and Technology Education Journal. It was edited by Erik Bohemia and Mike Tovey and it included a review of the conference and an editorial which related the developments in design pedagogy in higher education which the papers focused upon, to the wider issues of design teaching at the school level.

This second DRS/CUMULUS conference builds on these developments and develops them into new areas. Its theme of design learning for tomorrow encompassing design education from kindergarten to PhD is large and ambitious. The conference is intended to be an international springboard for sharing ideas and concepts about contemporary design education research. It is open to different facets of contemporary approaches to such research in any aspect and discipline of design education.

The context for this is set well by the organizers who say:

'Designed artefacts and solutions influence our lives and values, both from a personal and societal perspective. Designers, decision makers, investors and consumers hold different positions in the design process, but they all make choices that will influence our future visual and material culture. To promote sustainability and meet global challenges for the future, professional designers are dependent on critical consumers and a design literate general public. For this purpose design education is important for all. We propose that design education in general education represents both a foundation for professional design education and a vital requirement for developing the general public competence for informed decision making.'

This is a powerful and energising assertion for all of us involved in research in design pedagogy. It is possible that you could argue that this is what is needed, for despite a richness of activity, the number of journal papers on design pedagogy research could be higher. In a ranking of design research journals (Gemser et al, 2012) Design Studies was placed first. In the last year it has published only three papers on design pedagogy. This is better than the second placed journal, Design Issues, which has none, or another highly rated publication, The Design Journal which also has none. A challenge for scholars of research in design pedagogy is to achieve a greater impact amongst our journals.

Design research is not the same as research in some other disciplines. (Ref) 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.

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. Design research is clearly necessary for the academic respectability of the discipline.

One of the purposes of design education within schools is to equip students with the information and capabilities they need if they are to apply to study design at a university. It is an intention which probably applies to a minority of the students, but it is important nonetheless. In schools design education overall has to achieve much more and its broader reach is extremely important. It is important that research into design pedagogy should also have this wider relevance.

The recently published 'Design and Designing: a Critical Introduction' (editors S. Garner and C. Evans) is intended to provide an overview of design for those at school who are considering embarking on a university or college education in design. It consists of a collection of essays from a large number of contributors each concerned with a different aspect of design. In the first chapter for example Tovey asserts that the purpose of design education at this level is to provide students with a passport to enter the community of practice of professional design (Tovey 2012). For a significant time this has been the intention of practice based design education. Many students have the ambition of achieving a level of capability to function as designers in the professional world. In order to reach this standard they need to demonstrate a level of professional 'polish' and presentation to match that of the practising designer. However Tovey also argues that the most fundamental quality they need is one of creativity. The key to their achieving this lies in their abilities to think in a solution focused way employing visuo-spatial intellectual abilities. The ability to engage in creative thinking, and more particularly the creative synthesising of ideas through design thinking, is the most important capability required to enter the community of professional practice.

These are capabilities which need development from an early age. Abilities such as tackling problems with a solution focus, and thinking visuo-spatially are not developed ab intitio at university and college level. It has been argued that spatial ability is a fundamental form of intelligence along with others such a numerical and literary abilities.(Gardner, 1984) Cross has gone further in suggesting that designerly thinking might be a basic form of intelligence (Cross, 2006). Although the case for such a view is not proven, it is a productive stance to take as it helps to identify and clarify features of the nature of design ability and it offers a framework for understanding and developing it. What seems to be generally agreed is that these underlying capabilities are ones which need to be nurtured early and developed, not only as the basis for studying design but also to equip students with abilities needed across a range of occupations. As the organizers of this conference propose design education can make a vital contribution to the development of the general public competence for informed decision making. Thus design education can be seen to have a wide remit in both providing the next generation of designers, and developing competence in decision making more generally. If it is to meet these challenges then research into design pedagogy has a crucial role in supporting the development of innovative and effective design teaching.

Michael TOVEY
Convenor of the DSR Design Pedagogy Special Interest Group (PedSIG)

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About the Design Research Society

Design Research Society (DRS) is commending time, effort and energy and having already been investing these over the past 40 years to give rise to the most astute and relevant research in design.

When asked on numerous occasions to comment on design and design research, I've always been very careful, if not harsh, with regards to certain research projects whose content and/or approach seemed to fall short on the front of the relevant things in design. My reaction hit even closer to home in France where design is absent from academic disciplines, and design research has yet to really take off. I have to admit, nonetheless, that the strides undertaken by several universities abroad and continued by DRS have swayed me into believing that there really is an area that craves further learning and discovery, and cultivates fresh, relevance-hungry skills and competencies. Conferences and DRS-published works reflect a tremendous proliferation of new ideas, new projects and new ways to breed knowledge.

In 2010, and after having sat in on a conference in Seoul organized by the International Association of Societies of Design Research, I wrote the following: "Taking advantage of design's coming out and its lack of visibility research-wise for the purposes of Sociology, Psychology, Education Science, or even hard science, and playing them off as "design research" can only prove beneficial to design in the end. Employing the design research notion loosely, when, in reality, its usage is clearly career-geared, does not seem all that fitting to me either.

The scope of research needs to be clearly outlined in a category of its own, and based on a language that both captures and communicates the knowledge from all fields spanning social and hard science, not to mention the socio-economic challenges that riddle our everyday. Design is a language doubling as an interface that connects people, ideas and knowledge, and imagines them in a better tomorrow. We could come up with our own scientific version of it as long as we don't get carried away and throw everything together haphazardly merely because design is omnipresent, and it suffices to get the intellectual juices flowing every now and then."

Time may have elapsed since these thoughts first emerged, but the issue remains the same. This text reflected the questions that crossed my mind following the various presentations I had attended. One presentation, in particular, caught my attention. It was given by a doctoral student who claimed that the work he was doing on the design of a bicycle was research. Twenty years ago, designing a bike was considered design. Today, that same bicycle now aspires to fall under the category of "design research." Let's try and refrain from wanting to label any idea, even the most relevant, "research." Despite their efforts to make a hard science out of Marketing, business schools are busy filling in the gaps left behind by research done in the Marketing field. Every business owner and retailer in the world will tell you that Marketing is not a science, and wanting it to be one is just as futile as deciphering the gender of angels.

Design research is alive and well, and several universities have incorporated it into their agendas. It means nurturing a different kind of knowledge and insight at a time when other research fields lack the necessary to go head-to-head with the problems facing Mankind. There within is the incredible opportunity to truly, once and for all, set the fields of social and hard science apart. Kudos to DRS for being vigilant in choosing projects that are apt to map out a new direction between the two.

Just as design, creation and innovation are being positioned as solutions to problems in a world whose paradigms are crumbling, it would be, without a doubt, counterproductive for design research to cut ties with design practice. From an academic standpoint, it would also be a shame for design research to appear more virtuous and prestigious than design itself. That said, the loss would be just as great to reduce design to nothing other than a technique or representation. What design can offer goes beyond practicality. Design research goes beyond the designer. Their interconnectedness does not impede their individuality.

Design research and design itself are complementary. While loyal to the fundamental principles specific to each, both strive to find common ground and engage in a healthy give-and-take relationship to ensure balance and difference. With Mankind and its uses at the center of these issues, design gives impetus to an ideal or a potential, and not only pushes the limits of creativity and optimism to new heights, but seeks to defy them. At a time when science and technology are encountering a wary public, and where wealth and welfare are hitting glass ceilings, design provides an alternative future, and enables us to imagine it through a new lens. One thing is sure: Design researchers have their work cut out for them!

Christian GUELLERIN
President of Cumulus, International Association of Universities and Schools of Design, Art and Media

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Design Puzzles as a learning platform for morphology design research

Pedro REISSIG* and Cristhian CASTRO ARENAS
Universidad de Buenos Aires

Abstract: *Design Puzzles open up a new field of visual and manual learning material for research in design morphology. The way Design Puzzles are instrumental as educational tools involves using them as research systems (frame works) in which spatial / visual problems are posed, requiring formulations of hypothesis as strategies for developing solution paths. The concept can be applied to a wide range of products, (physical and digital), for different ages (K-12 through University) and contexts (open ended play and/or guided classroom situations). Problem identification and approach skills as well as creative thinking strategies are brought into play as spatial / visual challenges are encountered in systematic and organized contexts, requiring designing responses. There is a clear distinction made here between designing a response and solving a problem. The underlying idea behind Design Puzzles is to associate the intrinsic rigor of geometry with aesthetic sensitivity towards form within an organized system allowing variables to be manipulated within certain parameters. This association strengthens informed intuition skills while simultaneously developing analytical hypothetical deductive approaches. Through this integrated inquiry process, design thinking strategies are clearly identified and can be subsequently developed as specific design research skills and aptitudes.*

Keywords*: design research, learning, strategy, morphology.*

* Corresponding author: Facultad de Arquitectura, Diseño y Urbanismo | Universidad de Buenos Aires | Argentina | e-mail: preissig@fadu.uba.ar

Introduction

Design works with the basic attributes of form: shape, size, color, position and orientation. The better we understand these aspects of design morphology and how they relate to each other, the better will be our perception of them and consequently, our capacity to design (with forms). This heightened awareness of the basic attributes of form can also predispose us to detect patterns and form structure in nature at any scale and dimension, bringing us closer to the universal and timeless qualities of design as a human activity.

Design Puzzles is the name we give to learning material created for design morphology research. We use the term “design morphology” to distinguish it from general morphology (the study of form) used in other disciplines, namely linguistics, medicine and science. Design morphology is based on knowledge coming from geometry, symmetry and topology and is used to generate and codify the intrinsic logic and technique of form and space. Design Puzzles are based on geometric dissections oriented at different morphological themes including:

- Symmetry- presented in the product version of **Symmetrix**
- Triangles- presented in the product version of **TryAngles**
- Curves- presented in the product version of **Arcos**
- Tessellations- presented in the product version of **Tessellgrams**
- Fundamental regions- presented in the product version of **Poligrams**
- Self-similitude- presented in the product version of **Isomorph**
- Folding transformations- presented in the product version of **Transfolding**

The contents for learning design morphology which are put in play by Design Puzzles include mainly the first three of the five basic attributes of form: shape, size and color. The didactical situations created in the different instances of using the Design Puzzles are based on morphological principles stated in each specific product version presented as per the list above. The identification and association of the variables explored in each product touch different mathematical concepts, including geometry, symmetry, topology and combinatronics. A deeper inquiry into the mentioned attributes show the following cases which the design puzzles explore.

Shape: this attribute comes into play in all of the Design Puzzles, mainly through the transformations that are suggested, in which all of the pieces have to be employed in reconfiguring one composition into another. Many shape groups are created, visualized and classified according to the parameters stated in each case.

Size: many (but not all) of the Design Puzzles propose transformations of given shapes from one size to another. This can be a single incidence, or can be part of a symmetry type operation as in “extension”.

Color: all of the Design Puzzles are color coded to highlight operations that require the use of color (or themed images as in “transfoldings”) as a signaling device to organize compositional solutions simultaneously with shape. A basic color scheme is shown in most of the cases, but more complex combinations and palettes can be used. The double sidedness of the pieces increases the role of color as an element of codification, making design choices more complex as the same piece can represent two different options depending on the side used. The term “color” is used in a very basic sense in this presentation, representing a much wider universe of visual perception elements including hue, saturation, brightness and texture.

Context

Learning design morphology can occur in different stages of development, ranging from play activities at early ages to specific methods and instruments used at university level. Design Puzzles can operate at any of these stages and can be virtual or material based depending on the context, available resources and objectives.

A Design Puzzle is defined as a closed set of parts (forms) that relate to each other in specific ways based on the basic attributes of form. The ways in which the forms can be organized amongst each other can create logical structures given the parameters and objectives that are previously established in each case. The degree of spatial and visual order possible in the structures is based on the degree of association amongst the different attributes (shape, size, color, position and orientation). The closer the association, the higher the order of structure. The degree of association amongst its constituent parts depends on various factors, namely angle complementation, length and area ratios, proportions, color mapping, and other aspects of regarding regularity, uniformity and homogeneity of topological and symmetrical properties of these forms. The generation, transformation, classification and reading of these forms is what defines the activities which Design Puzzles propose.

The concept of Design Puzzles is based on research originally done by the author along with Alfredo Cattan beginning in 1994 (Cattan, Reissig 1997) within a theoretical framework specifically developed for teaching and learning of design morphology. This paper presents continued development of that work, presented as specific cases of Design Puzzles, some of which have been in use in high school and university classrooms over the past 15 years. As a result of the previous work in Design Puzzles, this paper proposes two distinct opportunities for design research:

1. Creating design puzzles is up to now basically a trial and error process and as such, dependent on sporadic and haphazard developments. We propose to develop this field in a more scientific and systematic manner so as to make the development of information and ideas more accessible to others interested in this concept. To date there is no known published research on systematic Design Puzzle development theory besides the author's work detailed in the references (Reissig, Castro 2011; Reissig 2004; Cattan, Reissig 2000, 1997). The closest field of research we can relate directly to Design Puzzles is known as dissection puzzles (Coffin 1991) yet these are not centered as much on developing design research thinking and creation strategies as they are on problem solving skills.

2. Design Puzzles have been found to be useful systems based on specific methods and instruments in forming human resources for design research. This result has been observed and recorded during a 7 year period (2003-2009) while teaching undergraduate design at the Universidad de Palermo in Buenos Aires and presented at various academic conferences as work in progress, culminating in a chapter dedicated to this experience in the author's PhD dissertation (Reissig 2012). It still remains to be tested and measured in different contexts with different goals and validated as such, but there is sufficient ground work accomplished to pave the way. Thus the second proposal which this paper offers is to use Design Puzzles as a research platform and framework, since thus far it was understood that Design

Puzzles were useful as design learning material, but not looked at for design research.

It is hoped that based on the two points outlined above that Design Puzzles can get further attention from the design education and research community, stimulating exchange of ideas and results in the interest of constructing a theory for Design Puzzle as concrete material for research in design morphology.

Previous work in this specific field is not easily identifiable (not meaning it does not exist) therefore the authors have looked to other fields for points of reference, mainly concrete mathematical learning material as well as construction toys and geometrical puzzles, popularly known as geometric brain teasers (Van Delft, Botermans 1995).

On a historical note it is worth mentioning the world renowned Tangram and its variants in use since many years ago (Slocum 2004), which we consider as a point of reference and inspiration in our work. Even though the Tangram fulfills our definition of a Design Puzzle in practical terms, it does not possess sufficient rigor regarding its morphological properties (geometry, symmetry and color) as to optimize it as a learning resource for design morphology.

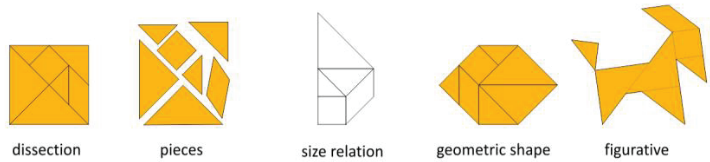

Figure 1. *Tangram*

Examples of six different morphological themes for Design Puzzles follow, as well as a more in-depth look at a distinct new concept under study. The images provide sufficient information so that anyone interested in testing the design concepts mentioned, can do so.

Symmetrix

Design based on generation and reading of spatial forms relating the four types of symmetry (reflection, rotation, translation and extension) while working with shape, size and color. It is based on dissecting a square into thirty isosceles triangles of four different sizes, with four colors double faced. Regarding specific learning activities, these are some of the morphological concepts which Symmetrix explores:

- Angles: complementation, addition, concavity and convexity
- Area/Perimeter ratios
- Geometrical dissections and transformations
- Sequential transformations of shapes and sizes
- Sides: comparison and relation of segment lengths and proportions
- Similarity and congruencies amongst isosceles triangles
- Symmetry types

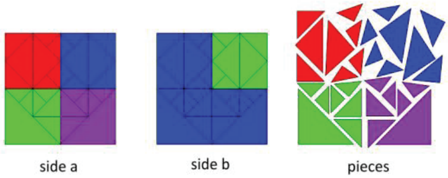

Figure 2. *Symmetrix dissections*

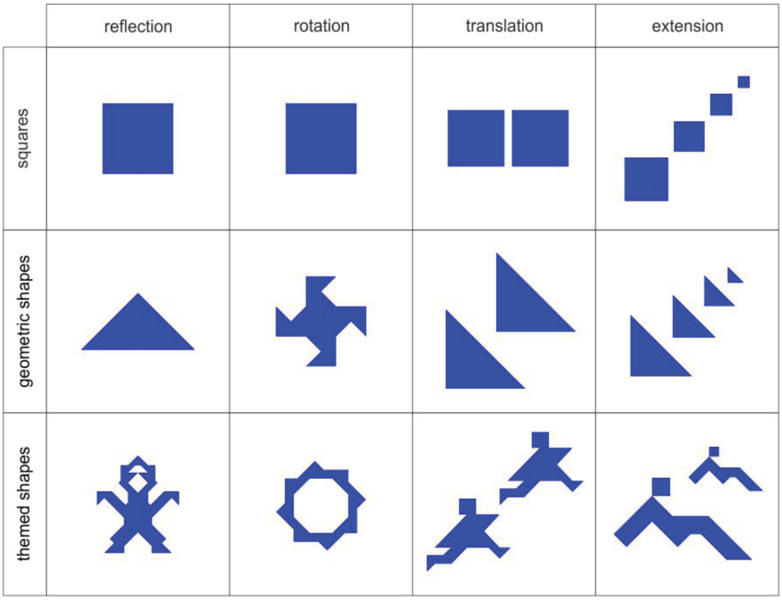

Figure 3. *Symmetrix category types and possibilities when monochrome*

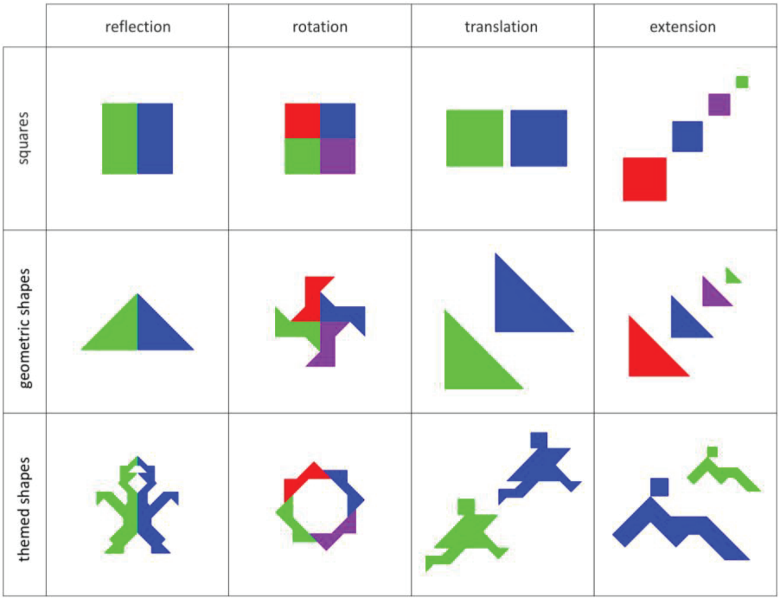

Figure 4. *Symmetrix category types and possibilities when color coded*

TryAngles

Design based on generation and reading of triangular forms, associating three of its attributes: shape, size and color. It is based on dissection of an equilateral triangle into twenty seven triangles of diverse forms and sizes (equilaterals, right and isosceles) in three colors double faced. Regarding specific learning activities, these are some of the morphological concepts which Tryangles explores:

- Angles: complementation and supplementation
- Area/Perimeter ratios
- Classification of triangles based on sides and angles
- Geometrical dissections and transformations
- Sequential transformations of shapes and sizes
- Sides: comparison and relation of segment lengths and proportions
- Similarity and congruencies amongst diverse triangles
- Symmetry types

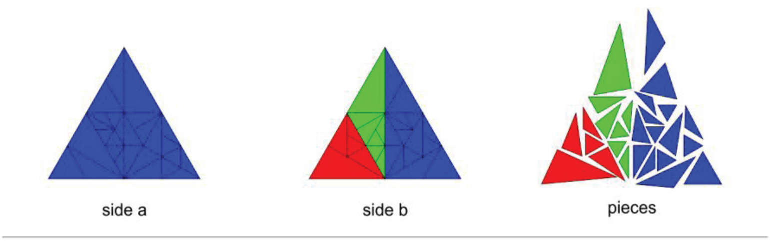

Figure 5. *TryAngles dissection*

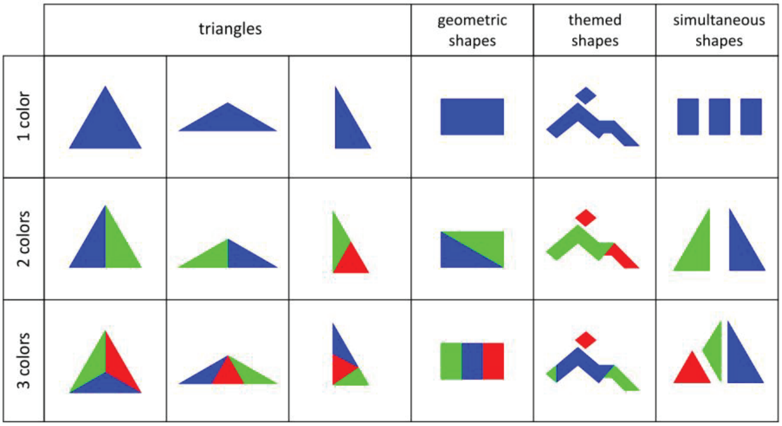

Figure 6. *TryAngles category types using all pieces*

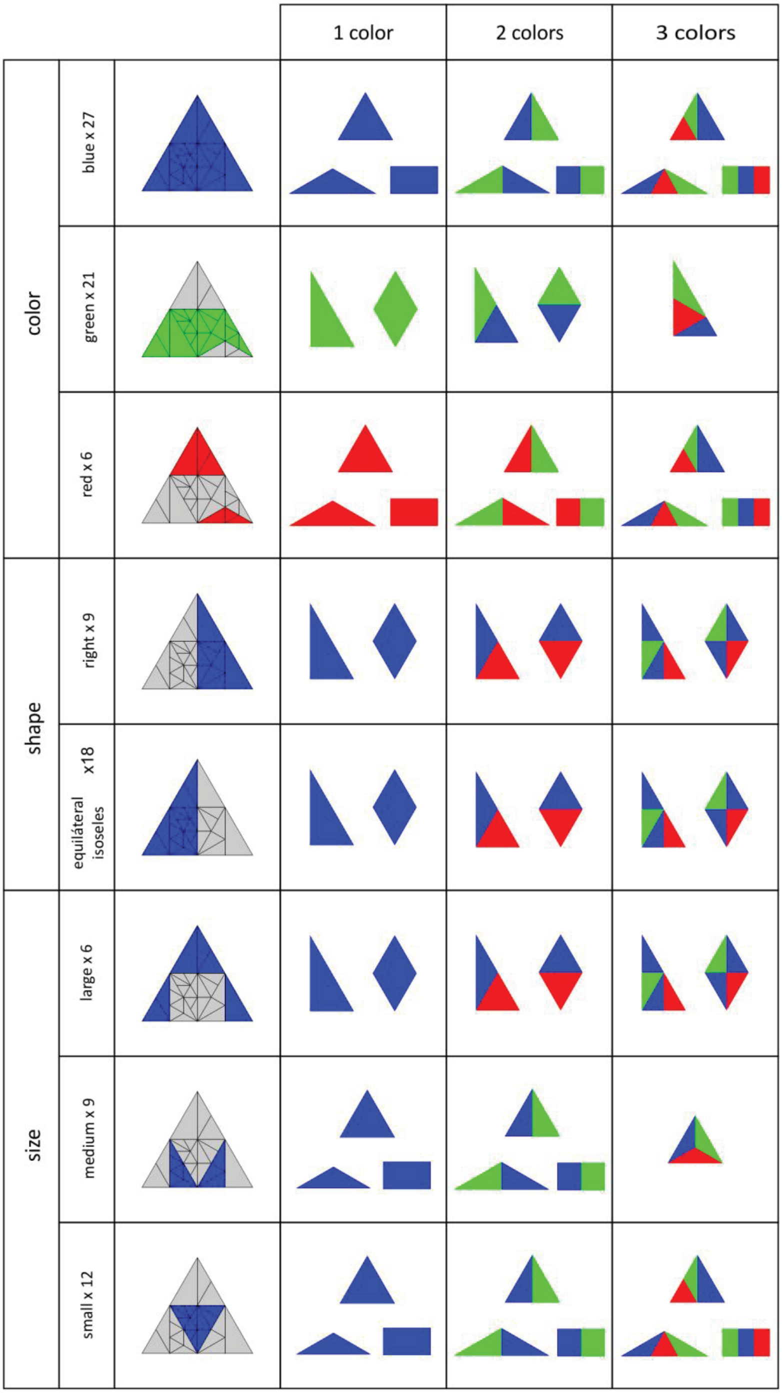

Figure 7. *TryAngles- category types using selected pieces*

Arcos

Design based on generation and reading of curvilinear forms relating rotational symmetry segments with varying radii based on concentric subdivisions of circles. This is an open set of pieces since the amount of circles can vary given the constructive nature of the designs. The case shown here uses four radii, and is based on a subdivision also of four, but both parameters are variable. Regarding specific learning activities, these are some of the morphological concepts which Arcos explores:

- Area/Circumference ratios
- Fractions
- Generation of open and closed curves
- Geometrical dissections and transformations
- Patterns and curved tessellations
- Symmetry types

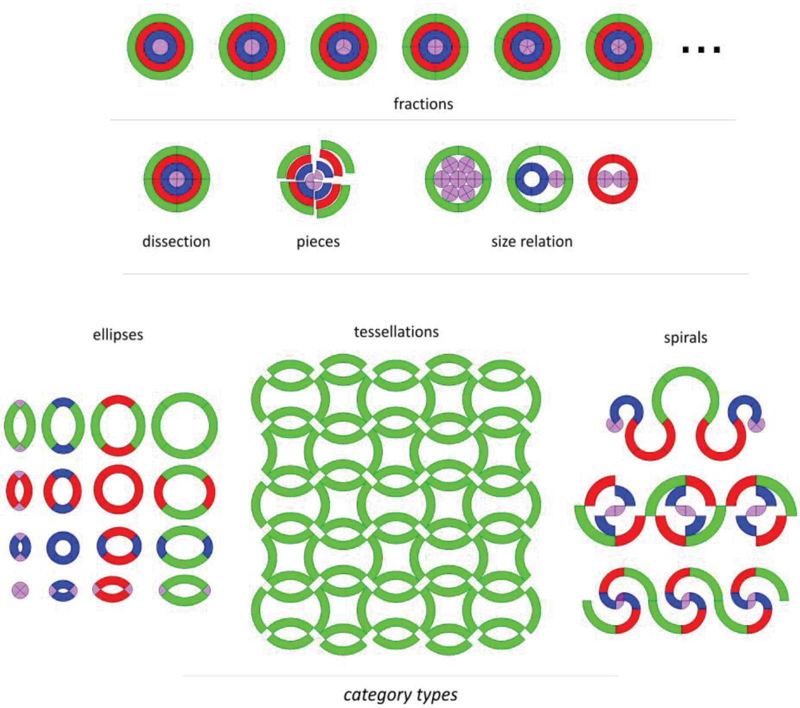

Figure 8. *Arcos*

Tessellgrams

This system is based on tessellations and its variants (lineal, curved, concentric, radial, fractal, etc) and can be open or limited given the amount of pieces utilized. The constructs can be saturated or not, and visual readings can be modified given the 3 dimensional effect that different color tones can create. This example is based on regular rhombi (60º/120º), but any tessellating polygon can be used.

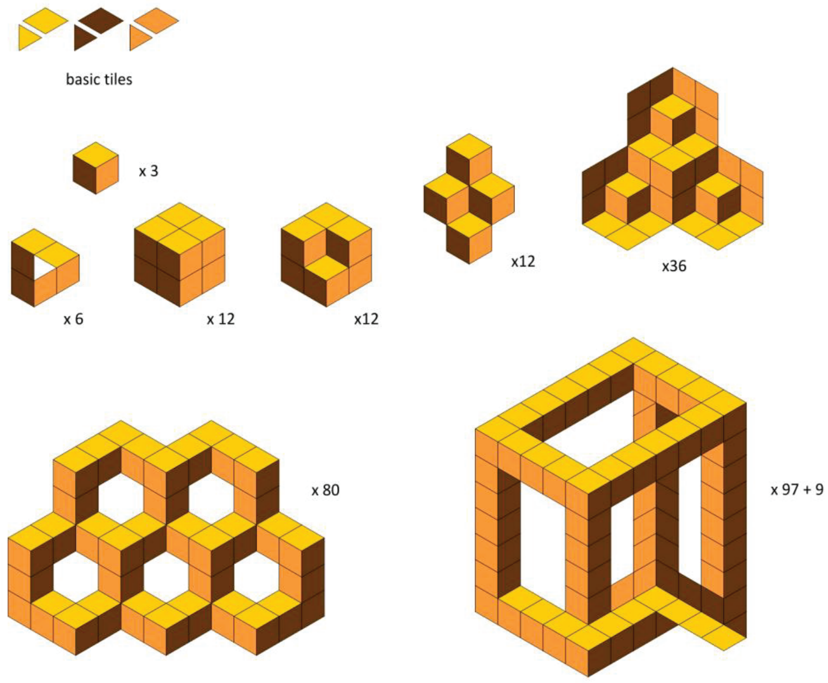

Figura 9. *Tessellgram- category types with color coding*

Poligrams

This system is based on fundamental regions and its possible dissections organized by rotational symmetry. It can be used as a closed or open set depending on the number of base sets used, and its possible combinations

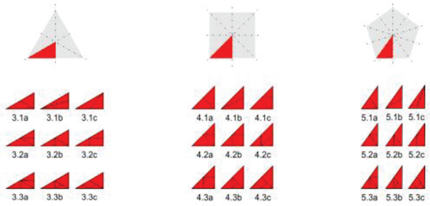

Figure 10. *Different dissections of fundamental regions of regular polygons*

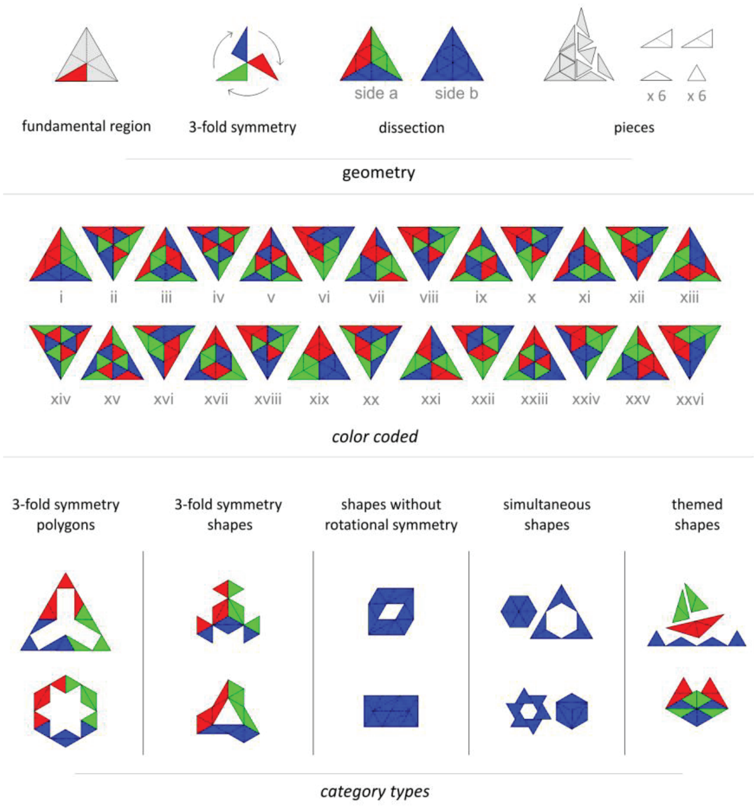

Figure 11. *Poligram 3.1a*

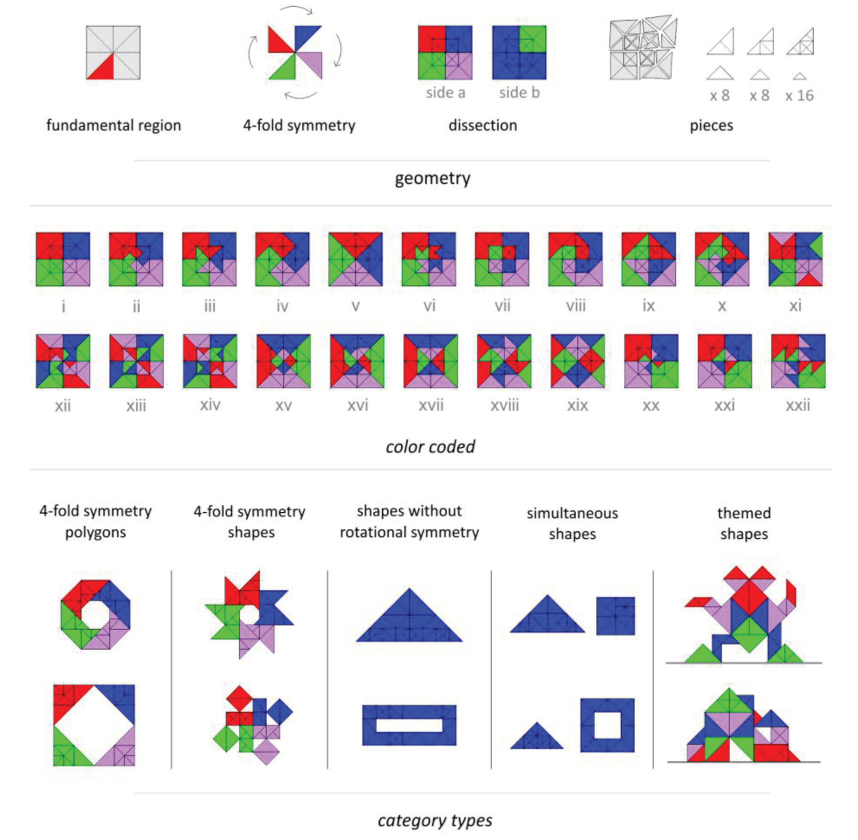

Figure 12. *Poligram 4.3x*

Isomorph

This system is based on consecutive bisections of forms guided by self-similar pattern repetitions in varying frequencies. The designs can be generated according to different symmetry types, including bilateral, concentric and/or radial structures, used alone or in combinations.

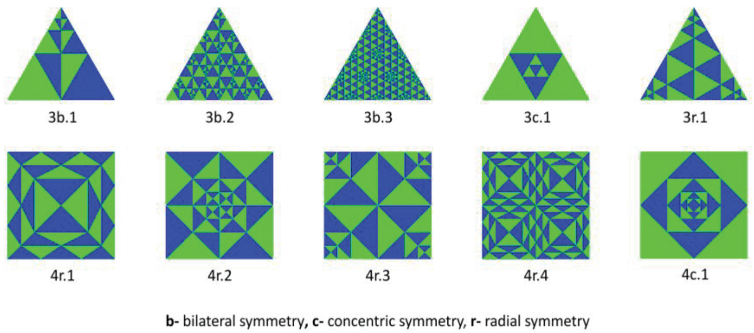

Figure 13. *Isomorph category types*

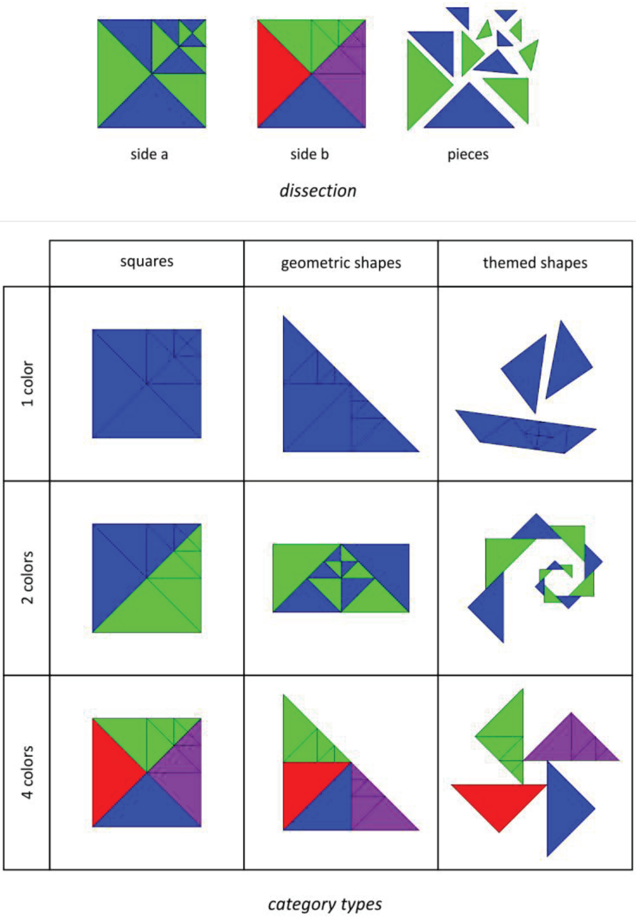

Figure 14. *Isomorph 4b.1*

Transfoldings for Design Puzzles

A new concept is being explored based on consecutive folding of a plane surface into diverse configurations based both on shape and image transformation. This concept can be seen as analogous to origami with two distinct differences. On the one hand the folds are reversible and not necessarily have a single solution. On the other hand, the puzzle solution requires that a given image (abstract or figurative) be solved simultaneously to the configuration solution. The nick-name of "1 piece puzzle / 1PP" has been given to this group of form structures to emphasize its simple and succinct character.

The definition of a Transfolding Design Puzzle is based on using a flat plane (paper) that has visual information on both sides in a way that permits subsequent folds of the plane to transform both the form and its consequent images in diverse manners. The different ways of folding can be oriented towards problem solving type of situations (e.g.: a 2 dimensional Rubik's cube) or towards open ended compositional explorations that associate both the formal and graphical constructs. The formal attributes that this type of puzzles explore include shape and size parameters, while the graphical attributes can work with compositional (formal) or communicational (expressive) factors.

Transfolding is a term we suggest to refer to the process by which an n-dimensional form can change shape, size and/or image every time it is folded differently. It is a semi-open process depending on the parameters utilized, but differs distinctly form Origami in that the later is focused using folds to reach an end product, not as a means in and of itself as a design process. These transformations occur while maintaining the premise of Design Puzzles in which the different attributes of form come into play with each other while solving for closed solutions or for creating open ended compositions.

There exist different potential instances which a transfolding puzzle can operate with:

- Transformation of dimension: the design can exist in different spatial dimensions as a point of departure (the base form) and can stay or not in that same dimension as a point of arrival (the final form). The design can be mapped as 1-D forms staying in 1-D or transforming into 2-D or 3-D in its final form, or it can begin with 2-D forms and stay in 2-D or transform into 3-D (as in traditional Origami).
- Transformation of shape: the design can change from one shape to another (E.g.: from square to triangle and/or vice-versa).
- Transformation of size: the system can change a given shape from one size to another.
- Transformation of image: the design can change its visual contents or maintain it as when working with a solid color or continuous pattern.

There are two types of activities which are possible with transfolding Design Puzzles: open and closed. The open activities do not require a specific solution to a spatial and/or graphic challenge, it is meant to explore different options and situations which are generated as transformations take place based on direction, location, shape and size of the fold. The closed situations are meant as problem solving exercises and foment specific spatial skills for solving, measured by time or steps taken to reach final solution. There is an infinite variety for different visual and graphic themes to work with therefore the current examples are for illustrative purposes only. Graphic options can range from themed motifs to geometric or abstract.

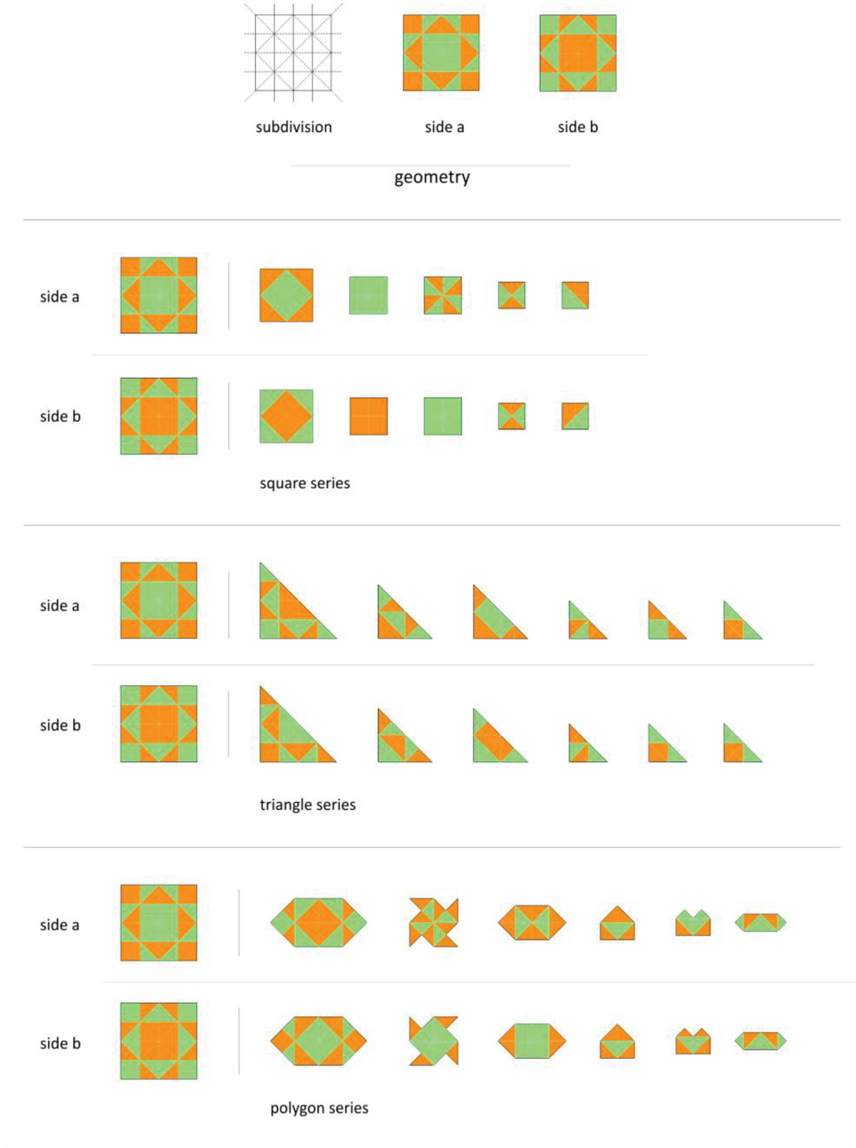

Figure 15. *Transfolding 4/4: operations of shape and size*

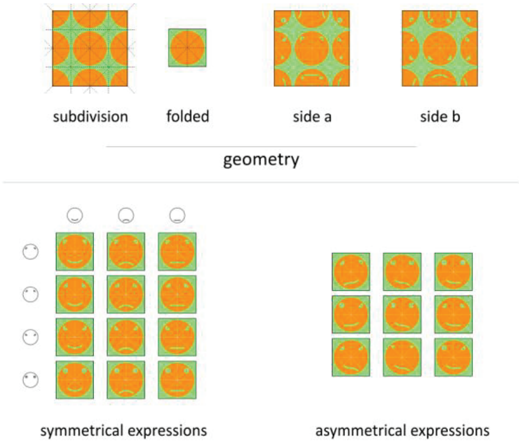

Figure 16. *Transfolding Faces: operations of graphic expressions*

Conclusions

This research proposes the idea of Design Puzzles as a systematic framework to identify and associate the basic attributes of form (design morphology) through the creation of concrete learning products. Furthermore, it is argued that this material for design education has intrinsic value for developing design research methods and tools based on the natural bridge the system offers for associating the logic and rigor of geometry with an aesthetic sensitivity towards form.

The two strategies being explored for generating Design Puzzles thus far include:

1. The use of systematic dissections as a form generator which tend towards minimal parts and maximum possibilities.
2. The use of specific morphological themes as a point of departure in which relevant contents are put into play in ways which offer learning activities related to the main theme, while exploring general issues of form and space.

Based on the above we are closer to understanding the general universe to which this group of learning materials belongs to and can imagine a more complete theory to justify and understand them in their totality. We leave on the drawing board ideas for next generation Design Puzzles applied to curved surfaces, three dimensional space and lattice type networks, amongst others.

An important concept encountered by Design Puzzle research includes “fundamental regions” and “fundamental dissections”. The first defined as the minimum morphological information needed to generate a given form, while the later refers to the minimum dissections performed on a given form in order to extract its fundamental properties that allow for recombination of its parts to generate a family of structures considered as sharing its basic form attributes. This last concept is analogous to DNA thinking in biology.

The agenda for further research into Design Puzzles as a pathway for better understanding logic and technique of form based on its basic attributes will allow further development of learning material specifically for design morphology research.

An intrinsic part of the learning material proposed involves associating the rigor of geometry with aesthetic sensitivity, essential to unifying design theory with practice.

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Teaching and evaluation strategies for drawing in design education: the use of drawing schemata as a tool for the in-class development of drawing for design.

Nora Karina AGUILAR* and Jose Luis HERNANDEZ AZPEITIA
Universidad Iberoamericana, Mexico City

Abstract: *Drawing education strategies have been centred in specific skill development models regarding observational accuracy, creativity or expression. New design curricula require effectively integrated proposals that develop these dimensions simultaneously and are focused in the development of professional competencies. Drawing is a fundamental medium to accomplish this task. This paper presents current results of a simple methodology being implemented at OUR INSTITUTION for the research, evaluation and development of drawing in our design students based on the concept of Schema (Kant,1787)(Piaget, 1927)(Andersen, 1977)(Eco, 1998). The fundamental hypothesis of this research is that drawing practice and learning is based in the binomial consisting of observation drawing and schema learning. The proposal is to merge the different models of drawing analysed in the paper to generate a comprehensive teaching and evaluation model for drawing for design. The paper also presents the results and analysis from the implementation of these methodologies.*

Keywords*: Drawing, Schema, teaching, evaluation, strategies, neurocognition, professional competences.*

* Corresponding author: Universidad Iberoamericana | Mexico | e-mail: karina.aguilar@ibero.mx

Introduction

How to properly teach to draw for design? This is a question design educators at UIA-Mx address frequently and the answer relies on a series of factors that depend on the emphasis of the drawing subjects and the degree of relationship between these subjects and the professional practice of design. Drawing effectively has been a constantly discussed topic in drawing manuals.

From experience, other questions have arisen about drawing teaching research in Universidad Iberoamericana, Mexico City (referred to as, in this paper: UIA-Mx*)* where simple problems such as drawing evaluation by lecturers and improvement of the drawing practice have become the main focus of the new curricula for design education, effective August 2012.

Models of drawing

Drawing is a complex neuroperceptive and psychological process where a set of operations take place to transform an input structure into an output result. According to Kosslyn, these processes include the perception of a particular reality, the reference and meaning net it creates in the observer's brain, the representation that the object creates and the later psychomotor activities that lead to physical representations of such concept. (Kossylin 1999)

These representational schemes are, according to Kosslyn, contained in a buffer. All of the contents of this buffer constitute what we consider to be the body of schematic essences of the objects that students perceive and recognise. These schematic structures have been studied and named by art historians and neuropsychologists and have been referred to as Stereotype, formula or canon (Gombrich 1998) other names include: Neuronal Pathway (Damasio 2001) and Graphic Stereotype (Parini 2002).

The concept of schema derives from the Kantian philosophy in its origin. It should be noted that the schema must not be confused with a mental image, as Kant warns in his Critique of Pure Reason. It is, in the words of Umberto Eco, a result of the capacity to imagine. Eco presents the schema as a procedural rule (Eco 1998). In other words; the schema acts like a structuring agent that dictates to the subject how to build a concrete representation/solution, in this case a mental image and/or a drawing, from a general abstract concept.

This differentiation of schemata, mental images and perception process allows for distinction between three types of drawing processes depending on how these relate: Observation drawing, imitation drawing and visualization drawing. In the observation drawing type, we have a perception / schematization / representation drawing process, where the observer has to perceive an exterior reality, pass it trough the experience filters and finally generate an exterior representation. In the imitation drawing process, the subject generates the solution from a set of previously learned rules; canons or schemata that articulate the representation of an exterior object in an idealised (canonical) way. The third type, visualization drawing, short-circuits observation and schemata to produce external representations of mental images; the object is never in sight, nor it does not exist outside the subject´s mind, but it uses resources derived from experience and structure-based relations from schemata.

Schemata should not be an obstacle to the development of observation drawing, as these are part of the construction of visual thinking and they prove to be of great use for drawing. Perception has an instrumental character to use the sensible contents derived from observation, in this way drawing becomes an interpretation of the visible world (Einser 2004). Drawing allows the designer to access these representations, and makes other peoples' mental images accessible.

Actual strategies

Drawing teaching and learning has been largely focused on the *observation drawing* model following a traditional observation/correction methodology: the student is asked to "copy from nature" in order to develop observational accuracy. The task is performed in a copy/trace fashion where the student tries to exactly reproduce the object of observation. This process of imitation is recurrent and it is described in life drawing manuals such as Betty Edward´s (Edwards, 1979) and Kimon Nicolaides (Nicolaides & Harmon, 1941).

This method for drawing has been popular in the art and design academies. Life drawing imitates nature, which according to Tatarkiewicz was a fundamental art thesis as it intended to reproduce *perfect models* (Tatarkiewicz 1991) and it is based on *what is looked at, as* considered by Da Vinci, who thought that observation was the way to create a *second nature* (Da Vinci 2004). Another example is provided by Vincenzo Carducci, an Italian artist whose art theory had a great influence on the New Spain Academy: drawing is when the artist *speculates* (Carducho 1979) (from lat. *Specularis; relative* to the mirror) Carducci means by this, drawing from life an object or person. In the Academy, this kind of drawing was executed by copying plaster casts and later moving on nude model drawing. (Pérez Sánchez 1986) Perfection in this drawing model is achieved by a continuous correction of the drawn model; it ideally approaches nature in an asymptotic manner after each correction performed as a simple algorithm: the student observes, memorizes, traces, compares, corrects and traces again, many times over, until the desired or requested degree of exactitude is achieved. In this process the student refines his observational and attention skills, and can improve his psychomotor abilities as well. The creation and enrichment of schemata is not done in an explicit way, so it becomes a long but experience-proven way of learning how to draw. Its main drawback resides in the underdevelopment of projective and speculative skills fundamental to the design process.

The second model, *imitation drawing* is based on the learning of canonical forms; as Gombrich states, it is based on a "schematic and correction" model. This kind of thought is aimed to produce what Gombrich considers to be a "graphic vocabulary" that constitutes a *visual literacy* (Gombrich 1998, 133). This approach to drawing is evident in the classical art academy education in the use of *cartillas* or drawing charts that contained graphic instructions to create ideal models and representations of different subjects. Drawing charts are abstract models that provide schematic resources that can be used to structure a drawing without the need of a live model. This model is useful for the representation of non-apparent subjects; drawing from imagination or constructing solutions through drawing, e.g. as in sketching for composition or solution of design related problems.

This practice is considered by Gombrich to be a proper way to gain visual literacy; In *Art and Illusion* Gombrich states the need of a structuring agent; that he calls *model, stereotype, formula* or *schema* (Gombrich 1998, 127).Simple elements that can be conjugated to create a more complex form; these models work as a sort of scaffolding that helps to determine the essence of objects to be represented in order to be able to own the"... infinite variety and variations of the objects around us." Gombrich also quotes on "the existence of books that teach scholars how to draw hands, feet, eyes"; and referring to drawing manuals "...huge encyclopaedias that show more of this in a few lessons." according to him, are -based in a "schematic and correction model" that show how to acquire a vocabulary "...based on simple geometric shapes that are "easy to remember, [and] to draw" (Gombrich 1998, 127) the problematic of focusing in this single approach includes a consistent and even expression in the students, as they all have the same reference corpus. Or if the student has little or no references, the proficiency of the visual expression and communication competencies result impaired. The graphic elements acquired by imitation drawing or trough visual thinking abstraction become the new tools that will be used to solve an image, for example when students learn about human figure proportions they tend to apply these new knowledge into their drawing practice then, it is supposed that the students are able to learn from imitation drawing trough schemata.

Observation and schemata are a constant in the drawing learning and practice process. It is trough these elements that the development and evaluation of the drawing practice is possible and so the visual thinking abilities. Schemata are developed in the observer's mind trough a simplification process: when the observer considers that his schematic representation is functional then it is considered as true, and tends to be used and repeated for every case that requires a similar solution. Saivens and Parini state that visual perception is based in a "mental economy" process where the mind generates a stereotype and it relative schematic categorization. (Parini 2002) Damasio further explains that the mind also has an optimizing mechanism, it looks for the effectiveness of the answer, and economy of media (Damasio, Y el cerebro creó al hombre 2010), so in other words the schemata, once validated it will remain true for every similar situation.

In the visualization drawing model the results are dependent on the subject's ability to exteriorize the contents of his mind; this process called *visual imagery* in neuroscience it represents an effective way to access the subject's memory, as drawing has been proved an effective way of accessing long term memory (Ganis, Thompson and Kosslyn 2004) Visualization drawing is directly related to creativity and invention core design competencies. The drawback of single focus in this model results in a conflict between creativity and the requirements of the design projects. The Visualization drawing model fosters creativity but it should also promote the useful aspect of drawing as a problem solving tool. The creativity should be focused in the actual needs of a project.

A series of diagnostic exercises was then adapted from Wilson et al. *Teaching Drawing from Art* (Wilson, Hurwitz and Wilson 2004) where the concept of *drawing learning* is related to specific abilities and attitudes that can be linked to the development of specific and generic professional competencies as: visual expression, visual memory, visual and motor coordination, visual communication, creativity, art history and aesthetic.

The book presents an integral drawing curriculum that was adapted to develop five core areas in drawing and design education: observation, memory, imagination, verbal-visual processes and experimentation. Furthermore these core areas can be directly associated with the professional dimensions in the UIA-Mx Design Curricula. The tests were designed to evaluate each of these areas.

Methodology

The sample was a mix-gender, 18 to 26 year old, 100 student designers, specializing in one of the following: Industrial, graphic, textile or interaction design; First the research was conducted under the premise of evaluating the actual capabilities of the design students in the frame of Protocol Analysis, particularly in the process-oriented approach (Dorst and Dijkhuis, 1995). For this, a series of diagnostic exercises were performed to determine the general student status in relation to drawing abilities.

The first diagnostic test consisted in asking the students to draw from memory a widely-known image. The particular objective is to diagnose the level of long term visual memory. In this case, as suggested by Wilson *et*. *Al*. Leonardo Da Vinci's *Mona Lisa* was used as the motif, as it is a widely-known and cross-media repeated image.

The test was conducted in the following way: An initial visualisation phase: where the students were asked to close their eyes and then invited to visualize the portrait by Da Vinci. All of the students were asked if they knew the image; all of them did, although the students did not have precise information on when was the last time they saw it. The first task solved by the student's brain is to link the concept *Mona Lisa* to an image by means of visual and semantic memory (Patterson 2005). The second phase consisted in the student generating a physical representation of the internal image, explored in the visualization phase, by means of drawing; the students were instructed to stop drawing whenever they consider the task was completed.

Figure 1 Long-term memory drawing. Da Vinci's Giocconda. Student: Aileen.

Figure 2 Observation drawing: portrait of a classmate. Student: Aileen.

In the third phase of the evaluation (45 min.) The students were asked to draw a portrait of one of their peers, with enough time to complete the task. The first working hypothesis supposed that these drawings would prove what abilities each of the students had. It was expected that the tests demonstrated if the students had observation abilities or if they had developed their visual memory.

This first test proved the working hypothesis wrong, as there was no reference frame upon which the lecturers could make a comparison to make an evaluation so it was necessary to generate one. The first and second phase drawings will work as the reference frame for further evaluation strategies.

Besides generating a reference benchmark to evaluate later drawings, the test provided interesting insights in the drawing process and its perception. The results of the drawing test showed a constant in almost every case: portrait drawings, the memory-based Mona Lisa and their peer portrait had an amazing resemblance. Both drawings were versions of a same image.

It was possible to identify the repeating patterns in drawings; structural constants used in the solution of elements such as eyes, mouth, eyebrows. These graphical constants were applied in the solution of both tasks no matter if their solution demanded different skill sets. It is important to note that the time span between the phases did not affect the results as the couples of drawings showed relatively the same structural solution. The tests were performed in a time escalated fashion ranging from minutes to days to a maximum of two weeks between phases two and three.

The test was repeated using different variables in the method, as in the subject. Those variations include: making portraits from memory of relatives, copying form live models or using photographic reference materials. The results were consistent; the similar drawing structures appeared in every case.

In figure 1 Da Vinci's Mona Lisa, drawn from visual memory belongs to the visualization drawing model; in Figure 2 is possible to attest the results of a observation drawing oriented task. It is possible to notice the great resemblance of both drawings; the shape of the eyes, the location and structure of the eyebrows, the overall shape of the lips and the chin's contour are similar. Eyes and mouth are basically the same.

In figures 3,4,5 and 6 is possible to see the same phenomena; as stated in the methodology the time span between tasks did not prove a significant difference in the results all of the sample drawings show similar structures in their solution.

Figure 3 Long-term memory drawing. Da Vinci's Giocconda. Student: Santiago Pérez Velazco.

Figure 4 Observation drawing: portrait of a classmate. Student: Santiago Pérez Velazco.

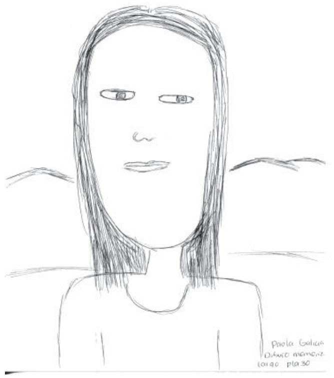

Figure 5 Long-term memory drawing. Da Vinci's Giocconda. Student: Paula García.

Figure 6 Observation drawing: portrait of a classmate. Student: Paula García.

Figure 7 Long-term memory drawing. The student's sister. Student: Andrea González.

Figure 8. Drawing copied from photographic reference Portrait of Frida Khalo. Student: Andrea González.

The substitution of the Da Vinci image with the memory of a relative or friend showed constant and interesting results: in the Figure 7 and 8 cases it is possible to see the portrait drawing of the student's sister, compared with the drawing of a model. In this case both drawings were generated by observation drawing of a model; live model in the former and photographic reference in the latter. Both drawings show great resemblance in their composition and structure. Specially note the resemblance in nose, eyes and shape and structure of the nose. Less evident is the solution of tone/ value in both images.

Figure 10.Observation drawing from photograph Student: Daniela Chein,

Figure 11. Observation drawing from photograph. Student: Daniela Chein,

Other variations in the methodology included the exclusive use of photographic material as reference for copying. In Figures 9 and 10 it is possible to see subtle, but still repeating structural elements. The student had perceived in great amount detail and proportion including tone and shadows but some elements like the lip contouring is present in both images. When the image is compared against the original photograph it is possible to see how the lips in the photo appear as a high contrast area whilst in the drawing is possible to see a hard contour.

It is important to mention that the time frame for the completion of each test varied significantly depending on each student but a maximum of one hour was established for each activity. The variation in time depended directly on the amount of detail the student remembered or wanted to include in the drawings.

Figure 12. Original photograph

Figure 13.Observation drawing from photograph.Student: Daniela Chein,

These clearly identifiable repeating elements is the procedural rule under which each of the solutions is generated, these procedural rules are the schemata that the students use to solve drawing problems, a relatively simple and easily remembered structure that allows many incarnations.

Figure 14.Observation drawing portrait (right), same subject with the application of a general face schema demonstrated in class (left). Student: Pier Luca Arienzo.

In figure 14 it is possible to realize the improvement of the general quality of drawing by using a mixed strategy consisting in drawing a portrait by observation only and later on learning a new face schema, and then repeating the portrait drawing. It is possible to see how the student incorporates the new structure in a same subject drawing.

Research results

After being tested, the students were asked for an opinion of the experience. This gave us useful insights that were considered for the following research results were obtained. These results serve as a basis for the further development of design research and strategies.

Main Hypothesis

Schemata and observation are an indivisible binomial in drawing practice and teaching.

Conclusion: The development of an integrated curriculum that addresses both sides of the drawing and representation process is fundamental for a quality drawing curriculum. These approaches have been developed in the XVIII century art academies, and they could serve as a model for the development of the design specific contents.

Second working hypothesis

Students make use of schemata to solve graphic problems.

Conclusion: Design students sampled tended to solve drawing problems by means of repeating similarly structured graphic elements in their composition. Schematic solutions dominate when the subject does not belong to the usual corpus of experience. This dominance of schema is result of a lack of observation skills; if the observation skills are somewhat developed a hybrid solution part schema use part observation emerges. These results are easily verifiable in the diagnostic test.

The repetition of the structural elements is independent on the topic, time span or approach dictated for solving each particular task. The use of visually similar topic allows for identification and comparison of such elements.

Third working hypothesis

Observation drawing practices enrich the underlying schemata, and schematic graphic elements are acquired by means of visual thought and abstraction processes. These schematic elements become tools for the solution of new graphic problems.

Conclusion: The quality of the schematic solution is proportional to the practice and or reference level of the students: students who have learned other canonical drawing systems, for example, *Manga* tend to present solutions according to this dominant schema. This does not necessarily make an impact in the amount of expressive variations or the quality of the drawing.

Fourth working hypothesis

Most students sampled are not aware of the observation process while drawing. Their solutions present high degree of similarity as they are based in schemata. The resulting drawing can be grouped in big families of similar images for this reason.

Conclusion: Upon realizing the dominance of the schemata a small number of students started to develop observation in their drawing tasks; the repetition of similar structures diminished while the variation of form and representation of details showed gradual improvement.

FIFTH WORKING HYPOTHESIS

An integrated approach of the use of schemata and observation drawing strategies implies a significant development in drawing quality and expression.

Conclusion: The learning of new schemata provided new solutions for unfamiliar problems. Learning of new schemata is done trough the observation drawing model, where a continuous schema and correction process is applied until the schema is learned. Once the schema is incorporated students make use of it to solve some of the drawing problems presented.

SIXTH WORKING HYPOTHESIS

A batch of tests can be used to diagnose the use of schemata and general drawing skills in design students.

Conclusion: The test revealed the richness of the student's schematic vocabulary: the more the images appear as version of a same image, the more dominant and poorer the schema is.

The tests also revealed the observation skills of particular students. The more resemblance a drawing has with a reference indicates good observation and disposition for perceiving detail in the perceived subject.

The test reveals the amount of attention to detail. The more details a drawing contains reveals the disposition also this might give insight in the type of visual thinking process weather it is abstract or concrete.

The results prove that the use of schemata in drawing is far more common than expected. The students are bypassing observation and using the schemata as a way of solving visually complex tasks. This is evident in the repetition of structure-like patterns not mattering if the topics of the task or the approaches to solve them are different. These results provide evidence that can be used as a diagnostic and evaluation strategy in the drawing classroom. The results also indicate the relevance of schemata use in drawing solutions which in turn could serve as a useful teaching and drawing development tool for design drawing.

Evaluation and drawing teaching strategies derived from this research

It is first necessary to develop a test to identify problematic areas in common representation problems. The solution started with the necessity of a grading and evaluation method for drawing subjects in the design curricula at UIA-Mx. The grading system required to take professional competencies into consideration, as well as to ponder the student´s specific drawing abilities. The diagnostic test can be a way of providing a starting point of reference to be able to diagnose the student´s current status regarding drawing expression abilities.

In the observation drawing model evaluation is limited to the accuracy of the mimetic process, weather the capabilities of observation and analysis are developed or the natural talent of observation emerges, it does not prove an efficient way of diagnosing other drawing capabilities or to establish an objective evaluation strategy beyond representational accuracy, it is also important to consider the fact that most of the freshmen students' don´t have prior drawing instruction.

In the imitation drawing model evaluation of the schemata is simple as schemata are set of defined rules; exercises include the development of drawing charts and its application. The evaluation of these exercises is done by comparison against a model. The more accurate the drawing is according to the chart, the better the schema has been formed. These schematics have been of popular use in design education; for example the drawing codes of fashion design and textile representation, product sketching, comic book style based storytelling, infographics, storyboarding and instructional design are a few examples of these schematic codes in design. Incorporating these topics into drawing project should be an easy way to form a professional graphic vocabulary in design student as a part of an integrated curriculum.

While the diagnostic tests provide information on the observation skills and the nature and dominance of the schemata in a student, the following teaching and evaluation strategies can be implemented:

It is necessary, in the beginning of each drawing course, to establish the evaluation benchmark and the mood and abilities of a particular group by use of the diagnostic test. This process will give valuable insights in how to develop a course of action with student-specific problems.

The implementation of a recursive teaching methodology that includes exercises related to the three models of drawing. The exercises should be implemented in a cyclical fashion and must have relation one and other in order to develop skills in a proportional way.

The teaching and use of schematic solutions for common design problems such as: human proportion, perspective and geometry in order to enrich the student's collection of schemata. The practical application of the new schemata should be contemplated in order to promote mnemonics and demonstrate the practical use of the schema. The program should also promote the self-development of own schemata to foster creativity and individual expressions in the classroom, as well as own drawing based problem solving methodologies.

The development of observation process awareness trough specifically designed exercises in order to develop attention to detail and representational accuracy as foundation competencies since design solutions emerge from detailed observation of phenomena.

These integrated drawing curriculum practices will promote the development of fundamental design and professional competencies as well as, according to Arnheim, the multimodal dimensions of visual thinking such as: active exploration, selection and abstraction of essential elements, simplification, analysis, correction, contextualization, and filling in, which are also fundamental in any professional and research environment. (Arnheim 1986)

Schemata prove useful in the drawing learning and evaluation process; these schemata include abstract concepts as well as psychomotor dispositions that make the representation of complex form possible (Piaget 2003, 124-125) they act as a organization of elements result of perceptual intelligence (Damasio, El error de Descartes 2001). Parini notes the relevance and the necessity to overcome with appropriate means the, in his words: "...so called copy of reality." Practiced in many levels of artistic education (Parini 2002, 163) this research intends to build a new approach to drawing teaching.

Conclusions

By understanding the drawing process beyond its creative potential it will be possible to formulate new pedagogic strategies. It is possible to use the elements of visual perception, as well as the neuropsychology points of view on drawing and its process to further develop drawing education. The use of schemata proved to be a valuable tool in the development of teaching and evaluation strategies that make comprehensive use of the brain resources to provide an integral approach to de development of drawing abilities for design.

Explaining and clarifying the perceptual and neurocognitive processes behind drawing and drawing representations makes easier to create made-to-measure strategies to teach and evaluate drawing. Students that become aware of the process significantly improve their development as they are more conscious of their procedures and have a basis to analyse their own results making them capable of self-correction.

Drawing as a problem solving tool is fundamental to the design process because of its relation to the perceptive process and its capability to structure reality. Proper learning of drawing and its possibilities in school can guarantee creative professionals. Drawing is an effective tool to develop professional competencies in design, especially those related to creativity, problem solving and research.

Drawing is a research tool that needs to be established as fundamental. Drawing teaching has fluctuated among traditional models that do not cover its entire field of possibility. The discovery use and evaluation of drawing abilities in design students is a fundamental starting point for the creation of strategies that respond to modern curricula, making the development of professional competencies a priority.

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Design School: Design Education in the Age of Digital Capital

Paul A. RODGERS[*a] and Craig BREMNER[b]

[a]Northumbria University, Faculty of Arts, Design and Social Sciences, UK
[b]Charles Sturt University, School of Creative Industries, Australia

Abstract: *Design, we are often reminded, has a direct social purpose that is capable of reaching all sectors of public life. National design organisations across the world proclaim that design acts reflect a nation's social and cultural values; design shapes the everyday products people use, the buildings we live, work and play in, and the clothes we wear. Furthermore, design communicates those values to others. It is therefore an extremely powerful tool that can communicate and express a nation's values to others and has a significant role in the social, cultural and economic wellbeing of its people (Newman and Swann, 1996). Moreover, it has been suggested that design is the best tool that we have available to us to make sense of the contemporary, complex modern world (Sudjic, 2009). But how should a design school in the age of digital capital best prepare future designers for this complex world? How can the design school maximize the potential opportunities suggested by this future, uncertain world? Can the design school truly help address some of the emergent and huge global issues we will surely face? By looking at the contemporary situation this paper explores how the structure of design education has been transformed by a number of internal, external, and contextual factors. The paper will expand upon the operative scope, flexibility, and vulnerability of teaching design, its history/theory, and representation in the years and decades ahead in the design school.*

Keywords*: Design School, Design Education, Irresponsible, Undisciplined.*

[*] Corresponding author: Northumbria University| UK | e-mail: paul.rodgers@northumbria.ac.uk

Introduction

This paper sets out to explore the nature of the contemporary design school from a global perspective and to examine the rich and diverse situations that exist in design production, both in theory and practice, and the character of the studio/history/theory interplays that prevail in contemporary design school life. It is generally acknowledged that any advance in design education should have a direct impact on the conditions of the world around us. Poul Rind Christensen, head of research at Kolding School of Design, Denmark, for example, considers design researchers' interactions with practitioners to be crucial for the capacity of design research to make significant contributions towards innovation in society. Christensen believes that "*In the design school of the future, researchers are not just distant observers of that which exists but creative co-designers of a new practice.*" (Christensen, 2010).

Design schools, we are told, are at the forefront of shaping a new generation of creative managers and entrepreneurs (Woyke and Atal, 2012). Design schools throughout the world play a growing role in supplying these highly sought-after people to corporate and non-profit organizations alike. The driving forces of innovation and globalization are pushing many companies to hire design school graduates with new skills and design schools across the world that teach design thinking with its emphasis on maximizing possibilities rather than managing for efficiency are in high demand. In this era of constant change, many of these companies want people who are comfortable with complexity and uncertainty and many of these individuals are to be found in design schools.

Any design school of the future, however, must first acknowledge that we collectively create things that nobody wants anymore. Moreover, a design school needs to recognize that we are destroying some of the most important features of society that we claim to hold most dear (*i.e.* our planet, our society, and our spirit). Our ecological crisis, wherein we continue to deplete and degrade our natural capital on a massive scale, using up the equivalent of 1.5 planets to meet our current consumption has resulted in one third of our agricultural land disappearing over the past 40 years, which will inevitably lead to food supply crises and an anticipated doubling of food prices by 2030. Our current social crisis sees nearly 2.5 billion people on our planet live in abject poverty. There have been many successes at lifting people out of poverty, but this figure has not changed much over the past few decades. Furthermore, the world is currently in a spiritual crisis where, according to World Health Organization (WHO) statistics, 3 times as many people die from suicide as die from homicide or in wars. Although we are currently experiencing a number of wars across the world, 3 times more people kill themselves than kill others. This inner crisis also manifests in many other forms including rapidly growing figures for burn out and depression that both indicate an increasing gap between our exterior activities and our interior sources of creativity and presence. These three dimensions of collectively creating results that nobody wants constitute the most significant failure of our time.

Universities, Design Schools, and their Purpose

Before we examine the nature and role that contemporary design schools play presently and might play in the future, it is important to contextualise their genesis. Many design schools, today, now operate within the organizational constraints of a much larger institution such as a university. A University, from the Latin word universitas (the whole), as we now recognise it is an educational institution designed for instruction, examination, or both, of students in many branches of advanced learning, conferring degrees in various faculties, often embodying colleges and similar institutions. Stefan Collini, Professor of English Literature and Intellectual History at the University of Cambridge, lists four characteristics of a modern university:

- That it provides some form of post-secondary school education, where "education" signals something more than professional training.
- That it furthers some form of advanced scholarship or research whose character is not wholly dictated by the need to solve immediate practical problems.
- That these activities are pursued in more than just one single discipline or very tightly defined cluster of disciplines.
- That it enjoys some form of institutional autonomy as far as its intellectual activities are concerned (Collini, 2012).

The earliest universities, in the Western world, were developed under the aegis of the Latin Church in Christian cathedral schools or monastic schools (*Scholae monasticae*), dating back to the 6th century AD (Riché, 1978). From the 12th century onwards, the rise of cities and the rise of universities occurred together and the model universities of Bologna and Paris were followed by Oxford and Salamanca (1219), Naples (1224), Prague (1347), Krakow (1364), Leuven (1425) and Glasgow (1451). The eminent historian, Peter Burke, states that around this time it was assumed that universities concentrate on transmitting knowledge as opposed to discovering new knowledge (Burke, 2000). Likewise, the opinions and interpretations of the great scholars and philosophers like Aristotle, Aquinas and so on were considered irrefutable and could not be equalled and the task of the teacher was merely to expound the views of the great scholars of the past. At this time the only disciplines that could be studied officially were the seven liberal arts of grammar, rhetoric and logic (the *Trivium*) and mathematics, geometry, music, and astronomy (the *Quadrivium*), and postgraduate courses in medicine, theology, and law.

It would not be for over 450 years from the rise of the universities and cities of the later Middle Ages that the first formal design school, the Bauhaus, would appear and open its doors for the first time. The Bauhaus, with its roots in the Kindergarten system of educating young school children perfected by Friedrich Froebel (1782 - 1851), gave rise to a number of "Masters" including Johannes Itten, Josef Albers, and Paul Klee. These individuals and others infused the Bauhaus' revolutionary *Vorkurs* programme of abstract-design activities, with an emphasis that owed a substantial debt to Froebel's Kindergarten system. In 1919 Walter Gropius was appointed head of the Bauhaus in Weimar, the then German capital. One of Gropius' key objectives was to integrate art and economics, and add an element of engineering to art. As such, students at the Bauhaus were trained by both artists and master craftsmen in an attempt to make "*…modern artists familiar with science and economics, [that] began to unite creative imagination with a practical knowledge of craftsmanship, and thus to develop a new sense of functional design.*" *(Bayer et al., 1952: 13)*. The initial aim of the Bauhaus was to "*…rescue all of the arts from the isolation in which each then found itself.*" (*Whitford, 1984: 11) and* to encourage the individual artisans and craftsmen to work cooperatively and combine all of their skills. The Bauhaus also set out to elevate the status of crafts to the same level enjoyed by fine arts such as painting and sculpting. Ultimately, the goal was to maintain contact with the leaders of industry and craft in an attempt to gain independence from government support by selling designs directly to industry.

Universities, Design Schools, and the Present Situation

The world we inhabit today is an increasingly complex and interdependent one; it is a world where the majority of society's big issues are not isolated to one particular sector or discipline; it is often said that we will not resolve these issues with the knowledge and thinking we used to create them in the first place. Typically, these issues can be characterised as emergent phenomena with non-linear uncertainties. Manuel Castells, a **leading sociologist of the city and new information and media technologies, in his** three-volume work on "*The Information Age: Economy, Society, and Culture*" (Castells, 1996; Castells, 1997; Castells, 1998) believes three parallel fundamental changes are taking place:

- The rise of a new, dominant social structure – the network society;
- The rise of a new economy – the informational economy;
- The rise of a new culture – the culture of virtual realities.

It is very difficult to predict how these significant developments will play out in detail over the coming years, but we can identify a number of ways these changes are challenging leaders and policy makers in universities and other organizations including design schools (Senge and Käufer, 1999). These challenges, frequently grouped together under the term "*new economy*," are fundamentally redefining the design industry today:

- ***Space***: the globalization of value creation, capital markets, and financial markets.
- ***Time***: Internet speed as an essential condition for competitive strength.
- ***Structure***: the primacy of networked structures and communities.
- ***Substance***: digitalization accelerates the dematerialization of value creation.
- ***Competition***: "winner takes all" markets (increasing returns) as the dominant form of competitiveness.

These five developments redefine the basic assumptions regarding ***time*** (instantaneous, any time), ***space*** (anywhere), ***structure*** (network), ***substance*** (digitization) and ***competition*** (increasing returns) under which the agents of design – consumers, businesses, investors – proceed and operate. These shifts combined have transformed fundamentally the way a designer's services are now funded, the manner in which a designer now works, and how the digital has transformed the manner in which we design, produce, distribute, and consume goods.

Claus Otto Scharmer, founding chair of the Presencing Institute at Massachusetts Institute of Technology, has written extensively on the failure of our contemporary institutions including our universities. Scharmer (Scharmer and Käufer, 2000) believes that the knowledge disseminated by many universities nowadays has becomes less and less relevant to leaders in organizations, and that the knowledge which is relevant is increasingly disseminated by institutions other than universities. Furthermore, Scharmer states the core of teaching at universities has less and less to do with the challenges characterizing praxis and that the kind of knowledge needed for thriving in the "*new world*" is almost absent from university classrooms.

The present situation in design and other related industries reveals a number of stark facts. In the "*new economy*", many highly successful entrepreneurs are not university graduates. These individuals often quit university in order to establish a company of their own. Similarly, in the UK, more than half of the designers practicing in the UK do not have a formal qualification in design (Design Council, 2010). This seems to show that many of the key competencies and knowledge required for success in praxis are not acquired at universities.

A Manifesto for the Design School of the Future

As has already been stated, the knowledge disseminated by many universities today is less and less relevant to society, and that knowledge which is relevant is increasingly disseminated by institutions other than universities. The core of teaching at universities has less and less to do with the highly complex challenges we now face and the types of knowledge needed in the modern world is absent from most university classrooms.

Table 1. Phases of University Evolution (after Scharmer and Käufer, 2000).

Concept of University	Teaching	Research	Praxis	Dis-Unity
Medieval scholastic university: *"Unity of Teaching"*	Study by lecture "co-listening, "co-thinking"			
"Humboldt's classical university: *"Unity of Research and Teaching"*	As above, plus seminar style studies "co-speaking"	The individual researcher "in solitude and freedom"; Institutes		
21st century university: *"Unity of Praxis, Research and Teaching"*	As above, plus infrastructures for "co-initiating", "co-creating", and "co-entrepreneuring"	Action Research; Research consortia Clinical Research, Community Action Research,	Strategic co-creation with companies, consortia, venture capitalists, business incubators	
21st century altermodernity: *"Dis-unity caused by Market Politics and Globalisation"*	Un-cooperative	Productively irresponsible action	Production without a product	What has to be done? How can I explain to myself what I am already doing/not doing?

Humboldt's university reform postulated a "*unity of research and teaching*" that shifted the focus from the dissemination of a given body of knowledge to the research process that underlies the generation of the knowledge base (Humboldt, 1990). This expanded concept of the university opened the view toward the process of knowledge *genesis* and, at the same time, changed the nature of university teaching. While the scholastic lecture involves the students as listeners ("co-listening," "co-thinking"), the seminar-style class engages students as partners in dialogue and discussion, as "co-speakers" rather than mere "co-listeners" (Table 1).

In the currently unfolding phase of the university's evolution, another shift is taking place. The development of the modern university shifted the dominant perspective from knowledge dissemination to knowledge research. Now the focus is on the generative conditions of praxis that determine the contextual conditions of research processes. Knowledge creation is no longer based on researchers reflecting in solitude and freedom, but on the co-creation of praxis. However, governments and markets are actively reshaping what we perceive of the thing called the university. And what was always a trickle of complaint about the domestication of the modern university post 1968, has become a flood of books, reports, opinions and editorials, public admonishments, proposals and counter-proposals, new methodologies (including the new deal for massive open online courses through new consortiums like Coursera, Udacity, and edX), and free 'universities' begun in protest such as the Free University of Liverpool[1] all questioning the future project of the university. This deluge of complaint is symptomatic of what Nicholas Bourriaud calls the altermodern condition (Bourriaud, 2009) in which we propose the concept of the university as now one of dis-unity caused by market politics and globalisation. For example, the value-for-money learning environment generally depicts the business of teaching as un-cooperative. And since praxis is now measured in the production of nothing we argue below that the researcher now needs to be productively irresponsible (Rodgers and Bremner, 2011). However, in this phase of the university Boris Groys reminds us "*Every contemporary subject constantly asks these two questions: What has to be done? And even more importantly: How can I explain to myself what I am already doing? The urgency of these questions results from the acute collapse of tradition that we experience today*" (Groys, 2012: 1).

In an earlier paper, the authors proposed that the generation of new knowledge in design praxis can now only manifest what we identify as undisciplined design and while it might be the manifestation of design without discipline, for research to be recognised, it might also require a new type of researcher/practitioner; someone finding their own way through the muddle of what were once labelled the design disciplines, and for whom not knowing is an invaluable aid to getting through it – *i.e.* getting it out while getting through it. As the fragmentation of distinct disciplines has shifted creative practice from being "discipline-based" to "issue- or project-based" (Heppell, 2006), we maintain that the researcher, who purposely blurs distinctions and has dumped methods, from being disciplined to being irresponsible, will be best placed to make connections that generate new ways to identify "other" dimensions of design research, activity and thought that is needed for the complex, interdependent issues we now face. The digital has modified the models of design thought and action, and as a result research and practice should transform from a convention domesticated by the academy to a reaction to globalisation that is yet to be disciplined. Thus, in these conditions designers and artists should be encouraged to apply themselves irresponsibly.

Scharmer (2011), head of the Presencing Institute at Massachusetts Institute of Technology, posits that the old way of solving problems has crumbled, decayed, and exhausted itself and he believes we must find new ways of regenerating our social

[1] http://thefreeuniversityofliverpool.wordpress.com/

fabric that in many places has fallen apart. Scharmer believes the core of the challenge is to awaken and increase creative cognitive human ability as it relates to seeing, sensing, mobilizing and bringing the future to fruition. The ability to visualize and enable creative imagination, inspiration, and intuition is the decisive factor in today's multi-layered and super-complex world (Jaworski and Scharmer, 2000), which constitutes a third kind of knowledge outlined in Table 2 below as "self-transcending knowledge" (K3) (Scharmer and Käufer, 2000). Most university departments today operate in no more than 2 or 3 of the column one boxes (K1) – the dissemination of know-what (*e.g.* cases), know-how (*e.g.* accounting), and know-why (*e.g.* theory of economics). Largely missing are the learning environments of column two (K2), which let students gather their own experience and learn from it. Finally, the learning environments of column three (K3), which let students develop the most strategically significant type of knowledge for the new knowledge economy are completely absent from most university departments and courses of study.

Table 2. Types of Knowledge in Organisations (after Scharmer and Käufer, 2000).

Knowledge/Action Type	**Explicit Knowledge (K1)**	**Tacit-Embodied Knowledge (K2)**	**Self-Transcending Knowledge (K3)**	**Not Knowing (K4)**
A1: Performing	Know-what	Knowledge in-use	Reflection-in-action	Reflection-and-reaction
A2: Strategizing	Know-how	Theory in-use	Imagination-in-action	Imagination-and-inaction
A3: Mental Modeling	Know-why	Metaphysics in-use	Inspiration-in-action	Inspiration-and-inaction
A4: Intention and Identity	Know-who	Ethics/Aesthetics in-use	Intuition-in-action	Intuition-and-inaction
A5: Mis-representation	Know-not	Translation-in-use	Imitation-in-derivation	Irresponsibility-in-action

The issue for many organizations and institutions today lies in the fact that their organizations claim K3 types of knowledge in their mission statements, whereas currently most have solid processes and practices for the transfer of K1 knowledge and a number of practicable methodologies for K2 knowledge, but these have tended to focus on reacting to problems of the past. Explicit knowledge and tacit-embodied knowledge are no longer, by themselves, enough to guarantee an institution's ability "*to sense and seize emerging opportunities*" (Scharmer and Käufer, 2000: 5). While today's global problems appear to require knowledge that will help individuals and social systems realize and bring to fruition the knowledge of imagination, inspiration, and intuition (K3), the current phase of universities illustrates even the problems are beyond knowledge. The root of this corollary resides in seeking comfort in the knowledge that by framing the global crises as problems of sustainability we can repair the future. But we know this is not possible, so in place of knowledge now the university has to learn to value not-knowing (K4). It can do this by misrepresentation (*i.e.* seeing the world differently), challenging the global currency of the derivative (*i.e.* insurance against change), and returning to risk (*i.e.* being productively irresponsible).

We propose that the design school of the future is in a truly unique position to influence and transform the increasingly complex and heterogeneous world we inhabit

- a world where we are wrestling with major social, cultural, political, economic and environmental issues such as climate change, housing and health (Lawrence, 2004). But a design school that is capable of creating knowledge that is based on imagination, inspiration, and intuition and what Scharmer and Käufer (2000) call "self-transcending knowledge" for the emerging world will not happen if it is based on knowledge we already possess.

An Irresponsible and Undisciplined Design School

Given that the majority of the world's problems in the 21st century are increasingly complex and interdependent, and they are not isolated to particular sectors or disciplines it is likely that any design school of the future will need to be more "undisciplined" in its approach to these challenges. Moreover, there might even be a need for the graduate to be "irresponsible" because we need more playful and habitable worlds that the old forms of production are ill equipped to produce (Marshall and Bleecker, 2010). We are advocating that there is a responsibility on designers to be "irresponsible" and, at the same time, "undisciplined" in their work. Brewer (2010: 92) goes even further in his criticism of existing forms of knowledge production and claims that contemporary "*specialized forms of knowledge have become debased instruments of social control and discipline.*" Moving towards "undisciplined" practice and states of "unknowing" in an age of alterplinarity therefore requires an epistemological shift. However, this will in turn offer us new ways of fixing the problems the old disciplinary and extra-disciplinary practices created in the first place.

The question of "disciplinarity" has featured large in design discourses in recent times, which has led to claims by some authors (e.g. Brown et al., 2010; Turnbull Hocking, 2010) that design is in a truly unique position to influence and transform the increasingly complex, heterogeneous, and crises-torn world that we currently inhabit - a world where we are wrestling with major social, cultural, political, economic and environmental challenges (Lawrence, 2004). Given this current situation, the world of design praxis has become a challenging and dynamic arena where professional disciplinary boundaries are increasingly fuzzy, economic and employment patterns are shifting, societal and cultural issues are enormously demanding, and technological developments (most notably in information and computing technologies) are expanding rapidly. This is a world where design praxis can involve the design of packaging for a new brand of expensive water one day and the next day require the design of a service for caring for excluded and disadvantaged people in rural locations. Design praxis now resides in a world where one-off designed objects such as a chair or a table can fetch hundreds of thousands of UK pounds at auction. This is a world where design projects regularly consist of teams that coalesce for a project, dissolve and reform with different personnel and expertise. Today it is increasingly common to find new fusions of creative practitioners working on projects. Designers, for example, no longer fit into precise categories such as product, textile and graphic design; rather they are a lively mixture of artists, engineers, designers, entrepreneurs and anthropologists (West, 2007). Tony Dunne, Professor of Interaction Design at the Royal College of Art, London states: "New hybrids of design are emerging. People don't fit in neat categories; they're a mixture of artists, engineers, designers, thinkers. They're in that fuzzy space and might be finding it quite tough, but the results are really exciting." (West, 2007).

This is not a new revelation, however. Design has always been viewed as a bridge between art, science and other subjects (Flusser, 1999). However, what is new is that designers and design companies in general are now faced with adopting and utilising techniques and approaches that until recently have been comparatively uncommon to them. Design praxis now commonly involves the usage of techniques from other areas like filmmaking, anthropology, storytelling, the social sciences, and so on. So it is fair to say that designers now transcend and transfigure several conventional disciplines. In other words, they often operate in "undisciplined" and productively "irresponsible" ways. Technological developments in the design and creation of products and spaces including rapid prototyping, 3D digitising, and motion capture has altered the practice of design enormously. There is a long list nowadays of contemporary designers that rely heavily on and exploit emerging computing and manufacturing technologies including Ron Arad, Ross Lovegrove, Frank Gehry, Thomas Heatherwick, Zaha Hadid to name just a few. The acceleration in digital design and manufacture tools has given creative practitioners new means of exploring new territories beyond and across the now fuzzy intersections that exist between art, architecture and design exploiting the latest computing technologies in their praxis (Rodgers and Smyth, 2010).

Figure 1. Nuage Vert (Green Cloud), by HeHe, 2008 (photo by Antti Ahonen). Source: (Rodgers and Smyth, 2010: 63).

A good example of "undisciplined" and productively "irresponsible" praxis, which rejects established knowledge and conventional ways of working inherent in the old disciplinary practices that contributed to many of the problems described earlier in favour of new ways of working is that of HeHe. HeHe are a creative practice who often don't work for a client brief. They are interested in using technology as a medium for helping them to express their creative ideas. Nuage Vert (Figure 1), a HeHe project that took several years to fully realise, originated as an idea of finding ways to materialise pollution where no prior knowledge was available. Helen Evans, one of the partners of HeHe, describes the "undisciplined" nature of the Nuage Vert project as:

…we learned along the way. I think when we first had the idea we didn't know how to realise it because we didn't know how to play the politics of it. We had one person inside the factory who was personally supporting the project even though his company wasn't. And so he would advise us and say, well if you can get the aviation authority to say this was possible, that would help. (Helen Evans of HeHe, *in* Rodgers and Smyth, 2010: 70).

Conclusions

The emerging opportunities and challenges that we will face in an increasingly complex and heterogeneous world that we now inhabit will provide significant tests for design praxis. This emerging world, where we struggle with major social, cultural, political, economic and environmental crises including the ecological crisis, the crisis of global poverty and the health and well being crisis of our future selves (Lawrence, 2004), will necessitate the destruction of traditional creative disciplinary boundaries. This will have a significant impact on design praxis, research, and education in the future.

The idea of "undisciplined" and "irresponsible" praxis described in an earlier paper by the authors (Rodgers and Bremner, 2011) proposes an alternative disciplinarity (*alterplinarity*) where the creative practitioner is viewed as a prototype of a contemporary traveller whose passage through signs and formats refers to a contemporary experience of mobility, travel and transpassing where the aim is on materialising trajectories rather than destinations, and where the form of the work expresses a course, a wandering, rather than a fixed space-time. This idea has its origins in Nicholas Bourriaud's notion of the "Altermodern" (Bourriaud, 2009). The fragmentation of distinct disciplines, including those located in traditional art and design contexts, has shifted design practice from being 'discipline-based' to 'issue- or project-based' (Heppell, 2006). This shift has emphasised and perhaps encouraged positively irresponsible practitioners, who purposely blur distinctions and borrow and utilise knowledge and methods from many different fields. Thus, we propose that the design school needs to shift from being "discipline-based" to "issue- or project-based", and "undisciplined", "irresponsible", and "unknowing" graduates will be best placed to make connections that generate new knowledge and methods and identify 'other' dimensions of creative research, practice and thought that is needed for the contemporary complex and interdependent issues we will surely face.

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Design Schools as Incubators of Social Entrepreneurship

Daniela SELLONI*
Politecnico di Milano

Abstract: *This paper aims to reflect on the intersection of design education, research and social enterprise incubation within a design studio run as part of the Master in Product Service System Design at the Politecnico di Milano, School of Design. Entitled "Accidental Grocers", it aimed to explore the potentialities of Service Design applied to "Local Distribution Systems" to provide the city with local food. Students were requested to rethink the way we do food shopping and to propose services based on collaboration, making use of existing assets, and creating unusual connections between profit and not-for-profit, amateur and professional, market and society. As experienced in previous workshops at Politecnico di Milano and Tongji University, the studio was related to an on-going action research project to create short chain food services in a district of Milan. The aim was to develop ready-to-use solutions, establishing direct connections with citizens and local stakeholders, using methods of community centered design and simulating the conditions for incubation in a real context. This experimentation field functioned as a "protected environment" to test potential service start ups and to develop entrepreneurial teaching and learning practices.*

Keywords*: service design education, service design research, incubation, start up, social entrepreneurship, social innovation.*

* Corresponding author: Design Department/DIS-Design and Innovation for Sustainability | Politecnico di Milano |Italy | daniela.selloni@mail.polimi.it

The relationship between teaching and research in service design

The relationship between teaching and research in the School of Design is very close.

In particular Service Design research has a recent history compared to other areas and this leads to its expression and development through didactic activities, optimizing processes and opportunities.

Pacenti and Sangiorgi (2010) identify three different Service Design research themes: investigations into the nature of services and of Service Design as a field, investigations into Product Service Systems, and investigations into social innovation and sustainability. When we talk about Service Design research, in this paper, we specifically refer to the third theme. This stream of research on sustainability and social innovation is strongly connected with existing examples of creativity among ordinary people to solve everyday problems by creating services related to food, housing, transport and work (Meroni 2007).

Combining research and teaching in this area allows creating a protected experimentation field in real contexts, where students, teachers and ordinary people work together.

Students play the role of budding researchers exploring the proposed areas and dealing with problems of a systemic dimension "...We believe these students can significantly contribute to “warming up” research thinking in this field... Actually, their involvement can result in a double achievement: practicing on real cases helps them to develop awareness towards sustainability and systemic thinking, and approaching these themes in design studios allows teachers to begin exploring new research topics with more freedom and creativity." (Meroni 2011)

This occurred in the design studio “Accidental Grocers”, the main subject of this paper, run as part of the Master in Product Service System Design at the Politecnico di Milano, School of Design.

The studio followed the example of previous workshops realized with students of Service Design and Product Service System Design from the School of Design of the Politecnico di Milano, and of Politong Master Program – a double degree program between the Politecnico di Milano and the Politecnico di Torino in Italy, and Tongji University in Shanghai, China (Meroni 2011).

In both cases extensive design experimentation has been carried out involving students, institutions, local communities and stakeholders, within the overlapping research and educational context, using methods of community centered design (Meroni 2008).

Furthermore, Maffei, Mager and Sangiorgi (2005, p.2) notice a growing interest in Service Design experimentation within design schools and studio and suggest "a further evolution toward a concrete integration within service development practice and related disciplines and methods." They also investigate on the possibility of enhancing innovation through Service Design research and education, especially in the stream of research that we are considering, the one on sustainability and social innovation.

They conclude proposing a strategic role for Service Design research and education by integrating actors, competences and approaches, bridging divisions between disciplines and collaborating with the areas of technology and business.

More specifically, in the design studio "Accidental Grocers" we can observe a multidisciplinary character in crossing Service Design research and education with overlapping fields of the social economy, social entrepreneurship and social enterprise suggested by Murray, Caulier-Grice and Mulgan (2010), to be discussed in the following paragraphs.

The relationship between teaching and professional practice in service design

In design schools, teaching and professional practice enjoy a more consolidated relationship than in other university disciplines (such as humanities for example). This is because student would-be-designers carry out a practical placement with a company during their course of studies and in some universities, as Politecnico di Milano, this practice is mandatory to obtain a degree.

However, in this period of economic crisis and job shortage, we are witnessing another phenomenon that links teaching and professional practice in a novel way, especially in the area of Service Design.

According to Manzini (2011), the job of designers has changed not only from product to service designers, but it is evolving in "agents of social innovation", replicating good ideas and starting up new ones, acting as (social) entrepreneurs.

What is happening is that instead of carrying out a practical placement in a company or an agency, some students are becoming “entrepreneurs” themselves. In other words, many of the ideas developed in the teaching constitute service solutions that, when properly modified and improved, can really be launched on the society and on the market.

Several young people with innovative ideas have actually moved on from their student status to that of entrepreneur during the final years of their university education. Anticipating a long period searching for work, some of them decided early to “invent ” it themselves and have taken the risk of carrying on with their own innovative ideas.

This also happens because setting up a service is much simpler than starting up a business producing objects. Often the resources required are few and available online, and low cost ICT plays a fundamental role in providing these services.

We provide an example of service start-up realized by a designer-student. It is not a random example, because it is connected to short chain food, the same theme of the studio "Accidental Grocers" and it is located in Italy.

Paolo Ferraris, student at IED Milano, established few years ago a start up called "Le verdure del mio orto - Vegetables from my garden." This is a service that creates a new channel for selling fruit and vegetables, establishing a direct connection between the farmer and the consumer by creating a virtual vegetable garden and delivering the results at home.

This example shows some key characteristics: it is a service start up; it is ICT based; it is the result of a student's entrepreneurship who makes profit of his Service Design practice; it is connected to job shortage and in a certain way it is also linked to social and sustainable values.

The transition from student to entrepreneur is therefore substantially bound up with the force of two drivers: one is social-economic i.e. the economic crisis (it looks rather like a contradiction in terms); the other is strictly technological, consisting of facilitated access to platforms and software, or to funding tools like crowd funding.

In addition, these service ideas turning into start ups are innovative because they were generated in areas that by definition produce innovation, i.e. education and research. In the UK, not a random example, 97% of highly innovative social enterprises are associated with the service offer (Alastair Fuad-luke 2009).

Within the same context, the UK, Nesta drafted a report on the necessity of putting entrepreneurship at the centre of higher education, arguing that

> developing entrepreneurial teaching and learning practices demands a shift from transmission models of teaching (learning "about") to experiential learning (learning for) and offers students techniques that can be applied in the real world. (Herrmann 2008, p.7)

According to Nesta, entrepreneurship education exposes students to environments that enhance entrepreneurial mindsets, behaviours and capabilities. This process can be used to generate value in various contexts from the public sector and corporate organizations, to social enterprises and new start-ups.

In Italy we still need to understand the extent of this phenomenon, because we are experimenting a pioneer phase and undoubtedly not all Service Design students will be able to turn into social entrepreneurs.

Research as a "protected environment" for developing entrepreneurial teaching and learning practices

So far we have briefly examined within Service Design the relationship between teaching/ research and between teaching/professional practice, entrepreneurial practice in particular. So, to complete the relational network between the three areas, we should now examine the relationship between entrepreneurial practice and research.

The assumption upon which this paper is built is that Service Design research combined with education can provide an appropriate framework to foster social entrepreneurship. To use an expression by Ceschin (2012) this framework is a "protected environment", a "lab" conceived to test, learn and improve innovation on multiple dimensions (e.g. social, cultural, economical).

Actually, in the case to be examined (the design studio “Accidental Grocers”), research constitutes a context able to connect education and entrepreneurial practice in a novel way. Within this environment the passage of the service designer from education to practice is encouraged and facilitated.

Service Design research, with its vocation as on-field experience with the communities, offers occasions, pretexts, tools that are useful both to teaching and incubation, becoming a sort of gymnasium for social enterprise. This environment becomes a "lab" to warm up service start-up incubation, offering to students the possibility of carry on their solutions in the real world.

The result of the studio “Accidental Grocers” is the production of semi-finished services: ready-to-use solutions generated and developed in this protected environment. This framework is the research place: a container that offers methodologies and allows for experimentation, failure, adjustment, implementation and hopefully incubation

A case study: developing ready-to-use-solutions in the design studio "Accidental Grocers"

A good example of how research and teaching can create a pre-incubation friendly environment for young start ups is “Accidental Grocers”, a design studio run as part of the Master in Product Service System Design at the School of Design, Politecnico di Milano.

“Accidental Grocers” plays ironically on the possibility that all of us, if equipped with initiative, appropriate tools and a support system, may become “grocers” within a Local Distribution System.

The concept of Local Distribution System is basic to the design studio and is defined as "an experimental system of food distribution based on new combinations of professional and non-professional contributions, unusual collaborations between stakeholders and hyper local networks of people and entities such us shops, businesses, associations, supported by dedicated digital tools" (Cantù et alt, forthcoming 2013).

The Local Distribution System (LDS) is a system of alternatives to large-scale retailing. It is based on disintermediation and short food chains and seeks to foster as direct as possible a meeting between demand and supply, between city and country. In this diffused local distribution system ordinary people play a strategic role because they become the mediators between end-users and peri-urban farmers.

The choice of this particular theme is linked to a research project, which is why “Accidental Grocers” virtuously exemplifies the merging of teaching and research with the additional element of enterprise pre-incubation. The project is called "Feeding Milan. Energy for change," launched by Slow Food Italy, the Politecnico di Milano-INDACO Department and the University of Gastronomic Sciences, Bra, Italy. This is a strategic design project for place development (Meroni 2011) aiming at creating a network of services to connect farmers in the peri-urban area directly to consumers in the town.

"Within this project a service design team integrates a multidisciplinary group of agriculturalists and gastronomists to design a network of interconnected services based on the principles of short food chain, multifunctionality and collaboration between stakeholders, in order to develop a scenario of sustainable agriculture and food supply for Milan." (Cantù et al. forthcoming 2013)

Figure 1. An evocative visualization of the Local Distribution System.
Source: Daniela Selloni

Context and actor system

During “Accidental Grocers” students became field researchers operating in a real context: that of zone 4, to the south-east of the city of Milan, a district that had previously been involved in “Feeding Milan” and had demonstrated a vocation for activism, participation and interest in the issue of services based on short supply chains.

Students were first asked to get to know the context, by applying research methodologies typical of urban ethnography. These are often borrowed by Design in order to analyze and interpret the environment of reference in the best possible way. Students undertook *action research* on the field, opening their research to the local community and various other stakeholders.

One of the key characteristics of this mix of research, teaching and social enterprise is the enlarged actor system.

The system consists of:

- an unusual group of researchers in that it comprises students, teaching staff and assistants;
- a community of pro-active citizens, local to the specific territorial area;
- a body representing public institutions, i.e. the local committee for zone 4 answering to the Milan city government;
- a food consultant from Slow Food;
- an incubator of sustainable social enterprise, in the form of Avanzi, a think tank active in the Milanese area in the design education and development of start-up companies
- a cultural operator able to design public space, and promote and organize collective gatherings and events, in the form of Esterni;
- an attractive, convivial space in the neighborhood of zone 4, to accommodate meetings of the various actors, such as co-designing sessions. This is located in the Cascina Cuccagna, a particularly significant place as it was saved by a group of pro-active citizens who recovered and renovated the building, which is part of the history of both neighborhood and city.

The outcome is that the design studio offers a rich, structured course of design education. The methodology followed is of learning-by-doing, with students taking an active part in society and the market. Learning occurs not only through traditional up-front teaching and design workshops, but also through experimentation on the field where student-researchers interact with different actors “guided” by a vision originally proposed by the teacher-researchers.

The various stages of the design studio "Accidental Grocers"

The process followed in the design studio falls into 7 main stages.

1_ Looking for cases of local distribution linked behaviour
2_ Analyzing contexts of reference
3_ Elaborating concepts
4_ Co-designing with the community
5_ Revising the services
6_ Implementating the services and open videotelling
7_ Ready-to-use solutions for prospective start-ups

1 Looking for cases of local distribution linked behaviour

Students were asked to look for emblematic cases of everyday practices that are capable of generating informal economies. These came under rather unusual categories as listed below:

"Since you are going...": taking advantage of someone who is already going to a particular place for a specific purpose.

"Since you are passing by...": taking advantage of someone who is already taking a particular route (eg: commuters).

"Since you are doing...": taking advantage of someone who is already doing something on their own behalf or for someone else (p2p communities).

"You give me I give you...": new forms of barter and informal exchange.

"Can I do it for you...": offering skills and knowhow in order to do something that others cannot. (Not a p2p relation).

"Might use your..." engaging someone who has an asset (e.g. time, space, specific knowledge…) to share with others.

In this way student-researchers produced a case collection of informal economies that in a sense constitute an example of diffused, local distribution. The cases were not only selected by traditional desk research, but also through interviews, using ethnographic research methods.

2 Analyzing contexts of reference

Exploration of zone 4 took place on the field, as in many *action research* projects. Context analysis was divided into different parts and assigned to research subgroups so as to generate collective knowledge where each group added their own contribution. In order to create the neighborhood information system more easily, the exploration was divided into the following areas of analysis:

- Food related places
- Gathering points
- Hidden Landmarks
- Living neighborhood
- Moving around
- Underexploited places
- Events
- Creative Communities

The aim of identifying different areas of study was to collect both quantitative and qualitative information. The intention was to collect stories to create a narrative and a shared interpretation of the neighborhood.

3 Elaborating concepts

Idea generating and concept elaboration is the stage that most closely mirrors traditional design teaching methodology. After a brain storming session 8 ideas were generated, studied in depth and developed into an appropriate form for the subsequent co-designing activities.

4 Co-designing with the community

In the co-designing sessions the student researchers submitted their ideas to two different communities. Obviously one of these was the community of zone4 residents, the second consisted of the group of producers who took part in the Farmer's Market set up in the framework of Feeding Milan. In so doing, feedback emerged from both the "demand" and the "offer" sides and there was no need for discussion with other actors in the chain, because the services proposed were already as disintermediated as possible, eliminating all passages between consumer and producer.

The co-designing activities were inspired by the community centred design approach (Meroni 2008) as a way to: work on-field within the local communities in order to design together the solutions for the problems they are affected by; take action and participate in the first person in understanding challenges and opportunities that emerge; use participatory design and service prototyping tools and methods as ways to design for democracy (Margolin 2012) and to motivate the stakeholders.

Co-design occurs by using various tools. Essentially, each group of student-researchers created a service mock-up for the resident community. The service mock-up, often a paper- cut mock-up, is useful because it stages the service making the actors, equipment, interfaces and action flows visible. This takes the form of a short narrative, made up of mouth to mouth stories, physical evidence and choreography, which makes it easier to understand how the service functions and what critical points there may be.

Co-designing with producers differs from co-designing with citizens because it has an informative rather than narrative value. It is not by chance that the tools used are mainly questionnaires and interviews, the purpose of which is to acquire knowledge, opinions and preferences on issues concerning the workings and the economic and environmental sustainability of the service.

Figure 2. Co-design session with the local community at Cascina Cuccagna. Source: Yanti li, Ege Samioglu, Francis Leo Tabios, Ludovica Vando, Jianli Wan

Figure 3. Co-design tools. Source: Yanti li, Ege Samioglu, Francis Leo Tabios, Ludovica Vando, Jianli Wan

Figure 4. Co-design tools. Source: Daniela Selloni

Figure 5. Co-design session at the Farmers' Market. Source: Yanti li, Ege Samioglu, Francis Leo Tabios, Ludovica Vando, Jianli Wan

5 Revising the services

The co-designing sessions produced a quantity of ideas that profoundly changed the initial service ideas, just as the initial hypothesis in a research process may be modified when confronted with the results of experimentation.

The solutions created were therefore implemented appropriately for revision by the experts from Avanzi and Esterni.

The revision carried out by the staff of Avanzi, specialized in enterprise incubation, essentially aims to bring the business model underlying the service proposals into focus. It is this activity that, more than any other, bridges the gap between teaching, research and social enterprise, since the services are selected and validated on the basis of their economic solidity, making them more or less ready for the market, generally as innovators.

A second revision is carried out by the experts from Esterni who, as cultural operators, are more attentive to the quality of experience offered. In addition, as specialists in organizing events in public spaces, they are able to assess the capacity of the services to gather people together and enhance social relations. This is particularly important when dealing with food, which should bring the added value of conviviality.

6 Implementating of the services and open videotelling

After revision by the experts, the 8 service ideas were modified further and implemented so as to be narrated through a novel form of audiovisual storytelling that leaves the co-designing process open.

The student-researchers explained the service through a video with breaks at key points to enable questions to be put to the viewers. These concern viewers' opinions of some of the service characteristics, since the videos were designed to be viewed on the internet, with the possibility of receiving written feedback, as occurs in various online platforms. This procedure stimulates open, virtual, participatory designing, parallel to the ethnographic research formats being developed at the moment, such as digital ethnography.

7 Ready-to-use solutions for prospective start ups

The outcome of the design studio "Accidental Grocers" consists of 8 service ideas ready to be incubated and launched on the market. They each require a provider: an entrepreneur to carry the process on from design project to service, and this role could be taken on by the students themselves. It often happens that designers fall in love with their own projects and wish to develop them. In this particularly moment of economic crisis, when jobs are lacking, many young people are becoming "start-uppers". It is for this reason that teaching and research should foster this passage and be prepared to acquire such expertise.

The 8 solutions have been returned to zone 4 in a public presentation at Cascina Cuccagna, to which various potentially interested stakeholders were invited.

They have in common the quality of using what already exists, creating innovation through the combination of elements already present in the territorial area.

> MECO_ a market that enables the residents of an apartment block to hold a farmers' market in their own front yard.

> JAM SESSION_ a platform that links producers to a multi-functional space, equipped with a common kitchen for jam making.

> UN SACCO SANO_ a platform that links parents with differing time availability, in order to cook healthy meals for their children during school hours.

> MENÙ CIFRATO_ a platform that links restaurant owners and producers to organize surprise dinners using left-over.

> BOX STOP_ a delivery service of local products by public transport network.

> FRESCA CONSEGNA_ a participatory logistics for periurban producers.

> 4SAPORI_ a delivery of quality food by the Italian postal service

> LEGAMI DI PANE _ a logistic system based on the routes taken every day by commuters that become active actors by transporting bread.

The 8 solutions are very different from one another. Some started with a brilliant idea and are already at an advanced stage of prototyping, others are weaker but with due adjustment they could constitute a valid service opportunity.

What is interesting is the hybrid environment of education and research in which they were generated and the revision process they went through to become services ready for the enterprise pre-incubation stage.

Social innovation and social entrepreneurship within the "protected environment" offered by research

The “Accidental Grocers” experience presents a promising mix of teaching, research and entrepreneurship, with the common aim of creating social innovation.

Mulgan proposes the following definition of social innovation: "social innovation refers to new ideas that work in meeting social goals."(Mulgan 2007, p.8)

The adjective “social” has many connotations, but it is interesting that it indicates the active role of people (consumers, citizens, but also institutions and organisations) in the realisation of innovation processes.

Social innovation is created by different actors: not only heroic single individuals endowed with initiative, but also governments, markets, movements, the academic world and that of research. More specifically, social innovation comes from the capacity to draw individuals, organisations and institutions together. We can affirm that this union of actors has occurred in “Accidental Grocers”: companies and associations, foundations and universities, public and private institutions are all involved to a greater or lesser degree in the network that has built up this singular teaching and research activity. The social innovation described by Mulgan is characterised by the capacity to connect differences: it often uses new combinations or hybrids of elements that already exist; it crosses boundaries between different organisations, sectors and disciplines.

Mulgan also notes how social innovation is involving areas that coincide with the experimentation in “Accidental Grocers”: "social entrepreneurship, design, technology, public policies, cities and urban development, social movements, community development." (Mulgan 2007, p.6)

He also lists the various stages of innovation as follows:

- generating ideas by understanding needs and identifying potential solutions
- developing, prototyping and piloting ideas
- assessing then scaling up and diffusing the good ones
- learning and evolving (Mulgan 2007)

What occurred in “Accidental Grocers” stopped at the second stage.

The 8 solutions developed reached the service prototyping stage, but stopped at the thorny phase of applicability and scalability. It is difficult to replicate and multiply a pilot project, especially if it has not gone through a proper stage of enterprise incubation. This is why it is to be hoped that the protected environment offered by Service Design research and education will be able to evolve into an incubation laboratory. The creation of such a hybrid container would make it possible to open the university world to the outside. Many design research units are already open to the market and the business world, but what we are proposing is a wider opening towards society, a proper entry on the field that would foster the integration of design education and research elements in the fabric of our cities.

Working together with and strengthened by research activities, the educational offering of our universities is capable of approaching the areas of social innovation and the bottom-up initiatives that at this period in time are characterising urban areas, inhabited by Creative Communities (Meroni 2007) and bubbling with ferments that are transforming informal economies into social enterprise.

If the students from "Accidental Grocers" wanted to carry on with their idea, they would be destined to transform themselves into social entrepreneurs, because they attended a course that aims to create innovation by designing collaborative services (Manzini 2008).

They would correspond perfectly with Leadbeater's definition:

> social entrepreneurs will be one of the most important sources of innovation. Social entrepreneurs identify under-utilised resources – people, buildings, equipment – and find ways of putting them to use to satisfy unmet social needs. They innovate new welfare services and new ways of delivering existing services. (Leadbeater 1997, p.3)
>
> The same definition also fits the type of service designed, both because this is part of the brief for Local Distribution Systems and because the course took place in a given territorial area in contact with a particular community, where it is easier to take existing elements and combine them.

The problem remains of the passage from pilot project, in an educational and research context, to enterprise outside in society at large.

Tools and expertise are required to:

- clarify the business models and understand how it may be possible to trigger the production of economic value without detriment to that of social and environmental value;
- identify a management system that is both efficient and socially responsible;
- build an appropriate partnership;
- build relationships with institutions and knowledge of public policies;
- raise capital.

An approach to some of these has been sketched out during the development of "Accidental Grocers".

However, when duly included in the Service Design - creative community - bottom up framework, the question remains both open and multi-faceted: can research successfully bridge the gap between design education and social entrepreneurship? Can these protected environments play the role of incubation spaces?

The answer would appear to be affirmative, but calls research units to open up further towards the outside world and set roots in local territory and community. This kind of growth may be particularly opportune for Service Design activities and the exploration of collaborative services, because it not only provides a field of experimentation, but also a network of connections and a space for the diffusion of future evolutions.

In an imaginary but feasible scenario, it is as though our cities were strewn with recognised, institutionalised spin-off universities, hybrid nodes of research that could be integrated with educational activity and social enterprise, fostering the shift from "learning "about" to "learning" for", as suggested by Herrmann from Nesta (2008).

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Systems Oriented Design: The emergence and development of a designerly approach to address complexity

Birger SEVALDSON*

Oslo School of Architecture and Design, Institute of Design.
OCEAN Design Research Association

Abstract: *Designers are especially well suited to cope with the complexity of the real world because of three reasons: they are trained to synthesise solutions from complex and fuzzy material and they are good at visualising which is an enormous advantage for thinking in complexity. Finally they are creative people trained to come up with new solutions. There already exists design practices geared towards dealing with complexity. But such practices need to be systematized and developed further. One way of doing this is to develop its relation to other practices of complexity found in systems thinking and systems practices. This paper reports on the development of Systems Oriented Design, an approach to learn how to better cope with very complex issues as designers. The approach is influenced and inspired by modern systems thinking and systems practice and inspired by generative diagramming. Design practice, systems thinking, systems practice, design thinking, information visualisation, diagramming, GIGA-mapping, research by design, research through design, design for complexity, sustainability.*

Keywords*: Design practice, systems thinking, systems practice, design thinking, information visualisation, diagramming, GIGA-mapping, research by design, research through design, design for complexity, sustainability.*

* Corresponding author: Oslo School of Architecture and Design | Institute of Design | Norway
email: birger.sevaldson@aho.no

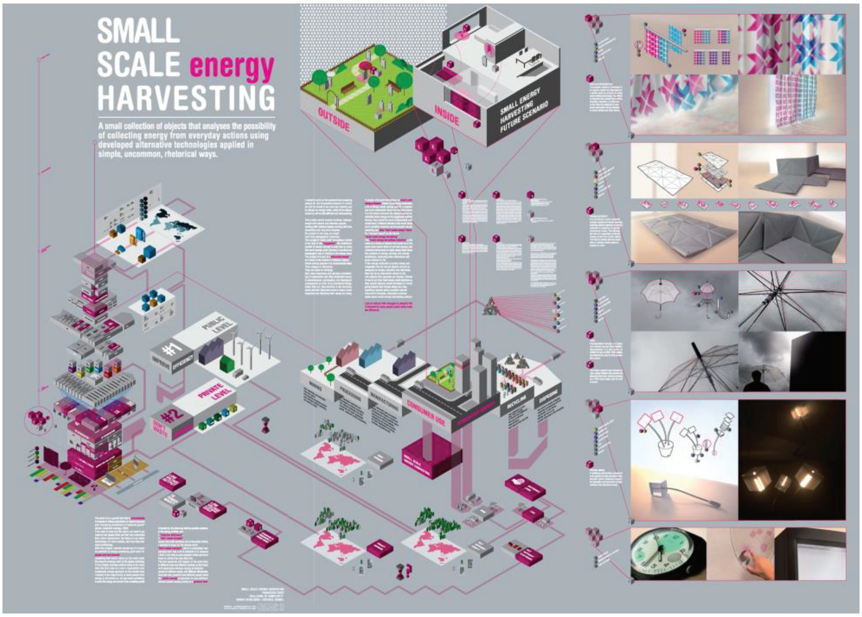

Figure 1. *The Small Scale Energy Harvesting project demonstrates a feasible way of making small everyday objects into energy harvesting rather than energy consuming items. A suggestion for super distribution of energy production. Energy is saved according to a piggy bank metaphor. (Master student Francesco Zorzi, tutor: author)*

Introduction

The practice of designers is forced into a process of change because of the increasing need for sustainable development and the increasing degree of globalization. Systems Oriented Design addresses these problems and intends to develop a better systems practice for designers to cope with these challenges. SOD is a skill based approach that is based on designerly skills. Designers are generally good at dealing with fuzzy and wicked problems (Rittel & Webber, 1973). This is recognized in different ways by people in other fields (Boland & Collopy, 2004; Brown, 2008; Maier & Rechtin, 2000; Martin, 2009; Rechtin, 1999). Within design we treat this ability as a tacit skill mostly taught in project based education and there are few if any efforts to improve these skills through targeted training and development of suited design techniques. The project based education is in some cases supplemented with different approaches to complexity that are taken from other fields, such as systems approaches or management tools. But such tools imported from other fields are not easily adapted to a designerly process. What we lack is an integration of these foreign approaches into design and a better training of designer skills to improve the inherent skills we already possess when it comes to dealing with difficult and complex problems.

SOD intends to develop such a designerly approach where certain external perspectives and theories are adapted and where inherent skills are better trained.

SOD looks at modern systems thinking which deals with the dynamic complexity of real world problems in a pragmatic way. These perspectives are re-interpreted in the context of design, combining them with concepts of designing for complexity coming from within design and architecture. Further on these perspectives are combined with design thinking, reflection in action and with designing. New design proprietary perspectives and techniques are developed. These different components in SOD are merged through design practice. This basic platform is taught to design students at different levels in an un-dogmatic and open manner. The design students ideally will be capable of using the SOD approach, merge it with other approaches and change it and adapt it to individual preferences and to new emerging needs.

SOD regards designing the design process for each project as the central strategy when dealing with very complex issues.

Traditionally designers tend to focus on the result, the object. Though it might be true that designers inherently have the ability to synthesise good solutions from very complex input, this object orientation is a disadvantage for designers. Complexity grows out of the interrelations of objects and hence we need to pay attention to the system level. New trends in design, like software design and service design, have changed the attention from object focus to systemic interventions, experiences, interactions and development over time through versioning. This development points towards a more complex design process that might have elements of systems thinking. But the scope of these projects is still limited. The framing of the projects in these cases tends to be set by commercial interests only or conventions or directed by “best practices”, instead of through active inquiry and mapping of many imaginable relations and of some of the possible consequences of specific design interventions. Such deep engagement in the systemic interrelations is needed to reach solutions that combine ethical issues with sustainability, economy, new technology, social and cultural and commercial considerations etc.

Systems Oriented Design is un-dogmatic and design oriented in its approach to systems. The systems oriented designer is initially less concerned about hierarchies and boundaries of systems and more interested in looking at vast fields of relations and patterns of interactions. She is geared towards looking at as many interrelations as possible and working with a “field-feel” and holistic overview, while making details accessible. The systems oriented designer is looking beyond the object (product or service) and she perceives the object merely as a “symptom” or “outcropping” of vast systems that lay behind the object (Figure 2).

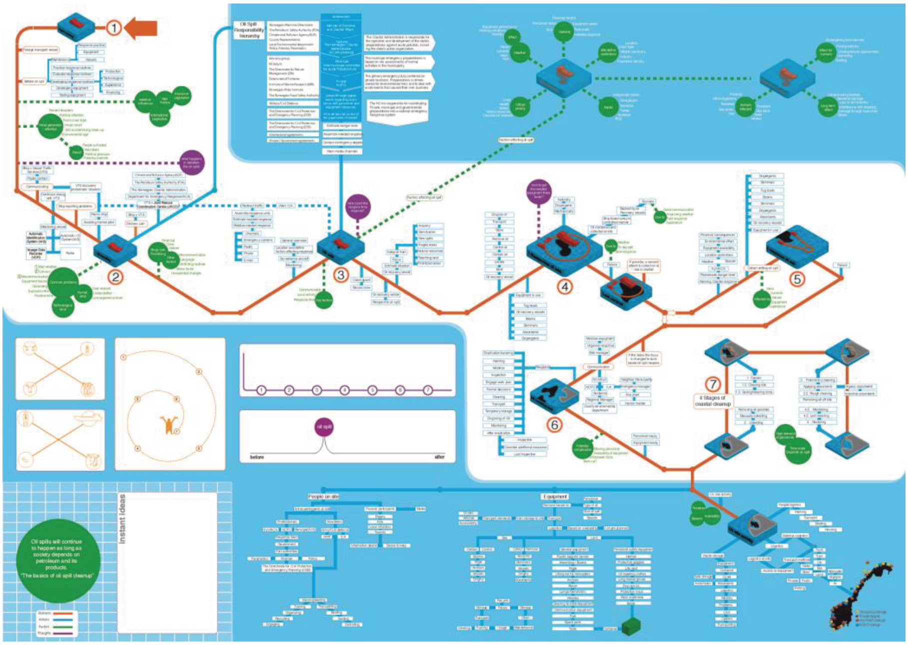

Figure 2. *The diagram shows the flow of actions during an oil spill accident when a ship runs on ground outside the cost of Norway. It shows all the actors and stakeholders involved and influenced by such an event. But moreover it also displays potential for new systems interventions. The result was an innovative way of interconnecting all actors, official and private in a social network that communicates risk factors and risk awareness, so that preparations can be made to prevent such accidents of happening. (Master thesis by Adrian Paulsen, Advisor: Birger Sevaldson)*

The systems oriented designer is both humble and bold. She is not scared by the complexity of a task but she rather embraces this complexity for the inherent potential for innovation. She is also not afraid to enter new fields for design, unknown to her. At the same time she is humble towards the need for knowledge and the need to learn very fast when entering such new fields. She relies on building up expert networks to compensate for lack of knowledge.

For each design case the phenomena at hand is deeply researched, starting with a very rapid learning process with a very steep learning curve. This process starts with visualisation: large maps are used for systematizing and interrelating the knowledge, preconceptions or speculations we already have of the subject. This needs to be done to an extent that produces several hundreds of items on the maps (Figure 3). Hence these are called GIGA-maps. The maps are reinterpreted and fleshed out together with stakeholders or new sets of maps are drawn together with them.

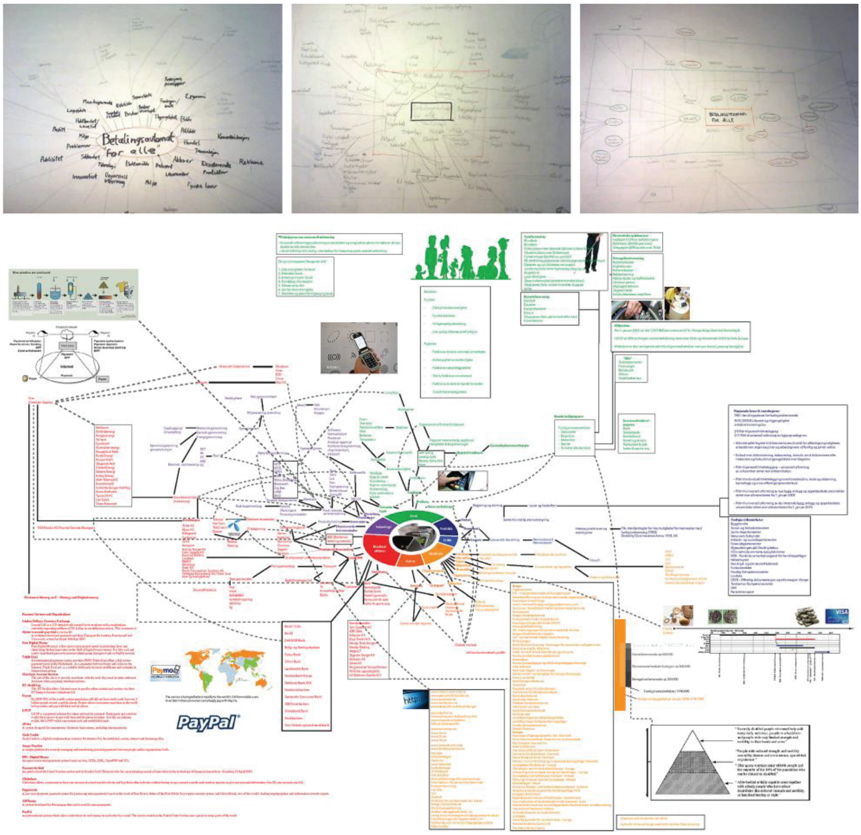

Figure 3. A project for a new payment terminal developed into a system for consumer empowerment through deep systems understanding of the processes of shopping at super markets. Needed information about relevant issues was provided at the buying moment to the consumers so that they would be able to make informed decisions. (Master Student: Erik Lindberg, tutor: Birger Sevaldson)

Blank spots are zoomed in for further research, the needs for expert networks are defined, and points for potential interventions are found. For each case the visualization methods vary. The approach resists too early and poorly founded simplifications. Where others tend to ask for simplifications in Systems Oriented Design we ask for richness. The models are built from the dialogue and research rather than built upon existing systems dogmas.

The systems oriented designer is a good designer (unlike many of the other approaches e.g. organisation design or education design, using the term design but where the value of design skills is disregarded). She uses designing as a way of thinking through, ordering and internalizing a picture of the information cloud needed to reach a resolution of the issue at hand and to induce a creative process. But she also resists the urge to over-design the maps. She keeps the design of the mapping open because she knows that it will always be incomplete.

The GIGA maps are used for drawing the boundaries and framing of the system and for generative processes. Only when one has mapped far beyond what seems relevant one can draw boundaries in a meaningful and informed way. Boundaries and frames are adjusted and redrawn when needed. New ways of diagramming might be invented and adapted to each case. The diagrams are developed through stages of redesign and refinement and ultimately used for reaching creative solutions and innovative interventions. Intuition and a holistic view and operating on many scales and zoom levels simultaneously, breaking schemata and looking behind typologies and clichés are all parts of these processes.

The research of SOD

The research on SOD is based on Research by Design methods discussed earlier in depth by the author (2010, 2000) and by various other authors. (Binder & Brandt, 2008; Dorst, 2008; Dunin-Woyseth, 2009; Fallmann, 2007; Koskinen, Binder, & Redström, 2008; Mattelmäki & Mathews, 2009; Niedderer & Imani, 2008)

The research reported has been conducted over the last years by the author and colleagues at the Oslo School of Architecture and Design and has been reported on in 2008, 2008, 2009, 2010 and 2010 and also earlier publications. It has been focussed on design student education and developed most of all as a way of teaching students to get better at coping with complexity. The research is under development and has at the moment moved into bigger financed research projects in collaboration with larger companies.

The theme and concepts of SOD have been developed within a teaching based research position. This is based on and located in a pedagogy of inquiry. This means that each student project has a potential for discovery and the creation of new knowledge and concepts. The student projects are not following given tracks; in contrary some of them are entering new fields of design. When students do this the studio and project based education reaches far beyond a master apprentice relationship or the simulation of a professional design project. Such projects quite often work in ways that professionals cannot operate in. The project becomes a real research by design project and takes a special role and mode of inquiry and reflection that only can be found in research oriented design schools. Much of the detailed experiences that are generalized in the Rules of Thumbs the types of relations and ZIP analyzes has emerged in that context through reflection upon students work and through dialogue with them.
Such a project that exemplifies these modes is shown in the following section.

Design for dignity in a sexual violence response system

This project is the master thesis of students Manuela Aguirre Ulluoa and Jan Kristian Strømsnes, 2012. The project was done in collaboration with the Sexual Assault Centre (SAC) at the Legevakten emergency hospital in Oslo. Starting this new collaboration with a field and people who have not previously considered the expanded role of design was not an easy task. It was like opening a new field for design and together with the staff from SAC investigate how design can contribute in this case. The project addresses many aspects of SAC, spanning from information to products and interior as well as processes.

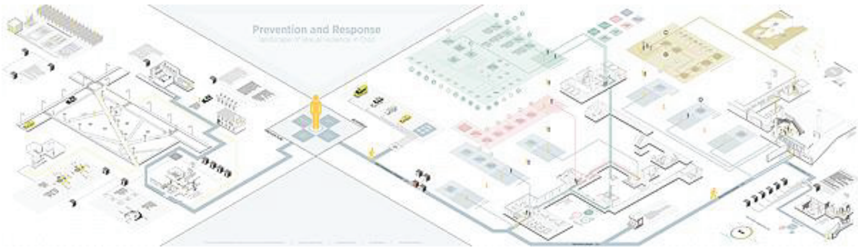

Figure 4. *GIGA-map showing the whole landscape of sexual assault. The prevention field to the left and the response filed to the right. The image shows the final map after it was developed through many iterations and developed to the final design artefact shown here. Designing the map is an important reflexive thinking-through-designing process that makes it possible to organise and internalise large amounts of information and to crystallise and design its relations.*

System Oriented Design gave them the right tools to get an overview of the whole landscape of sexual violence. The GIGA-map was based on research into qualitative and quantitative information and on expert knowledge (Figure 4). The research needed to be very extensive. They were entering a field where they knew very little and it was crucial to understand the systems properly to be able to suggest adequate design solutions. Through many iterating and quality checking the information with the experts, the GIGA-map was made as precise as possible. The map also became a tool for the staff at SAC and the collaborating special police unit. It created an overview of their own work and services and how the whole system operated. This helped the staff to coordinate their perspectives. Further mapping in collaboration with expert employees unfolded the processes that victims had to go through at SAC (Figure5). This initiated a user-centric perspective creating a base for the design process.

System Oriented Design helped the students to gain control of and systematise all of their ideas throughout the design process. The ideas emerged out of the context and the knowledge they gained and out of collaboration with experts. All ideas were documented in relation to the context (Figure 6).

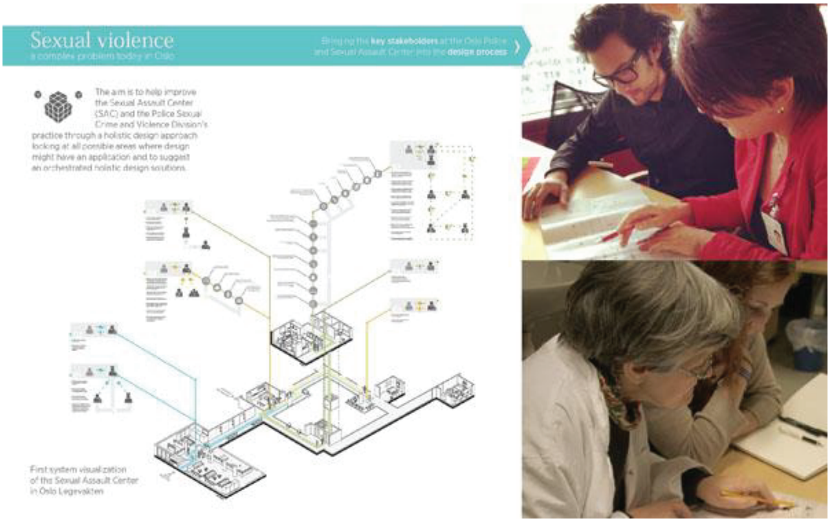

Figure 5. The map of the user journey to the left was constructed and co-designed with the staff from the police and SAC. While the intention for this mapping was for the students to learn in detail how the system works, it turned out to become a product of its own immediately adopted by the staff for their purpose

Figure 6. Information system (left) and Safety Blanket with built in pockets to prevent contamination of evidence on the victims hands (right)

The students reported on the following benefits from GIGA-mapping

- Sharing overview: People will synchronize the same overview
- Understandable, easy to point out and find opportunities for stakeholders and the designers
- Creates a common and understandable setting for dialogue and opportunities where new solution can be placed in the existing system resulting in stepwise improvement of the system.
- The GIGA-map can be used in a training program for staff members, teaching a common synchronized overview of the response system.
- Visualization in GIGA-mapping creates shared images between the designers.

While developing the GIGA-map partly in collaboration with the staff they realized that this overview became a product for the stakeholders. It was then redesigned with the purpose to be used by the staff, helping them to get a better overview of their own system.

The final proposal contained several choreographed and synergetic systems interventions spanning from small scale products to interior scale and information system (Figure 6 and 7).

Figure 7. Suggestions for spatial organisation and design for a new SAC. The design seeks to balance between the clinical, the comforting and a calming and neutral atmosphere. The design of the interior and information systems are synchronized.

The development of SOD

SOD is not only inspired by systems thinking but also from experimental architectural design in the nineties and early 2000. The outputs of these experiments are popularly known as blob architecture and folding in architecture. Animated processes and diagrams played a central role. (Bettum & Hensel, 2000; Deleuze, 1993; Eisenman, 1993; Kipnis, 1993; Lynn, 1993, 1995, 1998)

The author was working in the field of experimental digital architecture and design, using digital tools to question what the design process was, what it could be and what the role of a new type of open ended design could be (Sevaldson, 2005).

Using computers with e.g. animation software or programming algorithms generated new visions of design. The design process was partly and in periods taken over by the machine, though the designer maintained an influential decision -making role and applied aesthetic judgement in the development of the design. He anticipated to be surprised by the outputs of the machine. He created a framework and setup that had controlling devices but the running of the device generated to a certain degree unexpected results. By tweaking the many parameters involved and run it again and again continuously new and differing results would occur. This prepared the basis for new interpretations of the concepts of open design and versioning. The conception of a design output as ideal and with only one good solution was left and replaced with the idea that a design output could have many variations and forms. These forms could change over time. There was a notion of the unfinished as a way to involve users to inhabit designs with their own agenda. The user participation endured throughout the lifetime of the product, changing it according to emergent patterns and user needs. The designs were regarded as open dynamic organisms rather than static products.

These principles are now quite common in an increasing number of design fields. This is obvious in the field of software design through versioning and in the emergence of social networks where user generated content has the defining power, these principles made their ways into IT business and became central aspects of any successful strategy.

In this landscape it became more obvious that developing methods for designing for the unexpected, for change and for and with time was essential. The author experimented in design education within these fields. The design studio with advanced design students became a laboratory for developing new concepts. First there was a series of workshops investigating the use of software in experimental design, recognizing that the digital realm changed the conditions for design. These workshops were followed by several design studios investigating time as a design material, similar to other design materials like clay or computer code (Sevaldson, 2004). Time was explored in terms of composition similar to what a film-maker or music composer would do. This composition principle was easily transferred to the idea of the open design and from there to interaction design and service design. The other aspect that was investigated was using time-based approaches as analysing devices. Sequences of everyday activities were looked at in a very distanced and rigorous way. This could be observing a central public place in Oslo, observing the life at a café or observing oneself when cooking dinner.

These observations that did not have any intention of design output became design objects themselves. It emerged an effect of rediscovery and an eye-opening effect that created a foundation for creativity. It was especially obvious how these observations broke down prejudices and schemata. Seemingly simple everyday actions, like cooking, were rediscovered as enormously complex. It demonstrated that we don't only have schemata about things but also about processes. The process of cooking dinner is such a process schemata, simplified to something iconic or an archetype of the process that we have stopped reflecting about. The schemata stand between us and the pure unfiltered observation. Observation became a method of breaking schemata and arriving at innovations.

The sequential analyses and observations in the Designing Time studios also made causal relations emerge and at a moment it became clear that we had migrated into the field of systems thinking.

Systems thinking was a vast field to dive into. Approaching it from the design process and with the special story and a clear idea of what kind of practice we wanted to develop it also became clear very soon that the current theories, models and approaches in systems thinking were insufficient for design. There was a need to maintain the ways we worked and to enrich it with systems theories and approaches. E.g. hard systems models like casual loop diagrams where difficult to apply. Not everything can be squeezed into a cause effect model. When applying the fixed traditional systems models to design situations that reach beyond the purely descriptive and that are about generating something new, the models became moulds rather than analysing devices into which real life innovation and reshaping needed to be framed. The models tend to dominate the conception of the world. For design such reductive systems models where not very helpful except as a sub-analyses in a much larger process of information-rich and media-rich modelling.

On the soft side of systems thinking there we found more useful approaches end e.g. the so-called Rich Picture from Soft Systems Methodology. The Rich Picture is a diagram that is drawn to generate an holistic overview of a situation (Checkland, 2000; Checkland P. & Poulter, 2006). This was more close to what we needed. The view from SSM that systems not necessarily are given in nature but that they are mental models was useful though the author does not entirely commit to this relativist stance. But it opened up an approach that was more flexible to generative mapping. Still the concept of the Rich Picture was lacking some central features. It was still geared towards the descriptive and did not provide a bridge towards the generative design action. Also it was not involving designing as a central approach to the mapping process.

Instead of committing to one or the other existing mapping models we started to use very extensive mapping as an approach. It also became clear very early that keeping these maps very consistent and categorically correct was also not working. In fact we needed a certain degree of messiness and juxtaposing categorically different information resulted in the discovery of hidden relations and the creation of new ones.

Free-styling, media rich mapping was developed and eventually coined GIGA-mapping by the author.

The designerly approach to mapping made me aware of the importance of designing as a way of investigation and generation of visions that opened up the space for intervention. GIGA-maps therefore developed into design artefacts. This was an important step because this realization connected designing and analyses and reasoning into one device. Designing was used in close relation to analysing and synthesising. Also it became clear that designing the response and eventual output from the mapping very early was then connected to the research. By designing new questions emerged followed by new rounds of inquiries and mapping.

Through the discussions and tutoring with students GIGA-mapping developed into a nested design process, the design process of designing the maps. Designing the maps through stages of refinement shifting between manual and digital media also helped the designer to internalize very large amounts of information. It also became a natural part of the design space. Printing it out in hard copy and hanging it on the office or studio wall would make these large amounts of information immediately accessible at any time. The students' workspaces were altered with wooden boards to add more areas for hanging the maps and other information (figure 8). The war room reference or crime investigation wall panels were obvious (Leerberg, 2004). The concept of the Rich Design Space emerged from the testing of these principles. This was the physical space the media, the social space the internet and cultural space where the design process was playing out. The author argued that such spaces should be "gardened" to be rich

The GIGA-map acts as a bridge between inquiry and design.

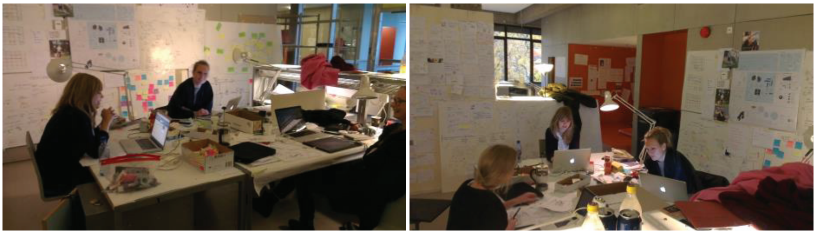

Figure 8. The Rich Design Space: A studio space with students working with defining design interventions in an elderly home on three systemic levels. They are immersed in their information gathered from different inquiries workshops, experts and collaborations.

While investigating the design development of the maps into ever more refined versions another pitfall became obvious, the over-designing of the maps. Designers have an urge to order and sort and compose their designs. When we started to look at the GIGA-maps as design artefacts a tendency to over-design and order the maps appeared. This has a similar unfortunate effect as the static old systems models, the map would start functioning as a mould rather than as a generative open ended tool. Therefore keeping the maps at an open level, not over designing them is important.

Current stage

Today we are at a stage where the techniques of SOD are about to be refined and lifted to a new level. We need on one hand to frame the techniques better so to develop a clearer methodology for SOD. But this has to be balanced. We don't really want to develop yet another method but a flexible tool kit for designing for very complex situations. System thinking is in our context a mind-set and a skill. By framing it to tight we run the risk of losing flexibility and innovation in the process itself. Instead of being a responsive systems thinker one risks of following yet another rule set, stopping with designing the design process and instead relating too much on patterns and repetitions.

Techniques and approaches to SOD

The systems oriented mind-set

The first problem one meets when working with super complexity is to switch mind. Complexity comes from the relations and not the entities themselves. Objects are relatively easily understood if they are not too complicated, that is composed of numerous components that interact. Then we are actually looking at an entity that reaches beyond the singular object, we are looking at an entity that is a system.
It is the relation and interaction that makes it difficult, otherwise we could just dismantle the system and look at the singular objects to understand the whole. It would be a tedious but simple job. The mind-switch needs to be in shifting attention from the objects and entities to the relations between them. This is the simplest way of explaining how to become systems oriented in your thinking and approach. But it is also one of the biggest challenges to teach to design students. There are big individual variations to how easily they adapt systems thinking.

To understand what systems thinking is we can turn to some central examples that everybody relates to. One such example is the concept of ecology. Ecology is an interdisciplinary science, about the interplay between numerous species and their environment. The science of ecology can't be reduced to singular fragments nor can it be sufficiently investigated through isolated lab experiments. Very advanced simulations and systems dynamic modelling can simulate parts of ecological interplay but renders only partial understanding of the problematiques, leaving a high risk of errors. Further on ecology is an interdisciplinary science, cutting across many of the natural sciences. Modern ecological thinking does not separate human activity from the natural but looks at the whole interaction of man with nature. Therefore ecology also touches upon economic, technological and even sociological issues.

Looking at businesses, organisations, advanced design interventions and even seemingly simple design projects in a similar manner, regarding organisation, businesses and operations as "organisms" living in "ecologies" is really helpful to change the mind set towards systems thinking. Designing involves technology, ergonomics, interaction, marketing, branding, competition, culture etc. Designers know that they need to relate to all these issues, but often react to them as necessities rather than source for creativity and innovation or they think of the as specialization fields rather as parameters necessary to address. Many designers are searching simplification to reach solutions. As a systems thinker one would proactively search for and increase this complexity because of an urge to understand it better and because one thinks that in the complex interplay between all the fields, knowledges and requirements that confront a design project one will find new approaches and solutions. This richness is conceived as a ground for creativity. A systems oriented designer would inter-relate these fields better and even increase the complexity by adding considerations about the client's organisation, culture, capacity, economy and global considerations on sustainability and fair trade etc. Further on one would be concerned about the life time of the product, the implementation process, the marketing, what the product would replace, how it would develop through versioning, and about recycling and sustainability. The systems oriented designer would also be interested in the secondary and tertiary impacts of the product. Also the unintended and counter-intuitive consequences of chosen design interventions would be necessary to foresee. She would also be interested in how the design intervention would act as a system in its own right. Would it survive unexpected disasters, so-called “Black Swans”? All these issues are not novel by themselves but they are typically addressed only partially by designers and many of them are addressed only by separate experts, technicians, economists, sociologists, in isolation. The systems oriented designer would try to achieve a holistic perspective to oversee the consequences and to find intelligent design outputs. In fact one would start to look at the product as a systems intervention, realizing that the product is merely a symptom of a large system.

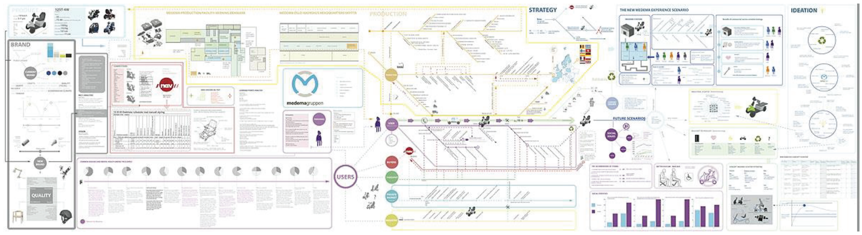

Figure 9. The final GIGA-map for MEDEMA. The map shows all aspects of the company operation from production facilities to economic and marketing aspects. The map is displayed in the board room of MEDEMA. (Christian von Hanno and Julian Guriby).

GIGA-mapping

As mentioned earlier GIGA-maps are very large and information-dense diagrams and visualizations (figure 9). Their purpose is to support the design process. They are developed from sketch to final design through using different manual and digital drawing tools and develop them through iterations. They are not meant for information visualisation where communication and simplification is central. In fact in many cases they are so complex that one has to be involved in their creation and design to “own” them and understand them. They help to keep track of systemic relations, information and to internalize as much as possible. They are moving far beyond the descriptive towards generative modes designing interrelations and new structures. This is becoming a design process in its own right where design thinking and designing is used as central approach to reconfiguring and generating new information. Therefore we regard them as design artefacts

The central way of keeping track of the complexity that unfolds when shifting mind from being object oriented to being systems oriented is, for designers, to use design. We use our design skills as a way to create an overview and to generate a picture of the whole.

I use the terms create and generate consciously because as systems oriented designers we go quickly beyond the purely descriptive. We want to go beyond “what is” and towards “what ought to be”. By using the designers skills in the process of understanding and designing for complexity we realize three things:

1. We realize the strength and potential of designing as a way of sorting, ordering, and visualizing complexity.
2. We also realize that any model, diagram, visualization of real world complexity is a mental construct or a design. It always fails to remain purely descriptive but the models and techniques frame the interpretation of real life and take

on a generative role. This role can be strong or weak but there is always a generative aspect in the diagrams.

3. Designing and developing these generative interpretations consciously and using design to develop them beyond “what is” towards “what ought to be” is an efficient approach to design for complexity.

The term GIGA-mapping engulfs all these processes of using visualization in design processes to understand and develop complex systems.

There is one important issue to remember: It does not embrace the common approach to complexity that urges for simplification. Simplification is needed sooner or later in the design process but before we understand more of the system simplification done without that knowledge is dangerous. It can lead to totally wrong conclusions and assumptions. To early simplification is regarded as a lack of real attempts to read, wrestle and interact with the immense richness and systemic entanglements that surround us. These will not disappear by being ignored. The task of GIGA-mapping is not to simplify. In contrary it is to explode the systems to get at the hidden relations and connections, to reach beyond the simplified schemata that are embedded in our typologies and archetypes.

Simplification and boundary critique

Only when we know enough of the whole picture we can draw a systems boundary (simplify) that is relevant. A critical approach to the boundary and looking at the boundary of the system as adjustable is important. This approach is theoretically rooted in boundary critique (Ulrich, 2002).

Mapping process

The mapping typically starts messy with paper as the main medium. This is like any other design process, starting with messy tentative design sketches. Large formats are necessary. Small formats and working on the computer are insufficient simply because of lack of resolution. A simple rule of thumb is that we need a minimum of 300 entities and their interrelations on the systems sketch.

SKETCHING

The mapping often starts in one of two ways: network mapping or timeline mapping. The main issue is to very early to have great attention to the relations. Sketching should start immediately without prior inquiries into literature or other sources. The initial sketching is meant to activate already existing knowledge and imaginations about the issue at hand. After this initial round we start doing literature research, talk to experts, search for projects etc.

It might seem that the immediate sketching could impose a preconception onto the problem, but in fact the intention for this is the opposite. The sketching out discussing and reconfiguring of one’s prior knowledge is not only to activate this knowledge and make it explicit, but also to raise consciousness of the inherited frameworks that we tend to take for given and that if not challenged would bias the information gathering.

After the initial sketching phase the maps are developed through information gathering. The map indicates areas where one needs more information and experts one needs to talk to. The map works as a guiding device for the research, while the research feeds back into the map and develops it further.

Very early in the process we need to start the design process by several activities
1) Starting to create relations on the map moving form a descriptive mode to a generative mode.
2) Imagining and sketching solutions and design outputs
3) Deriving new questions from design outputs to the map

The map in itself does not generate design output. For that we need a synthesising process that starts early and runs parallel and in dialogue with the mapping process. At any stage we use ZIP analyses to make findings in the map (described below)

CO-MAPPING
Mapping in groups has an effect on dialogue. It fosters dialogues and collaboration. Especially the short workshop types developed for strategic meetings in leader groups has a very strong impact on the dialogue.
These most often are time based maps that follow a timeline. The time line is used as a sorting device that is immediately understood by everybody. This sorting device allows the group to skip the agenda, as long as one has a theme to investigate. The conversation is allowed to jump back and forth. Jumping in the discussion is done easily because everybody is brought along in the jump by pointing to the time line. The conversation stays focussed on the topic but remains open ended and holistic.

REDESIGN AND ITERATIONS

After the initial sketching phase it is a good idea to change media and to redesigning the map in illustrator. This is when design thinking fully kicks in. The process of converting the messy handmade sketch into a well designed illustration implies a mental process of sorting and ordering. It also has the effect that the information is internalized and memorized often in an astonishing way. This might be a phase where one works alone and the holistic overview is generated. The role of keeping a holistic overview is by some described as being a feature of singular individuals or very small groups working very closely together (Maier & Rechtin, 2000)

TYPES OF RELATIONS

Another difficulty in mapping is the tendency for us to emphasise objects rather than their relations. It is important to develop the relations and to be specific about them. Therefore we have developed a guide for analysing the types of relations.

(See addendum 1)

THE USE OF MAPPING SOFTWARE

We have tested and looked into a long range of mapping software but do not recommend them for other use than for partial models embedded in the GIGA-map. They tend to be too inflexible and unappealing for designers. The software tends to become moulds for the model of reality we intend to develop.

Reference to http://www.systemsorienteddesign.net/index.php?option=com_weblinks&view=category&id=38%3Asoftware&Itemid=48

FREE-STYLING AND RULES OF THUMBS FOR GIGA-MAPPING

There are no fixed rules for GIGA-mapping. It is not another systems model to follow but it is a generative and creative process. Therefore we emphasise GIGA-mapping as free styling where each case demands a partly genuine design process and each map will look differently and their adequacy has to be judged according to the case they serve.

Despite this we have managed to generalize some of the experience in a soft manner, resulting in a long list of Rule of Thumbs for GIGA-mapping The most important one is to mentally switch of the relevance filter in the beginning of the mapping process and not to over-design the maps so that designing becomes too much of a forming mould for the description and conception of the system.

(See addendum 2).

Analysing

ZIP analyses

ZIP-Analysis is a simple method for developing GIGA-maps and to find potential areas for interventions and innovations.

ZIP stands for Zoom, Innovation, Potential. Actually it should be ZPI because the three modes are gradually moving towards innovation but ZPI-analyses sounds strange :)

Z : Zoom is used to mark areas or points in your map that need more research. It is a reminder for you that you lack information and an initiator to make additional maps zooming into this area.

P : P stands for potential. If there is an obvious problem this is a potential for improvement or if there is something that works exceptionally fine there is a potential to learn from it.

I : I stands for innovation and / or intervention. If you find something new you can do or you find a solution to a problem or you can link things in a new way by creating new relations these are I-points.

(To see more details of ZIP analyses see Addendum 3)

Research by design, Synthesis and designing

The GIGA-map can provide ideas for innovations e.g. through the ZIP analyses, but it does not generate a design solutions by itself. It is important to not phase the process in strict sequences but to layer them and start designing and sketching in parallel and very early. The design solutions can be back checked to the GIGA-map. Only through design relevant questions will emerge and this will inform iterations of mapping and research. Then new design solutions have to be visualized and from them new knowledge realizations and questions emerge.

The GIGA-maps are research by design driven because they are design artefacts that generate novel needs for information. As well as the design sketches that are driven forward in parallel will have this functionality of research by design by clarification of problems that needs to be solved, of posing new questions to the map and by the emerging novel solutions.

Only through these design driven knowledge processes we can reach new design resolutions.

The application of the approach:

GIGA-mapping has been tested and developed in a long series of semester long studios from 2007. These include eight semester studios at AHO and one semester studio at Syracuse University School of Architecture. Another main format has been weeklong workshops. We have been running these workshops at Tallinn School of Technology, Kolding School of Design, Ålesund University College, Oslo National College of the Arts, University College of Oslo and Akershus, OCADU in Toronto. Shorter workshops have been run at Chalmers Institute of Technology institute for Architecture. Its earlier phases have been practiced and tested in numerous two hour workshop sessions with companies and organisations in a professional context. Amongst them are, the Norwegian Research Council, BUFDIR (The Norwegian Directorate for Family Youth and Children) and others.

There also further development of the mapping has been done in one case with TPG and a student and with several development projects with Gjensidige insurance and with The Norwegian Housing Bank with research assistants.

The Results

The feedback has been consistently positive. Only in one case the mapping was less successful because of the mindset of the participants.

We can separate the users into seven groups

1) Design students in SOD studios who have used GIGA-mapping in longer projects spanning over one semester
2) Design students who have participated in one-week workshops
3) Companies who have been partners in longer projects and who have done GIGA-mapping in shorter workshops with the students and who received a project result in the end of the project.
4) Companies and organizations that have a long term R&D-based relationship with SOD
5) Companies who have participated in shorter workshops in a professional consultancy setting
6) PhD candidates using systems theories and SOD as part of their research framework
7) Testimonies from colleagues in design education

(See addendum 4 for a partial and intermediate summary of feedback from some of the different groups)

The reports from the different groups have been consistently positive. There are some problems in the incompleteness off this tentative registration of feedback and it needs to be followed up with a more robust inquiry.

The technique of GIGA-mapping has developed into many different variations and we have started the work to analyse the material. Two main strands have emerged and have been developed:

The main approach is GIGA-mapping for designers to use designing as a way of dealing with complexity. These are maps that go through generations and that switch media and are refined and consulted many times through a complex design project.

The other important strand is GIGA-mapping for open ended meetings on strategic level. These are normally done with leaders in companies and organisations. They are normally non-designers. The main format is timeline mapping and there is an emphasis on dialogue and content.

For education a lot of experience is collected and resulted in two main formats: Longer project based education where SOD is the central approach. This format has proved to be very well suited for master level students to enter new fields and open up new areas for design. The approach generates creative and systemically grounded results. The students are very well equipped to develop this approach further but would ideally need additional training and instruction.

The other main format is the one-week workshop. This has turned out to be a very efficient format to teach SOD and GIGA-mapping very quickly to a level where students are able to adopt the technique themselves. They will not have a good overview of the theory and would have to get further instruction especially on the systems analyses and understanding. But the workshop is easily embraced by the students and they adapt GIGA-mapping quickly.

Especially the last point proves that the designerly approach GIGA-mapping represents is attractive to designers.

For PhD fellows we are just in the start of investigating how to implement and use SOD approach in such longer research projects.

Another emerging result is the extraction of mapping principles from the GIGA-maps. This work has barely started and it needs to also be compared with and informed by other information visualisation work.

Summary and conclusion

Systems Oriented Design is under development and there are many imaginable techniques and approaches yet to be explored. The responses to the concept and the techniques have been very positive. Design students and some professionals have embraced the concept and especially the technique of GIGA-mapping. The flexibility and creativity in the approach has a great appeal to designers. Also GIGA-mapping with groups of professional leaders and other stakeholders has resulted in very positive feedback. The technique has been adopted by the counselling group of the Norwegian Design Council.

The bases for a larger R&D project into SOD is created and summarized in this paper.

The concept as a research project is now moving into its second phase where experiences will be investigated more systematically and the concepts developed further, and emerging patterns of use and application will be mapped and reported on.

Addendum list

Addendum 1

http://www.systemsorienteddesign.net/index.php?option=com_content&view=article&id=220&Itemid=136

Addendum 2

http://www.systemsorienteddesign.net/index.php?option=com_content&view=article&id=214&Itemid=126

Addendum 3

http://www.systemsorienteddesign.net/index.php?option=com_content&view=article&id=212&Itemid=125

Addendum 4

http://www.systemsorienteddesign.net/index.php?option=com_content&view=article&id=224&Itemid=137

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"Not two weeks in a place tidying-up the paper drawer" – an employability agenda case study

Ian James SHARMAN* and Zoe PATTERSON
School of Design, Edinburgh College of Art

Abstract: *It seems improbable that a student might graduate from four years of full-time education with an honours degree and, simultaneously, three years of work experience. Yet this is the premise of the Design Agency Project at Edinburgh College of Art, University of Edinburgh. It celebrates four years within the BA Graphic Design programme so 2012 provides a natural opportunity for reflection, marking the graduation of the first cohort introduced to the project at the commencement of their studies.*

Annually, the students of the programme's senior year form several design agencies. They brand and advertise vacancies, for which students in junior years are interviewed and appointed. The university's human resources and enterprise departments provide guidance. The agencies operate as profit generating companies with provided briefs and self-initiated commercial work. Each agency has an established industry expert as mentor. All undergraduates are allocated one day per week to work on the project throughout the academic year.

This paper presents the project as a case study, with viewpoints from lecturers, students and industry mentors. The project is timely since employability has gained traction as a measurement of HE performance outcomes, yet the term itself remains nebulous. Specific case study may elaborate.

Keywords: Design Agency Project, case study, ECA, Edinburgh College of Art, Edinburgh University, graphic design, employability, mentoring, pedagogy, industry.

* Corresponding author: School of Design, Edinburgh College of Art | University of Edinburgh | Scotland, UK | e-mail: Ian.Sharman@ed.ac.uk

Introduction

The Design Agency Project is a highly collaborative, cross-year framework that exposes undergraduate students to employability issues within the field of graphic design. It was introduced in 2008 within the BA (Hons) Graphic Design programme of the Edinburgh College of Art, University of Edinburgh in Scotland. Almost five years later, the first cohort of students who experienced the project throughout their studies has graduated, and a further fully-immersed cohort is nearing the conclusion of the programme.

Self-selecting teams of senior year students form their own graphic design agencies, which they name and brand. They advertise vacancies for junior roles, for which students from junior years of the programme apply and are interviewed. The university's HR Department provide guidance about employment obligations, whilst enterprise departments assist with advice about business formation. So each agency has students from across the years of the graphic design programme, and they are strongly encouraged to physically locate together on the day per week dedicated to the project (though they are free to collaborate outside of this time).

Individuals established design professionals volunteer as a dedicated mentor to each of the agencies, and each manages this relationship in their own way. Task briefs are provided for agencies, and they are encouraged also to seek-out profit-generating work. Agencies are free to invest or disperse profits as they wish, though part of the programme involves generating funds for the Lake Victoria Disability Centre in Tanzania.

Aims

This paper aims to present the Design Agency Project as an individual case study, with viewpoints of numerous stakeholders – the graphic design lecturers, students, and the industry professionals who act as their mentors. We illustrate the observed behaviours and captured perspectives of the project's actors in an attempt to "make sense of, or interpret, phenomena in terms of the meanings people bring to them [with] a wide range of interconnected methods, hoping always to get a better fix on the subject matter at hand" (Denzin and Lincoln 1994).

In other words we do not attempt to draw definitive quantifiable generalisations here about wider deployment, but to extract the qualitative meanings for the participants within the project. Bassey (1999) cautions:

> Case studies are, of course, studies of singularities and so the suggestion that findings from them may be applied more widely may seem somewhat contradictory, if not invalid. (Bassey 1999, p.xi)

But we hope that where we may have inferred a pseudo-claim-to-truth ('fuzzy generalisation'), that the reader can take it in the spirit of Bassey's mitigation:

> It is argued that, in any case, qualitative 'fuzzy generalizations' are more honest and more appropriate to much research in educational settings than are definitive claims for generalizability because of the complexity that is usually involved. In other words, in schools, doing x rarely invariably results in y. (Bassey 1999, p.xi)

We do not, however, abdicate commentary on the qualitative data, since we still aim "to construct a worthwhile argument or story" (Bassey 1999, p.65). For that reason, our exposition may appear to veer towards Bassey's designation of 'evaluative case study' which "set[s] out to explore some educational programme, system, project or event in order to focus on its worthwhileness" (Bassey 1999, p.63). But whilst there is an element of summative evaluation, it is mostly framed here within individual commentaries and observations. So Yin's (2003, p.46) term 'descriptive case study' provides perhaps the best nomenclature, since he relates perfectly our desire to seek a balance to "mediate between trying to describe "everything" and being too sparse" (Yin 2003, p.49). We take on board his advice that "repeatedly referring back to your rationale for selecting the case study being studied may provide some guidance for staying near a golden mean" (Yin 2003, p.49).

Our rationale comes from the key anniversary of the project. The first graduates that have experienced the project throughout their higher education have now entered their working environments: we seek to appreciate some magnitude of its effective*ness* by summarising its *effect* on its actors and agents. The project has been shortlisted in the UK for the 'employability' category of The Guardian University Awards 2013 (Guardian News and Media Limited 2012). Whilst it is gratifying to acknowledge external recognition, it is nevertheless important for us to relate and sense from within what the project's contribution is towards that highly politicised agenda, since it was not conceived from a political stance but as a pedagogic approach.

Perhaps it would be naïve to separate the two, since employability has recently gained traction in higher education as a measurement of performance outcomes. For instance, the UK's Higher Education Academy's 2012 Thematic Seminar series (The Higher Education Academy 2012) requests proposals exploring employability as one of its three key targets for UK funding. The Scottish Funding Council (responsible for securing coherent provision of further & higher education in Scotland) has 'Employability and Skills' as its first listed outcome (Scottish Funding Council 2009, p.20). It maps that as directly contributing to 11 of 16 generalised national performance outcomes (The Scottish Government 2012) which outline what the Scottish Government wants to achieve for the nation. Nevertheless the term can appear nebulous and difficult to anchor to specific approaches. This is illustrated by the 2012 update to the 'Pedagogy for Employability' guide (Pegg et al. 2012) , in which an additional wider definition is added:

> Employability is not just about getting a job. Conversely, just because a student is on a vocational course does not mean that somehow employability is automatic. Employability is more than about developing attributes, techniques or experience just to enable a student to get a job, or to progress within a current career. It is about learning and the emphasis is less on 'employ' and more on 'ability'. In essence, the emphasis is on developing critical, reflective abilities, with a view to empowering and enhancing the learner. (Harvey 2003)

It is hoped that focussing on this particular example of how "we best integrate and balance different ways of teaching and learning that promote both effective learning and employability for students" (Pegg et al. 2012, p.4) might provide some clarification. The case study is intended as a contribution to the employability agenda by illustrating the organic genesis of a project that reconciles some of the inherent dilemmas of embedding pedagogic approaches that have (later) been identified as conforming to that agenda within an academically and creatively respected higher education institution.

In neighbouring England, concurrent with The Design Agency Project, Stockport College's Thoughtful Six Project (Corazzo 2009) had relocated a commercial agency to the college's design department. There, six students were selected to work with the agency for six months as a kind of 'internal work placement'. Whilst there was a shared desire to engage industry employers, the two projects were independent and had significant differences in relation to the locus of power, 'real life' ambitions, scope of student numbers and duration.

Research methods

This paper amalgamates research conducted independently by the co-authors, though thematically collated here with a unifying narrative. This has heightened the sense of a "wide range of interconnected methods" espoused by Denzin and Lincoln (1994), and permitted us a metaphoric 'triangulation' in drawing together a narrative of the dual packages of enquiry. Many of the methods are the collateral of activities within the project (i.e. they were not intended primarily to form a study), and that is the prime motivation for our designation of the case study as 'descriptive' rather than 'evaluative'. Nevertheless, we hope that the narratives and perspectives presented paint a worthwhile picture.

Video Interview and Sketching

Semi-structured video-recorded interview was conducted with the programme leader, during which she was asked to sketch various thematic aspects of the project whilst narrating their meaning – edited version available as Sharman (2012 , 7:59 - 9:01 mins). Those sketches are presented in this paper, and quotes from that interview are attributed using 'ZP'. In the interests of transparency, it should be stated that the programme leader is a co-author of this paper, but that the interview took place between the co-authors prior to their collaboration on this paper with no intention of later collaboration. We hope that the collaboration has nevertheless provided a useful juxtaposition of 'viewing angles'.

Observation

Observation of the college's graphic design studio was conducted by locating a research station within the studio. This is a desk from which the (PhD student) researcher conducts everyday study, but which is adjacent to the studio desks of the most senior students of the undergraduate graphic design programme. This has permitted observation of key points in the programme, and of the ongoing ambience of the physical setting and sense of its everyday to-and-fro.

Student journals & vivas

Formative evaluation was evident through each year of the project from extracts of students' ongoing reflections contained within journals maintained by them during the entirety of the time with their respective agencies. These journals are dedicated to their Design Agency Project work, and kept in confidence by the students except when shared with tutors. This is where the student can most emphatically express their identity as 'student' rather than 'employee', and this has led to free and honest commentary by them on the operation of their individual agencies and the relationships within them. They are able to dissent privately even where they have followed majority decisions, though this was in no way intended to replace face-to-face discussion within agencies.

Summative student questionnaires & workshops

More formal summative evaluation was conducted through year-end questionnaires and workshops within the organisation. These were where students were able to express their wider hopes, wishes and concerns to someone outwith their agencies (or department). This also facilitated a provocation for the students to maximise the potential of the project for their own goals and benefit. Vivas of fourth year students provided an additional opportunity for summative reflection.

Student artefacts

Students naturally produced artefacts, and these often acted as formative intermediate and year-end summative graphic reflections of their processes and learning. Some of those outputs are presented here (Figure 5 demonstrates a particularly apt example). The quality of individual design skills is not explicitly assessed, but rather conformance to the formal metrics of the learning outcomes that are set for every module undertaken at the college. The students are provided within an extensive project brief that develops throughout the year’s iteration of the project, together with learning outcomes. These documents are available by contacting either author.

Extracts of ad hoc communications with mentors

The project leader has extensive ad hoc communications during the year with the industry mentors for that year. These are mainly by email, and provide a good record of developments and mentor perspectives. There are also individual meetings with mentors at the commencement and conclusion of each academic year that yield further insights. Extracts of some of those ad hoc and unprompted communications appear in this paper where they provide a particular perspective of the project and the sender has agreed to publication.

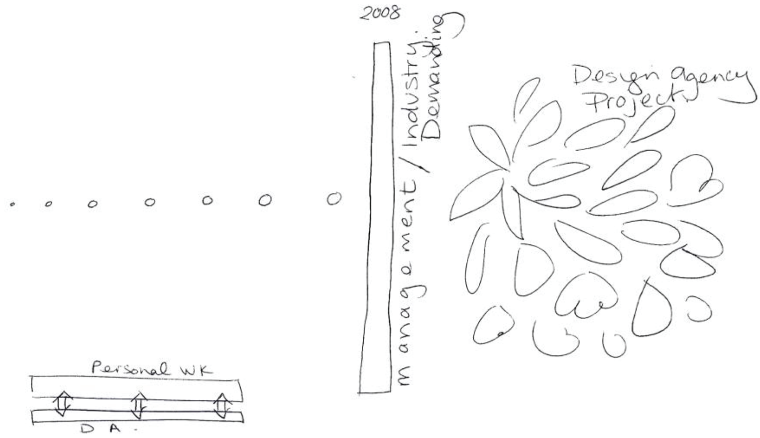


Figure 57 - Sketch outlining the phases of the Design Agency Project drawn by its creator during video interview. Referring to the circles centre left: "These are little… seeds… growing and ideas starting to formulate, but at the time having no vision that this was coming.

Project formation and intention – What problem did it solve and how did it begin?

In interview, Zoe Patterson (project creator) explains its origins. There were two major factors for its creative ignition. First, there was fuel in the form of a particular example of established good practice that students had enjoyed:

> The reason why the Agency Project came about? Lots of different reasons: we'd… been running something very loosely connected to team-building and introducing students to the new semester for probably twelve years. And it was working so well… that I thought 'Well there's something bigger there'. (ZP)

Conflicting political and pedagogic ideologies created environmental conditions, which provided a motivation for change:

> Alongside that, the new management at the art college about four years ago [were] very keen on… final year students not being such commercial designers… a theme of study rather than short deadlines or commercial projects. And yet industry – out there – was asking us to deliver students who would answer the phone, know what a time sheet is, work to deadlines, all these sort of production issues. (ZP)

There is an honest assessment of the original rationale for the project by Zoe, who suggests that it is only hindsight that permits attribution of contributory factors:

> This is me post-rationalising, because at the time I didn't realise what I was doing. Bringing that all together so that we are nodding in the direction of management… but then working in teams, in design agencies to nod in the direction of what industry wanted… And students themselves wanted both – I don't think we could… have one without having a complaint about the other. (ZP)

There is clear ‘ground-level’ evidence here of Pegg et. al’s (2012) suggested need to “integrate and balance of different ways of teaching and learning”.

> “We tested it for a year. And the last three years it’s been running… so the graduating fourth years are the first year group that have been through every year.” (ZP)

The indication of testing indicates reflexivity by the educator. The start of the edited form of the definition of ‘educational action research’ offered by Carr and Kemmis (1986) hints that the Design Agency Project may provide an illustrative example:

> Educational Action Research is used to describe a family of activities in curriculum development, professional development, school improvement programs, and systems planning, and policy development. (Carr and Kemmis 1986, p.164)

Figure 1 shows a sketch produced by Zoe Patterson during her interview. As she draws, she orally relates how the students across the year groups were initially annually collaborating in a one-week exercise. She draws increasing sizes of dots to indicate these exercises having developed by ad-hoc iteration:

> These are little… seeds… growing and ideas starting to formulate, but at the time having no vision that this was coming. (ZP)

In other words, whilst there was a repeated classroom exercise with solid intention that received positive feedback, there was no contemporaneous intentionality:

> There was no parameter, it was just open… because I thought as soon as you’re assessed on it… people can get slightly scared, and it stops them being experimental. (ZP)

And this is where the formation of the Design Agency Project diverges from the definition of educational action research:

> These activities have in common the identification of strategies of planned action which are implemented, and then systematically submitted to observation, reflection and change. Participants in the action being considered are integrally involved in all these activities. (Carr and Kemmis 1986, p.165)

The Design Agency Project *was* action-based with participant observation and reflection – but not *systematically* so. This elaborates too our categorising of this case study as descriptive rather than evaluative, albeit there are voices of judgement here.

Despite a lack of intent to systematically test and inform theory, it is clear that those annual exercise nevertheless informed development of the Design Agency Project: “so without me knowing it, these are the little seeds; little ideas” (ZP). The on-going present-day development of the project is discussed later, but it is important first to detail the earlier imperatives.

In the sketch (Figure 1), Zoe adds an elongated vertical block, tagged ‘2008 management’ explaining how she had been somewhat resistant but pragmatic about new developments:

> This big brick wall came up… management [saying] that we needed to… shift our philosophy… [They said] it looked too commercial. (ZP)

Zoe extends the ‘management’ label on the wall, adding ‘industry demanding’:

> Alongside that, you've also got industry demanding business-savvy students… it's two parts of the same problem... So I don't think that these two things are against each other. It's just… coming up with a good compromise. (ZP)

One of the mentors emphasises the industry perspective:

> We see a lot of graduates who just aren't really prepared. This project is a chance to help the students understand what a design consultancy is looking for in a graduate and their portfolio. (Mentor B)

Whilst innovative and sudden in its scaling, this was in no way a revolution nor abandonment of what had gone before.

> That brick wall… didn't really stop the seeds of this project, because I just manipulated that then… I see it as… organic. (ZP)

Zoe elaborates that this organic compromise took into account the issues of the other stakeholders, but that these coalesced to students' benefit:

> I think what that's done is it's satisfied this demand [indicating 'industry demanding']; it's satisfied that vision [indicating 'management']; but more importantly than that… it's enriched the students. (ZP)

"Not two weeks in a place tidying-up the paper drawer"

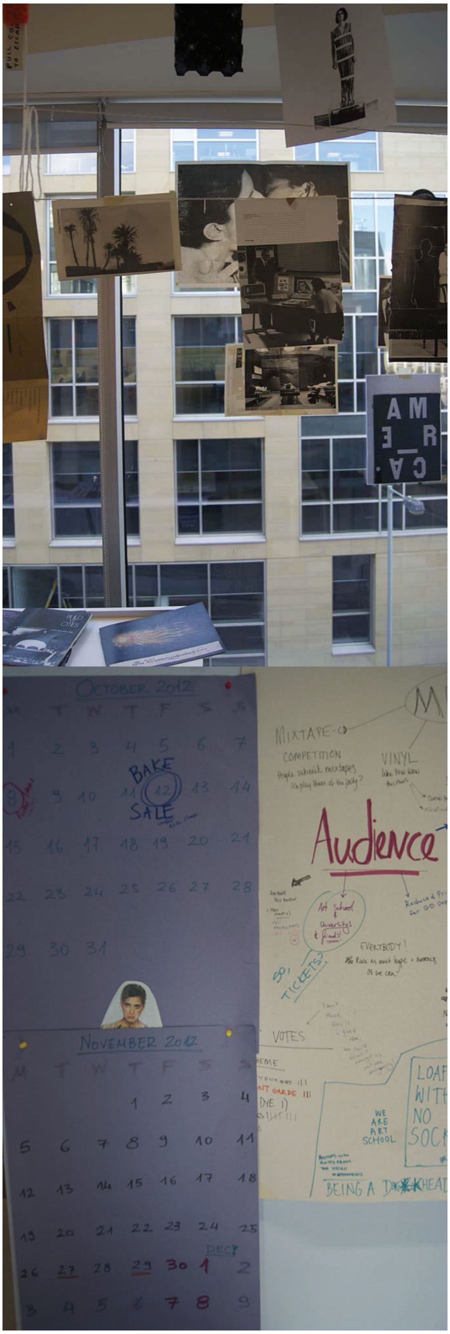


Figure 2 - The graphic design studio for the Design Agency Project at Edinburgh College of Art. Source: Ailie Hutcheson, 4th Year Graphics, Edinburgh College of Art.

Project operation – What does it feel like and what has it achieved?

Zoe Patterson elaborates (Figure 1) with two rectangles linked by bi-directional arrows, representing respectively the Design Agency Project and the students' own personal work:

> They dovetail well together… this would be the Design Agency Project under-pinning… their own personal work. So [each of the] years have got their own work… but together they do the Design Agency Project. (ZP)

This provides an important feature of the project: that there are group tutorials and critiques that respect the year divisions, but there is also another cross-year flow of students amongst agencies. The agency's students visit each other's desks. This provides a non-'policed' vibrant environment for which the students are responsible (and which follows student norms where it is very peaceful prior to 10am, but busy well into mid-evening).

Though in a modern office-type building with walls of windows, it feels eclectic and grungy. Desks and walls are festooned with work and inspirations, blended with agency outputs – even hanging on makeshift 'washing lines' (Figure 2), stuck on windows, and acquired boards. Maquettes and other three-dimensional experiments lie about – the students appropriate this space with gusto.

The project ethos is infectious – so even year-group work is arranged into shrine-like displays with neither inhibition nor self-consciousness. In other words, there is a natural process of exchange and critique across all work. Zoe Patterson provides an analysis of this observed cross-pollination and prolificacy:

> I think this personal work… would not have much merit without the strength of the Design Agency under it because we are graphic designers – it is vocational… So to me, they work well together, and that's what a degree course should be about. (ZP)

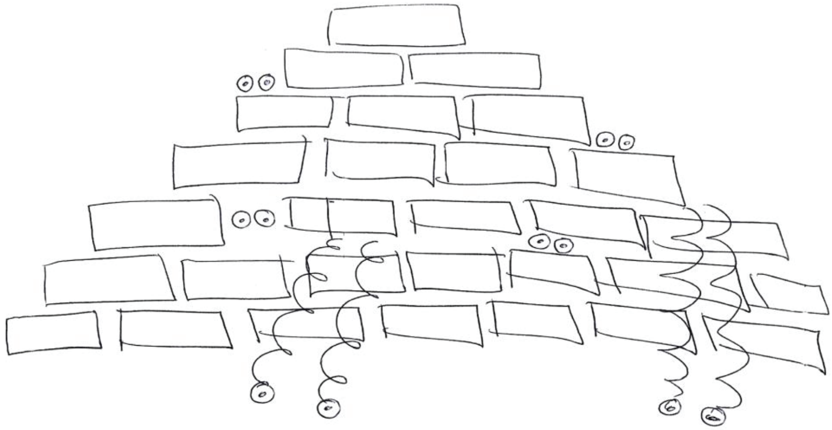
One of the mentors to the project describes the sense of creative energy that results from this harnessing of tensions:

> Mentoring for ECA was genuinely thrilling for me, such an exciting opportunity to engage with and nurture young designers [with] explosive and infectious energy. (Mentor A)

Previous inferences about student and educator positions are now made more explicit as Zoe Patterson draws a sketch of the overarching ethos of the project (Figure 3) in which the students are drawn looking 'out' from behind a protective wall:

> The brick wall that we were sort of faced with, with what management wanted, what industry wanted, what the students want, and as a staff member what you see as your vision for your course… how can we play those together and balance it? … So to me that's them looking out… on springs… so they're already out there, but with some protection for some of the students.

This is pointing to one of the dichotomies of the employability agenda – how to expose the students to work-like scenarios and skill sets whilst retaining the safety of the academic environment:



> It's a safety net for our weak students [too]… They might be creatively not as strong as others in their peer group, but as managers – as organisers … they shine. (ZP)

A student reflects on the benefits of having a framework from within which they are able to experiment safely:

> The agency project is simply a learning curve. It is important to make mistakes, and more important to learn from them, as real working life is not plain sailing. (Student E)

So the student goes further than extoling *toleration* of mistakes to advocating that mistakes are *important* to the learning process. Zoe Patterson takes up this notion too:

> We'd rather them make all their mistakes here – would an apprenticeship allow that? I don't know… Here, they can test what a design agency means. (ZP)

Corazzo (2009) supports this finding with a student's perception of a benefit of its project's on-campus location: "here I still feel connected – it's like having a little safety net" (Corazzo 2009). Nevertheless, Zoe was probed how tolerance of (even desire for) mistakes dovetails with an academic assessment process:

Figure 58 - Sketch by Zoe Patterson during interview of ethos of project. It illustrates the eyes of students looking out 'at the world' from behind a protective pyramidal wall, with some on springs "already out there".

> It's not a maths situation where everything is right: there's got to be experimentation, there's got to be failures… I guess in some ways the failures are successes. The students… [where]… there's been no bumps along the way –

> boring! They've got… nothing to write in their reflection other than "life's great". The ones that have had to fire someone – dealing with all those issues: you can't teach that; they can only do that to each other. And I think the learning in that is what we are looking for, their reflection on what's happened, and how they overcame those issues. That's what we're looking for: not how great a piece of work they've done. (ZP)

A student elaborates on the development of resilience:

> I have realised that in real life as well as in work, you cannot always pick or edit the people you work with. The agency project has merged university life with the real working world, giving pre-insights into how agencies actually work. (Student F)

But the educators too require belief that the students are resilient enough for the inevitable relationship challenges familiar to those in employment:

> We have been a mixed bag of a group, plenty [of] different personalities that haven't clicked straight away but have slowly managed to work as a team. (Student E)

This provides cues to students' consideration of dimensions of team working (particularly for graphic design, where parallel creative projects are the norm):

> Learning time management; it is important personally as well as in an agency; balancing agency time and other project work. (Student E)

Students recall multiple developmental creative tasks: "Our mentor agency… set us a project to rebrand a group" (Student A); and "We learnt practical tasks such as working a blog and how to apply a vinyl to a surface" (Student E); whilst another student proudly cites an extensive varied list of clients within the year. And a mentor of the project confirms the sense that the students have a raw creativity, providing too an indication of the strength of identity formed within the different agencies:

> [I] was delighted to be asked to step into this project… We have the stamina to go the distance and our agency… [students are]… young, enthusiastic and have bags of creativity. (Mentor D)

And yet, an otherwise creatively competent and confident student reflects that those attributes of creativity are nevertheless not solely sufficient:

> Before this, I viewed myself as unmanageable, not very good with authority and certainly not a team player… I was dreading being part of an agency and receiving tasks from other people. Throughout my life… I have struggled to 'behave' myself, finding it difficult to work with others and respect authority…. The Agency Project has changed this. I believe this has developed me as both a person and a team member, and now feel confident that I would fit into most workplaces working within teams and under management. (Student F)

The matter of team working, and the protection and support that comes from their senior peers is discussed by a junior student:

> The creative directors [senior students] have been open to all our suggestions and our input is important to them. Creative directors have [also] been supportive through personal projects we were given and are very approachable; they made it

clear from the start that we can talk to them about anything we need help with. (Student E)

So the cross-year fertilization is pastoral as well as creative, and is not contained just to the agency project but is 'leaking' into the other elements of the programme. The 'Top Ten Skills Value Audit' (Table 1) conducted with the 2011 graduates reflects these peer-working and leadership skills. It lists the skills and facets of the project which students mentioned most.

Figure 59 - Graphic design promotional materials produced by various student agencies

Table 1 - Top ten most frequently mentioned skills value audit from 2011 graduates (these are not ranked in relation to each other – the numbers are for referencing purposes only)

1	Fun
2	Saw the other side – saw the viewpoints of tutors, employers and other students
3	Agency acted as a shield – allowing taking more risks
4	Understood the importance of 'selling skills'
5	Junior years ability to look ahead and see standard of work in future years
6	Sharing of skills and knowledge between peers

7	Increased confidence in presenting, dealing with people in different areas of industry and the workplace
8	Engendered greater valuing of work, and how to price it
9	Learned leadership skills and how to give advice
10	Appreciated the difficulty of delegation

This demonstrates a wide variety of skills most frequently mentioned by students, and it is notable how many are related to enterprise/ problem-solving issues such as risk-taking, selling, presenting, networking, pricing, leadership and delegation. 2, 5, and 6 all support earlier student observations that the cross-year-group methodology is having a powerful propagative effect. But the first listed item presents a philosophical matter - is 'fun' a skill? Perhaps, as Mary Poppins suggested, the skill is to "find the fun" (Sherman and Sherman 1964) in which "Snap! The job's a game." It suggests that, however categorised, fun through on-going immersive engagement and experimentation (with toleration/ encouragement of mistakes) is an important element of this programme.

But it is not just skills development that is recognised by students. The mentors, well respected within their field, hold an established network of contacts, and one of the students relates the benefits of this:

> We've also made contacts with designers and makers… which has been an invaluable experience. [Student C]

The mentors and their respective agencies value that opportunity too:

> The agency project is almost like a dating agency, whereby design agencies can meet and get to know the students, and if things go well, start a permanent relationship! (Mentor C)

This mutually beneficial opportunity for exploration between student and agencies is underlined by a mentor from one of the larger agencies involved in the project:

> In the previous two years that we have participated in this project we feel we have… been able to contribute to the student's understanding of what agency life is like… in return we… get to know the students [and] offer placements to some of those students, one of whom is now part of our permanent staff. (Mentor B)

The student responses demonstrate the reflexive environment of the project, where the students reflect not only on outputs but also on processes. Each student keeps a personal journal for the project that is shared only with tutors, so can share freely. It is seen in the student reflections here (and graphically illustrated in Figure 5), that they readily identify where things can be improved, and take responsibility for both symptom and solution:

> We get to make the big decisions; but with this freedom comes a lot of hard work and responsibility, which mirrors the reality of graphic design. (Student A)

The theoretical responsibilities (to which the institution's HR department introduces the students) are developed throughout the project, so that these are viewed in a much more powerful wider societal context later:

> I have learned that every individual… should be allowed equal opportunity to make their opinions both heard and valued. Making a conscious decision to sit back and listen to everyone's thoughts and ideas... I would have not gained this without being part of an agency. (Student F)

Figure 5 – "If at First You Don't Succeed..." produced by Fetch Agency. Reflexivity in action as this agency produces a graphic design output containing the problems they encountered, and their solutions.

Conclusion – What has been learned and what's next?

It was not our intention to draw pedagogic generalisations from the Design Agency Project. It is offered as an example of outcomes that conform to a wide employability agenda within a higher education institution. We should caution that this was an art and design college in which self-reflection and critique are established norms. This institutional philosophical and pedagogical stance repeatedly surfaces in analysis of the project. The openness to new methods, experimentation and reflexivity has permitted the project a level of traction here that may not be achieved elsewhere without friction. One of the staff members underlines this essential facilitative element:

> The teaching process being developed within the design agency project is on going - the practice of reflection, experimentation and consolidation is highly fluid. It is vital, particularly in the teaching of such an experimental area, which is at the forefront of visual communication, to be reflective about one's experiences and to be receptive to new ideas and approaches. (Staff member A)

In this spirit of dynamic evolution, drafting of this paper has provided the authors an opportunity to reflect on the meta-outcomes of the Design Agency Project, and there are a number worthy of further exploration. The paper has particularly highlighted for us gaps in data through lack of systematic collation. This meant that we had no option but to position this case study as descriptive rather than evaluative. A dedicated researcher is currently addressing that situation. Initial goals in this respect are:

- To initiate contact with the qualitatively significant 2012 graduates, inviting each to contribute about their experience of the programme. We hope this will inform a systematic analysis as part of a longitudinal study into what happens after graduation;
- We are to canvass participating members of the Design Business Association for insights about the project;
- We will examine the effectiveness of the established learning outcomes which support the project, being open to opportunities for improvement in the authenticity of assessment;
- We wish to examine how we might evolve a deeper/ broader analysis to establish whether there are wider lessons – in particular to probe further what problems this approach presents;
- We need to understand better what the project yields for mentors, and how that might be better inscribed within the project.

The evolution of this project demonstrates that there is a role for educators' autonomous risk-taking in design education methodologies. This project was conceived of as neither a contribution to the employability agenda nor did it fulfil the rigours of action research. It evolved from a series of small annual interventions in the curriculum to generate energy and familiarity between students (and years of the programme) at the commencement of each year. It was an extended yearly 'ice-breaker' prior to commencing the 'real learning'. But the recognition of the student benefits in this accident was so compelling *and* the autonomy of the programme leader wide enough to permit its integration into the wider curriculum.

It is possible that the process of formal application for funding to evolve or to study the project at its early stages may have ironically quashed its potential. And yet, we must contrast that with what has been described as the ‘sprinkling of magic dust’ on the project. It has been cited several times by institutions concerned with progressive design education, and shortlisted within the top three in the UK for the Guardian University Awards 2013 ‘employability’ category. There are good and solid points made in its favour, but its alchemy is currently strong enough that we fear dissenting voices may have been quieted, and valid opportunities for improvement may be missed.

In other words the project benefited from the freedom to evolve without being tied to educational funding or pedagogical imperatives, but equally is now hoping to reap a reward from more systematic reflection in-situ. It may now even qualify as educational action research. There should be pause for reflection about trying to force lessons or pedagogic outcomes on educational projects at their inception – particularly doing so by concentrating funding on topics such as ‘employability’. Perhaps those specific lessons are more likely to emerge through a wider initial remit – for instance, funding opportunities in a ‘wildcard’ category.

Whilst the most frequently mentioned skills (Table 1) are important, the prime interest for us is turning its indicative perspectives into more systematic findings by deeper and expanded probing. Nevertheless, even now the role of enjoyment emerges as an interesting indication because ‘employability’ (fuzzy though it may be as a term) can attract a reverence that strips it of this important element. We may be providing a sense of being ‘employable’ but it is only one part of design education. Primordial to that is the optimisation of opportunity to freely experiment (and enjoy doing so) since we are not simply a production line for industry. There is a paralleled commentary from Stockport College’s Thoughtful Six project:

> We realised that perhaps it's okay that design education isn't some boot camp for the industry where every student is drilled into preparation for a job. Because, guess what? We've learnt not every single design student really, really wants to be a successful designer… and their design degree is just the first step. (Corazzo 2009)

Zoe Patterson support this broader view of employability in suggesting that the Design Agency Project empowers students to recognise and prepare alternatives too:

> All the design related jobs you don’t know exist… they’re getting a taste of that… and some of them are slightly rejecting that, or looking further afield for agencies that don’t follow that type of model… So it is opening up other opportunities… We’re not saying to these students they have to work in a certain way… Many of them are working as though they’re collectives as opposed to design agencies… Some of them have rejected all of that… and they write their philosophy. (ZP)

A staff member who has charge of one of the year groups cements this with a hopeful view of the wider possibilities for the project and his students:

> The agency project offers me the opportunity to be part of the single most exciting and fundamentally far reaching teaching and learning experience I have witnessed in my decade of practice as a design lecturer. Better yet is the knowledge that we have only just started to realise the true potential of this project and the best has yet to come. (Staff member A)

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Liminal moments: designing, thinking and learning

Manuela TABOADA* and Gretchen COOMBS
Queensland University of Technology

Abstract: *This paper provides a contextual reflection for understanding best practice teaching to first year design students. The outcome (job) focussed approach to higher education has lead to some unanticipated collateral damage for students, and in the case we discuss, has altered the students' expectations of course delivery with specific implications and challenges for design educators. This tendency in educational delivery systems is further compounded by the distinct characteristics of Generation Y students within a classroom context. It is our belief that foundational design education must focus more on process than outcomes, and through this research with first year design students we analyse and raise questions relative to the curriculum for a Design and Creative Thinking course—in which students not only benefit from learning the theories and processes of design thinking, conceptualisation and creativity, but also are encouraged to see it as an essential tool for their education and development as designers. This study considers the challenges within a design environment; specifically, we address the need for process based learning in contrast to the outcome-focused approach taken by most students. The authors base their reflections on teaching design students at a university in Queensland, Australia.*

Keywords: *Design education, design thinking, creativity, threshold concepts*

* Corresponding author: School of Design, Creative Industries Faculty | Queensland University of Technology | Australia | e-mail: manuela.taboada@qut.edu.edu

Introduction

The current context of university teaching, as described by Biggs and Tang (2007) and Friedman (2003), focuses on the teaching of the professions to very large groups of students that are not necessarily interested in the "higher" end of the higher education system. This fact alone has a strong impact on all disciplines and an interesting effect on teaching design in a university setting.

Friedman (2003), briefly describes the trajectory of design education from the apprentice artisan craft traditions, through professional education and into universities. He highlights the need to understand design as a planning process that involves a multitude of skills always directly related to the production of artefacts. He states that "artefacts are in fact the implementation of a design solution", and implies that the act of designing starts way before the production of the artefact. Similarly, Buchanan (1998) describes two stages on the evolution of design education and how theory relates to practice in each of them. In 1998 Buchanan envisioned a "third era" of design education as he forecast schools that would be informing the practice through the new knowledge created in their design studios and research efforts. In a setting where theory goes beyond practice to develop solutions for problems yet to be perceived by the industry, instead of following trends, according to his vision, design students would determine and create future trends. We agree with Clark (2003) who suggests that there is "opportunity for design to define itself as a field with its own knowledge/s that facilitate, not only thinking about design and through design, but of design as a way of knowing, thinking and doing", and with Lloyd (2012) that role of designers is changing into becoming more focused on social engagement and on the process of designing rather than on problem-solving outcomes.

The purpose of this paper is to reflect upon the introduction of a new first semester unit on design thinking to the Interactive and Visual Design program at Queensland University of Technology (QUT), and to raise questions on how to optimise learning in units that deal with disciplinary threshold concepts (Meyer and Land 2003) in design. We describe and analyse the course environment and some current trends in design education, and compare these to the achieved outcomes of the unit through a general student perception survey and in class observations.

This is a position paper that results from the realisation of a problem that needs to be addressed. While it does not aim to offer any final solutions or recommendations, it aims to help design educators reflect upon what could be the real threshold concepts (learning "portals") students need to get through during their design course to learn how to **be a designer**, as opposed to how to **do design**. It is our hope that the results of this investigation can inform design educators about these concepts and about some of the challenges of teaching students solely focussed on the outcomes of design instead of the processes of learning through design.

Teaching and learning design in a higher education context

Teaching Design

In order to set the context of this study it is useful to look into what is the current environment around university teaching (and learning) in general, and around design education specifically. Tony Fry (2003) claims that currently the essential thinking activity in university setting has been "forgotten", and that as a consequence,

> the abilities of a self to comprehend its (fractured) being, the (difference of the) being of others and the being of the worlds of dwelling constantly diminishes. In contrast, the ability to operationally function in the maintenance and extension of projected, and frequently incommensurate, worlds increases.

When Biggs and Tang (2007) describe shifts in university settings, they mention the change in the type of students that search for a higher education degree, with special emphasis on students who now come from a broad range of backgrounds and that in their majority are not necessarily "used to" the traditional academic ways of learning; their main objective at university is to acquire the necessary skills and knowledge that will guarantee them a good job. In other words, they are not used to and some times not interested in thinking about or reflecting upon their practices. They want to learn to "do", instead of learning to "be". This tendency might be more prevalent within the creative industries where there is increased emphasis placed on finding a measurable outcome for creative degrees.

In addition, Smith, Hedley and Molloy (2009) observe that most students' lives are "often fractured between work, family commitments, personal issues and study", and that this context influences and contributes to the way they learn. The situation is no different with the contemporary design students. Both Biggs and Tang (2007) and Smith, Hedley and Molloy (2009) suggest that models of teaching (and teaching design, specifically) should evolve in order to accommodate the new needs of the students. Biggs and Tang (2007) emphasize aligned teaching as a way to help most students to engage with learning on a "higher level". Smith, Hedley and Molloy (2009) propose a model of delivery that is focused on problem-solving activities strongly rooted on experimentation and theory. Following this thought Sharma (2011) observes a movement towards cohort-based learning where smaller groups of students engage with academics in more informed discussions based on already available, open-source online material. He believes the movement in this direction has already started and the general low lecture attendance rates are a good sign of this change. Another sign is the frequent sharing among students of extra material available online that is related to course content, and that students subsequently engage in discussion via online social networks.

The new, contemporary design practice has a strong focus on design thinking as its main product, rather than any specific media or product type as it once was. With the evolution of technology the production of design artefacts has become easier and cheaper, and most of the time the designers themselves have full control over the whole process—from creation to production and marketing. If we think about the print industry as an example, in the beginning the main concern of the "designer", or "typographer" was to set the lines of text properly so that the newspaper page could be read easily and with a minimum number of mistakes. This process involved a couple of people in different roles, large-scale machinery, and toxic (and non-washable!) ink. The text was written by the copywriter, page laid out by the type-setter, on metal types and wood, which was put into the printing machine and "stamped" onto pages of paper as many times as copies were needed: then to the next page and to mounting the newspaper, packing and delivering it to houses and / or points of sales. Neither the copywriter nor the typesetter knew exactly how their pages were going to look until the first one was printed. The design was defined by the production process and existed for the purpose of making it work properly, neatly, and maybe make pages look a bit nicer to read. The process went through many hands, and the focus was primarily on producing the artefact.

Today, in contrast, the other side of this industry is that the writer sets his own text on a computer, most of the time seeing exactly how it will look if printed. Much written media is consumed in its original digital form: the copywriter sends their article to the newspaper's online system that will "digest" it according to the styles defined by the designer (who based it on theories of legibility on screen and matched it to the newspaper branding guidelines), and publish it almost immediately. In other desktop publishing situations the graphic designer has full control over the design, photography, illustrations and most of the printing process. If they want, they can work by themselves, from any country in the world without leaving their home offices. With 3D printers becoming more popular, even product designers can develop, prototype and sell their products to be printed in their customer's home.

These shifts in the design process indicate that the differentiation of a design service / consultancy no longer relies on the quality of the graphics, or the aesthetics of the products they create. The main point of difference becomes the thinking that goes behind that solution and how that solution will transform the client's business, life, social interactions and create new cultures (Brown 2009, 2008; Vogel 2010). High level, top edge design companies value and focus on the transformative powers of design through multidisciplinary teams, collaborative work within teams and with stakeholders, and community / social development around their products. Central Design, IDEO, Someone In London, and Futurebrand are just a few examples of these global design companies.

Therefore, the current challenge for the academics in higher education design courses is to find ways to prepare the students for this world of critical, strategic design, that is highly technological but should be focused on human experiences. What are the practical changes that need to be made in our courses to accommodate the changes in the industry, its new demands, and specifically, the changes in the way students learn?

Friedman (2003) advocates the need to think of the design solution as a series of skills, tasks and planning process that comes before the production of the artefact. Design courses should focus on developing design thinking skills rather than focus mainly on production. Buchanan (1998) agrees by stating that the focus on developing skills to solve problems of the present through a stronger flow of communication between industry practitioners and educators is valid, but that this should evolve into a different relationship between theory and practice. He believes that theory should go beyond practice developing idea and solutions for problems yet to be felt by the industry, through studio practice and design research. Tim Brown (2008, 2009) crafts the term "Design Thinking" to represent the strategic role of design in igniting ideas and the identification of issues at very early stages of development of a "solution", as opposed to the common view of design as a "tactic" activity that "builds on what exists and usually moves it (only) one step further. Designers than have their roles shifted from simply solving an aesthetic problem to become the core strategists and thinkers, helping not only to solve, but also to better outline the problems (Brown 2008, 2009; Lockwood 2010).

These arguments easily underpin the idea of aiming for a transformative design education, where the higher levels of reflection and transformation are achieved through the act of learning how to become a designer. This also aligns with QUT

Creative Industry focus on practice-led research where the practice is to inform and generate new knowledge and this new knowledge, in turn, transforms and helps the practice evolve.

As teachers of design we understand that "creative spaces" need to be devised for students so that they exercise their own ideas and design processes. These spaces involve not only physical space and diverse opportunities and freedom to experiment, but also time to think, research and connect ideas, and to engage on rich conversations that allows for multiple perspectives to be explored (Gadamer 1977; Shaw 2002; Polanyi 1967; Rust 2004; Senker 1995). These can help consolidate formal "new knowledge" acquisition, harness and build upon learners' tacit knowledge (Polanyi 1967; Rust 2004; Senker 1995), and also help new knowledge and innovative ideas to emerge.

Literature shows that creativity is strongly related to trust and diversity (Goldschmidt and Tatsa 2005; Myers and Torrance 1967); (Atkinson 2002; Polanyi 1967; Torrance 1967). Trust, however is something that takes time and effort build, and it does not exist if it is not authentic (Cole-Edelstein 2004; Healey 1997)mar(Marzano 2006; Palmer 1997; Polanyi 1967). One cannot be "forced" into trusting someone else. As is well described by Brookfield (1995), it is the very subtle actions of the teacher that will make students feel secure enough to trust, or that can easily undermine any possibility for trust to happen.

On the other hand, Clarke and Clayton (2010) state:

> Australian design schools appear to share an assumption that the undergraduate degree is structured around the imperative of educating graduates capable of taking up—or generating—employment in design: that students will have the skills, conceptual reach, entrepreneurial capacity and confidence to make a transition from university design education to paid work in a design related field, or to higher degree research and its implicit professional pathway.

This outcome-focused view of design education although understandably necessary, can undermine or make it harder for students to engage with concepts that are not obviously related to the direct outcomes described by Clarke and Clayton (2010). Therefore, the ultimate transformative experience in design teaching will come from a strong bonding of creative trust between students and tutors, which should provide stronger engagement with more abstract issues and also reinforce and inform connections to the needs of the industry. We believe design thinking combined with process-based learning can help engage students in their self-transformation.

Smith, Hedley and Molloy (2009) suggest a model of learning to the course of Interior Design that builds upon students tacit knowledge of design—the knowledge they already have about the designed objects and environments they interact with. Students develop and improve their own design process through adding and relating knowledge they already have with the knowledge they gradually "acquire" during their university program. The connection between these different instances of knowing, the comparison, usage and adaptation of knowledge to solve design problems is what constitutes their learning, and what will build the scaffolding for the creation of new knowledge. Smith et al.'s (2009) approach "incorporates diversity, exploration, and consolidation, as the student learns about designing by designing and critiquing design from the different perspectives of the three strands".

This was the sort of approach we incorporated to the Design & Creative Thinking unit recently introduced to the Interactive and Visual Design program at the School of

Design, Creative Industries. The aim of the unit is to offer a foundation in design thinking and introduction to the processes and methods designers employ when working in a contemporary cross-discipline environment. It does so by introducing design history, creativity theory and the evolution of design thinking. The delivery was structured between weekly lectures (1h) and studios (3h). Lectures address social, cultural, economic and technical themes that have continued to shape the design industry and the role of designed objects in society, as well as its practitioners, styles and methodological approaches. Studios consist of problem-based learning activities and group discussions. During studios, apart from creativity and observation and interpretation exercises, students were given a variety of design briefs and had different time frames to work on them. Their solutions were presented during in class critiques. Assessment consisted of two items: (i) a written essay—as one of the unit objectives is to develop academic writing skills—and (ii) a design charrette at the end of semester, where students were given a brief and had 48 hours to develop and present their design proposals.

Learning Design

Our experience teaching first year design students has revealed some challenges. During the course, one of the main issues was to engage students in the course, motivate them to attend lectures and secure their attention and meaningful participation on the practical activities. After the course and through analysing the survey data, we realised that students could not grasp the real purpose of the unit—possibly the cause of our engagement issues. One of the students expressed in the end-of-semester survey, “I feel like hardly any of it [what they learned during semester] is actually relevant to what we should be learning”.

It has been our experience that classroom numbers drop off dramatically after four to five weeks, leaving tutors to reinterpret and deliver lecture material. This practice counters what we hope tutors accomplish in their tutorials, namely, process-based activities that encourage students to problem solve. In addition to this issue is the acute focus that most students give to assessment. While this is an understandable goal of students in a university environment, it seems to be at the expense of learning to work through problems to achieve better outcomes. There’s a reluctance to engage with new and unexpected tasks or processes unless they will be assessed in some manner.

The authors are sympathetic to the challenges university graduates face—decreased employability and pay rates, increased competition for jobs. Nowhere is this more evident in creative fields where there are more graduates than there are jobs (directly related to creative practice degrees). Indeed this reflects a tendency for most creative practitioners as the emphasis on combining ‘the creative’ with ‘industry’ has encouraged students to instrumentalise their creativity at the (often) expense of that very creativity. What might compound this pressure on educators are the characteristics of this generation of students, Generation Y (Gen Y): an age group born into technology, reliant on it in every manner, distracted by it in every context, and who have short attention spans and demand immediate rewards. How Gen Y attributes relate directly to some of these pedagogical challenges is difficult to quantify: the authors express this based on their experience with this age cohort.

For instance, one of the observation tasks the students were given during their studios consisted of sitting outside, by themselves, for twenty minutes to silently observe what happens around them. Later the students were asked to design a poster addressing their experience. Students were instructed to leave their mobile devices in the classroom. The aims of this exercise were (i) take the students out of their comfort zone of screen-based thinking and research, (ii) to encourage students to develop a different perspective upon a familiar place—once “removed” from it and silent, (iii) to start familiarizing students with open-ended possibilities and uncertainty and (iv) to start developing some critical interpretation and visual translation skills. As a result of this exercise we had students that were extremely excited and produced posters that addressed interesting political, social, ecological and even sometimes humorous issues, such as the strong relationship between coffee and academics. On the other hand, some students didn’t “get” the purpose of the exercise and saw it as a “waste of time”. Some students also didn’t engage with the activity and told us they “decided to go for a walk” instead of sitting in one place, or stayed with a group of friends, rather than by themselves.

We are assuming that the creative process is a complex one, and within the context of design, this process gets compounded with design’s inherent goal of posing solutions through a variety of tangible design outcomes generated through processes of interaction, feedback, prototyping, and ultimately a product (or experience) of some sort. Yet, from our experience teaching Design and Creative Thinking, there appears to be resistance to focus on the process aspect of design. Most students look for quick solutions and don’t engage with the criticality of the design work. Research skills are limited, and there is very little will to do further research into the design problem they are working on. Visual research is mostly digital and they don’t look further than the screen for their sources of inspiration; creativity is limited by what has already been done. We might also speculate that some of this reflects a generational tendency to want things ‘right now’ (the pun on Generation Y - Generation Why-Not-Now?).

It has also been our experience that students in our design course (as opposed to other courses such as architecture) are quite reluctant to critique each other’s work as part of the design process. We might speculate that this may be one, a reaction to critiques where the teacher asserted their power; or, again a generational tendency to get affirmations and recognition for just showing up. While scant literature may support these assertions, it has been clear that there is a certain anxiety towards the future that is pervasive in the study body that supports this contention. We also want to make clear there are many students who do engage with process, who focus on the problem-solving—and “problem-finding”—aspect of design and are not wed to immediate outcomes, as can be demonstrated by another student’s statement on the end of the year survey: “The best aspects were that I learnt from the assignments and tasks in the studio. I had a lot of moments where things all came together and related and I understood things”. Further, we have encountered many students who actively seek critique for their design process and are enthusiastic about reworking their designs to better respond to mock briefs.

Design thinking: a threshold concept in design learning?

Meyer and Land (2003) define threshold concepts as “portals” of knowledge that the students go through when advancing on their learning. They characterise these units of knowledge as being transformative, irreversible, integrated, troublesome and bounded. Transformative and irreversible because as students learn the concept their understanding of the discipline, industry or self is transformed and there is no going back to seeing things the way they saw before—an ontological change, ostensibly. Integrated meaning that it pulls together a broad range of knowledge in the discipline and helps make sense of it. Bounded as it helps delimit the boundaries of the discipline; and troublesome because it is not always concepts that are "easy" to understand and make sense of, and it can be often counter-intuitive or seem "illogical" to the students coming from a certain point of view.

One of the aims of adding a unit in first year first semester that deals with issues of creativity and design thinking was to create the opportunity for students to focus on the conceptualisation aspects and thought process behind the design (making) work, helping them access and experiment with diverse conceptualisation, research and prototyping processes as early as possible in the course. This allows them to apply, refine and make sense of these skills throughout the entire course and in different sorts of projects. More importantly we aim to initiate students on the Design Thinking approach, where designers engage not only in finding solutions for a set problem, but in actually scoping the problem itself. In order to achieve this, it has been our practice in this class to provide students with open design briefs that mostly addressed social issues. Students were then asked to think of the problem and how it could be tackled. The focus on making something look good or functional is removed from the initial stages of designing. Actually the act of "making something" is given a lower priority in relation to the act of mapping the environment around the given issues, its stakeholders and social implications. All this helps students to outlining the problem through different perspectives before crafting possible systemic alternatives.

By removing the immediate focus on tangible / aesthetic design outcome from the aims of this unit, and concentrating on the methodologies of design strategy, creativity theories, research methods and prototyping as a development tool we intend to get students to understand the value of spending time on and developing the research and thinking stages of the design process. This, however, adds a level of "troublesomness" (Perkins 1999) to the unit that we did not foresee. Flagging the idea that Design Thinking characterises as a threshold concept in design education.

In a preliminary analysis, Design Thinking as a concept in itself fits within all five attributes of threshold concepts described by Meyer and Land (2003). There is no question that once you understand the meaning of Design Thinking it completely changes the way you see your role as a designer, the design activity and its outcomes, and after you cross this "portal" it is very hard to go back to the previous perspective of what design might constitute. This therefore characterises Design Thinking as a "transformative" and "irreversible" concept (Meyer and Land 2003). In terms of being a "bounded" and "integrative" concept, Design Thinking does help define the boundaries of what is meaningful design and what is merely "aesthetic" design. More importantly it defines design as a highly human-dependent and interdisciplinary activity—as opposed to the current technocentric view that good design (specially graphic design) can be made by one single person (a competent trained designer, preferably) sitting behind a computer screen. Design Thinking also allows students to realise the connections between the concepts they are learning in other units and how they integrate these concepts into a holistic, critical and meaningful pedagogical process.

However, what interests us most and came to our utmost attention was that Design Thinking actually demonstrated to be a "troublesome" concept (Meyer and Land 2003; Perkins 1999) for student learning. It was noted that the concept of design thinking in fact contradicts students expectations that design is about "making things" and using technology to generate the desired outcomes. Most of the students were surprised—and somewhat disappointed—to sit on a class where they were taught about the thoughts behind design and sometimes asked to do nothing but observe a certain situation and think about the constraints and opportunities that could emerge from it. This sense of discomfort of the students is demonstrated by their comments on the end of semester survey. Some of these comments describe feelings of time being wasted and information not being relevant "to what we should be learning".

Therefore, our main question is: What can we to do and what should we change in the way the unit is delivered and assessed in order to take students through the "Design Thinking Portal" in a more subtle, confident and conscious way?

Action Plan

Considering the contextual issues and the raised questions we decided to review the curriculum of this unit. To put in practice what we have been praying, we decided to use a design thinking approach to the task. We believe that design thinking can add some dimensions to curriculum design practices—which is already a genuine human-centred design process. However, what is different about our approach is that instead of focusing only on the usual teaching and learning aspects of the unit, we want to consider other broader aspects such as student lifestyle, teachers profiles, general expectations from students, teachers, the department to which the unit belongs, the university as a whole and more importantly the role of this unit in helping students become designers and thinkers that will make a difference in the future of the industry.

The first step of this process was to map the environment around the unit (Figure 1), determine the main issues (constraints) we want to address and the outcomes we want to generate—these are more than the learning outcomes of the unit, they represent what we want to achieve with and through this unit by the end of the semester in general terms.

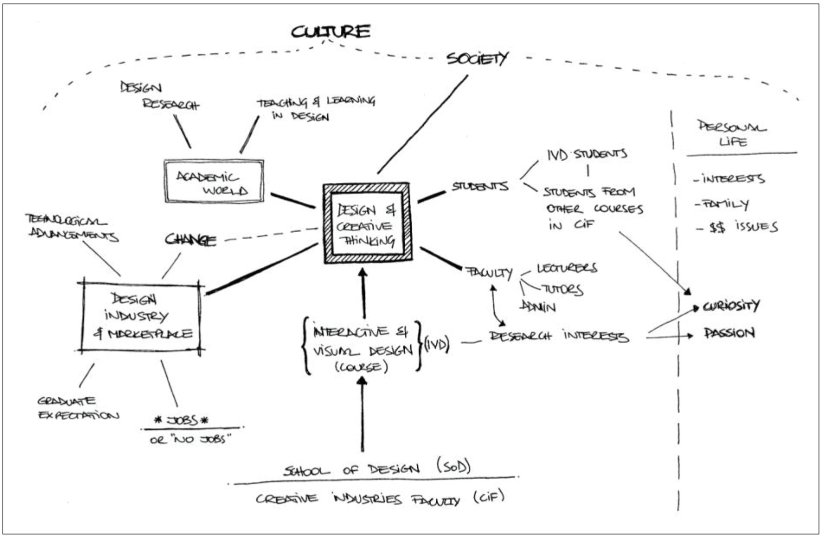

Figure 60 – Design & Creative Thinking environmental map

We chose to address two main topics in the first iteration of change:

Issue 1: Design thinking = a troublesome portal

Design thinking was identified as a threshold concept which offers some contradictory troublesome knowledge that is mainly caused by the mismatch between students expectations of what they “should be learning” in such a unit, and what is actually delivered. In order to tackle that, we feel we need to address the differences between learning to do design and learning to be a designer, an epistemological obstacle between the roles making and being, acquiring and becoming, which determines how transformative the journey through this unit will be for the student.

Therefore, what we want to achieve by addressing this issue is the creation of a “smoother passage”, a conscious crossing of this conceptual portal, where students can identify and reflect upon the liminal moments of learning, as they know what to expect and understand the transformation they will go through.

The plan is to make the focus on process explicit from the beginning by clearly stating it and by embedding it into the first studio activities so that students can discover it by themselves.

Issue 2: Weak engagement with the new knowledge and activities

As part of the process of becoming, or as a matter of fact, for the “transformation” to happen and the crossing to occur students should engage with the designed learning activities. As described on the previous sessions of this paper, current Gen-y students have diverse modes of learning, a busy lifestyle and an urge to get things done quickly. They are also described as performing better when challenged and left alone to complete a certain task. We want our activities to follow and tap into that potential, offering guidance as an exciting road of “discovery”—almost disguised as game tokens that they will “find by themselves”. This implies in changes in modes of delivery and assessment activities.

As a consequence, the plan we outlined for the next iteration of the unit is based on one line of thought: give voice and ownership of the unit to the students without losing control of its content and learning objectives. This sounds obvious but is not easy to implement. We will work in two levels: one that will help students think about the purpose of the unit on a high level; and another one that will engage students on developing their own briefs and designing some of the assessment criteria.

More specifically, to tackle issue 1, we intend to survey the students at the beginning of the semester and ask them what they think the purpose of the unit is. The answers will be shared in class and together we will outline and explain how each activity will lead and prepare them to achieve that purpose. This will be approached the first design brief they have to think about. The collective design will be implemented through semester. At the end of the semester students will be asked again what they thought the purpose of the unit was, if they think they had achieved it, and how. Comparison of the two answers will help us have a better idea of how students expectations change during semester and which activities give them a sense of achievement of their goals, which activities clearly relate to the “passage”, to the understanding of the threshold concept.

We will address issue two by involving students in designing their own assessment criteria. One of the assessment items in this unit is related to academic research and writing skills. It is our intention to make this more aligned to industry standards of writing not losing focus on the academic rules. So students will be pointed to and search for examples of outstanding practice in industry and academic writing in the field of design thinking, critical design and creativity. Together we will deconstruct these examples and they will be asked what elements they think make those pieces excellent. From the results achieved with this, we will design their assessment item (around industry and academic writing skills and styles) and criteria.

This way students will be defining parts of the delivery mode and activities of the unit, as well as the parameters of assignment. We believe that by giving more ownership of the process to the students we might achieve better results in terms of engagement and quality of assessment.

We understand however that giving that much power to the student cohort could have negative implications on the unit. For instance, students might read that the coordinator and teachers are not sure what to do about the unit; they might feel insecure about the quality of their learning if so much is being defined by them, who are just entering the university; teachers might feel unsure about the possibility of having to deal with unexpected results from the interaction with students. All this, however are issues that the process of Design Thinking brings, and it needs to be based on trust on the process and on the creative and tacit knowledge of the stakeholders (students and teachers in this case).

In order to balance the strong student input in the unit, similar activities will be undertaken with industry stakeholders and other faculty members. They will be asked what they think should be the purpose of a unit such as this and also to engage on some deconstruction of content of some renowned design publications. As such we are able to compare the perspectives of students with those of industry and faculty, and to balance these as we outline and apply new approaches to delivery, activities and assessment.

Conclusion

Course curriculum can be seen as a sequence of portals that students go through during their journey of learning and discovery. One of the challenges of doing this is that this should not be limited to change of curriculum on isolated units, rather there is a need to identify and map the threshold concepts that students should go through at a course level and apply the changes consistently.

Buchanan (1998), Fry (2003) and Palmer (1997) analyse teaching from a philosophical perspective and advocate that teaching can be a way of changing paradigms and shift ontologies, and question the paradigmatic assumptions (Brookfield 1995) that surround their teaching and their practice. Buchanan (1998) states, "in the very process of teaching students how to design, the design educator is also investigating the nature of design, seeking to better understand its methods and principles". This is in line with the design thinking approach and the cycles of prototyping iteration and improvement through reflection on the process.

This paper is the result of the realisation of design thinking as a threshold concept in design education and on its role as transformative—though contradictory—notion. Using a design thinking approach to re-design the curriculum for this specific unit is an attempt to facilitate change from bottom-up by altering the way first-years engage with the design activity from the start, so their approach at the end of the course is more holistic, critical and media independent, and they pass through conscious transformations to **become** designers and critical-thinkers.

We agree with Buchanan (1998) when he suggests that “we must be alert to new developments and prepare our students for a changing world – not only in technology but in the needs and expectations of the human beings whom we ultimately must serve”. If we teach what we love (Palmer 1997) and teach to change the world (Brookfield 1995), we need to enable our students to envision the future of a viable world (Fry 2003), and to empower them with techniques, skills and wisdom to design and build this world

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Form, fit and flair: considering the design doctorate

Laurene VAUGHAN* and Andrew MORRISON

RMIT University & Carnegie Mellon University, and Oslo School of Architecture and Design

Abstract: *Across the domains of design education the Design PhD is an area of much contemporary discussion and debate internationally. As the field of the discipline of design matures, so does its relationship with this qualification: its form, methods and relevance within and beyond the academy. In this paper, the authors critically reflect on their respective observations of differing models of undertaking design PhDs and subsequent models of submission and examination. Founded in their observations of the diversity of design PhDs pedagogically and structurally, the authors have begun a global mapping of current PhDs in design and are exploring how the various forms of design PhDs 1. Reflect socio-cultural and economic contexts of the study, and 2. Evidence a design research mode of inquiry and contribution. Through this discussion they question how do we design Design PhDs that have relevance to the field, respect design's particular contributions, and maintain the critical and scholarly contribution that is the basis of the PhD qualification?*

Keywords*: design, doctorate, education, research.*

* Corresponding author: School of Media and Communication | RMIT University | Australia | e-mail laurene.vaughan@rmit.edu.au

Changing landscapes of design knowledge making

Doctoral education in design is maturing fast, both pedagogically and in terms of research and associated publications. Following the theme of this conference, *what are we to make of the histories and current configurations of the PhD in Design as part of anticipating, and ensuring richer futures for learning and researching design at this level?*

In recent years a number of international events have taken place that examine and discuss the character, variety, diversity and complexity of teaching and learning the PhD in design (e.g. Durling and Friedman 2000). A set of international papers entitled 'Practice, Knowledge, Vision' came out of a Doctoral Education in Design Conference held in Hong Kong in 2011. A substantial book of edited chapters called *The Unthinkable Doctorate* (Belderbos and Verbeke 2007) emerged from the same named event, resulting in subsequent explorations into new forms of doctoral education at Sint-Lucas School of Architecture, Brussels & Ghent in Belgium. This was just one example within design and architecture critical reflections by members of the academy (Heynen 2006). Recent DRS and CUMULUS conferences have included work relating to post-graduate education and in particular methods in design research. In Norway, the host of this DRS / CUMULUS conference, considerable work has gone into discussing the changing character of the design PhD (e.g. Dunin-Woyseth and Michl 2001; Michl and Nielsen 2005; Dunin-Woyseth and Nilsson 2012; Morrison 2013). In Sweden a national doctoral school has tackled a multitude of issues to do with practice-based inquiry and the diversity of design domains a PhD school needs to address.

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

Complexity and diversity on the design PhD

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

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

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

We approach the medley of from, fit and flair in the changing character of the design oriented PhD by referring to our individual and shared experiences in design, teaching and researching doctoral education in design. We draw on this experience in a mode of dialogue between two teachers and researchers in design at post-graduate level who come from, and work in contexts that are widely separated geographically. That said, we have both moved across and between our own locations and contexts of learning, teaching and design practice, and doctoral education has been a shared topic of discussion and exchange between us.

A tentative and heuristic framework

Following several years in collaborating on design education and overlapping research interests we have identified a need to look more closely into the characteristics of doctoral design. We do this by offering the first phase of a wider research inquiry into a ‘mapping’ of PhD design education. To date we have discussed our shared experiences, frustrations and successes in design research based on our own roles as doctoral candidates, and then researchers, curriculum developers, programme coordinators, project leaders and supervisors.

Through these discussions we have devised a working, heuristic frame for the further and more systematic coverage of PhD design education. This is an education that we have invested in deeply, often with few resources from outside our own institutional contexts. We have found a need to look beyond the similarities of our two remote settings and towards building understanding of the diversity of PhD programmes in design.

The matrix of key aspects in doctoral education in design we have devised and present below is offered therefore as a device to revise and reposition: through the conference, its review processes and assembled discussions. We are in the process of making a related large research grant application to pursue further study of PhD education in design that would involve a wider set of representative participants from the contexts mentioned, as well as others not currently listed. It is important to state that we do not intend this matrix to be a decisive and divisive tool. In making it we have both seen the value of shaping a space and schema for shared discussion regarding the many issues pertaining to the design doctorate. To be clear, we are undertaking this mapping not with the ambition of using the data to design THE design PhD. Rather, we are seeking to identify the qualities, knowledge contexts and cultural differences that underpin design education at doctoral level, in the same manner that we understand the diversity in the practice of design. As we discuss in the conclusion, this is one step in a larger research inquiry that needs to be extended to and across different institutions, design domains and settings..

Mixed modes of knowing

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

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

Designerly ways of knowing and the PHD

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

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

Directions

In the sections below we first present the wider contexts for looking more closely at the complexity and diversity of doctoral design programmes. We then present the tentative mapping of a variety, but not all, PhD programmes in design. This provides us with a set of categories for discussing the range of programmes and their specific characteristics. We further map this by noting our own various experiences and participation in different aspects of these programmes across and within several countries and educational structures. The categories are discussed in relation to both the longer histories of developing graduate education in decision while also taking up more recent initiatives and innovations that are informed both my educational theories and research, some of it outside design, and the developmental innovations that have been implemented to meet many of the design specific challenges and needs mentioned above.

In so doing we discuss some of the implications for wider curriculum development in the design doctorate, at local and institutional levels, but also globally and transdisciplinarily. Linked to this is the matter of examination formats, student mobility, new ‘design’ scholarship and research methods and post-PhD employment. In the longer term we see this research to be the first phase in a larger and unfolding research project into a more nuanced detailing of the matrix that would be conducted online and is one part of the larger ‘project’ that design graduate educators face in understanding and shaping the future of doctoral education in design.

Context

Discussion of the design PhD cannot be considered in isolation. As a research training degree the PhD must be considered within the broader context of design research and its evolution. Following on from the developments of the design degree within universities, over the past 15 years we have seen graduate education, the development of the design PhD and design research as areas of academic endeavour expand exponentially – both seeking identity, methods and recognition. As argued by Victor Margolin (2010), ‘Today they [design PhDs] exist in many countries and more are on the way, despite the fact that the fundamental questions about what constitutes doctoral education and what it is for remain unresolved. Most new programs appear to be devised locally without reference to elsewhere’ (p.70). Such questions about what is a design doctorate, what is it for, and what is its relationship to design research, scholarship and practice, in themselves evidence the diversity of what constitutes design from various perspectives. These are variances that are based on criteria of nationality, profession, academic tradition and scholarly position. Margolin argues that

that one of his concerns is that design research remains 'cacophonous and without a shared set of problematics' (2010, p. 70), or what he would desire – 'a consensus as to how we identify the subject matter of design and, of equal importance, what design research is for and how different communities of researcher contribute to its purpose' (p.71).

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

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

Although design schools internationally are facing this challenge, and there are numerous conferences, publications and discussion lists seeking to articulate what this will mean, rather than creating a greater level of understanding and universality of academic practice, it seems that the first stage is to highlight the differences. These differences appear to be grounded less in the actualities of design in practice, and more in the external or associated disciplinary fields that have been drawn on to legitimate knowledge production and knowing.

Perhaps one core of the problems in considering what a design PhD is or should be, is the very nebulous nature of the word design. A design PhD may be theoretical, historical, technical, poetic or performative. It many be aligned to any number of design professions or fields of practice, from architecture and engineering, to communications, fashion or service design. It may be undertaken within the model of the laboratory, the studio, the library or 'the street'. The application of the knowledge may span Frayling's (1993) categories of design 'through, for or about'. It may also be 'through, for *and* about', depending on the nature and context of the study. In addition, the form of the PhD, its measures and modes of inquiry will be equally driven by the educational context that it occurs in, including the location of the awarding institution (Davis 2008).

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

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

Perspectives

In response to the authors' observations of doctoral education in design the following list of categories of forms, contexts, modes of study and evaluation of PhDs has been drafted. It draws on our combined 30 years of experience in the field, with over 50 successful MPhil and PhD candidate completions, and 20 examinations internationally. This is in conjunction with our participation in the scholarly and design research community as peer reviewers, authors, editors, conference convenors and practitioners, and lead researchers on funded research projects incorporating PhD candidates.

Both of the authors have also been coordinators and directors of PhD schools, graduate education and the design and delivery of research methods programmes and associated research skills development. These categories have also been shaped through reflective critique and by way of 5 years of international collaboration and co-teaching and exchange visits between our host institutions.

Initial Observations of Doctoral Programs Structures and Activities	
Place	The location of programs is fundamental to all other observations
Mode of Study	Research only
	Coursework + research
	Research Methods
Supervision/Advising	Internal
	External
	No of people involved in advising/supervision
Context of Study	Project funded research
	Self initiated
	Embedded within organisation
Funding source	Project grant
	Self funded
	Government funding
	Industry funding
Milestone activities in progress of study	Completion of coursework
	Examination
	Progress review
	Proposal approval
	Completion seminar
Submission format	Thesis/monograph
	Thesis by research publication
	By publication past practice
	Project or by practice
Examination	Viva – Public
	Viva – Private
	Thesis only – no viva
	Project and exegesis – no viva
Examiners	Internal
	External
	Mix
	Examiners identified
	Examiners anonymous
Enrolment status	Part-time
	Full-time
	On campus
	Off campus
Field of inquiry	Design studies
	Design history
	Practice
	Material science
	Methods
	Interdisciplinary
	Industry
Expected student university roles/activities outside of study	Teaching
	Researcher assistant
	Member of research team
	Co-publishing
	Networking

Table 1. An incomplete mapping criteria for design PhDs.

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

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

In addition to pedagogic frameworks and modes of inquiry, we have also identified there are variations across programmes based on modes of study, involvement or employment of doctoral candidates in the daily life of the design school, teaching duties, and funding models. We have included these in the categories as we they help to identify the differing social, cultural and economic frameworks present in the course of a doctoral degree, and the relationship between the doctorate, the academy and design practice.

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

Discussion

As a first step in our research project into the various forms of the design PhD, we undertook an initial mapping of our respective experiences (Table 2). Although each of the categories that has been identified may seem at first glance obvious and instrumental, it is our hypothesis that an issue such as place, or funding source can have a profound influence on the research that is undertaken, what is reported, to whom and how.

Author encounters		**Laurene Vaughan**	**Andrew Morrison**
Place		Australia, UK, USA, New Zealand, Norway, Austria, Belgium	Norway, Sweden, Australia, South Africa,,Denmark, Finland, UK
Mode of Study	Research	X	X
	Coursework	X	
	Research Methods	X	X
Supervision	Internal	X	X
	External	X	X

	No of people involved in advising/supervision	From 1 solo supervisor, to 5 advisors	Typically 2
Context of Study	Project funded research	X	X
	Self initiated	X	X
	Embedded within organisation	X	X
Funding source	Project grant	X	X
	Self funded	X	X
	Government funding	X	X
	Industry funding	X	X
Milestone activities in progress of study	Completion of coursework	X	
	Examination	X	X
	Progress review	X	X
	Proposal approval	X	X
	Completion seminar	X	
Submission format	Thesis/monograph	X	X
	Thesis by research publication	X	X
	By publication past practice	X	
	Project or by practice	X	X
Examination	Viva – Public	X	X
	Viva – Private		
	Thesis only – no viva	X	
	Project and exegesis – no viva	X	
Examiners	Internal	X	X
	External	X	X
	Mix	X	
	Examiners identified	X	X
	Examiners anonymous	X	
Enrolment status	Part-time	X	X
	Full-time	X	X
	On campus	X	X
	Off campus	X	
Field of inquiry	Design studies	X	X
	Design history	X	
	Practice	X	X
	Material science		X
	Methods	X	X
	Interdisciplinary	X	X
	Industry	X	X
Expected student university roles/activities outside of study	Teaching	X	X
	Researcher assistant	X	X
	Member of research team	X	X

Co-publishing	X	X
Networking	X	X

Table 2. The authors' encounter with the incomplete mapping criteria for design PhDs.

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

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

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

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

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

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

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

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

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

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

Conclusion

In the introduction to this paper we declared that we were not undertaking a mapping of doctoral programmes with any expectation of designing THE design PhD. In fact, our ambition couldn't be further from this. Our aim is to use a diverse range of methods to collate the various approaches to design PhDs globally, and from this, to then identify the various pedagogic approaches and contexts for design PhDs.

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

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Design and business double education: cross-country comparison

Fabiane WOLFF[*a], Brigitte BORJA DE MOZOTA[b] , Andrea CAPRA[c], Daniela SZABLUK[d] and Julia Stephanou NASCIMENTO[e]

[a] UniRitter - Laureate International Universities, Brazil; [b]Paris College of Arts (PCA); [c] UniRitter - Laureate International Universities; [d] UniRitter - Laureate International Universities; [e] UniRitter - Laureate International Universities

Abstract: *Design thinking is the buzz in the management community these days. Managers are encouraged to get out of the box, apply user-oriented research and think more systemically and less analytically, the way designers are trained to do. Previous research on business education best-sellers in France and Brazil shows evidence that design is not considered or is restricted to a very limited content, pointing out that managers are not prepared to understand design. That reality is also perceived on the day by day relationships of both designers and managers and brings forth the issue of double education. Is it the solution? Does teaching design to managers bring value to the relationship? This paper proposes a discussion on double education as a way to bridge this gap. For that, researchers in Brazil and France conducted an exploratory study that investigated how design and management could be developed as double education to better develop design management.*

Keywords*: Design Management, Double Education, Cross-Country research.*

Introduction

Design thinking is the buzz in management community these days. Managers are encouraged to get out of the box, apply user-oriented research and think more systemically and less analytically, as designers are trained to do. Lockwood (2009)

[*] Corresponding author: Design School/UniRitter – Laureate International Universities | Brazil | e-mail: fabiwolff@hotmail.com

points out that many reasons led companies to think that designers have a way of thinking that can contribute to new product development strategies.

According to Borja de Mozota (2003), design can be integrated into a company in many ways considering the intention and approach of the company to the design use.

Design adopts different courses of entry in order to be integrated into an organization. The variety of design applications, however, must not hide the fact that there are some common structures among these different management perspectives. The three most common structures for design entry are: corporate communications and branding policy; product and innovation policy; and retail space and retail branding positioning (Borja de Mozota, 2003, pg.13).

In this context, designers and managers should work together and share decisions in those fields of work. As Kotler and Rath (1984) consider, design, not to be neglected in a company process, requires mutual understanding, especially among professionals involved in product development. 'If a company recognizes the need for more and better design work, then a two-way process of education must occur. Marketers must acquire a better understanding of the design process and designers must acquire a better understanding of the marketing process.' (Kotler and Rath, 1984, pg.19)

In this sense, marketing can be the link between designers and managers. Designers have interest in different areas that are apparently related to marketing. For a good design, these areas must be considered in the whole process of project. Design goes beyond aesthetics, and treating design superficially, with no contact to strategic team, is the mistake of many companies. On that, Kotler and Keller (2005) affirm that in increasingly accelerated markets, design is the factor that will bring competitive advantage. As long as it is integrated to the strategic process in the company.

We can easily see how marketing is important to business and management. Kotler and Armstrong (2007) affirm that the good marketing is essential for the whole company success. For Dickson (2001) the challenges faced by managers involve new product development and adapting to these changes is the secret for companies to achieve marketing success. If marketing is the link between designers and managers, product development is one of the points that connect marketing to design.

Nonetheless, previous researches on business education best-sellers books show evidence that design is not considered or is restricted to a very limited content, pointing out that managers are not prepared to understand design. That reality is also perceived on the day by day relationship of both designers and managers and brings forth the question of double education. This paper discusses the question of teaching business students design as a way to bridge this gap and improve the relationship between design and management.

Objective and Method

Considering a previous research on what is delivered regarding marketing to design students, this research seeks for the other way around. Aiming to discuss the double education on design and management, this paper proposes a discussion on what is presented to business school students in terms of design.

For that, researchers in Brazil and France are working on an exploratory study that investigates design in business/management education. To do so, a three-step exploratory research is being developed: a literature review, an undergraduate programs investigation and interviews with professional.

For the literature review, preliminary on this work, business/management and innovation books, especially the ones with marketing focus, were reviewed to list which ones address design, as chapter, quote or example. At the same time, programs from the main business and management undergraduate courses were reviewed with the same purpose. Following those two phases, in-deep interviews with professors will be applied to continue the exploration of the double education role in design and management education.

By the time this paper was written the two first phases were complete in Brazil and the interviews were about to start. They were finalized in the beginning of December. Data comparison on books and undergraduate programs are shown next, as well as the discussion regarding some questions on double education.

Previous Research

In order to explore the approaches used to teach marketing in design schools, an exploratory study was developed in Brazil, with three major focuses: the understanding of this theme by both new and veteran students, the approaches developed by many other design colleges, and the theoretical definitions of marketing and design (Wolff and Capra, 2008). Regarding students' perception about marketing, the results show that the words and phrases mentioned were basically the same, but the depth and the understanding of concepts became different over time, what may indicate a certain evolution of students' understanding of the subject.

As for the approaches developed by design colleges in Brazil, results show that almost 73% of Higher Education Institutions in Brazil understand the importance of marketing as an academic subject that should be considered when teaching design. Nevertheless, the programs indicate a superficial knowledge of marketing, often focused on areas that meet some specific interests, rather than knowledge on the subject as a whole. Also, several authors have been superficial in relation to theory, composing bibliographic references that are not compatible with the knowledge expected of a Design student.

The last part of the study focuses on a theoretical approach of the theme. Of all topics discussed in the study it is important to note that, although they are linked in several ways, it is possible to highlight two major areas of study and integration between marketing and design. The first one is 'consumer behavior' and the relationship consumers develop with products. This area has something to do with the creative characteristic of design and the unconscious factors affecting consumers. The second major area would be related to the development of new products. In this sense, marketing interacts with design technical issues, such as the use of materials engineering, prototyping and production processes.

This study provides some thoughts on how marketing is offered to design students, but what about the other way around? What do business/management students know about design? What does the business school offers their students regarding design?

Also prior to this research two processes took place in France: 'speed dating' and 'personas'. Both were developed as seminars and meetings and had the objective of talking to designers and managers to understand how they felt about each other and how they dealt with this relationship. 'Speed dating' put designers and managers together in a dynamic similar to speed dating meetings. Pairs of professionals had to talk to each other in a simulation of the manager as the designer's client. This dynamic showed the researchers the skills designers had to use or develop to face the different types of enterprises.

From this exercise, examples of relationships between the company/designer functions could be perceived by the researchers and skills/stereotypes of professionals could be understood, as presented in figure 1. It was perceived that the design is perfect for the artist marketing manager or buyer of intellectual services, as they can understand its role easily. The same can be said for the eco-designer for the brand manager or managers of sustainable development.

The exercise shows that design-trends professionals relate better with the communications director, since this professional can better understand design skills and values. The 'experimenter' design consultant can be trained in an innovation setting, and the humanistic design-director relates better with professionals who work with sustainable development. Finally, the speed dating meeting showed that the design-transformer could work well with the customer relationship manager. The interaction designer fits well with the supply chain director, thus showing better entries in companies for each designer's competencies or profile.

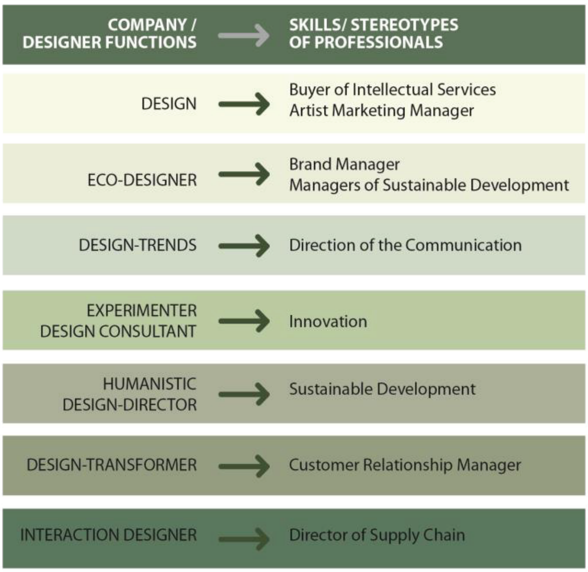

Figure 1. Different Designers for different Clients.

The 'personas' exercise took place in a workshop about user-oriented design and worked with the stereotype of managers. The researchers could understand that the functions in an organization can be defined as manager head, research and development and marketing managers, and this is how the groups involved with the exercise were defined. All the participants spoke first about those functions and departments. After being prepared by the seminar leader and motivated to talk about each function and design, they were able to successfully find three personas for each function. Analyzing the dynamic developed, the researchers could understand that there are different personas for design and managers, and, for example, a web marketing manager can easily sell designer artist inside the company, but it will be hard to sell him a designer problem solver and able to do market research. In addition to that, it will be difficult to sell brand design and sensory or emotional sensitivity to the responsible for research and development. As for the leader lost in high places, far away from design, strategy could be a good way to introduce design in the company, and the competence of project coordinator can easily access design in business plan. Even though design is also far away from strategy books as the research presented in this paper shows.

Results

The results presented in this paper show the desk research and books comparison and the Brazilian business schools programs investigation. The next research steps involve business schools programs investigation in France and in-deep interviews with academics and business that will be held in Brazil and France.

Results on Desk Research

For this research phase, books on management and business, especially the ones focused on marketing, innovation and product development and, strategy were reviewed to verify how and when design is mentioned. The researchers chose 23 books, Brazilian, French and internationally known, considered the main references to business students in undergraduate courses. In each book researchers verified the table of contents and the index looking for design (table 1). When found, design or correlated areas such as branding and product development, the books were signalized, and the content is discussed as follows.

Table 1 - part I - Design on Business Books.

	Book	Authors	Design in the table of contents/Index
MARKETING AND BRAND	Business Model Generation	Osterwalder *et al*	Yes
	Marketing Management	Kotler and keller	Yes
	Marketing: best practices	Czinkota *et al*	No
	Marketing Management	Dickson	Yes
	Marketing	Churchill	Yes
	Branding Management	Lewi and Lacoeuilhe	No
	Mercator	Lendrevie, Lévy and Lindon	Yes
	Marketing fondements et pratiques	Dubois and Jolibert	No
	Développement de	Gotteland and	Yes

	nouveaux produits	Haon	
	Marketing de l' Innovation	Manceau and Le Nagard	Yes
	Les marques capital de l'entreprise	Kapferer	Yes
INNOVATION AND PRODUCT DEVELOPMENT	Managing Innovation.	Tidd et. al.	Yes
	Gestão do Desenvolvimento de Produto[1]	Rozenfeld et.al.	No
	Management de l'innovation	Le Loarne	Yes
	La boite à outils de l'innovation	Giboin	No
	Encyclopédie de l'innovation	Mustar and Penan	No
	Oxford handbook of Innovation	Fagerberg et. al.	No
STRATEGY	Competitive Strategy	Porter	No
	Competitive Advantage	Porter	No
	Management & RSE	Pluchart and Uzan	No
	Strategie industrielle	Tarondeau	No

It is possible to verify that, out of 23 books reviewed, 11 identify design in their table of contents or index. Although design appears in many books, the approach can be different. Osterwalder *et al*. (2011), describe in a chapter entitled *Design*, techniques and tools from the designer's world that, as the authors point out, can help to develop better business plans, creating customer value and offering new approaches to business.

Porter (1986) does not mention design, but as he explains differentiation strategy and the urge to create something new that can be considered unique by costumers, he indirectly considers design. The author explains that differentiation does not allow industries to ignore costs, but those are not strategic targets in this strategy. In Porters (1989), the very well known 'value chain model' design is not shown. The author suggests marketing and sales as activities that deal with customers and satisfy their needs. This model also appears in Kotler's book, Marketing Management, as a part of the customer's satisfaction, value and customer retention chapter.

But Kotler and Keller (2006) also present design as an important part of product development and branding. In the Brazilian edition, there is a special section of the book with local case studies, showing how important design is to a company success.

In the same way, Churchill (2000) explains that good design can add value to a new product. He considers that well designed products can please customers without being more expensive, especially when industries use multidisciplinary teams to develop products. If marketing, engineering, and production can work together and develop a

[1] New Product Development Management

new product it can be beautiful, have a nice performance, and be easy to produce and use.

Tidd (2008) focuses on design as he considers product development as a process with many functions, from marketing to design and production, including quality. For this author, design activities are, many times, treated apart from production and sales, and this can lead to problems in product development as a full process. Set design apart from market can result in inappropriate models, where consumers' needs are not satisfied, or worse, badly dimensioned, creating technical sophistication or standards higher than expected by the markets and, as a consequence, products that cost too much or are not welcome by consumers.

Czinkota (2001) also focuses on product development without considering design. He argues that success in product development is a matter of discovering the consumer's needs and problems that are not satisfied and develop a product with competitive advantage. A product with competitive advantage solves problems better than its competitors and, this is possible due to technical, manufacture, management or marketing solutions. And even though Czinkota proposes cooperation among those areas in product development, he does not consider design as part of it.

In the same way, Rozenfeld (2006), the main Brazilian Product Development book, describes the whole process of product development without considering the designers' role. The book highlights a stage gate product development process that proposes the designers' capabilities without considering designer as a profession.

Dickson (1997) presents design as a part of the product development process. The author points out the role of the senior manager as to 'guide, support, and champion the team's efforts, but not to direct the specific design solutions' (p.382). Also, design is presented as the tool to simplicity and reduced costs. 'In short, design simplicity produces what competitive rationality and TQM strive to achieve: higher quality, lower cost design, and manufacturing processes that are completed fast' (p.383).

Results from the Brazilian Business Schools Programs

In order to explore how design works in Business Schools in Brazil, 10 Brazilians Universities had their curriculum reviewed. Seeking reliability, all universities chosen are associated to ANGRAD – National Association of Business Schools – and are included in the raking of best schools in the country, according to the Brazilian Ministry of Education.

For this phase, the colleges investigated are Universidade Federal do Rio Grande do Sul (UFRGS), Universidade de São Paulo (USP), Fundação Getúlio Vargas (FGV), Universidade Presbiteriana Mackenzie, Escola Superior de Propaganda e Marketing (ESPM), Universidade Federal do Rio de Janeiro (UFRJ), Universidade Federal do Paraná (UFPR), Universidade de Brasília (UNB), Universidade federal de Minas Gerais (UFMG) e Universidade do Vale do Rio dos Sinos (Unisinos). First, the website of all selected Schools was accessed to find their programs. In cases that the same course is offered in different shifts (morning and night) or has specific qualification areas, all programs were considered. After that, the disciplines of each program were analyzed, seeking design relation/entry points (table 2).

Table 2. Design and related courses in Business Undergraduate Programs

	Marketing	Design	Innovation and Technology	Product Process Development
UFRGS	x		x	x

USP	x			x
FGV	x			
Mackenzie	x		x	
ESPM	x	x	x	x
UFRJ	x			
UFPR	x			
UNB	x		x	
UFMG	x			x
Unisinos	x		x	x

It was found that all colleges analyzed have at least two marketing disciplines, and maximum eight. This shows how marketing can act in business administration and how their study requires a look in different points of view.

Another important finding was the recurrence of technology and innovation disciplines: five of all colleges analyzed offered courses on 'Entrepreneurship and Innovation', 'Technological Innovation Management' and 'Innovation Management". The 10.973 Brazilian law states that innovation is 'the introduction of something new or the improvement in production or social environment that results in new products, process or services' (Brasil, 2004, pg. 1). For the Oslo Manual, innovation can be [...] 'the implementation/adoption of new or significantly improved production or delivery methods. It may involve changes in equipment, human resources, working methods or a combination of these.' (2005, p. 9)

Thus, considering design as the key to innovation or its own representation, when a new product is developed, from the conception to the conclusion (Tidd *et al*., 2008), the innovations disciplines offered in business schools are a great opportunity to introduce design aspects for managers and bring both design and business closer.

It was also found that four schools offered courses related do product process development like 'New Products Development', 'Planning and Controlling Production' and 'Product Design and Production Process'.

Finally, of all analyzed colleges, only one of them offered a discipline directly related to design. ESPM School has 'Branding' in their program. Lindstrom (2007) explains that branding consists of creating emotional bonds between brand and consumer. This fact may be attributed to ESPM's tradition on marketing and advertising areas, and the relation between marketing, business and design when it comes to brand management.

Conclusion

Although still in its initial stages it is possible to see some conclusion for this study. The little or nonexistence of design in bibliography, as well as in the Brazilian schools analyzed in this study indicates a gap in the curriculums when it comes to design management. The previous study in design schools shows superficiality regarding marketing topics, which may be the link between design and management. This study, at least in Brazil, shows the same regarding how managers learn about design. On that, a question arises: If designers are not prepared in managing and managers do not learn about design, who should be responsible for design management?

Considering the analysis for the business schools in Brazil, the courses involving technology and innovation seem to be the potential insert point for design in business and management. According to Gomes (2009), design is a growing activity for innovation process. Through it, ideas arise and materialize, not only regarding the creativity level, but also in determining technical and producing capabilities, opening new market opportunities. Therefore innovation is one of the factors that managers should focus their efforts, but for this, they need basic knowledge on design.

Another potential entry point for design in business happens through product development, which is shown in five of the ten analysed institutions and in the books. Product development process has strategic importance in organizations seeking to identify market and clients' needs, investigate technologic possibilities and develops products in appropriated time (faster than competitors), with the appropriate cost (Rozenfeld *et al*., 2006). Design can be inserted in different points of the process – starting in briefing, product conception, material and technology analysis until production and management leading to better practices and best results. Thus, design has a direct relation with product development, as well as innovation and strategy, and should be present in academic topics inside management and business schools as presented in figure 2.

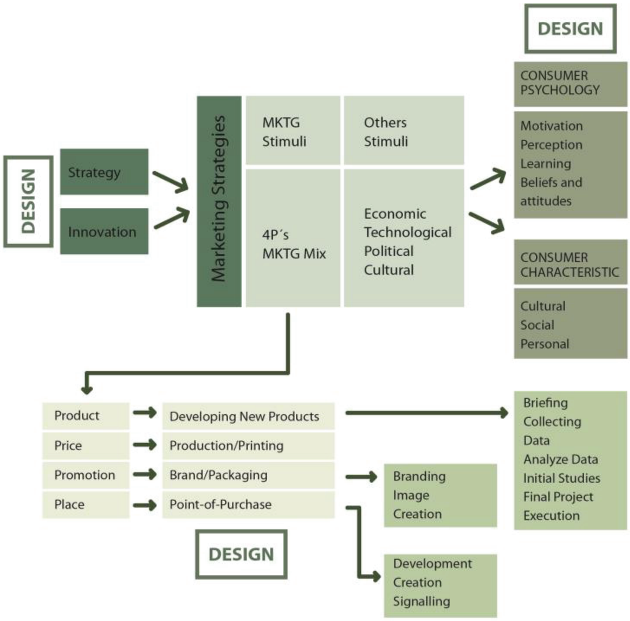

Figure 2. Design and Marketing Management Relationship – points of entry

But why this is not the way it happens? What this research could find, even if we still have a long way to go to finish our research process, is that the design community, when they want to bridge with business, tries to do it through innovation and new product development and not with marketing and strategy. The truth is that the business of design is, most of the time, in marketing, which can be seen through the book comparison, previous research and the schools research. Marketing is paramount in business, but design is not a part of all marketing books and, even if mentioned in the index, it is not a separate chapter in the curriculum. And, even if designers think they are strategic, design is never in a strategy book.

Finally, cross-country studies have the advantage of comparing realities and promote debates. As our research is to be continued, we also seek to improve discussions and relate different areas, thus deepening the comprehension of double-loop education to improve the relationship between designers and managers. This study proposal is also to find ways for managers to reach designers and vice-versa. The next steps will focus on cross-country comparison, and the in-deep interviews with professional will allow a look from the market viewpoint.

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Teaching New Product Development to Design Led Innovation

Cara WRIGLEY* and Sam BUCOLO
Queensland University of Technology, Brisbane, Australia.

Abstract: *Recently many international tertiary educational programs have capitalised on the value design and business can have upon their interception (Martin, 2009; Brown, 2008; Bruce and Bessant, 2002; Manzini, 2009). This paper discusses the role that two teaching units – New Product Development and Design Led Innovation – play in forming an understanding of commercialisation needed in today's Industrial Design education. These units are taught consecutively in the later years of the Bachelor of Industrial Design program at the Queensland University of Technology, Brisbane, Australia. In this paper, each teaching unit is discussed in detail and then as a conglomerate, in order to form a basis of knowledge students need in order to fully capitalise on the value design has in business, and to produce a more capable Industrial Design graduate of the future.*

Keywords*: Design Led Innovation, Design Education, Industrial Design.*

* Corresponding author: Queensland University of Technology | Australia | e-mail: cara.wrigley@qut.edu.au

Introduction

Traditionally, the role design has played within companies has been geared towards the manufacturing and production arena, or as a stylised afterthought. Nowadays, design is increasingly being viewed as a vital and important strategic business resource (Dell'Era, Marchesi and Verganti, 2008) and consequently companies worldwide look to design to help them innovate, differentiate and compete in the global marketplace. This is done by properly employing, carefully evaluating, skillfully managing and soundly implementing design holistically throughout a company's business strategy. The value design possesses, is a different way of thinking, doing things and tackling problems from outside the box. In practice, design is key to greater productivity, whether by way of higher-value products and services, better processes, more effective marketing or simpler structures. Essentially, design is no longer a niche market luxury. It is the most pervasive method for solving problems, ensuring long term sustainability and gaining competitive advantages.

Many international management programs have capitalised on the value design can have upon potential business solutions and strategies (Martin, 2009; Brown, 2008; Bruce and Bessant, 2002) as well as many international design programs introducing designers to business theory and curriculum (Manzini, 2009, see also Stanford D.School). This paper however, presents an approach to integrate design and business innovation into an already existing 'human-centred' Industrial Design program that has been in operation at the educational institution for over thirty years.

The Queensland University of Technology's Industrial Design course philosophy is to educate Industrial Designers to play a leading role in the development of products and systems in our changing environment. It aims to enhance quality of life by ensuring that new technologies are working to the benefit of its users. The curriculum focuses on a human-centred design approach, innovation and systems thinking. The aims and objectives of the program reinforce life-long learning by facilitating the enhancement of graduates' knowledge and skills as part of their career development. It is envisaged that the graduates of this course will be able to contribute to the development of their profession, respond to changes occurring in their environment, and make an immediate and positive contribution to industry, community and the profession.

Undergraduate students enter the Industrial Design program not wanting to become the business leaders of tomorrow but rather, they have a desire to engage more humbly with design, to help people and to make a difference in the world (Wrigley and Bucolo, 2012). A previous study published by the Authors found that the design profession has seen a gradual shift, from object-centric outcomes to the seeking of systemic solutions, which engage the broader society and have a global setting. Although this shift within the profession is evident, there is resistance from industry, traditional education academics and even students around why designers need to engage in commercialisation, strategic thinking and business model design (Wrigley and Bucolo, 2012).

The bigger issue and focus of this paper, however, is not *why* this content should be taught, but *how* design led innovation and new product development theories can be integrated into a human-centric design course program. At its core, this challenge is about building upon the human centred design skills acquired by Industrial Design students in third and fourth year, and turning these concepts into feasible commercial solutions through business.

The practice of Industrial Design has undergone rapid transformation over the past decade (Wrigley and Bucolo, 2011). As educational institutions attempt to keep up with industry demands, changes in curriculum content and new graduate skills and capabilities are required. In recent years, Industrial Designers, typically, have formed part of a larger eco-system of professionals, which develop innovative sustainable products and services for a wide spectrum of clients. To meet this changing demand, the knowledge and skills of a contemporary Industrial Designer have expanded to compliment their existing expertise in manufacturing design, but to also consider the experiential, business and supporting services of a final design solution. As part of this transformation Industrial Designers are beginning to be brought into a project at an earlier stage and it is expected that they assist in defining a product strategy rather than solely defining a one off solution (Behrendorff, Bucolo and Miller, 2011).

New Product Development

New product development is defined as the process by which a new product is brought to market (Ulrich and Eppinger, 2004). One stream of the New Product Development process involves the design activities of idea generation, product design, and manufacturing detail. The other stream of new product development is dependent on market research and marketing analysis. These two streams converge design and business approaches in order to transform knowledge or conceptual ideas into commercialised new products and services as part of a greater strategic focus (Koen, 2004).

Within the realm of New Product Development (NPD) Industrial Designers play a significant role and hold various responsibilities. These roles vary from maker to marketer, but one role that is universal throughout the NPD cycle is the skilled ability to question, re-frame problems and converge and diverge on the solution design at hand. At the same time being able to confidently present a proposal that incorporates good design and good business. Product innovation and the development of new and improved products are crucial to the survival and prosperity of the modern corporation (Bucolo and Matthews, 2011). At its core lies the generation of the ideas and concepts which underpin product and service innovations. Being able to translate these ideas and concepts into commercial opportunities is also a critical step in the product development cycle.

The unit, New Product Development, taught within the Industrial Design course at the Queensland University of Technology, introduces the relationship between product design and commercialisation to third year Industrial Design students. During this process, students are exposed, for the first time, to strategy development, aimed at meeting consumer expectations, whilst achieving corporate objectives.

Design Led Innovation

Design Led Innovation, broadly refers to a set of methods which allows the designer to consider and evaluate their design development from multiple perspectives, typically spanning user needs, business requirements and technology demands. The final design solution is not presented as an artifact in isolation, but an integrated product and service concept. As the design profession moves from servicing a manufacturing economy towards a knowledge-based economy, the role of a designer assisting their clients has also evolved and new approaches to design are being developed and implemented. Design Led innovation is a strategy that aims to radically change the emotional and symbolic characteristics of products through a deeper understanding of broader changes in society, culture and technology. Rather than being driven by user needs or technological developments, Design Led Innovation is pushed by a firm's vision about possible new product meanings and languages that could diffuse in society (Verganti, 2008).

Chhatpar (2007) argues that in order to do their job most effectively, designers need to be brought into the innovation process at the very earliest stages. Many companies today still make the mistake of keeping business strategy and design innovation separate. "Typically, marketers conceptualise a new product based on business strategy; the project team gets input from various areas of the company and creates a business case; and senior executives make a final choice from among the possibilities they're given. Only then does the idea go to the designers" (Chhatpar, 2007:30).

The sequential method above ensures that the product fits within the company strategy, allowing the team to build a general consensus, and gives senior executives an array of options, this unfortunately takes time. Design Led Innovation however, brings designers in at the very beginning of the process, allowing designers to disseminate innovation and creative thinking at the ground level, producing a more innovative solution. As the business case is being developed, prototypes are put into circulation to uncover users' responses and attitudes with the project team, enabling the company to nimbly adjust to changes in market opportunities long before the product concept is set in stone. The Design Led Innovation teaching unit is taught within the Industrial Design program at the Queensland University of Technology and introduces the relationship between business model creation and design to fourth year Industrial Design students.

Teaching Theory

Within the New Product Development teaching unit, the aim was to provide students with background knowledge pertaining to management, financial and marketing parameters surrounding the development and commercialisation of consumer products. Lectures were given throughout the semester pertaining to: product classification, service design, competitor analysis, market size and share, intellectual property, path to market strategies, funding sources, manufacturing requirements, return on investment and preparing a business case and pitch.

The aim of the Design Led Innovation unit was to provide students with knowledge pertaining to product integration within various service and system contexts, relevant to Industrial Design. This is imperative due to the fact that professional Industrial Designers frequently need to integrate different contexts and cross discipline boundaries in order to achieve a successful design outcome. Lectures throughout the semester crossed a variety of subjects including: client engagement, market analysis, intellectual property, co-designing business scenarios and design strategies. What differentiates these two units from the traditional human-centred approach to design, is the theory and design outputs (Table 1). The units of New Product Development and Design Led Innovation require the foundational skills and knowledge taught in the human centred approach to design.

Table 1. Approach Comparison.

Approach	*Output*

Approach	*Output*
Human Centred Design	Ergonomic Considerations Usability Requirements Product Aesthetics Context of Product Use
New Product Development	Commerical Viablility Implications Business Context Requirments Competietve Advantages Intellectual Property Protection
Design Led Innovation	Business Model Prototyping Design Thinking Capabilities Value Propositions Deep Customer Insights Strategic Design Briefings

New Product Development Project Context

In groups of three, students were required to take a design concept and develop a business case enabling the product to be launched into the market place within an eighteen-month timeframe. The project consisted of developing the design concept through the application of business analysis tools to generate a range of design concepts. Students were also taught business theory, enabling them to critically analyse design alternatives and preferred design options. This was achieved through utilising the tools introduced within this unit, specifically: The product classification matrix, various NPD strategies and SWOT, dynamic and thematic SWOT analysis.

Students were then required to develop a business case for the launch of their new venture. The business case included the launch details, intellectual property protection, business model design, funding requirements and projected returns and risks. This information was then translated into a short professional pitch of the their new venture, delivered to an external panel of experts at the end of the semester.

The student outcome examples presented in this paper (Figures 1-5) were taken from the same group of students progressing through the Industrial Design program (Matthew Buckley, Morgan Beames and Logan Fairchild) who completed the NPD unit in 2010 and the DLI unit in 2011. These images demonstrate their process and progress in the development of these skills and capabilities.

The starting point of this project was to take an original design concept already developed by one of the students and to investigate the competitive advantage and address the market gap. In this case the students designed a highly portable, flat-packable stand, which reflected the mobility features needed in portable tablet stands. All stands for this device were, to date, still awkward, bulky and extremely non-portable (Figure 1 illustrates this).

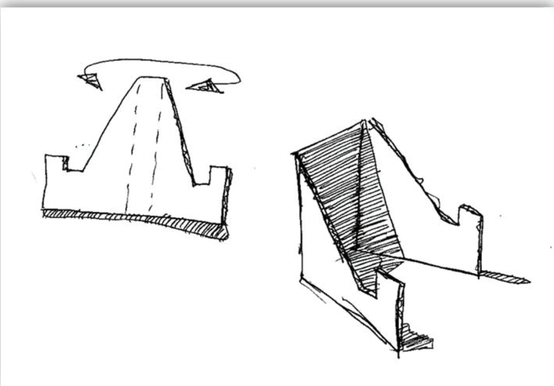

Figure 1. Concept Development and Prototyping. Source: Buckley, Beames and Fairchild.

Initially, the stand was determined to be a multi-part, alloy stand mimicking the form-factor of the current bluetooth keyboard when folded up. This allowed the stands to ‘fit into’ each other in a bag, reducing space during transportation (Figure 1). It is at this point that the design direction changed based on the product classification matrix tool taught in class, this allowed conceptualisation of the product to move from incremental to radical. They achieved this by leveraging the New Product Development theory and by critically reframing the initial response to the design. They then began experimenting with recyclable, low-cost materials- initially cardboard and finally as recycled polypropylene. The structural elements of polypropylene afforded high structural integrity when the stand was folded and supporting the tablet, but more importantly it provided a large flat surface area on the folded stand that could be die cut very quickly and flatly transported.

The New Product Development approach requires a holistic view and approach to business decisions. This means, not only focussing simply on the ‘artefact’ outcome, but the broader business solution framework. Keeping this in mind, the design team identified a bootstrapping approach to commercialisation. This was achieved through the flat surface areas of the stand, which the students identified to be uniquely applicable to advertising; as a result, a business-to-business service model became evident. By undertaking this process, the initial product solution was transformed – from an incremental product to a fully recyclable advertising platform for business to enhance their brand equity while supplying a unique, ubiquitous product (and ultimately a billboard) for the everyday use of their customers (Figure 2). This was a critical point in the design process as it made the design and business scalable and sustainable fairly quickly and easily.

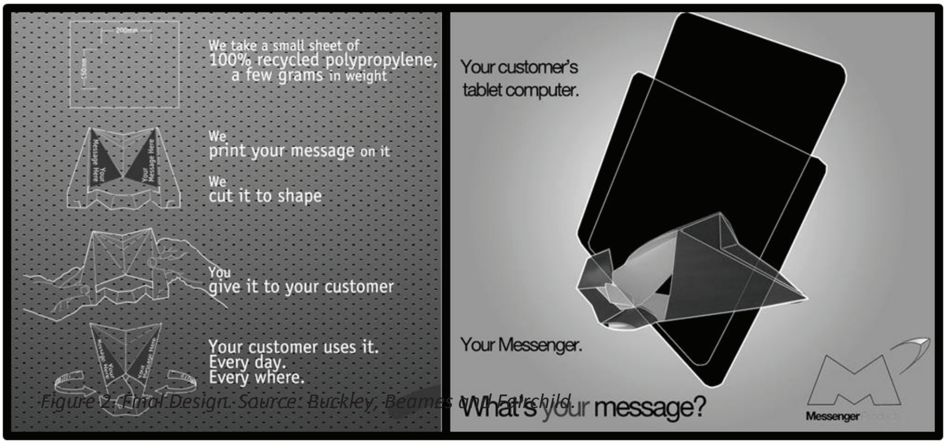

Figure 2. Final Design. Source: Buckley, Beames and Fairchild.

Design Led Innovation Project Context

This project focuses on the application of a Design Led Innovation (DLI) approach to the development of an innovative product and service solution, based on an existing technology or research finding. This project was also conducted in groups of three and required the use of an existing proven technology or solid research finding based on a Queensland University of Technology live research project which students had the option of identifying. Students were expected to explore, design and transform a piece of Intellectual Property (IP) into a feasible, sustainable design concept and business opportunity to be launched onto the market within an eighteen-month timeframe. At the conclusion of the project students were required to present enough detail to communicate the product vision to allow the client (research project team and Queensland University of Technology) to determine if they should proceed with the additional product development required (Wrigley and Bucolo, 2011).

The same group of three students partnered with an industry client, an engineer who had developed a unique renewable energy solution, with the aim to commercialise. The piece of technology developed was a zero-emission, renewable electricity generator. Theory taught during the semester on Design Led Innovation established a different way to think about strategic business management (Bucolo and Matthews, 2011). Within the design led model of innovation there exists a tri-consideration of Business needs, User needs and the Technology's perceived value (Figure 3). Therefore as one-standpoint changes in the commercialization process of the innovation, considerations needed to be made to the other two as they were also impacted.

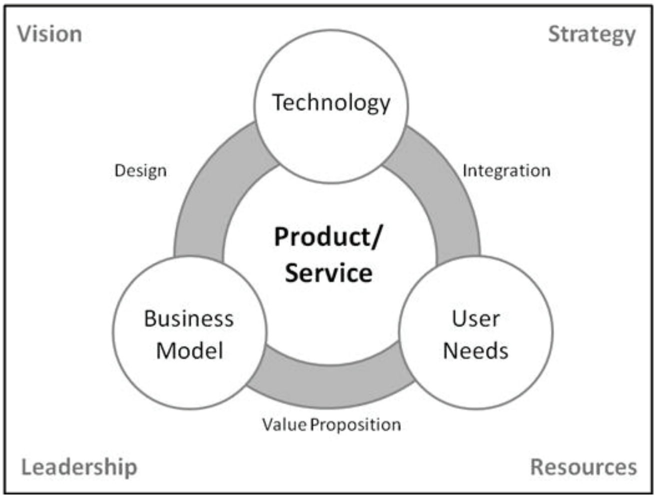

Figure 3. Design Led Innovation model.

Whilst it was important for the students to have a basic understanding of how the generator worked, the focus was appreciating the technologies capabilities and synthesising its possible application. The students challenged the partner's vision for their technology, so that unexpected, radically innovative directions could be prototyped. The first task was to begin matching the technology's capabilities with a wide range of user groups such as relief for emergency power following the Japanese nuclear disaster; remote mining; military and transport systems (Figure 4).

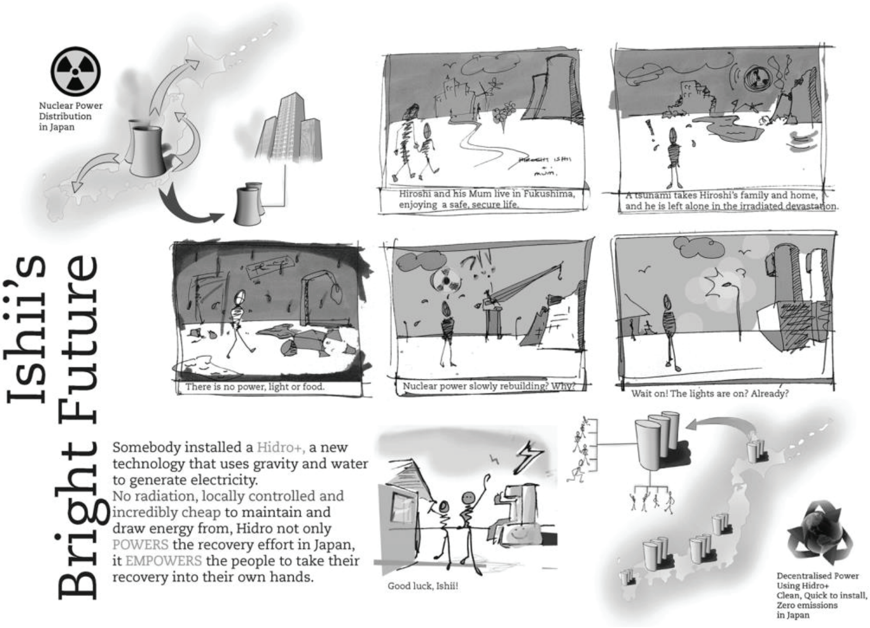

Figure 4. Storyboard and problem description. Source: Buckley, Beames and Fairchild

The guiding philosophy throughout the process of selecting and eliminating user groups was the question – which pairing would create the greatest customer value in the shortest time? Using the business model canvas, various design tools, narratives, story-telling (scenario), value propositions for each market segment were matched and business operations such as distribution channels, key partners and revenue streams where used to build viable business solutions. The inception of a five-point criteria based on DLI theory was used to guide this process. Through the application of this conceptual framework, a model based on energy provision for property developers to on sell to homebuyers, was finally generated and presented to a local city council as the House Land and Energy (HLE) Package (Figure 5).

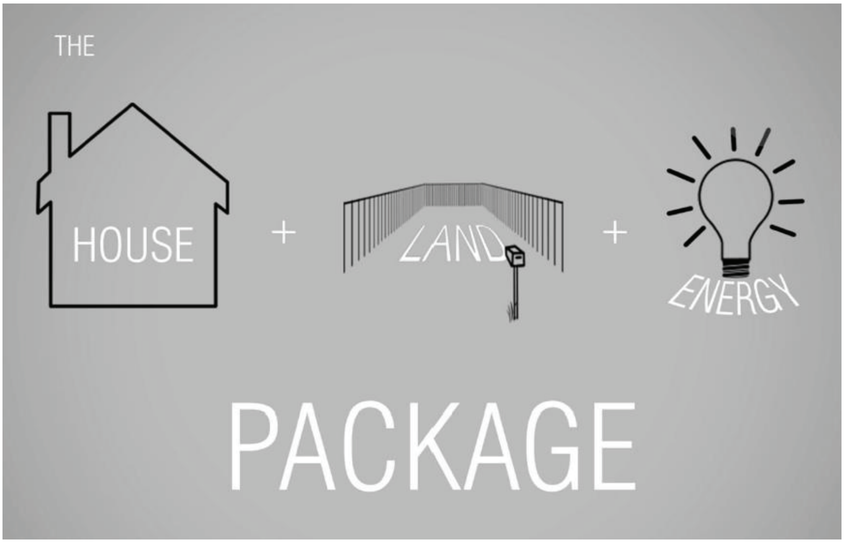

Figure 4. Final Design Outcome. Source: Buckley, Beames and Fairchild.

Unit Comparison

The New Product Development unit, which is taught to third year students, combines the fields of product design and business to leverage innovative products through conventional market-driven strategy. Design Led Innovation (DLI) taught in the fourth year, builds on this to introduce an emerging approach to product and service development, by using design-thinking and business model design approaches.

Both units have been developed and run by the Authors for the last four years, during this time both units have undergone an evolution and refinement process. This has occurred each year, allowing for critical reflection by the authors to enable corrections and improvements to the teaching content for the subsequent year.

Table 2, provides a Comparison Summary detailing the differences of the units outlined in this paper – Human Centred Design, New Product Development and Design Led Innovation. Table 2 highlights the development and thought process of the students as well as the acquired skill sets at different points in time throughout their degree. In addition, the column detailing Human Centred Design details the typical human centred design approach to Industrial Design. As a conglomerate, all units form the required knowledge base a graduate Industrial Designer of today should be equipped with to better prepare them for the future.

Table 2: Comparison Summary

	Human Centred Design	**New Product Development**	**Design Led Innovation**
Value	Human centred approach	Product centric approach	Business centric approach
Learning Objectives	• Gain a deeper insight into the human centric design process • Demonstrate an understanding of ergonomic data and design principles application • To show feasibility through manufacture • Gain an understating of usability design requirements	• Demonstrate an understanding of new product development processes • Demonstrate understanding of management and economic issues surrounding the introduction of products to the market place • Confidently evaluate a design concept within a commercial framework	• Gain an advanced knowledge of design process and creative thinking • Understand product integration within relevant contexts • Understand the impact of various context to product design • Confidently collaborate with product development teams
Theory	• Ergonomic requirements of design • Human usability considerations • Manufacturing details and analysis	• New product development process • Idea generation • Strategic planning • Introduction to marketing • Product screening and evaluation • Commercialisation and post launch review	• Advanced design process and creative thinking • Knowledge integration within various contexts • Understanding Industrial Designer's role within collaborative projects.
Mode	Hours per week: 4 Lecture: 1, Tutorial: 3	Hours per week: 3 Lecture: 1, Tutorial: 2	Hours per week: 4 Lecture: 1, Tutorial: 3
Approach	The unit consists of lectures and studio workshops.	The unit consists of practical exercises, lectures, discussions and case studies	The unit consists of design studios, lectures, workshops and discussions.
Assessment	**Assessment Item 1:** *Concept Presentation* Application of theory in a human design approach to the development of a feasible product solution for human user needs **Assessment Item 2:** *Final Design* Develop and present the final product design concept through the	**Assessment Item 1:** *Theory Examination* **Assessment Item 2:** *Final Design* Develop a product design concept through the application of business analysis tools to generate a range of design concepts. Develop a Business Case for the launch of your new venture as well as the pitch and	**Assessment Item 1:** *Concept Presentation* Application of a design approach to the development of an innovative product and service based on an existing technology. **Assessment Item 2:** *Final Design and Portfolio* Extend on the selected concept and undertake further design

	Human Centred Design	New Product Development	Design Led Innovation
	application of usability and ergonomic requirements	presentation of the concept to a panel of experts.	development. **Assessment Item 3:** *Report* Depending on the role (User Needs, Business or Technology) a written report outing the requirements for the design solution from that role is submitted.
Group Size	4-6 students	3 students	3 students
Group Roles	Each group member took on the same role.	Each group member took on the same role.	Each group member had a Business, Technology and User Needs approach to the design.

Unit Evaluation

At the completion of each of the units a unit evaluation was undertaken. This involved the same three students to undertake an interview at the completion of their Industrial Design Degree. During the interview, students were asked to discuss the value they felt these two units had in regards to their overall education. One student commented that “it was good that DLI followed NPD because it took those foundational skills developed in NPD enabling system thinking for DLI so when we were given an industry partner to work with that we had to find a path to market for, having those existing NPD skills first was very beneficial”.

Another student commented that “these two units alone have completely re-shaped what I thought design was, it is far more than producing three dimensional outputs, outside of a commercial context”. All students commented together that “the only way for Industrial Design to move forward is if other sectors learn to appreciate it, and for that to happen we need to communicate with them better, and what better way than to learn to speak their language. NPD and DLI give students a set of communication tools that allows them to go on and understand the business mind and translate that skill effectively, synthesise and bring them together”.

Challenges

Even after much success with the development and delivery of both these units over the past four years, there are challenges that still remain; challenges involving students, staff and industry alike. Both of these units experiment and challenge the traditional role Industrial Designers hold in industry, and as a result, educationally they remain not for everyone. It is evident that DLI theory and application is emerging as a new global trend in Industrial Design education. The authors have embraced this opportunity and capitalised on it by establishing the New Product Development and Design Led Innovation units. Furthermore, running both units consequently over the last four years, has enabled for on-going improvements to unit delivery and subsequent incremental development of unit theory, content and application.

As these skills move from being a niche set to becoming the fundamental knowledge base of an Industrial Designers' education, it becomes all the more important to move forward and accept that at some point all designers will need these skills. The challenge however, is to change the mind-sets of not only the design educators but also that of industry to establish and employ designers in new roles that embody these new skills. Another challenge is the recruitment of diverse disciplines into the Industrial Design class rooms, to teach the external content such as; management, business and marketing. The final challenge is the designers themselves who do not believe they need this knowledge and do not want to become business people. They believe that their role is to help the end user and make life easier and more beneficial for them (Wrigley and Bucolo, 2012). While this might be a worthwhile cause, it is evident that broader, systemic thinking and actions are required to meet the increasing complex challenges that face society today. Simply looking toward user-centric solutions will only address a small component of the system and will only create incremental innovation.

Final Remarks

A conglomerate of the units described in this paper is rapidly becoming the foundational skills for Industrial Design graduates all over the world. As these units continue to evolve so must Industrial design education and industry practice. As this paper demonstrated, the greatest challenge is the ability to integrate this curriculum with an already existing Industrial Design course. As illustrated, the foundational human centred design skills are imperative to the success of this evolution in thinking. The end goal is not to convince designers to become business leaders but to integrate the two so that they are able to communicate better with the business world.

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Constructing design knowledge built up on the kindergarten education

Meryem YALCIN*
TOBB Economy and Technology University

Abstract: *This study aims to further the growing body of knowledge about design education with an alternative view; discussing the importance of beginning it at the kindergarten which ideally suits to the approach " develop the creative-thinking skills". In an environment where children" imagines, creates, practices, modifies, recognises, manipulates, shares etc..." knowledge, experiences and objects through play are crucial issues in the design education. Derived from this concern the study brings the argument of advancing and directing early childhood education on the basis of 'basic design issues' such as design principles, conceptualization, 2D/3D spatial allocation and composition more comprehensively which will provide to construct children perceptual, critical and analytic point of view in a very early age and the ability to develop in the future. This hypothetical study's argument is to establish a curriculum of design education in the kindergarten which will constitute children the basis of a strong ability of design knowledge, enable and stimulate their cognitive development.*

Keywords*: child-design education, basis design knowledge , develop creative thinking..*

* Corresponding author: | TOBB Economy and Technology University | Turkey | e-mail: : myalcin@etu.edu.tr

Introduction

The child gains different skills in different stages of his/her maturation period. In order to improve skills, the child should find sufficient interest and support in accurate time within his/her environment. Components of a learning system are targets, physical environments, social texture, learning units, methods and teacher. Different socio-philosophical-pedagogical theories on the construction of children knowledge. What is important here is enabling and directing children in an accurate way in the period time when children develop and learn very fast and construct their knowledge. In addition children are very creative in these ages they *imagines, creates, practices, modifies, discovers, recognises, manipulates, shares etc...*These skills are effective in design education, but not covered in the early childhood curricullum professionally in terms of design issues.

The paper’s argument is advancing creative-thinking skills is only possible starting in the early childhood education. Since, as mentioed before artistic development between the ages of 2 and 6 years are occur more than at any time. In this four year period, a child progresses from scribbles to representation, disorganized to organized representations. Drawings and modellings produced by children during these years are filled with a vitality and freshness that diminishes rapidly in the older ages.

On the other hand Preschools are undergoing a dramatic change. For nearly 200 years, since the first kindergarten opened in 1837, kindergarten has been a time for telling stories, building castles, drawing pictures, and learning to share. But that is starting to change. In effect, Froebel was designing for designers – he designed objects that enabled children in his kindergarten to do their own designing. Froebel’s work can be viewed as an early example of Seymour Papert’s *constructionist* approach to education, which aims to engage learners in personally meaningful design experiences. In creating his Gifts, Froebel was limited by the materials available in the early 19th century. With today’s electronic and digital materials, we can create new types of construction kits, expanding Froebel’s kindergarten approach to older students working on more advanced projects and learning more advanced ideas. With Mindstorms and Crickets, for example, children can create dynamic, interactive constructions – and, in the process, learn concepts related to sensing, feedback, and control (Dudek, 1998).

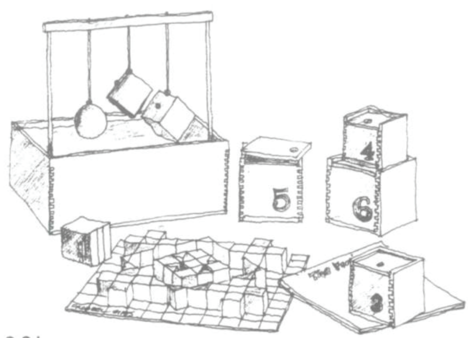

Figure 1. Shapes and building blocks Froebel's gifts and occupations' (Dudek, 2000)

Creativity is at the root of *perceptual, critical and analytic point of view in a very early age to be developed in the future.*. If we want children to develop as creative thinkers, we need to provide them with more opportunities to create. Friedrich Froebel understood this idea when he opened the world's first kindergarten in 1837. Froebel filled his kindergarten with physical objects (such as blocks, beads, and tiles) that children could use for building, designing, and creating. These objects became known as Froebel's Gifts (Resnick, 1998). Providing *knowledge, experiences and objects through play are crucial issues in the design education.* However these issues have to be professionally processed and integrated with *design principles, conceptualization, 2D/3D spatial allocation, color, texture and light composition more comprehensively* in a curricullum.

Basic Design Education in the Kindergarten

Education medium of pre-school education entities directly or indirectly affect systematic learning, formation of specific objectives. the child should be presented with the opportunity to live at free and well-processed programmes providing unlimited freedom where he/she can experience himself/herself and skills. It is essential to direct childrens unlimited imagination, creativity and curiosity corresponding chidren development and to provide them broad scanning.

In going through this process, kindergarten students develop and refine their abilities as creative thinkers. They learn to develop their own ideas, try them out, test the boundaries, experiment with alternatives, get input from others – and, perhaps most significantly, generate new ideas based on their experiences. In reality, the steps in the process are not as distinct or sequential as indicated in the diagram. Imagining, creating, playing, sharing, and reflecting are mixed together in many different ways (Fulghum, 1986). But the key elements are always there, in one form or another. Some of the most creative artists and inventors of the 20th century credit their kindergarten experiences with laying the foundation for their later success which children ***imagine*** what they want to do, ***create*** a project based on their ideas, ***play*** with their creations, ***share*** their ideas and creations with others, ***reflect*** on their experiences – all of which leads them to ***imagine*** new ideas and new projects. The visiual art curriculum for early childhood education is quite noncommittal. It underlines that art activities should provide experience, self-expression, fun and satisfaction and an opportunity for children to show their own view of life. It also points out that child depicts objects and events idiosyncratically; uses different medium and techniques; observes and describes their product. In an age in which art and scientific curiosity are not a prominent part of educational systems and are deemed less important than acquiring competencies aimed at technological development, providing clear answers and solutions to the afore-mentioned questions is truly crucial, especially bearing (Resnick, 1998).

Children before the age of 6, show many examples of aesthetic pleasure and pleasure in their own art making. Teachers of young children provide material, motivation, structure and psychological environment for the visiual art education of their charges. Interaction between preschool children and their teachers has been studied by Rosario and Collazo (1981) and Brittain (1979). Brittain (1979) found that the quality of art experiences of nursery school or kindergarten children is particularly vulnerable to the expertise of the teacher. Younger children generally are unable to seek children out of information from libraries or effectively discuss subject matter with peers, teachers or parents. The young child depends on the teacher to determine the art activities, and praise or criticism for their performance. The children in nursery school and kindergarten are totally dependent on the teacher to provide design materials and activities in the school setting.

Circumstatial combining two applied disciplines, pedagogy and design, can contribute to the improvement of the quality of life. The challenge for design education in the older aged students configured the understanding build up creative skills up on the early childhood education and complementary construction in the future. in order to design objects, sense of 2D/3D space allocation, stimulate children to be capable to provoke questions, suggest answers, inspiring action and thought of acquiring new skills.

In addition children have a special way of looking at spaces and objects. Often, the tools with which the children interact become objects with their own visual identity, different for each child, in which tactile capabilities of the child are also enhanced through education and freedom to decide the final use.

Constractıon desıgn knowledge ın the early chıldhood

Recently, design educators have started to explore the characteristics of learning styles of students that can be used for the enhancement of learning in design (Demirbas, Demirkan, 2003; Demirbas, 2002; Kvan, Yungan, 2000; Uluoğlu, 2000). This literature suggests that design students should learn by experiencing, reflecting, thinking and doing in the process of finding solutions to assigned design problems. Therefore, design education can be considered as being in line with the Experiential Learning Theory (ELT) of Kolb (1984). This study aims to focus on learning in design education using Kolb's learning styles and explores the relationship between learning styles, gender and academic performance. describes learning styles in the ELT of Kolb “as the individual's intellectual approach to the processing of information”. Consequently, each child has her/his preferred way of percepting, organising and retaining that are distinctive and consistent (Chou and Wang, 2000])explicit instruction in certain key skills.

Iteration is at the heart of the creative process. Mentioned before the process of Imagine, Create, Play, Share, and Reflect inevitably leads to new ideas – leading back to Imagine and the beginning of a new cycle.. Within the process of constantly critiquing, adjusting, modifying, revising. This is for becoming a creative thinker is itself an iterative. Historically, kindergarten has provided a good foundation for creative thinking. Thinking of kindergarten as the first time through the creative-thinking cycle. Unfortunately, after leaving kindergarten, children have not had the opportunity to iterate on what they learned as in kindergarten, to continue to develop as creative thinkers (Resnick, 1998) . By extending the kindergarten approach and provide opportunities for learners of all ages to build on their kindergarten experiences, iteratively refining their abilities as creative thinkers throughout their future academic life.

Whereas the practices of designing learning in early childhood education should be developed to facilitate The designing process in terms of can be considered as an crucial activity where educators and children share experiences. Participation also includes the participatory skills, such as negotiation and sharing (Göncu & al. 2009), which, according to the educator descriptions, aim to develop result in common decision making and shared planning together with educators and children. When design learning involves planning of educational practices beforehand (Härkönen, 2002), it could also involve planning of design learning practices beforehand. Children ages impact on the participatory practices available to them. The older the children in group.

Whereas, reflection is a critical part of the creative process, but all too often overlooked in the classroom. In recent years, schools have adopted more “hands-on” design activities, but the focus is usually on the creation of an artifact rather than critical reflection on the ideas that guided the design, or strategies for refining and improving the design, or connections to underlying scientific concepts and related real-world phenomena (Resnick, 1998) .

In this context, the process of planning activities is an important part of the design teaching process. Not only should educators and participation, but children should also take part in the creative thinking cycle mutually. Enabling children to apply basic design principles, attitudes and manipulation of materials, essential to classroom activities in the kindergarten level covers many aspects. Emphasis is placed on the developmental stages of design and how these are affected by the intellectual, physical, perceptual, aesthetic, creative, emotional, and social growth of the child. So, Design education of the preschool children covers rather extensive and complicated issues. Up to the present the curriculum of creative art and design activities have been applying. However, their relevancy and efficiency have been limited with the knowledge educator or equipments of the preschool centre. This education supposed to be not only pedagogical but also professional assessed by academic designer. Derived from these issues following model been proposed;

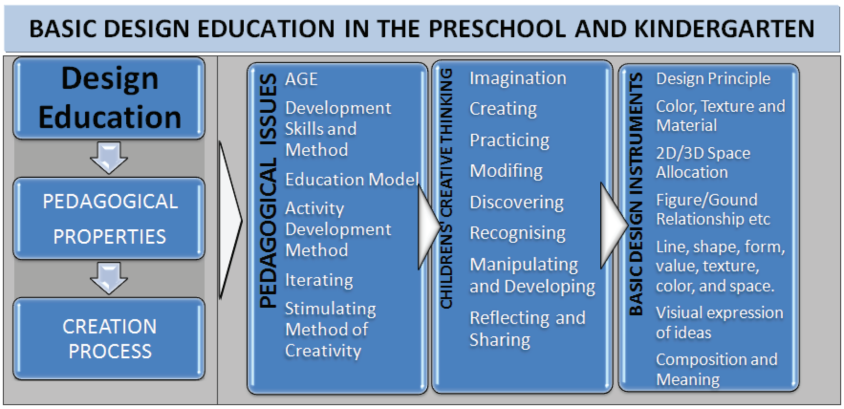

Table 1. Model of 'Basic Design Education in the Preschool and Kindergarten' . Pedagogical issues, children creative thinking skills and basic design instruments are issues which supposed to be evaluated as a whole.

This table summarises the creative thinking cycle, dependent and independent variables of ‘Constructing design knowledge with in the kindergarten education’ model. Pedagogical Issues, childrens' creative thinking approach and basic design elements are explained as following;

Pedagogical Issues

Different socio-philosophical-pedagogical theories on the education models built for and around the child led to the construction of understanding current issues and curriculum of basic design in early childhood education. "It was found that there were statistically significant differences between the performance scores of students having diverse learning styles at various stages of design process" (Demirbas and Demirkan, 2003: 437). The important point is to provide various learning experiences and methods that emphasize different learning styles during design process. Each design instructor has his/her strategy while communicating with the student. As (Schön, 1984) proposed, the instructor should refer to all communication means as reflection-in-action. Furthermore, it is important to stimulate the diverging children for bringing to the class their range of ideas and ways of creative process. While composing a design facilities for appropriate age and skill development, in a harmonious and balanced way, the sensory, perceptual, motor, linguistic and intellectual abilities of early children have to indicated. Flexible teaching methods application and iteration will enhance children motivation and stimulate their imagination.

- The role of creativity in learning of children
- The developmental stages of childrens' basic design education
- The philosophy, social context and attitudes of design education on the preschool level
- Knowledge of the curriculum (goals, organization, materials, vocabulary) as
- contribute to the growth of the children.

Children Creative Thinking Skills

Aesthetic education had a spectacular evolution which is able to say that by making a comparison between the studied curriculum. which imposed immobile, certain subjects, in time we had a very permissive one, in which we have professional terms and which allows the options to be taken by the children and the teacher. The accent is more and more on creativity, on stimulating children creativity, on improving pre-school children talent from this early age. The relation between this branch of aesthetical education with other disciplines from the school field in order to create together an ensemble, needed in developing children personality is also important.

The process of becoming a creative thinker is itself an iterative process. Historically, kindergarten has provided a good foundation for creative thinking. Think of kindergarten as the first time through the creative-thinking cycle. Unfortunately, after leaving kindergarten, children have not had the opportunity to iterate on what they learned in kindergarten, to continue to develop as creative thinkers. By extending the kindergarten approach, we hope to provide opportunities for learners of all ages to build on their kindergarten experiences, iteratively refining their abilities as creative thinkers throughout their lives (Resnick, 1998).

In a way that, a child gets an idea and begins to implement it. He knows what equipment and materials he will need and gets them. An educator is an enabler who offers the child any materials that are unavailable, but necessary. Such an idea often sparks other new ideas, and the original idea develops during the process. The participation is seen from the child, who is excited and involved. The activity draws attention from other children. All of them are sufficient for the creative process consisting ; imagination, creating, practicing, modifying, discovering, recognising, manipulating and developing, reflecting and sharing. As mentioned these issues have been present in the early childhood education and relevant issues for the design process. However children have to be stimulated and directed professional as well to construct the basis perceptual, critical and analytic point of view in a very early age and the ability to develop in the future.

Basic Design Instruments

Basic design principles are the fundamental issues. What is important here is the medium of instruction for children such as; Play, storytelling, puzzle, cartoons etc...could turn into an experience of design. So, the curriculum could provide children to build up a model that will guide them to understand and apply the knowledge, skills, process and theories of design and to provide a balanced synthesis between the conceptual and physical aspects of design.

- Perceptual awareness by identifying and using the elements of design - - line, shape, form, value, texture, colour, and space.
- Design concepts based upon using the elements of design and the contrast,
- principles of 2D/3D space organization - - balance, rhythm, emphasis, unity etc...
- Cultural heritage through the interaction of design and art in society.
- The processes and materials appropriate to the preschool children.
- To understand self - expression through visual communication of ideas, experiences and feeling.
- Getting know the vocabulary peculiar to the design issues.
- Use of natural and ecological materials allowing healthy growth of a child and his/her awareness on basic design issues in the perspective of order, proportion, principles etc...
- Experimentation creative designs, geometrical and structural forms with colour, and texture engaging, imaginative and innovative technologies and materials.
- Designing spaces, perspectives and environments, whose purpose is to enhance intuition, imagination and creativity of the child along with development of his/her aesthetic and scientific thoughts.

On the other hand to form an efficient the design curriculum for children contemporary design education has to be studied. Demirbas, Demirkan, 2007 studied them under four categories. In the first category, there are fundamental courses that develop the design formation; the knowledge in these courses is generally theoretical rather than practice based. Secondly, there are technology-based courses that provide the scientific formation of design; the acquired knowledge in these courses is both theoretical and practice based. The third category consists of artistic courses that strengthen the base of design and expression; the acquired knowledge from these kinds of courses is the presentation techniques of preparing and expressing design ideas, so the expected outcomes are directly related to the application of them. childrens' playful creativity in the preschool period can be regarded as artistic and are capable of appreciating design and various activities involved or engage in it. There can be numerous different kind creative activity practices which will support childrens' full development and personality in an age in which art, design and scientific curiosity has been arisen.

Conclusion and Recommendations

The graduates of a design department are expected to be highly motivated, technically competent and mentally prepared to deal with ideas at a professional level (Demirbas, Demirkan, 2007). Achieving these outcomes in a four or five year education

is both for the student and instructor very complicated and discouraging. This paper makes the emphasis that Design Education is accumulation of knowledge, like most other disciplines, and foundation of this knowledge has to be given in the early childhood education.

Another offer of the study is the model for the basis construction design education;presenting and identifying all relevant independent and dependent variables in terms of pedagogical, creativity, basic design issues. In such way that, learning and teaching methods which aim to balance the creative process with a critical awareness considering methods and mediums in terms of developmental aspects of children. Each design outcome tends to be unique, non-repetitive and immanent in its conception and development. During a design process each children transforms a field of inquiry into a proposition or scheme. Children have special point of view but the learning process could classified in terms of age and gender.

Even practically or conceptually design has been integrated in almost all aspects of our life. the traditional kindergarten approach to learning is ideally suited to the needs of the 21st century (Resnick, 1998). In a society characterized by uncertainty and rapid change, the ability to think creatively is becoming the key to success and satisfaction, both professionally and personally (Florida, 2002). For today's children, nothing is more important than learning to think creatively – learning to come up with innovative *Constructing Design Knowledge Built up on the Kindergarten Education* solutions to the unexpected situations that will continually arise in their lives (Sawyer, 2002). Unfortunately, most schools are out-of-step with contemporary necessities: they were not designed to help students develop as creative thinkers (Resnick, 1998). However, the traditional kindergarten approach has to be professionally reorganised in terms of contemporary design approach, materials and medium of education. Preschool curriculum should cover and comprise both pedagogy and design - multidisciplinary goals, contents and methods of early design education and get continues knowledge and skills in perceiving, planning, implementing, evaluating and developing design skills in their future academic and professional life.

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Design education for non-designers

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Connecting for Impact: multidisciplinary approaches to innovation in Small to Medium sized Enterprises (SMEs)

Mark BAILEY* , Neil SMITH and Mersha AFTAB
Northumbria University

Abstract: *This paper reveals the methodology developed and adopted by groups of Multidisciplinary Design Innovation Masters students whilst working on projects with regional Small to Medium Sized Enterprises (SME's). It exposes an eight-stage approach and shows how the creation of a 'problem-space tapestry' acts as a mediator between different disciplinary approaches. The authors used a combination of observation, interview, post project-analysis and auto ethnographic reflection in order to uncover this process and to draw conclusions about the conditions that are necessary to support university based multidisciplinary design-led innovation projects of this type.*

Keywords: multidisciplinary, innovation, SME, problem-space.

* Corresponding author: Northumbria University | UK | e-mail: mark.bailey@unn.ac.uk

Background

This research reveals the methodology adopted and developed in a suite of team-based, design-led, multidisciplinary innovation projects conducted in collaboration with a series of regional SMEs. By unpicking the methods adopted in the projects' execution, the authors are able to identify a number of key points that informed their understanding of the conditions required to support this type of work.

The research is situated within a post-graduate Masters programme in Multidisciplinary Design Innovation (MDI) which is a collaborative venture run by Northumbria University between their School of Design, School of Computing, Engineering and Information Sciences and Business School. The MDI programme is a one-year, three trimester Masters programme in which graduates with first degrees in Design, Business and Technology and other specialisms like politics, psychology and fine art learn together and are taught by specialist academics from each of these disciplines.

This programme was developed in response to Sir George Cox's Review of Creativity in Business (Cox 2005) which suggested that establishing long-term economic business sustainability in small businesses requires an agile approach to innovation and employees who are open to change and capable of working across disciplinary boundaries. In response to Cox's report, Northumbria University made a proposal to the Regional Development Agency and was awarded a grant of circa £500k with which to establish post-graduate multidisciplinary innovation projects to facilitate knowledge sharing with local SMEs. Through this scheme, a suite of 18 projects was undertaken over a 2.5-year period involving 50 MDI students.

Case Studies

Project case studies are presented in the book Connecting for Impact: 18 Inspiring stories of multidisciplinary innovation, (Bailey and Smith, 2011) which outlines the approaches and value of multidisciplinary innovation in small to medium sized industrial settings.

Typical of the projects was one undertaken with touring caravan manufacturer, Elddis. The initial brief was to look at how the company might position its products to attract a younger market. The briefing was conducted in and around caravans and involved the students exposing, with the client, their initial perceptions of caravans and caravanning. This raw data was recorded on large rolls of paper and included anecdotes and childhood memories, rapidly sourced images and statistical data provided by the client. Following this outpouring of tacit knowledge and ideas, the students sought to cluster the data in order to make sense of what they were uncovering. Material was grouped under headings such as 'on the road', 'blue-rinse set', 'space-use', 'at one with nature' etc.

Following this initial externalising of knowledge and perception, the students were primed with questions and ideas to test in a real-world setting. The company loaned the group a motorhome and they visited a number of caravan sites where they immersed themselves in caravanning life; observing and engaging with caravan enthusiasts, first-timers, site owners and employees.

In order to understand more about the business, they visited retailers and tradeshows as 'secret shoppers', following up by declaring their purpose and interviewing business managers about their relationships with the manufacturer and customer. Simultaneously, they conducted on-line research via blogs, interest groups and surveys. They made site visits in order to understand manufacturing processes and the company's capacity for change.

Concurrent with this data gathering they engaged in creative exercises in order to generate, prototype, evaluate and refine ideas based on their emerging knowledge base.

Ultimately, they drew their thinking together in order to present three clear opportunities to the client company;

1, they revealed critical insights and opportunities surrounding the relationship that existed between Elddis, the retailers and ultimately the end users.

2, they offered technical innovations in the way that caravans could be manufactured to support the requirements of a younger market.

3, they proposed radical new routes to market appropriate to that audience.

Research methods

Verganti (2009) argues that radical design-driven innovation can be made to happen when actors from different disciplinary fields work together as 'interpreters' through design discourse for the benefit of a company. In large organisations, this can happen when employees from different functional groups come together with users and representatives of partner organisations as a 'project team'. In contrast, the limitation of resources and broad-spectrum knowledge and skills available internally to SME's often dictates that such a project team needs to exist outside the organisation. In the projects that are the subject of this research, teams of MDI students, drawn from different disciplinary backgrounds, act as 'interpreters' for the benefit of the SME's involved.

This research was undertaken using four principle methods:

1, Observation and post analysis of each case study was used to establish the common stages of activity adopted in each case and to explore common traits and differences in the projects in order to identify the best conditions to enable project success. In this case, the researchers consider success to mean that significant learning took place for both the students and the organisation involved. This does not necessarily mean that significant innovation was achieved.

2, Semi-structured interviews with participating students and company employees were used to establish what learning had occurred and what impact this learning had.

3, Analysis of the participating students' reflective learning accounts ('Portfolio of Practice') was undertaken in order to understand whether the students were aware of the structure that they had adopted in undertaking the projects and whether there were common points at which learning took place which might indicate important conditions for project success.

4, Auto ethnographic reflection was also used in order to validate the emerging picture presented by the data revealed through the aforementioned methods.

Preparation for the projects

The students spent the first two trimesters developing their design-led innovation practice skills using the MDI 'Safe Environments' approach (Bailey and Smith 2010). 'Safe Environments' refers to the curriculum, assessment (predominantly pass/fail) and working environment design adopted in the MDI programme that encourages experimentation and risk-taking in pursuit of learning. In Trimester 1, students engaged in 'Familiarisation Projects' through which staff introduced and guided students in research and creativity. In the second trimester, ‘Experimentation Projects’ were used to encourage students to be more exploratory in their approaches.

Finally, in the third trimester ‘Integration Projects’, the cohort was divided into mixed-discipline groups of three or four students to work with a different regional SME client evolving and deploying the most appropriate suite of mixed-discipline methods to suit the circumstances of the client organisation and project type. The constitution of the team members and their disciplinary background was matched to the needs of the project and the individual students’ personal learning plan.

The working environment spatial design provided an essential element in supporting the project methodology in that it facilitated the externalising, display, mapping and organisation of all ‘data’ gathered and developed through the projects. The space was dedicated to the programme and made up of a flexible studio, teaching room and boardroom with walls that were designed to be written upon. The students were at liberty to arrange the space to suit the project.

Establishing the projects

Through auto ethnographic reflection and semi structured interviews, the researchers identified that before each project was introduced to the students, significant meetings to scope the background and set-up work had been undertaken by the academics, working closely with the companies. In each case time was spent establishing the focus and scope of the project to be undertaken. Whilst six of the eighteen companies were familiar with working with *design* students on *design* projects, they all had to be ‘educated’ regarding the potential of the new design-led multidisciplinary innovation approach in order to ensure that the scope of the project brief represented a suitably strategic challenge for the students.

The researchers saw that in each case, the key element in establishing projects that delivered significant innovation potential and long-term value (learning) to the client was the fact that the academic staff didn’t approach the clients’ situation from a design perspective, but rather from a business one. During these meetings, the academics probed the company’s key stakeholders in order to establish, from their perspective, what they considered to be the organisation’s strengths and weaknesses, aspirations and future direction of travel. They explored the company’s organisational structure, financial model, capabilities, capacity, competitor and sector landscape and lastly current and future product or service offer. Important here, is the fact that the academics in question were all designers with significant commercial, as well as academic, experience. Whilst the MDI projects are essentially Design Thinking (Brown 2009) projects and often result in designed artefacts, systems and services, it was essential to communicate that they respond to business situations. This was revealed to be an essential element of the collaboration as near-to-market development activity was deemed by the academics to be too focused and narrow in scope.

By approaching each situation from an holistic business perspective, the available territory framed for the project was greatly expanded creating room for the client to be challenged by the questions and possibilities presented to them at the end of each project. This is exemplified in the aforementioned caravan project. Initially with a very specific design brief for the development of caravans to attract a younger customer, the client got a project that delivered three strategic opportunities.

These three opportunities only came about as a result of the initial business framing of the brief undertaken by the academics showing the client the scope that the broader brief offered.

An evolving, co-constructed method

In the projects, the students were required to plan and execute an appropriate project approach based upon their prior experiences and the needs of the task at hand. This meant that, as well as employing the structures and approaches that they had learned and rehearsed in the first and second trimesters, each disciplinary sub-group brought the conventions of their practice to bear on the situation. In order for these practices to be adopted by the wider group, the merits of the practice had to be demonstrated to the other team members; thereby the students exposed each other to new ways of thinking and doing.

In this situation, the academic adopted the role of facilitator rather than tutor, allowing the project to evolve; giving 'permission' to experiment and only intervening when adverse interaction between the activists looked likely to derail the learning.

Observation and post-analysis of each project, along with analysis of the students' Portfolio of Practice documents allowed the researchers to identify an eight stage approach which all the projects followed. In this approach, the researchers were able to trace Johnson and Johnson's 5 elements of cooperative learning (1994). These are positive interdependence, individual accountability, face-to-face interaction, social skills, and processing. Johnson and Johnson saw these as essential for effective group learning, achievement, and higher-order social, personal and cognitive skills (e.g., problem solving, reasoning, decision-making, planning, organizing, and reflecting).

The MDI approach that we have identified is a team-based approach that bears similarities to a Grounded Theory strategy (Glaser & Strauss 1967) in which both generative, abductive logic (Dunne and Martin 2006) as well as inductive, reductive logic are brought to bear on complex problems through the creative practice. In the MDI approach, we see that there is a simultaneous explorative 'what if?' enquiry alongside the 'what is going on?' questioning typical of Grounded Theory.

Verganti (2009) emphasises the importance of 'what if?' envisioning. He cites the need to make connections between emerging developments in socio-cultural and technological terms in order to create new meanings that represent new possible ways of living. Within the suite of projects investigated here, this same 'what if?' envisioning was evident.

This is very important because it is this type of enquiry that is necessary to reveal the 'unknown unknowns' that Bontoft (2012) of Team Consulting cites as being a critical stimulus for innovation.

Bontoft sets out a model of design research that acknowledges that there are some things that we know we know; assumptions, but that these aren't ever tested, that there are things that we've forgotten we know; tacit knowledge, things that we know we don't know; typically these are the gaps that research is trying to fill, and there are the things we don't know that we don't know. What this research has shown is that the MDI teams do challenge assumptions by requiring the knowledge owners to explain it to peers with different disciplinary backgrounds; 'dumb questions' are encouraged.

The authors have seen that the data derived from observing what was going on was over-laid with data about what was likely to happen (market trends, proposed legislation, demographic predictions etc.) and 'data' (in the form of opportunities identified) about what *could* happen and finally what *should be made* to happen. This latter layer was considered as research data whose purpose was to provoke further questioning (within the company) and inform strategy making. Whilst the first three layers were seen in the very earliest stages of the projects, the last only emerged as a consequence of dialogue and evaluation with the project stakeholders.

The eight stages

Client briefing

In each case, the client briefed the students, either in their own premises (Figure 1) or within the MDI facilities. There were three essential elements to the briefing.

Firstly, students came face to face with their client – the project assumed an authenticity and real-world context through this interaction which acted as a motivator; ”...it felt real, it felt commercial and it was reflective of what we would encounter when we transitioned into industry” (MDI student, Industrial Designer). Establishing a relationship between client and student at this stage was essential to the iterative development of the project in subsequent stages.

Secondly, the briefing gave the organisational context to the project. This means that the client gave the students a macro view of the organisational structure, financial model, its operations, place within the sector and future direction. The research showed that the more open the client was able to be at this point and the greater access to colleagues and data they were able to afford, the greater the opportunity for the project to deliver real value and impact.

Finally, the briefing needed to establish the scope of the opportunity or challenge being presented to the group. The briefs varied from very broad, overtly strategic enquiries to more tightly focused product or sector developments. Unsurprisingly, in the more open briefs, where the client organisation was more receptive to challenging thinking, the researchers saw far greater opportunity for radical innovation. Here the opportunity for a truly *multidisciplinary* contribution was greater because the issue under consideration was viewed as a high-level business issue; the point of entry was different; "…the open brief allowed us to push boundaries and have freedom with the research [methods], which is something I learned a lot from" (MDI Student, Social Scientist).

Figure 1. On site project briefing

Problem interpretation and deconstruction

Immediately following the briefing, the student group engaged, en-masse, in creating what became known as a 'problem-space tapestry' by undertaking a non-judgemental 'brain-dump'; sharing their collective assumptions and tacit knowledge of the situation in a visual and textual way (Figure 2). The problem-space tapestry was a simple device that the students developed whereby they used large sheets of paper and populated them with imagery and words that captured their immediate thoughts and ideas about the situation. Initially these were an un-sorted, haphazard and spontaneous response to the briefing. This activity sought to identify and consider the problem from the perspective of all stakeholders and contextual factors that may have influenced the project.

This way of showing connections called 'designerly ways' (Saikaly, 2005; Yee, 2009) of conducting creative research lead to highlighting tacit knowledge and its connection between information provided in the brief and assumptions within the problem space. The students used this creative mixing of processes like data mapping, linking, and making sense of the connections to lead to innovative outcomes.

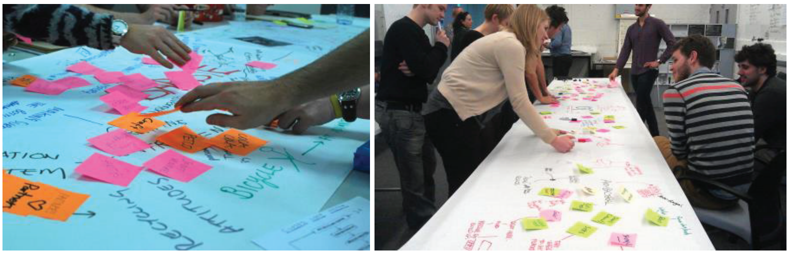

Figure 2. Creating problem-space tapestries

The researchers saw that the value of this exercise was threefold;

Firstly, it exposed a surprising amount of valuable, relevant pre-existing knowledge, assumptions and opinions. It caused students to think both within and outside their discipline as they sought to align disciplinary knowledge and life experience with the company context before them.

Secondly, because it caused them to externalise their thoughts, it allowed the group to visualise the knowledge that they had and the gaps that existed in a way that ensured that all of the group were involved and that the immediate outpouring of response to the brief was captured and displayed in a way that could be referred back to as the project unfolded. This 'open-plan' approach to the project chimed with Bontoft's view that projects should be given "maximum surface area" in order to act as stimuli for the knowledge that the team have forgotten they have.

Finally, because it was conducted immediately after the briefing had taken place, it rehearsed and embedded the knowledge delivered through the briefing and opened up the students to the range of possible directions that the project could take. It also gave them 'ownership' of the project.

Scoping initial idea development

The problem-space tapestry provided a platform for scoping the project. In a separate, initially more evaluative phase, students re-visited the tapestry and started to rearrange the data, seeking patterns and themes that connected with each other

(Figure 3). Once initial themes had been identified, a more creative activity ensued, the purpose of which was to establish the scope of the project by taking each emerging theme and posing “what-if?” questions around it. The researchers consider this to be a linked activity representing one stage in the process as the initial ideas developed are consequential to the themes that are exposed and established the scope of possibilities that the project may explore. It was important at this stage for trends to be identified and brought to the picture to ensure that the work was future facing rather than simply reactive. Sharing this emerging tapestry with the client established buy-in from the clients and demonstrated the power of the multidisciplinary approach; “The project focused on previously unrelated items and brought them altogether into a strategy. The ability of the multidisciplinary team was a huge benefit to the outcome” (Colin Foxton, CEO Sarabec)

Figure 3. Seeking patterns and connections in the data

Insight identification and opportunity creation

Whilst the tapestry was the landing-point for the data gathered, working in the field was an essential aspect of the MDI approach. Students sought to establish contextual experience by becoming immersed in the experience of all of the stakeholders in the project. “We lived Berghaus and this gave us the confidence and the understanding to complete this project successfully” (MDI Student, Transportation Designer).

We saw that where they had buy-in from the most senior stakeholders within the organisation, they were far better able to work closely in the company. The data that they garnered from this fieldwork was brought back to the tapestry. At this stage, the tapestry allowed students to observe the data set as a whole, making conscious and sub-conscious connections that informed the identification of useful insights. The meaning ascribed to ‘insight’ in this context is the ‘ah-ha’ moment; the point at which the available data connected with the students’ contextual experience of the situation in a way that allowed them to see clearly an opportunity. They were able to use the tapestry to present these opportunities to the client and show them the interrelationship of the various observed factors that lead to them.

Around each opportunity, the researchers observed that the students developed a narrative, creating a tangible story that allowed them to share and understand its potential. (Smith, Bailey, Singleton and Sams, 2010 and Young, Pezzutti, Pill & Sharp, 2005).

Through previous research (Bailey and Smith, 2010), we have seen that in order for multidisciplinary teams to function successfully, communication is a key element. Students needed to be able to understand each other’s meaning which could be influenced by both their cultural, linguistic and disciplinary backgrounds. They needed to develop confidence to travel into new disciplinary spaces. Doy (2009) explains that students and researchers who moved from one discipline to another "encounter languages and cultures which may seem alien, or perhaps welcoming. They feel uncertain and lacking in confidence sometimes, because they do not feel "at home" in the new discipline...". A 'common-language' is needed. The tapestry, because of its open and visual nature, helped in this. The creation of stories, however, revealed each individual's interpretation of the meaning in the opportunities thereby allowing the team to debate and adapt them with a common understanding. As the stories were developed, the richness of the multidisciplinary team-members' individual contributions could be leveraged, capitalising on the different communication tools used in each discipline. This was important as it ensured that the story spoke equally to all of the stakeholders who were involved in a review of opportunities.

The use of stories as a means of describing ideas, rather than some of the more traditional designer's tools such as sketching, helped team members without the designer's skills to voice their ideas on an equal footing.

This stage was often repeated through a series of cyclical refinements until the opportunities were clearly defined. It was often the case that there was more than one opportunity and in this case, cyclical development ensured that only the strongest emerged either as single directions or a coherent suite of ideas.

Rough prototypes and rigs were often used as development tools and to help articulate the emerging opportunity.

Strategy development and in-depth investigation

Analysing the final project reports and individual student portfolios of practice, it was clear that, at this point, the opportunities were merely a series of ideas and observations tied together by a narrative. In order for them to take on the potential to represent true innovations that could deliver impact for the client company a development strategy was required. Here, the balance of disciplinary influence shifted to a greater reliance on the skill sets of the business and technology students. Whilst the commercial viability and technical feasibility were always considered simultaneously with the desirability (Brown 2009) of the opportunity, it was at this point that they took the foreground, with the business graduates typically taking leadership. All the teams now focused on how the opportunity could be realised; what conditions needed to exist in order for their ideas to be turned into relevant reality for the organisations? These innovations may have been concerned with organisational structures, new business or trading models and routes to market, the creation of new job-roles or the development of new brands. Equally, they may have involved investment in new manufacturing capabilities, investment in fundamental scientific research or the development of strategic alliances. Here the multidisciplinary teams appeared to take a 360° view of the project in order to consider the implications of the opportunity from the perspective of each of the company and external stakeholders.

Refinement

At this point, when an opportunity was clearly articulated as a creative proposal told through a story, and a strategy existed for making it become a reality, the project was, once again, subject to review with the client. The researchers saw that it was important that the communication tools used to present the opportunity remained loose, still leaving the opportunities open for refinement. Presenting a 'fait accompli' at this point closed the project down and missed the opportunity to make further refinements based upon the client feedback. The more successful presentations captured and used a combination of the tapestry to establish context and remind the client of the genesis of the opportunity, an illustrated story to demonstrate the end-user experience and a business benefit focused presentation to outline the strategy. These three elements were often drawn together as a single slide presentation. They also formed the spine of the final documentation of the project.

Feedback from this review guided the refinement of the creative proposal, the detail of the strategy and, importantly, the communication of the whole. In each of the case-study projects, a degree of confusion and misinterpretation from the client was witnessed at this stage. This was an important rehearsal for the final presentation, which often reached further into the organisation than the key contact with whom the students worked throughout. Responding to these misunderstandings allowed the students to consider and tune their communication strategy for the final project delivery, and ensure that it would speak equally to all stakeholders. In some instances, this involved students developing demonstration models and prototypes, again drawing on the wider skill set of the multidisciplinary team, with typically, but not exclusively, the design and technology specialists taking a lead in producing artefacts and rigs in order to make tangible the sort of products, systems and services that the strategy was intended to deliver.

Project documentation & final presentation

The structure, style and methods in which the project conclusions and insights were ultimately presented had a significant bearing on the potential impact and influence that the projects had within the client organisations. Some clear patterns were identified.

Whilst each project presentation tended to be context specific, what emerged in all cases was the production of an illustrated book, which framed and detailed the contextual background within which the innovations were situated. The books also included the opportunity narrative and the strategy mapping as well as the actions required to implement it. In addition, the researchers noted that product and promotional simulations, faux-advertising material, animations and video presentations were very well received as they "brought the proposals to life" (Figure 4).

Along with the polished, finalised proposal, it was observed that clients valued two other presentational elements; a catalogue of all of the material that led to the final proposal, including a capture of the tapestry or tapestries with all of the fragile early ideas and stories that didn't make the final cut. In addition, particularly where the client had little or no previous experience of working in design-led innovation, a journal that outlined the processes and working methodologies adopted in executing the project were greatly valued. Providing this record allowed the clients to seek to emulate the process; "As a producer of paper tubes and cores for over 100 years our people have thought of most applications or possible use for tubes and cores… or so we thought! As a result of this project, we are now challenging our people to think in a similar way to that of Northumbria University about new applications and markets to enter" (Gary Morgan, Sonoco Alcore)

Figure 4. Presenting the final documents to a client

Further consideration and debrief

In conducting the project, there was a to and fro of information between the student group and the client stakeholders. The pace and nature of this was typically driven by the students, who often ended up spending some time in the client company where their questioning became almost an accepted part of the working day. “It felt like we were working with them, not for them” (MDI Student, Graphic Designer)

Through this, the students could also manage expectations and start to understand the nature of the communication necessary to engage each of the stakeholders from each of their different disciplinary perspectives.

The researchers observed that the final client presentation often posed as many questions as it answered and client feedback invariably left students feeling that there was more to do. This was, in fact, the legacy of the project; that it left the companies with work to do having learned something new about themselves and their market.

A final refinement of the communication of the proposal allowed the students to reflect on the ‘final’ feedback and make any necessary changes for clarification or emphasis. No matter how close the students were able to get to the client organisation, it was often the case that the client would see something in the final proposal that the students considered peripheral but they, in fact, saw as pivotal. The fact that this situation occurred supports the value of providing the client with the full raw data set as this may, in time, be found to contain germs of ideas that make more sense as the context changes over time.

By presenting the findings in high quality, professional-standard book form, and providing the client with multiple copies, the material took on a reality and gravitas that allowed it to assume a catalytic effect within the company. Evidence of the strength of this approach is seen in the clients who have asked for multiple reprints for broader company dissemination.

There was a final act of debriefing that allowed the students and staff an opportunity to consider the question ‘what have we learned about design-led multidisciplinary innovation here?’ The students answered this question through their ‘portfolio of practice’ submissions; a factual account and reflective commentary document that informed their individual assessment.

Conclusions

The investigation of these projects has revealed an eight stage approach that differs from the typical 4 stage model determined by the UK Design Council (Design Council 2005) in that it allows for greater fluidity and takes equal account of emerging factors and business models as it does user-centred issues of form and function. By observing and analysing the projects, and questioning the key stakeholders in the projects, the authors have identified five conditions that are required to support projects of this nature. They are all linked as they are dependent on the relationship established with the client company. The five conditions are;

1, Framing the project brief as a business problem rather than as a design challenge. This requires that the projects are set up by staff with both design and business acumen.

2, Access to the senior management team within the organisation. This ensures buy-in and access to the highest level thinking of both an operational and strategic nature.

3, Creative exchange and openness between the organisation and the project team. This acknowledges that the client is a learner too and that the value of the outcome is dependent upon their willingness to engage with an open-mind and accept the challenges presented by difficult questions.

4, Co-creating with the stakeholders a flexible project framework that supports critical enquiry. The client and the students need to agree a way of working together that will allow for frequent, full and open dialogue.

5, Acceptance of visualisation of data as a primary development and communication tool within the project. This takes full advantage of the value of the problem-space tapestry.

This last point was critical to the projects as it addressed all four of the aspects of research for design that Bontoft identifies. It united the team and client around an emerging common-purpose.

By hosting a collective ‘brain-dump’ it allowed students to challenge assumptions. Through its open, visual nature it stimulated recall of tacit knowledge. By allowing data to be visually categorised and connected it identified gaps, and as a visual tool, it promoted communication of emerging opportunities (Figure 5).

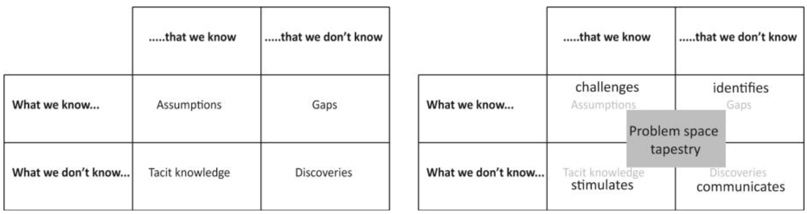

Figure 5. Relationship between Bontoft’s design research matrix and problem-space tapestry

In almost all cases, by virtue of the multidisciplinary approach, the projects revealed an horizon scan for the client where the true impact was neither in the designed service, system or product, nor in the strategy to deliver it. It was in the questions that the project posed and the legacy that it left in terms of new ways of thinking, communicating and working. In the case of the aforementioned caravan company, as an example, this was evident in that "the project acted as a catalyst for further work within the organisation. We have even utilised some of the methods used by the team within our own processes" (Gary Lees, Elddis)

The methods referred to in this case related to the communication of ideas and restructuring of meetings to take on a more multidisciplinary approach.

The project teams in the way that they interacted with each other and their clients demonstrated a social dynamic in working practices that few organisational structures support or reward. Their common purpose was innovation, which, by its very nature, is experimental, and experiments are prone to failure. However, few organisational structures or remuneration schemes encourage or reward failure, even if it is competent failure in pursuit of breakthrough success. What these projects did was give permission to think and behave in ways that recognised failure as a stepping-stone to success and demonstrated how this could be managed. By breaking down the typical functional structures and bringing mixed discipline teams to bear on a project, conceived at a macro business level, stakeholders could take ownership of that common-purpose. What the projects did was show how this works and how it can answer questions that weren't even asked (the unknown unknowns). Through the continual to and fro of the project, the stakeholders started to engage in and learn about the value of co-creation.

Through the MDI programme, we have learned the importance of students developing a common language of innovation that crosses disciplinary and cultural backgrounds. Through these projects, we have seen that their true value to the client lies in experiencing the approach rather than simply receiving the outcome.

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I "Like" Design: Participatory Web Sites and Design Lessons for the Masses

Mary Anne BEECHER*
University of Manitoba

Abstract: *In North America, published advice literature and design-based television and radio programming served as prominent vehicles for communicating lessons about what or what not to do when making their own interior design decisions to the general public in the twentieth century. This passive approach to teaching the lessons of design has been supplemented in recent years by a more interactive model: the participatory web site. This research is a qualitative analysis of social media platforms, independent web sites and blogs that monitor and promote new contemporary works from around the world and this paper focuses on the content of four: designsponge.com, apartmenttherapy.com, clippings.com, and houzz.com. By providing platforms that use imagery and text as persuasive devices to promote new designs, such sources present the qualities of "good design" to be potentially absorbed by the general public. By linking site readers to design professionals or by addressing direct inquiries about solutions to design problems, today's participatory sites enable non-designers to envision improvements to their own environments. The invitation to comment on designed products and spaces provides a valuable vehicle for formulating and sharing critical perspectives on the qualities of design that matter most to those who participate.*

Keywords: Advice literature, design criticism, design-based web site

* Corresponding author: University of Manitoba | Canada | e-mail: beecher@ad.umanitoba.ca

Introduction

Design education for non-designers has the potential to take many forms and address many dimensions of design. This research is focused exclusively on aspects of design education that address the interior architectural environment through the cultivation of knowledge about the design of buildings, interior environments, and features or objects intended to be used in interior environments. While models for design education that relate to the built environment exist to one degree or another throughout Western culture, the focus of this discussion will be on North America, and most specifically, on the impact of the resources analysed here within the context of the United States and Canada.

Modes of educating non-designers about design varied from the latter half of the nineteenth throughout the twentieth century, ranging first from printed and published materials to radio and later to television programming. They also include face-to-face presentations to various types of women's clubs and group meetings (Beecher 1999, 254).   The interpersonal communication of design knowledge occurred most directly through short-term or informal educational programs, and also as part of design-based housing improvement efforts such as the "Better Homes in America Movement" that were initiated by social reformers at certain critical points in history (Hutchison 1986, 168).

Domestic advice literature appearing in newspapers and several women's magazines throughout the twentieth century gave non-designers guidance based on the application of the principles of design, often filtered through factors of taste and economy. Author Sarah Leavitt details the history of this literature in *From Catharine Beecher to Martha Stewart: A Cultural History of Domestic Advice*. Leavitt traces the epicentre of published history of domestic advice to Boston and New York in the United States and she links interest in making improvements to one's environment to the proliferation of educational opportunities for women via the rise of the study of home economics (Leavitt 2002, 26).

In state-sponsored universities across the U.S. and provincial schools in Canada, design education emerged from the context of architectural engineering and home economics. In both countries, such institutions reached out to the general public through nation-wide systems known as "Extension." Through these programs, free published bulletins communicated design principles to a largely rural readership with narrative, diagrams, and drawings. Later, photographs were also used to communicate lessons about color theory; visual principles of balance, rhythm, and emphasis; facilitation of function through the installation of appropriate lighting; layouts that minimize effort; and the incorporation of other aspects of efficiency by integrating storage opportunities. The extension program brought information about new materials to persons interested in modernization by promoting their properties and appropriate applications (Cushman 1933, 15-17).

In the United States, shelter and builder's magazines such as *House Beautiful*, *Better Homes and Gardens* and *American Builder* all routinely ran articles during the first half of the twentieth century that featured discussions of significant and emblematic historic examples of Western—mostly European and Early American—architecture and design. By pointing out the crucial characteristics of historic architectural styles and describing important historical properties, readers were trained to recognize key stylistic characteristics along with the relationship of those traits to the design elements and principles such as symmetry.

Along with these educational articles, popular magazines also sometimes provided opportunities for readers to consult with experts about design problems by sending in questions that were subsequently answered in a published column. Readers received guidance about colour choice, furniture arrangement, and strategies for updating outmoded environments through such means. For instance, the popular builder’s journal *Keith’s Magazine* published a column variously entitled “Inside the House” and “Decorating the Home in Good Taste” between January, 1922 and December, 1928. This feature invited readers to send in letters describing the exposure of the room in question, its woodwork finish, the reader’s preferred colour scheme and a diagram of the floor plan. These inquiries were to be submitted to “Keith’s Decorative Service” so that answers could be published for all of the magazine’s subscribers to read (Keith’s Magazine 1922, 28). In these ways and others, popular magazines became one of the first and most prominent modern vehicles for educating interested members of the general public about design practices such as the use of significant historic works as precedents in new design efforts and the importance of dialogue and participation in the form of question-and-answer formatted advice columns.

Although this early modern period saw the establishment of a modest number of design experts through the publication of domestic advice, the latter part of the twentieth century hosted an explosion in the number of celebrity experts on design, particularly, in the domestic realm. The emergence of Martha Stewart is perhaps the clearest example of how experts (with massive support teams) established wide-sweeping multi-media efforts using paper-based publications, television and radio broadcasts, and Internet-based communications for conveying design information to readers, listeners, and viewers about what to do to improve their environments and how to do it. From the inception of her media strategies, Martha Stewart’s interest in the application of design elements such as colour, pattern, and texture; her use of taxonomies; and her promotion of connoisseur-based practices for discerning the quality of designed objects served to promote rhetorical strategies that resonated with followers who hoped to gain knowledge about designs—past and present—from the prolific body of knowledge provided through her various media venues. Stewart’s corporate web site, “marthastewartliving.com,” became a ground-breaking model for communication by providing participatory opportunities for participants to communicate with Martha and also with each other through devices such as discussion boards. Her extensive and graphically-appealing site, and others like it, encouraged persons interested in the design of their domestic environments to seek knowledge using web-based resources.

Method

While the web sites of rather specialized American design and life-style gurus like Martha Stewart still play a role in the communication of design information to non-designers, such lessons are usually presented within a dense web of recipes, health news and craft projects. Today, a proliferation of more architecturally-oriented web sites, social media platforms, and blogs that monitor and promote new contemporary works in interior design around the world serve as clearer and more focused sources of design knowledge for non-designers and designers alike. Sites such as Stewart’s combine a rather “local” knowledge about design with a full range of domestic practices that include crafting and cooking while web sites and blogs that concentrate on the architectural environment often provide a greater global focus on the design of buildings, interiors, and domestic objects such as furniture and light fixtures.

For the purpose of this qualitative research project, the content of eight web sites and blogs has been tracked over six months to establish the extent to which education about design is explicitly and implicitly communicated to readers. The thirteen knowledge categories used to define the professional standards of the Council for Interior Design Accreditation (CIDA) have been used to define the attributes that constitute the presence of design-based lessons in the sites studied. Preliminary application of these categories indicated that only ten appear at a level of significance in the content of the web sites and blogs. The relevant knowledge categories are: global perspective for design; human behaviour; design process; communication; history; space and form; colour and light; furniture, fixtures, equipment and finish materials; environmental systems and controls; and interior construction and building systems.

In this paper, four of the design-oriented sites will be discussed as cases that illustrate how web-based resources best extend the historical traditions of domestic advice literature and promote the idea of the taxonomic study of works of architecture and design as a means of extending design knowledge. These four web sites serve as clear examples of the overt and also the more subtle ways that non-designers are exposed to design lessons as part of everyday societal practices. The sites are "*designsponge.com*," "*apartmenttherapy.com*," "*clippings.com*" and "*houzz.com*."

Web Sites and Blogs

DesignSponge.com

Similar to Martha Stewart's communication model (and the more conventionally-published models that preceded it) is Brooklyn-based writer Grace Bonney's blog entitled "*Design Sponge*." Bonney worked as a contributing editor at a number of shelter and design-oriented publications before she established the blog in 2004. Now with more than 50,000 daily visitors, *designsponge.com* is a full-service life-style blog that covers interior design, product design, and do-it-yourself projects alongside life-style or domestically-oriented information about gardening, cooking and travel, among other topics. The blog's current senior editor, Amy Azzarito, hales with a master's degree in the history of decorative arts and design from the prominent American design school Parsons/Cooper Hewitt and under her guidance, the blog sustains an emphasis on combining the physical and emotional qualities of one's environment through design considerations, attention to detail, and carefully channelled consumption (designsponge.com 2012).

Perhaps because of its more recent development and slightly more youthful and eclectic perspective as seen in the range of its features and topics, the site has been dubbed by *The New York Times* as a "*Martha Stewart Living* for the Millennials" (*New York Times* 2008). Like Martha Stewart's brand, from the graphics used to the content categories, *designsponge.com* seems to be marketed largely to women. Indeed, according to data published at "findthebest.com" (a site dedicated to comparing web sites based on collected data), 71% of the regular visitors are female; most are Caucasian and 35% are between 18-34 years of age. The bulk (57%) of the blog's readers are over 35, however, and just over half of site registrants have graduated from college and a quarter have graduate degrees (Findthebest.com 2012).

One of the distinguishing characteristics of *designsponge.com* is its role as a platform for featuring amateur and professional design efforts, mostly in urban centres of the U.S. eastern seaboard. Blog editors present photographs and descriptions of inhabited spaces every week and readers are welcome to comment on what they see. Each week, two or three "Sneak Peeks" at spaces are provided and participants on the site actively weigh in. The "Sneak Peeks" provide a range of photographs of spaces as well as descriptive commentary provided by the resident and/or the designer and/or the editor. Often the person responsible for the design provides insight into the sources for some of the finishes and products shown in the photographs and more details often emerge in the dialogue generated by readers' comments and questions. Some of the projects generate sixty to eighty notes of praise—one is hard-pressed to find a critical remark among the commentary—making the content of this web site less useful as an educational site since popularity seems to be the primary criteria for measuring what is deemed "high quality" by participants. Readers of *designsponge.com* definitely "like" design but there is little evidence that the site helps them become substantially more knowledgeable about it as a subject.

ApartmentTherapy.com

Rather than taking on all aspects of the domestic environment, some blogs and web sites are more focused on particular types of spaces. Author and interior designer Maxwell Gillingham-Ryan and his brother Oliver Ryan established the popular web site "*Apartment Therapy*" in April, 2004 (apartmenttherapy.com 2012). The site's intended audience is intentionally broad and the content focuses on the organization and aesthetic quality of smaller-scale residential environments—mostly in cities but not exclusively urban—as well as their ability to promote health and well-being. Despite the web site's name, not all designs shown are rental units. By emphasizing environments that tend to be smaller in square footage and are less likely to be owned by their occupants, however, readers' attention can be steered toward the use of temporary and affordable means of cultivating improved designed environments.

Web site data identifies more than 60% of Apartment Therapy's readers as women and that same percentage of site visitors are 35 years of age or more. The site's visitors tend to be college educated as nearly half of the more than 4 million visitors per year have a post-secondary degree and a quarter have also been to graduate school (Findthebest.com 2012).

The *apartmenttherapy.com* site regularly includes features such as tours, how-to and do-it-yourself information, contests for site followers, and free classified ads for readers in various U.S. and Canadian urban centres. It is supported by advertisers and corporate sponsors such as Sherwin Williams (a prominent American paint company). With the inclusion of the "Chip It" toolbar tool from Sherwin Williams, site users can see photographs of their favourite interior spaces converted on screen to a series of the company's paint samples should they want to execute the same colour scheme in their own rooms. A link to a "marketplace" sends users to the source sites for vendors whose works have been featured, and many are independent artisans and small companies.

What is most noteworthy about *apartmenttherapy.com* in relation to this research is the nature of the some of the participation found on the site and its ability to further the notion of design education. While the tours usually elicit the usual range of generically praising phrases ("Love the house!" "Cute place" "Awesome tour!"…), this web site is also often used by readers who request design advice that will improve their ability to make design decisions. The "Good Questions" area of the site invites users to post photos and floor plans of their dwellings if they want some guidance from peers and the answers that result from such queries are often quite detailed and specific. For instance, when "Brooklyn Studio updates?" posted a photograph and floor plan of an empty one-room apartment, twenty-seven responders chimed in with suggestions that ranged from radical alterations such as changing the location of the kitchen to voicing opinions about whether the flooring should be consistent throughout to minute details such as shopping advice for particular furniture items, radiator covers, and light switch covers. "What's Needed in this Room?" heard from well over one hundred respondents who weighed in with suggestions about the scale of the rug shown in the room, the lack of colour and texture in the space, as well as the general lack of variety in what could be seen in the photo. These terms, and their associated meanings, all added up to a concise design lesson for readers who participated and the voyeurs who follow along.

Clippings.com

Like the two web sites already mentioned, *clippings.com* seems geared toward both designers and non-designers alike but it isn't as open or public as *Design Sponge* or *Apartment Therapy*. The intent of *clippings.com* is to feature the works of designers, new design ideas, and designed products and to help link persons in need of help with designers in their area. It is also a web site developed to capitalize on the popularity of *Pintrest*, a site that provides a virtual means of collecting, arranging, and automatically sharing what users discover when searching the web through social media. By making one's interests known by using *Pintrest*, it is believed possible to then identify others who share them or who are inspired by similar images as a contemporary means of making connections through sites like Facebook that automatically broadcast images to one's "friends" list when something is "pinned."

Clippings.com may be capitalizing on the popularity of *Pintrest*, but it is different in both its focus on bringing together persons offering design services and potential customers and the level of privacy it offers users who browse and "clip." The UK-based site was developed by the same group that produces *Openbuildings.com,* an ever-growing database of information about buildings around the world. The site is organized around three categories: "Shop," "Ideas," and "Professionals." Under the "Shop" heading, new products for interiors are featured in a category that is dedicated to presenting details about the item, including its cost (in UK currency) and providing a link to the supplier for *clippings.com* users who wish to make a purchase. Photographs of whole rooms with prices attached to certain goods or images of individual products are both used to entice users' interest. The "Ideas" category presents the contents of folders that are curated by site editors who bring together thematically related items, processes, or spaces. In the "Professionals" category of the web site, professional architects and designers are invited to contribute information about themselves and portfolios of their recent work so that persons who seek a designer in a particular locale can get detailed information about one alongside general fans of design who also surf the site.

Users, who must register and choose a password to access the content and use the "folder" save feature, create private or public collections of the images they choose and organize according to themes that each defines. Much like traditional practices of "clipping" photographs from magazines as a means of documenting and articulating what design features a person desires and admires, this now digital practice has the advantage of providing a global and ever-expanding collection of options to site users who are no longer constrained by the editorial direction of an individual magazine.

While this may, at first, sound more like a digital match-making service than an opportunity for non-designers to learn about design, it is important to recognize that the actions required to use *clippings.com* actually rely on two foundations of design education: precedent-study and curatorial practices. Although the study of design history has slipped in its prominence as a part of many designers' contemporary education, the analysis of precedent buildings, spaces, or objects—old or new—to inform contemporary design decision-making is still a widely-embraced method of teaching design. By closely examining existing works, it is believed that design students can understand more vividly certain consequences of converting theory into practice. The assembly of virtual collections of images on *clippings.com* mimics this activity. The site presents a broad spectrum of designed environments for site users to study and select with the implied intent that the images will become models for future design activities of one form or another, either as inspiration or as a means of identifying a designer who is capable of producing some version of the work again.

Likewise, the practice of collecting and, more importantly, curating images invokes aspects of analysis based on functional and visual criteria. Site users determine the themes or purposes of their folders. They then identify images to "clip" and place in each based on the ability of the image to suggest new information that relates to the theme. By assessing and comparing designs, and then determining if and how they share or illustrate certain design traits, users of the site are taught to recognize the expression of elements and principles such as pattern, colour, texture, and scale along with harmony, variety and emphasis, among others. The assembling of folders with contents that share properties becomes a bit like playing a mental puzzle game where the ability to recognize and evaluate the content of images is valued. This active seeking and filtering process is employed by many contemporary web sites that acknowledge that trends in web-browsing have slowly crept from "searching" to "discovery" with the rise in popularity of social media sites.

Houzz.com

Houzz.com, as the name suggests, is a site dedicated to aspects of the design of houses/domestic environments. The founders of houzz.com are non-designers, but they are not a presence on the site. Like *clippings.com*, one of the original purposes of the site was to help match people in need of design services with interior designers and architects. This activity was first directed at the area surrounding the site's home base in the Bay Area in California, but it quickly became a much geographically broader repository of information. It is noteworthy, however, that the site began as an archive of the recent works of active designers and there are links on the home page that help users identify design professionals in their area as well as to leave reviews of their performances.

Visitors to the site tend to be women and college-educated persons with an income of more than $60,000. Registration and the establishment of a profile are required to access the contents of the site. Like *clippings.com*, registrants' profiles and saved content can be private or public. The site's current popularity is shown by the fact that it had more than one million iPad app downloads as of March, 2012 (Kurtz 2012). It is also one of the top ten web sites noted as a source for imagery registered on *Pintrest* (engauge.com 2012).

Similar to clippings.com's use of folders for saving design ideas, *houzz.com* users have the opportunity to create "Ideabooks." They can be made public or be kept private. "Ideabooks" operate like scrapbooks because they are places to collect inspirational images and projects. In addition to sorting saved images according to their shared characteristics or themes, comments about each project can be registered and saved. When an image is saved to an "Ideabook," users are asked what they like about the project. These comments, if made public, become an important registry of considerations of the design lessons that can be learned from the published projects.

As with other web sites, the comments posted by web site users are largely favourable. Questions about where an object or finish material can be purchased are frequently posed, perhaps because unlike other web sites that focus on the domestic environment, houzz.com is not a venue for selling products or services. Like the others discussed here, it is only a portal to other sites.

Public idea books and the dialogues that they generate, however, are the real places where design lessons are taught on *house.com*. For instance, Bud Dietrich's Ideabook entitled *"Discover the Real Meeting Grounds of Architecture"* communicates Dietrich's theory of how to best identify the presence of "architecture:" that is, that architecture is created "where two things meet (Dietrich 2012)." Illustrated with an eclectic grouping of images found on the Houzz website, Dietrich's blog-like visual essay communicates the importance of considering the role that architectural elements play in the establishment of transitions between the ground and a building, between one plane and another, or between a plane and an opening. Dietrich uses the stylistic differences of different eras to illustrate his points and by pointing out shifts in the construction of transitional elements over time as a means of understanding and explaining the differences. The effectiveness of his "teaching" is shown in the comments left by readers such as *"Thanks for this article, it gave me a more focused way to look at and think about things I thought I already understood."* (from "Pam") and *"Thanks for the interesting article. I'll never look at my house (or anyone else's for that matter) the same way again."* (from "terryp") (Dietrich 2012).

Other public Ideabooks are geared toward more practical information. For instance, in *"How to Design an Accessible Shower"* by John Whipple, a bathroom renovation contractor, a range of bathroom projects by various designers and contractors exemplify what Whipple considers to be desirable attributes of bathrooms designed for elderly or physically disabled persons (Whipple 2012). Although the numerous comments left by readers are largely complimentary about the quality and usefulness of the information, some of Whipple's recommendations raise debate. With regard to the use of a step in front of deep tubs, some responders present a case for the importance of maintaining a level relationship between the floor and the bottom of the tub for persons with compromised balance or mobility. Other readers questioned the slipperiness of some of the wet room floor designs promoted by Whipple. Technical details about the skid-resistance of specific tile products were even provided by one reader, adding creditability to the contrasting opinion. The tone of the dialogue in both of these examples remained civil and respectful, even when contrasting views were being presented, and such decorum seems to be the norm on the *houzz.com* site, evoking a professional atmosphere.

Conclusions: Lessons Learned

Although each of these sites offers a slightly different model of design education for non-designers, there are some characteristics they share that are worth noting. First, as long as someone has a computer with an Internet connection, web-based resources are broadly accessible and information is immediate. Most design sites and blogs streamline access to imagery and descriptions of spaces and objects to enhance readers' efficiency and enjoyment. Secondly, the content of design-based web sites changes frequently. Because blog authors and editors desire to entice readers back on a very frequent—often daily—basis, they endeavour to post new material weekly, daily, or even hourly. Thirdly, one of the greatest opportunities presented by web-based educational resources is interactivity in the form of providing a platform where designers and persons interested in design can come together. With the prevalence of social networking, most web sites have integrated the ability to initiate dialogues and leave comments about materials posted by others. All of the sites reviewed here provide mechanisms for allowing readers to ask questions about what they see, whether it be requesting the specifics of a paint colour, the source of a particular product, or clarification about some aspect of a depicted or described condition. More than anything else, the interactivity takes the form of an invitation to users to register opinions of what they see, and this is done predominantly in the form of expressing approval if users like what they see/learn. Lastly, because the Internet is truly a world-wide platform for information, these sites have the potential to expose readers to a broad and international range of designs and design applications. The exposure to examples of designed environments from nearly every continent encourages site users to see similarities and differences in the execution of design ideas in a wide range of places, and readers are undoubtedly exposed to possibilities and potentials that they might otherwise not have imagined. At the same time, most readers are probably struck by the similarities seen in interior spaces that share no geographic commonality.

On all of the sites considered here, new designs—both spatial and product-oriented—are featured, and their presence broadly demonstrates what is valued or considered "good design" today. By exposing users to patterns that emerge through their repeated contact with images and other content, the criteria to be used for evaluation are implied and absorbed as a kind of framework for helping users develop the ability to evaluate design quality. Statistics that verify blog and web site readership demonstrate that participation with both frequently becomes habitual, making them all-the-more powerful sources of design information (Steele 2005). By returning again and again, it is easy to imagine that readers can't help but notice the commonalities and differences between projects and products in combination with the copious amounts of reader feedback provided. This process begins to implicitly lay out a case for what *good* design is in the historical tradition of advice literature.

Given the statistics that register the gender of site users, it is tempting to further the association between contemporary web sites and blogs and their largely female readership with historical modes of discussing and teaching about the interior environment that assumed that making improvements to spaces was largely the purview of women. Although there is little evidence of the establishment of a significantly gendered identity for most of the site content analysed, certain female-centric and uncharacteristically negative dialogues did sometimes emerge when specifically male gendered spaces were featured and discussed. For instance, when a line-up of remote controls for electronic gadgets showed up as a design detail in an

Apartment Therapy tour recently, the readers quickly disparaged the gratuitousness of the photography and also the general character of some of the spaces shown. One reader even described the apartment as going from "frat boy chic to man-child cool" (Comment by Cooklyn, 2012).

By presenting all participants with opportunities to inquire about solutions to their own problems, design knowledge is instilled by site contributors who acknowledge and capitalize on this condition. A*partmenttherapy.com* founder Maxwell Gillingham-Ryan noted in the *New York Times* that he views his site as a "form of coaching to help readers to solve problems..." and the focus on linking design professionals with members of the public on *clippings.com* and *houzz.com* furthers the intent to publically solve problems that can also serve as lessons to others who may share similar challenges and circumstances, also a previously established mode of design teaching (Steele 2005).

Although the critical dialogue about design is limited on the sites reviewed here, discussions on *houzz.com* that involved designers and non-designers alike revealed the most substantive exchanges. The value of exchange is verified by Hall and Davison in their research on the use of blogs in educational processes. They demonstrated that giving people access to the ideas of others and opportunities to leave feedback and comments enhanced opportunities to increase their understanding of a subject. By exposing an author's posted content to the challenges of others, such exchanges also become an important aspect of the constructivist learning context—a mode of learning that is rooted in connecting knowledge to first-hand experience (Hall and Davison 2007). Even when simple questions are posed and answered, therefore, the public exchange of information facilitates an educational environment.

Although there are many positive conditions to recommend design-based web sites and blogs as educational tools for non-designers, there are limits to this system as well. First, the nature of the design lessons conveyed in such circumstances is more likely to be implicit than explicit, since it is possible that the majority of the site users "lurk" as passive readers and observers rather than as open participants. The ability of the content to register clearly as educational is most applicable to those who are actively seeking input or information.

Likewise, because the use of the Internet is not consistent on a world-wide basis and less than half of all Internet users are English-speaking (Zahedi and Bansal 2011), the nature of this enterprise as a global means of promoting design education has yet to be assessed as all of the sources considered here are geared toward a North American or UK-centric audience. A much broader multi-lingual study would be required in order to assess whether or not the conclusions drawn here are applicable in other global regions.

Because products and other consumables are so prominently featured on most design-based web sites and blogs, it is tempting to look at them sceptically as thinly veiled commercial enterprises instead of neutral sources. The fact that projects and products are sometimes reviewed helps convey the possibility that the content of such sites extends beyond the purview of commercial promotion (although most sites display sponsors' advertisements prominently and the potential for conflicts of interest does exist when associations between contributors and manufacturers are not made explicit). Still, the web sites and blogs discussed here uphold the position of acting only as conduits to the sales sites of others by providing links rather than becoming point-of-purchase entities themselves in order to maintain the perception that they are disinterested and critical. By maintaining this line, such sites sustain greater credibility as educational resources and community- rather than special-interest-based places.

What is also missing from the ability of design-based sites to cultivate real dialogue and new knowledge about design is increased clarity about what constitutes high quality and conditions to which to aspire. The application of principles of sustainable design practices are explicit on some sites but not all, and in many instances, the designed interiors and products featured are expensive and culturally-specific. If the design lessons of the twenty-first century are to transcend the realm of taste and perceptions of preoccupations with high culture, there is still work to be done. Yet the participatory nature of these sites provides a platform for such shifts to occur. Site users who demand that designers demonstrate the relevance of their work to the benefit of the masses stand to shift the lessons of design in new and perhaps even more significant directions. This may not happen, however, as long as design-based sites continue to celebrate “like”-able projects that photograph well but do not communicate their roles in shaping the social, environmental, and economic fabric of readers’ lives.

This work is a first step toward defining the place of this media in the process of providing design education to non-designers. In future phases of this research, this qualitative “outsider’s” perspective should be verified by establishing the overt intent of web publishers to include or promote design lessons as content on their sites. This should also be balanced with a study of users’ experiences in order to determine whether or not there is a conscious perception of educational efforts on the part of regular site readers/followers and whether, in fact, the lessons are learned. These subsequent studies could also contribute a more holistic understanding of whether or not these lessons are intentional or are the unintended by-products of other purposes. Finally, a study looking at a more international scope of web sites could add valuable comparisons to support assessments of a more broad-based potential for this mode of communication and education.

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Student Goes on a Journey; Stranger Rides Into to the Classroom: Narratives and the Instructor in the Design Studio

Elizabeth BOLING[a], Martin A. SIEGEL[*a], Kennon M. SMITH[a] and Patrick PARRISH[b]

[a] Indiana University
[b] World Meteorological Organization Geneva

Abstract: *Enthusiasm is growing in non-traditional environments for teaching design by adapting knowledge and approaches from studio pedagogy, described as a "signature pedagogy" by Shulman in 2005. Meanwhile, those in fields where some variation of studio pedagogy have been used for decades are engaged in addressing some of its experienced shortcomings. Within this landscape of change, the authors have been engaged in study of their own studio-based courses, (interior design, instructional design, and interaction/experience design), reflecting on how this form of pedagogy is contributing to students' development as designers. In this study we consider the role of the instructor in the studio using a lens informed by narrative aesthetics and transformative education. The narrative that an instructor encourages students to experience with regard to themselves, to the instructor, or to both, has a profound impact in the studio environment. This paper will explore that impact within the context of the authors' own courses via review of course notes and collaborative reflection with colleagues.*

Keywords: studio education for design, transformative education, narrative

[*] Corresponding author: Indiana University | USA | e-mail: msiegel@indiana.edu

Enthusiasm is growing in non-traditional environments for teaching design by adapting knowledge and approaches from studio pedagogy (DiGano, Goldman & Chorost 2009), described as a “signature pedagogy” by Shulman in 2005. While multiple variations of studio pedagogy exist, a recent study of architecture, industrial design and interaction/experience courses using studio approaches (Cennamo, Brandt, Scott, Douglas, McGrath, Reimer & Vernon 2011) begins with a general description of studio based learning, which includes “a space where students are assigned individual desks that are, in most cases, available to them at all times;” classes usually meeting “multiple times a week for three- to four-hour sessions, with students encouraged to work in the studio rather than at home during off-hours;” design problems which students work alone or in small teams to solve; and “formal and informal critiques.” Cennamo et al. point out that instructors do not lecture, but provide “experiences that lead students to new insights in their work.”

Meanwhile, those in fields where some variation of studio pedagogy have been used for decades are engaged in addressing some of its experienced shortcomings. Key concerns include questions about critique, specifically their efficacy, consistency, and transparency (Anthony 1991; Barrett, 2000; Webster 2007; Wilkin 2000), about prioritizing physical characteristics of designs over social and political issues (Salama 1995), and about focusing inward as a cultural norm in the studio versus focusing on the concerns of users clients (Nicholson 2000; Mewburn 2010). Studio models of teaching and learning require a lot of time and space, making them difficult to justify in times when budgets and student-teacher ratios are shrinking—even as competency requirements for design students multiply (Morgado 2009). Tight budgets also make it difficult to maintain faculty expertise required by studio teaching (Salama 1995). Instructors note barriers their students face in learning within the studio approach (Matthews 2010; Siegel & Stolterman, 2008) and students report difficulties navigating the studio environment (Chen 2001; Willenbrock 1991).

Transformative Learning and the Studio

Learning how to design can be transformative for students who think they will find prescriptive processes or, at the other extreme, the freedom to express their artistic visions with little regard for clients and other constraints. In fact, transformation may be necessary just to get novice designers out of their preconceived notions of design (Siegel & Stolterman, 2008). In an attempt to uncover those qualities that contribute to making a learning experience transformative, rather than mundane or merely utilitarian, Parrish, Wilson and Dunlap (2011) have looked to Dewey’s aesthetic and ontological theories of experience (Dewey 1934/1989). They describe the transactional basis of learning experiences in terms of the contributions made by the situation (the designed experience) and by the individuals involved (learners, instructors, and instructional designers). As these qualities are enhanced, the experience has higher potential to move from being unsatisfying to becoming challenging and aesthetic, and even transformative (see Figure 1).

Elements of the studio—open working space, the design brief as a primary assignment, critique—may naturally enhance the immediacy, malleability, and compelling quality of the learning situation. However, design briefs may or may not include “activities that move in concert toward a clear consummation,” and instructors who “bring … personal qualities to the table as they interact with learners” may or may not be intentional with regard to resonances and coherence (Parrish, Wilson & Dunlap, 2011). And no matter whatever else is going on, some of the qualities outlined in this framework may not be fully achievable without some integrating force, one which attention to narrative might supply.

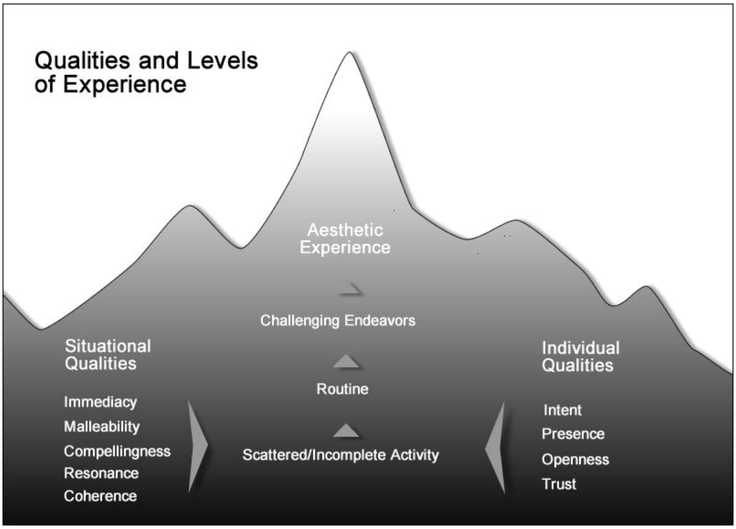

Figure 1. Situational and individual contributors to aesthetic experience. The qualities shown on either side of the diagram interact with each other, working together to promote higher levels of challenge and aesthetic experience, but they are not uniformly present at all times. Therefore the level of challenge and aesthetic experience will fluctuate over time as shown by the fluctuating line.

Narrative structures and the instructor's role in the studio

Despite the unending stream of stories generated in books, films, and theater, fictional narratives manifest themselves in what turns out to be a surprisingly narrow range of prototypical structures (Booker, 2005). Our ability to find this narrow range is likely due to the fundamental role of narrative in helping us make sense of our experiences (Burke 1966; Bruner 1990). For example, Dewey describes the narrative nature of experience as the definitive quality of the "live creature," a narrative stimulated by the impulse to resolve indeterminate situations and given structure by the pattern of inquiry that follows (Dewey 1934/1989; Dewey 1938/1991). Those exploring fictional and religious narratives find something deeper and more poetic. Campbell (1968) examines the prevalence of the hero's journey in our mythic narratives, a pattern in which a person ventures out to perform a heroic deed and is transformed in the process. Writers of fiction recognize these, but also find their own broader and more prescriptive patterns to help stimulate and validate their creations. For example, although the categories vary in name and breadth, writers on fiction often see narratives as falling a half dozen categories, all of which can inform our views of the learning process.

However, some have found it useful to narrow the range even further to the following two archetypical narratives: 1) stranger comes to town (bringing novelty and conflict, and challenging the status quo); and 2) someone goes on a journey (which forces the person to face novelty, conflict, and a challenge to their internal status quo). Because learning, and particularly learning something as challenging as design, can require significant personal change, in this paper we use these final two narrative structures as our starting point for reflections that may lead to further inquiry.

The role of the instructor within studio pedagogy is not to envision or re-design the super-structure of that pedagogy, which is to some extent set and contributes to efficiency on the curriculum level, according to Shulman (2005), but to bring situational and individual qualities together within the individual studio providing what Cenammo et al call "experiences that bring new insight." Mention of instructors runs like a thread through discussions of all the other, tightly integrated features of studio. Researchers also examine the activities of studio instructors directly. Klebesadel and Kornesky (2009) speak in detail about instructors' contributions to critique, and their effect on students and learning in the studio, potentially positive and negative, including the need to negotiate a relationship that includes both support for the student and judgment of that student's work. Lawson and Dorst (2009) discuss the observed role of the instructor (tutor) in the studio, concluding that discussions between tutors and design students "require enormous skill to manage" (p. 256). Aiming to help instructors who may not themselves experience studio based learning, but who have been expected to practice it, Cennamo, et al. (2011) conclude, based on their observations and analysis, that "… experienced studio instructors increased the transparency of the design problems as they modeled their design-thinking; guided students through the heterogeneous, dynamic nature of the design problem through their assignments, sub-assignments, and associated meta-discussions; and helped students learn to evaluate the legitimacy of competing alternatives as through questioning and prompts."

In each case, the instructor is depicted simultaneously as a sensitive instrument serving a role in the overall pedagogical system, and as simply one element (albeit a complex and sensitive one) in what seems almost like a self-running system. Shulman (2005) explains that signature pedagogies are efficient because both instructors and students move from course to course without having to relearn the pattern of these features and practices. In traditional domains of design, the assumption might be made that studio instructors know what to do because they studied in studio themselves—absorbing not only the learning that developed them into designers, but the model of how to be an instructor impressed on them by virtue of its being a vehicle for their development. For the individual instructor in the studio, however, is this view sufficient? Can such complexity and sensitivity be managed on a piecemeal basis—as elements of critique, of problem-setting, of setting and moderating discussions, and so forth? In the attempt to avoid an arbitrary approach to studio pedagogy (Elkins 2001), but to acknowledge that the individual instructor must bring him- or herself fully into the studio—at least as a professional self—in order to play the demanding role required, we see the need to begin examining studio instruction from the instructor's perspective.

Reflections of Studio Instructors

The co-authors of this study have been engaged in separate and collaborative studies of their own studio-based courses (interior design, instructional design, and interaction/experience design), reflecting on how this form of pedagogy is contributing to students' development as designers (Boling & Smith, in press; Siegel & Stolterman, 2008; Smith, in progress). Over several years of weekly conversations specifically focused on our lived experience of teaching in the studio, it has become clear to us that none of us enacts our roles in the studio, or is even capable of doing so, in exactly the same way as the others. We also attribute some critical dimensions of our studios to our individual presence and approach. This makes sense in light of the framework we apply here; our personal qualities are manifest differently in each of us.

In this paper, each of us presents the case of our own studio teaching in reflective form, using our combined discussions with each other, review of course notes and field notes, as well as previous and ongoing research into our own courses. We choose this lens of narrative aesthetics (Parrish, 2005) and transformative education (Parrish, 2011; Parrish, Wilson & Dunlap, 2011) in the shared understanding that design education is intended to transform the student (already possessing the human's natural inclination to design) into an individual prepared to work as a professional designer, and that narrative may help to explain how studio instructors handle the overwhelming complexity of this signature pedagogy.

The Cases

Case 1: Undergraduate Interior Design – Student Goes on a Journey

The studio students with whom I work are on an adventure that lasts multiple years. They may work with me for only one studio, (often in the middle of their journey) and have come to recognize certain patterns, but have quickly learned that individual studio instructors all interact with them differently. In narrative terms, they encounter a series of diverse characters along the path of their journey. For some students this is disorienting, especially early on. By the time they are in upper-division studios, they seem less threatened by the variety between instructors, even appreciating that they are working with professionals who bring different approaches and outlooks to the classroom. The challenge as an instructor is to provide reasonable continuity while not artificially simplifying the natural complexity of design, and the various outlooks we bring to design situations.

In many journey stories, the protagonist is assisted by a mentor to overcome a common foe or to fulfil some difficult quest. One of the challenges in studio is that students sometimes seem to regard me as mentor one moment, and foe the next. In regular work-sessions, most students freely share their work-in-progress, and receive and respond to feedback. I sense that they regard me as a mentor in this setting and view my suggestions and questions as contributions to their progress. However, in some other cases, it seems that there is a fine line, in the student's mind, between assisting and frustrating their progress. If I give radical feedback that they cannot connect to their current position, or that requires work beyond what they are willing or feel capable of doing, the interaction suddenly feels very different—that I am regarded as an obstacle instead of a help. While an instructor might recognize that a real mentor sometimes should stop or re-direct forward progress, the student might interpret such critique as over-reaching, or an attempt on the teacher's part to assume ownership over their project. This dual face of the mentor-companion is a staple of journey stories.

Additionally, I often am playing multiple roles (not simply friend or foe) and must mediate among them when interacting with students. Specifically, I am there to assist the student in overcoming challenges, but also to ensure sufficient challenge to stretch the student beyond current abilities. On top of this, I am ultimately responsible for grading the student's project, which creates a somewhat artificial dynamic and seems to cause significant discomfort to some students.

An example helps illustrate the multi-faceted role I play in the student's journey. If I am working with a student on a residential remodel and I see a space-planning decision I know is inefficient, for which I can imagine a more seamless configuration, do I stop the student and offer the alternative that is informed by my longer years of experience, or do I permit the student to proceed with the strategy they have initiated? From my perspective, one choice may provide practical knowledge in situ that the student did not have before; the other—though uncertain in outcome and potentially time-intensive—may offer the student a chance to experience a deeper connection with her work and my knowledge while she works through the problem than she would have had otherwise.

From the students' perspective, when they show me their preliminary work, they are likely doing so for two inter-twined reasons: first, to get feedback on how they might improve the design, and second, to gauge where their work falls in relation to standards I will be applying when grading. In other words, they are seeking guidance to lead to a successful product (me as a mentor character in their journey), but also to gauge their potential grade (which casts me as one of the monsters they must overcome on their way). This perspective is not present only in the students' minds; as an instructor I could choose to give an A to any project on which I consulted a student, or I could choose to assist students at such a level that all their work would earn a justified grade of A. But my role here is reminiscent of Merlin's in the story of Arthur's education (White 1977)—Merlin transforms Arthur and himself into a variety of animals, some of them placing Arthur in actual jeopardy, in order to develop the qualities he needs to have as a knight.

This dual role can interfere with developing the confidence needed between a successful protagonist and their mentor or advisor, unless the protagonist trusts that ultimately the mentor will not let them struggle for no reason, but because something is to be gained through such a difficult experience—something which cannot be gained in another way. In the studio, this seems to play itself out in very different ways depending on the characteristics of the student with whom I am working. Interactions between us often work best when I have had the opportunity to work with a student long enough to be able to make judgments beyond what I see in a sketchbook. Two students may come to class with little work in hand. To the talented one I may offer comparatively little help so as to not reinforce the idea she can coast through. To the one who is struggling, I would offer more detailed suggestions to help him identify a beginning point for moving forward on his own.

In the end, this narrative illuminates the complexity of interpersonal relationships between student and instructor, the multiple roles the instructor often assumes, and the increased importance of the instructor being able to recognize areas of relative strength and weakness among their students. In other words, I see myself as a character in the story of each student's journey—each of them encounters me, but each is the protagonist of her own story and to each, therefore, I am a different character. The mix of mentor and monster is always present in me, but it varies dynamically as it intersects the narrative of the student.

Case 2: Instructional Graphics Design: Student Goes on a Journey—with a squire

In a studio course on instructional graphics design, created and studied together with the second author of this study, and taught primarily by the first author, in this section referred to as "me," since 2005 (Boling & Smith, 2010), students grapple frequently with the challenges inherent in the briefs that confront them when the course begins. The most challenging of these is "Draw 100 Things." In addition to the challenge of time (eight weeks), many of the students have little or no background in creating images and most have no experience with composition or layout at all. They have variable experience with the tools they will need to use.

In early iterations of the course, my co-designer and I realized that we needed to develop new briefs. We were using exercises similar to those that my collaborator and I remembered from our own studio experiences (see Figure 1). Students were not engaging intensely with these simple exercises, and many of them were perseverating over 1-2 unproductive trial images far too long for them to experience either much practice or much iteration in designing. The "Draw 100 Things" brief which replaced them was not developed rationally, based on some principle of instruction or top-down analysis of the students' needs. It was partially an inspiration that felt like an intuitive gamble at the time, but on reflection was likely the result of two influences. First, we could see that the students seemed to struggle to figure out how the smaller exercises related to each other; second, in a different set of courses I had seen students put in far more than the minimum—or even the expected—effort on projects when they chose topics close to their interests but larger than I would have counselled them to try.

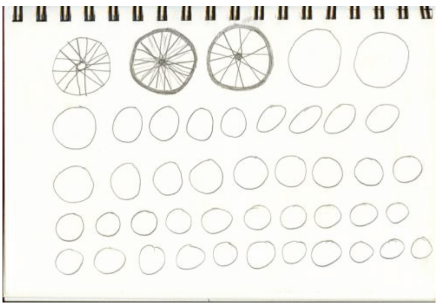

Figure 2. Sketchbook page from 2005 student attempting to complete an exercise focused on appreciation of negative space and selection of simplified shapes for describing forms.

"Draw 100 Things" had been an optional project for a previous iteration of the course, so we had seen that it had something of a fascination for students, but that it was also too daunting for most of them to tackle voluntarily. Reflecting on this project using analogy and a familiar lens for me, gestalt principles of perception, I had speculated that the fascination of the project was partially in the title. It displays "figural goodness," (Easterby 1970), which is a property achieved by visual shapes that display closure, continuity, symmetry, simplicity, and unity. Simply put, the title is self-contained and transparent; when students ask questions about it, it does not change—it displays continuity. It folds all the aspects of the former individual exercises into one activity, which I interpret as closure and unity.

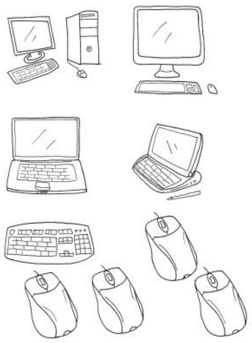

Figure 3. Sketch page from 2009 student preparing for "Draw 100 Things." Note the student has drawn a computer mouse five times and a notebook computer twice. For the students in this course (not majors in graphic design or illustration) this represents a high, and a productive, investment in practice over the example in Figure 2.

However, I did not have a conceptual basis on which to consider its daunting quality. After making this brief required for all students in a calculated gamble to require more, and more intensive, eye-hand practice, I was frankly surprised at how readily the students embraced it, despite their trepidation. The narrative lens helps to explain this. When the brief is introduced in class, my presentation is matter of fact. From what students tell me later in the eight weeks, I may as well have told them that in order to pass the class they each need to slay a dragon. The brief is presented in low key manner, like the start of a fairy tale in which a pleasant kingdom is introduced (the studio), and then, of course—because it is a fairy tale—a seemingly impossible quest has to be undertaken. Each of the students will undertake this quest in a personal way, finding the means to do so individually. This is business as usual in fairy-tale land and, as in such stories, each student rides off from the castle toward an uncertain future, experiencing a unique mixture of anticipation and dread.

In my field notes it is obvious that I am grappling with these students' challenges alongside of them. I talk with them about what they are trying to accomplish and offer suggestions to them, but I am often unsure how these suggestions will turn out—or whether they are the most productive directions for the individual student. This is not because I am unsure of myself as a designer, or as an educator, although I hope I have healthy levels of humility and doubt about both. It's because I see myself as a squire riding alongside each of them. Each of them is the main character in this story. I facilitate the plot twists, provide a little comic relief, and do a lot of the logistics, navigation and scouting required for a successful outcome. And I squire each of them differently depending on how they seem to be framing the quest. For those full of fervor, yet increasingly burdened by the enormity of the responsibility they have taken on, I hope to emulate Sam Gamgee—steadfast and encouraging, keeping an eye out for pitfalls, but refusing to complete the quest for the student who must do so for herself (Tolkien 2007). For another I am Sancho Panza, down-to-earth and even somewhat simple, as I question the scope of a too-ambitious plan, yet follow doggedly along to help see the project through (De Cervantes 2005). The squire role is one in which I am comfortable. I find that I can draw from myself appropriate responses in class while I am inhabiting this role, even though I have little idea what might come up next for each of my students.

Recalling my first year in a BFA program, I was handed a brief reading, "Plan and complete a drawing on which you spend a minimum of 30 hours actually drawing." This appeared to me at the time as a Herculean labor (Burkert 1985), punishing, arbitrary and likely impossible. I realize that the story of this experience was much the same for me as "Draw 100 Things" is for the students in our class. The difference is that the instructor in my BFA course played a very different role to that of my fairy tale squire. He played King Eurystheus, setting incredibly difficult tasks for me and disallowing any outside assistance with my work, including his own. This narrative worked for me, as did other, very different, ones played out in other studios where I studied, and it was a transformative experience. But as a studio instructor myself, I cannot play the role of the king. I believe that I would look and feel a little ridiculous doing so. My own notes also reveal to me that I want to go along on the journey, and I know that I do not have what it takes to resist giving advice when someone asks me for it.

Case 3: Interaction design: Stranger Rides into the Classroom

In one form or another since 1984, I have been teaching a graduate course in human-computer interaction design. Its latest variation is called "Interaction Design Practice" (IDP). It is the first master's course for students in the HCI Design program at Indiana University. The course requires students to understand design from multiple perspectives and to complete a series of difficult and comprehensive real-world problems within a team-based context. The curriculum is not for the "faint of heart," and to complete it requires dedication and skill. The students come from diverse backgrounds—computer science, engineering, informatics, psychology, journalism, education, and graphic design. The characteristic they share is that they are naïve designers shaped by their undergraduate training. Consequently their early perspectives require transformation; for example, the students believe incorrectly that there is a "best solution" to design problems, they adopt a technology-centered versus human-centered view of design, they worry more about grades than valuing critiques, and they tend to hold onto a single design concept versus systematic exploration of multiple concepts (Siegel & Stolterman, 2008). To challenge these barriers, I introduce a new kind of classroom environment whereby the well-practiced academic routines of past courses—traditional research methods, memorization of facts, writing of papers, use of algorithms to find "the answer"—no longer yield the kind of instructor approval and high grades of their former selves; these students encounter a new kind of rigor that includes systems thinking, critique, and reflection. To signal this "new game," I enter the classroom as someone who does not appear to follow the normal rules, a kind of "stranger who rides into the classroom." Everything I do, including the stories I tell, signals a topsy-turvy world where old assumptions get questioned and new behaviours must be learned.

The transformation begins informally during graduate student orientation, one week prior to the first day of classes. Second year students begin to tell the first year students, "the newbies," how IDP unfolds: "It may be one of the most difficult classes you take, but it's very much worth the effort." They refer to the course as a boot camp experience. "Each person in the cohort will know everything about you before the semester is over," they explain. "There are no secrets here." The new students meet me during orientation and I provide a brief overview of the course—not your typical syllabus of readings and papers: "It's a journey, an act of surrender." Making reference to an Edward Monkton cartoon titled "Zen Dog," I refer to him as our mascot.

(“Surrender? A mascot?”) The cartoon shows a picture of a beagle with eye patch, reclining in a row boat, floating in a large body of water. The caption reads: “He knows not where he’s going / For the ocean will decide – / It’s not the DESTINATION… / …It’s the glory of THE RIDE.” I tell the students that at times the journey will not be easy, but if you jump into Zen Dog’s boat you will survive. One proud student proclaims, “I’m not afraid,” and I respond, evoking the voice of the Star Wars character Yoda, “Oh you will be!” The students laugh nervously. Their transformation commences; the puzzle unfolds.

The first day of class begins with the lights turned down low. I stand before the students and play the Tingsha Tibetan cymbals, one sustained sound that resonates for nearly a minute. Then a short video begins, filling the nine screens encompassing the studio space. The images begin with the outer reaches of space, zooming into and circulating above planet Earth. The students see aerial images of their own country; if you look closely you can see the Great Wall of China. We come to the United States and zoom into Bloomington, Indiana. There we begin to see pieces of technology, from slide rulers, large scientific computers, to modern laptops, Kindles, iPads, iPhones and Apps; iconic names like Apple, Microsoft, Google, Facebook, and Twitter appear on the screen. All the while an exotic Indian tune plays in the background (exotic, that is to most of the students, and surprising to the few Indian students in the class)—haunting, distant, and yet inviting. Finally, the students read these words from Hesiod: *Before the gates of excellence the high gods have placed sweat; long is the road thereto and rough and steep at first; but when the heights are reached, then there is ease, though grievously hard in the winning.* Then the final words appear to the fading music: “Welcome to Interaction Design Practice—a human-centered view!”

The students are uncertain about what will happen next. The lights turn up; I reach for a cold can of Coke. I pop the lid. Psssh! “Did you hear that?” Listen to it again. I pick up another can. Psssh! “That sound was not made by accident. It was *designed*.” The class continues with the design of other everyday objects. I open a Kleenex box. No matter how fast I pull tissues from the box, the next one pops up automatically. I ask some students to try it. “Someone, or more likely, some group of people designed this tissue box so it performs as we observe.” We end the class with the syllabus and the unveiling of their first of five design problems.

The sound of cymbals, the video, the exotic music, the popping of Coke can lids, and the display of other objects entertain and instruct. More importantly, however, they signal a different kind of course. “This one will be different from the others,” they think. And it is. In this course experience there are no right and wrong answers, and grades matter less; in its place I continue to act as “stranger,” showing and telling in non-traditional ways, challenging their norm and slowly establishing a new one.

There are many occasions throughout the course where my “stranger rides into the classroom” narrative challenges their traditional “ways of knowing.” An early example involves team process. I illustrate the challenges of working in groups through the introduction of the Tomy Big Loader—a Rube Goldberg-type toy with many parts. I dump the pieces in the middle of the floor and invite a team of five students to assemble the train and its associated parts. The “team” begins by grabbing pieces and trying to attach one to another. No one talks to the others and each person works independently for the first few minutes. The other students observe the team and take notes. After several minutes with little progress, I remove one of the team members and invite another in his place. Still, there is no success in assembling the Big Loader. I stop the frustrated students and ask them to describe what happened. Every aspect of dysfunctional teams manifests in this little experiment: absence of trust, fear of conflict, lack of commitment, avoidance of accountability, and inattention to results (Lencioni 2002). Moreover, the students forgot to ask the most important question: “Does anyone have the directions?” I smile, remove them from my pocket, and hold them up for all to see. It is a big revelation to the students; when you don’t ask questions, especially the most obvious among them, you miss important information that will retard your success as a designer.

My talks in the studio continue the “stranger rides into the classroom” narrative. One example focuses on a design analogy—thinking like a Zen raku potter. I begin the session by describing the history of raku pottery, a Japanese technique used since the 16th century. The process includes a thermic shock causing small cracks that become black from the smoke. Novice raku potters require many trials before they succeed in creating their first satisfying pot; to the new potter, the pot is precious. But the Zen master reminds the apprentice that the design is not the pot; the design is within the potter. The Zen master emphasizes this message by taking the novice’s pot and throwing it to the ground, turning the once intact pot into many ceramic shards. When I tell this story, I meticulously show the students a beautifully designed raku pot. And then SMASH! The pot is a manifestation of the potter’s design; it is not the design. I then ask teams to shred their design sketches for their current project as they look into their “design abyss” and wonder if they can reclaim their true design. One student commented:

> I’m still remembering when Marty broke the pot in class on Monday. I definitely didn’t expect that. It took him about eight minutes to unpack the thing; he took it out so very carefully, mentioning that he valued it greatly. He was carefully holding the object as he walked around the room showing everyone. We were all like “ooo, ahhh, wooow, it's really nice.” Then, just as I was starting to drift in and out of attention, BAM! It was shattered in the center of the room… it TOTALLY threw me off. I almost thought it was accidental, like he was going to just “fake” throw it. I immediately was like “oh shit” in my head. I zoned in on Marty’s face, waiting for what he would say next… And I saw this calm look; I heard with 100% clarity his explanation and his analogy… I was able to pick up a piece of the pot before class was over. I now keep that piece in my pencil pouch so that every time I take out a pencil, I will see that piece to remind me that nothing is permanent – that my sketches and ideas should never have a permanent attachment to my mind. I will be reminded that I can start over and that I can take a piece of all or some of my ideas to create something new, something that can be better than anything previously…for the real design is within me.

Discussion

As educator/scholars, all four of us are familiar with the rational-systemic design philosophy, dominant in instructional design, and centered on problems carefully sequenced from simple to complex with activities thoughtfully chosen to provide practice in a well-defined set of skills (Merrill, 2002; van Merrienboer, Clark & de Crook, 2002). We are aware that experiencing this instruction can, in practice, feel routine and require additional strategies to be applied in order to engender or to improve motivation to learn. Our reflection on our own studio teaching suggests that we are not just replacing such rationalized systems of instruction with studio pedagogy, but enacting narratives, broadly defined, whether we set out to do so consciously or not.

Viewed through the framework provided by Parrish, Wilson and Brent (2010) we can see that the time, space and activity of the studio, seemingly chaotic to an observer or a novice, can be drawn together *through the narrative* as a form with compelling emotional quality and resonance.

The rational, systematic view of course design suggests that the potential for success in the design lies in the structure and strategies of the design, further implying that the ideal design may be enacted successfully without regard to the instructor. This view clearly stems from a different design philosophy than the aesthetic transformational view. While recognizing that even the most tightly controlled course designs are not likely to be enacted the same way twice, we see studio teaching as a loose structure within which the role of the instructor – enacted, not prescribed—is instrumental. Not every instructor is well matched to every role, which means that two studios covering the same material and taught by instructors of different temperaments will not be integrated successfully by the same underlying narrative.

Narratives played out in the studio do not have to be overtly stated or recognized, and may not be fully conscious on the part of the instructor or the students. In none of the situations we have described did one of us set out purposefully to script a narrative for ourselves. It is not clear that our courses would be improved simply by virtue of our having done so, and it seems intuitively likely that imposing an overt narrative on a course would reduce the compelling and immediate qualities required for highly aesthetic experiences—particularly if that narrative did not emerge uniquely from individual instructors. This having been said, developing the narrative impulse in studio instructors may well help to develop a deeper awareness of the roles we are playing in the studio and how we interact with situational and individual qualities that enhance the aesthetic, and hence the transformational, quality of design education.

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Designing a creativity training plan for companies

Marita CANINA*, Elisabetta COCCIONI, Laura ANSELMI and Stefania PALMIERI
Politecnico di Milano

Abstract: *It is widely recognized that training in creative techniques enhances competitiveness and efficiency of the company production process. Relying on the idea that creativity is the basis for innovation, to learn and manage creativity techniques becomes strategic to meet a company's need for innovation. Hollanders and van Cruysen's system of indicators (2009), based on the European Innovation Scoreboard (EIS), is aimed at quantifying creativity and design, and the role of professional training is key for a company's success on the market. This paper presents a methodology for drafting a training plan for companies. The methodology counts on two approaches similar in structure but different in outcome, both able to meet a company's specific needs. The first approach considers innovation enhancement based on a company's ability to be creative (IDEActivity). This approach relies on co-design and it aims at teaching how to shape creativity tools in an independent way. The second approach is centred on CPS (Creative Problem Solving) aims at enabling people to work creatively both individually and in teams. It aims at training the employees' ability to generate innovative solutions. The methodology presented in the paper aims at: enhancing creative collaboration; teaching techniques tools; coaching companies using hands-on workshops in order to promote the use of methodologies and techniques for innovation.*

Keywords: Creativity, methodology, creativity tools, innovation

* Corresponding author: | Politecnico di Milano | Italy | e-mail: marita.canina@polimi.it

Why it is important to learn how to be creative

The future of the economy and society is becoming more and more influenced by creativity and by the ability to produce ideas, knowledge and innovations. This ability has always been important, but in the last twenty years has literally exploded.

Creativity, other than contributing to self-fulfilment, is one of the primary sources of innovation, which is recognized as one of the main driving forces underneath sustainable economic development (Bessant, Whyte and Neely, 2005). This driving force is fundamental to the creation of companies able to enhance Europe's competitive edge on an international level. People with their intelligence, knowledge and ability of being creative are the centre of attention of this innovation system. The need of a new entrepreneurial culture capable of stimulating, encouraging and fostering the possibility of development of individual and group abilities emerges as an inspiration for new innovating strategies (Amabile, 1998).

When we talk about innovation in the industrial field, we mean a change that is not only generating improvements, cost optimization, turnover, and better performances, but is also developing competitiveness. Every change is in itself an innovation. In a company, changes become innovation (technological, strategic, of the product, manufacturing, cultural and so on…) when market competition increases.

Craft (2005) sees innovation as the "implementation of new ideas to create something of value, proven through its uptake in marketplace. An innovation can be seen as a new idea being launched on the market for the first time". However, innovation without creative ideas does not exist. On the contrary, creativity is at the basis of innovation (West, 2002). They are complementary, and we can say that creativity is not only the source of innovative process, not just an input for innovation, but it is the environment where the innovative process can easily develop (Shani and Divyapriya, 2011). Creativity is the context, and the reference frame where innovation can develop in a sort of humus and rich soil in order to be fostered and spread (Swann and Birke, 2005).

The spectrum of what we can achieve with creativity is broad. Creativity can simply renew the products or achieve much more relevant results, such as the creation of new product lines and/or the creation of new companies.

It is generally accepted that creativity in a business strategy becomes the means to face the complexity and dynamics of the economic context, and to beat the competition.

If we face a problem using a rational approach we achieve correct results, but traditional logic models always limit these results. When we require a different and innovating solution we have to change the reasoning scheme and see things in a different perspective. We have to abandon vertical thinking, the one based on logic deduction, to embrace the creativity of lateral thinking (De Bono, 1990).

In relation to the above, everyone can be creative, so creativity can be studied and developed using tested techniques and experiments to stimulate creative abilities.

In general, a creative environment in a company is fundamental to build a new relationship among creativity, design and innovation in order to satisfy the need of competitiveness and innovation in a new way. Creativity is actually in a direct relationship with design and design is in a direct relationship with innovation.

Co-design activities together with a *learning by doing* approach are used to tailor a training plan able to both adapt to the specific company's needs and to increase the awareness and the ability to use methodologies and techniques for innovation inside the company.

Companies among creativity, design and innovation

Creativity and design are elusive and overlapping concepts. This in part explains why their treatment in analysis and policy is less developed than that of more tangible issues, like capital investment. Although creativity is recognised as vital to business success it is the more science and technology based channels of creative input, such as R&D. “Design is what links creativity and innovation. It shapes ideas to become practical and attractive propositions for users or customers. Design may be described as creativity deployed to a specific end”. (Bitard and Basset, 2008)

Creativity means: the ability to create new ideas and it is preliminary to the act of innovating. Creativity (mental phenomenon) always anticipates innovation (economic, social and cultural phenomenon) generating ideas that once communicated shared and adopted by the community, develops innovation.

Creativity and innovation are related to the process of creation and application of new knowledge, and have a real impact on the ways of doing business. “Creativity and innovation are considered to be overlapping constructs between two stages of the creative process; both are necessary for successful enterprise” (Martins & Terblanche, 2003).

The word “creativity” is often confused with the word “innovation” and vice-versa, but there are basic differences between the two terms.

Creativity might be defined according to Amabile as “the production of novel and useful ideas (Amabile, 1996) while innovation might be defined as its implementation phase, the transformation of a new idea into a new product or service, or an improvement in organization or process” (Heye, 2006).

Gurteen (1998) defines creativity as “the generation of ideas” and innovation as the transformation of the ideas into action through a selection, an improvement and an implementation. Vicari and Trolio (2000) have the same idea and affirm that creativity is the input while innovation the output and analyses the influence of creativity in management. The management, through a conscious leadership, needs to understand and direct the different and numerous contributions coming from the employees. Both in managerial and more operational activities it is important to detect people’s preferences and potential in order to enhance their proactive role in the company.

As a consequence, the decision making process, usually the responsibility of the managers, might be carried out with different forms of collaboration with the employees. In order to innovate, relying on their own internal potential and abilities, companies need to understand the value of this kind of participative managerial approach. This approach needs to be one of the firm objectives, wanted and supported by the management, together with the strategic objectives of enhancement and implementation of employees’ potential creativity. Innovation built on people’s knowledge and abilities might be much more relevant than technological innovation or product innovation.

Most of the techniques used today as creativity support are mainly based on the concepts of knowledge, knowledge sharing and knowledge management. The objectives of the techniques and tools used aim at promoting and generating creativity, thinking outside the box, stimulating imaginations and improving the conditions where creative idea is produced. It is necessary to work on the entrepreneurial culture on its whole, making the effort to provide new approaches and tools for the enhancement of in-house creativity and creative problem solving.

In order to generate innovation or innovative solutions becomes crucial to well define the problem and to clarify the main objectives/aims before proceeding to the generation of the possible solutions. Creativity or creative problem solving don't necessarily need to be used for any kind of problem/decision. For programmed decisions, which are iterative and well defined, there are consolidated procedures in every firm, while for non-programmed decisions there are not systemized criteria or standards. It is on this last kind of situation that managers need to focus due to the quick shifts of the market. This circumstance induces to reconsider the rational perspective, which is typical of the sequential or linear reasoning, to undertake the decisions in a more flexible and not pre-defined way.

Intuition, creativity and experience end up being the main elements that allow us to identify the problems and the search for solutions. The collaborating dimension leads to the development of the value of the "human asset" on the condition of giving its contribution to entrepreneurial growth, accepting the fact that an innovation might not necessarily come from high management.

In this sense, new techniques to stimulate creativity can be used in every area of the firm: strategic planning, business strategy, product development, services optimization, functional strategy, finance, human resources, marketing, information managements, quality management.

Objectives of the educational process

In order for companies to remain competitive and to further broaden their markets they need to understand the role of creativity and learn how to manage their own. It becomes strategically important for them to identify and foster conditions in able to create a work environment where creativity thrives and is enhanced as a long lasting process, rather then a quick way to address immediate issues. Innovation in an organization is significantly influenced by components characterizing its employees, the creativity-relevant skills and processes and the intrinsic motivation and by the environment in which the employees work (Amabile 2012). These creativity-relevant skills can be developed, sustained, and enhanced through formal and informal mechanisms such as training and education (Amabile 1988).

An important dimension of creativity relates to the relevance given to knowledge, knowledge sharing and knowledge management. Knowledge might be individual or shared at group or organizational levels and have implications within the whole creative process. It becomes an important factor for the transformation of ideas into value and is to be considered in the context of creativity for innovation. Creativity can be learned and developed using tested techniques to help people to get out of their usual analysis patterns, facilitating the consideration of wide scope alternatives to improve productivity and quality of work. Nussbaum shows that creativity is learned behaviour that gets better with training, like sports. People can make creativity routine and a regular part of their lives. "That's true for big companies as well as small startups, corporate managers as well as entrepreneurs. Creativity is scalable". (Nussbaum, 2013)

The foundations of the research are focused on the creative process while the applied research is developed on two different methods (Creative Problem Solving – CPS and IDEActivity) and is focused on how environments and personal attitudes might be able to foster or inhibit creativity in a work context. According to Amabile's latest theories on creativity, we are working on the four necessary components enabling creative responses: three components within the individual (domain-relevant skills, creativity-relevant processes and intrinsic task motivation) and one component outside the individual (the social environment in which the individual is working).

Considering the above, the aim is to create a methodology built on two different creative approaches. One is more structured based on both personal attitudes (using the Foursight approach) and divergent and convergent thinking (CPS – Creative Problem Solving) and one is more hands-on (IDEActivity).

The principal objectives of the methods used are different and can be summed up as follows:

- raising companies awareness of the importance of enhancing creative work environments as a basis for innovation;
- understanding, managing and developing tools able to foster creativity and support the process of idea generation;
- testing and validating the methodology proposed with theoretical and practical sessions assisting each phase of the whole creative process;
- defining new professional training procedures, contents or methods.
- structure and encourage the creation of "creative labs" to be set up as collaborative/conceptual spaces able to support the generation of ideas and be catalyst of otherwise unexpressed thoughts.

This last objective aims at stimulating an "ongoing creative attitude" of all the employees through the creation of a collaborative environment for innovation. The space then becomes a tool.

The structure of the educational process on creativity, which is organized into actions, is flexible and adaptable to the needs of each individual firm where it may be implemented; macro and micro objectives are nevertheless left unchanged.

What our research group is trying to do is to strengthen the firms' creative behaviour/creative thinking with its educational plan. This means allowing a "way of thinking" to settle in individuals as a consolidated behaviour and to facilitate creative thinking in groups. Main points in the training remain such micro-objective as:

- *inhibiting factors for creative thinking:* recognize, face and overcome creativity blocks;
- *identification of potential:* development areas of creativity at individual level and within the organization (fluidity, flexibility, originality and production);
- *exercise techniques that favour creative thinking and therefore behaviour:* techniques for the development of creative tactics and strategies (with Tactic Creativity we refer to original and relevant answers to medium difficulty problems, with Strategic Creativity we refer to the process of advanced creative research when facing high difficulty problems).

It is possible to appreciate the methodology proposed as a complete path to structure a training course for companies. The structure of the methodology highlights what are known as the 4Ps (Person, Processes, Products and Press) in Rhodes model (2012). The 4Ps are identified in the characteristics of Persons creative nature, the Processes they might use, the Products (or outcome) resulting from their efforts, and the Press (or environment) that fosters or inhibits their creativity.

The aim of our methodology is to engage the participants in being active in the creation of knowledge and knowledge sharing, and to make them shift from being consumers of creativity to being generative creativity protagonists. "To encourage creativity, we need to let them experience the creativity process in which possibilities are made in reality" (Atkinson 2011).

Creativity as an educational process

The path to a company's innovation development is connected to the improvement of their production processes through training/intervention Actions (see page 5) aimed at the acquisition and employment of competences of creative problem solving and creativity. The training plan is structured on the base of an innovation program developed by the Politecnico di Milano, starting from needs and requirements expressed by the companies. Methods, instruments and techniques highlighted in the plan are capable of generating innovation, and they can be implemented in every step of the production process as well as in the final product. More specifically, they can be implemented in the production and manufacturing of the product by analysing the impact of every phase of the process. Furthermore they can be used in the idea generation, design and development phases of a new product as a support to both technical and organizational requirements. From the analysis of the firms' needs we can deduce that it is necessary to abandon fixed processes, to stimulate imagination, and regardless of the method to improve the conditions under which an idea is produced. We decided to adopt a process that could be easily implemented in different environments. The aim is to contribute to the development of creativity and innovation abilities of a firm, through a pragmatic approach able to demonstrate how every step of the process can be reshaped according to the context. In particular, the training plan deals with two complementary macro areas:

- the first deals with the innovation development process through the firms' ability to be creative. It relies on co-design experiences designed to enhance creative awareness and abilities, using methods and techniques aimed at creating a competitive advantage via creativity (**IDEActivity**);

- the second is centred on a method, Creative Problem Solving (CPS), aimed at strengthening the ability to find innovative solution to problems and enabling both individual and teams to be creative in an effective way.

The planned innovation process will be implemented via a dual methodological approach:

- a first approach aims at detecting the training needs of the firms. It is set in a sharing environment where everyone is free to express his opinions. In particular, will be carried out activities to acquire competences and abilities in creativity and creative problem solving;

- a second approach aims at tailoring the interventions to the specific needs of each firm through a direct link to their real daily activities (firm mode). In particular, direct interventions will be carried out in relation to firms' real problems and activities using a learning by doing approach.

The training plan is composed of 4 Actions:

Action 1. Lecture: general introduction of the method and presentation of the training plan.

Action 2. Audit finalized to the mapping of expectations, guidelines, critical points, needs by individual and organization as a whole.

Action 3. Detailed outline of the program for the development of innovation in terms of specific areas of intervention, objectives and expected results.

Action 4. General training on methods, models and techniques for creativity, based on collaboration and the use of Creative Problem Solving, IDEActivity and Gamestorming: Leadership and Creative Team Building; Advanced Techniques; Definition and implementation of techniques on specific products as required by objectives and work team involved.

Each Action has a specific objective while contributing to the general structure of this new and effective training tool. In this paper we will not describe each training action in detail, but we will focus on describing the structure as a whole and the relationships between the Actions.

During the preparation phase of the training plan we conducted a demand analysis with the intention to identify the training needs of local firms. The analysis was used to tailor the programs and design in detail every training intervention.

Method and instruments of the training plan

The lecture mentioned in Action 1 is aimed at describing the fundamental methods that will be used, their goals and underlying logic. The goal of this first Action is to clarify the concept of creativity in association to innovation and underlining the value of creativity tools in a business-oriented environment.

The phases will follow this order:

Preliminary definition of creativity at individual and organizational level; description of relationships between creativity and innovation; definition of creativity as an evolutionary process; description of creativity's typical dichotomies; introduction to the main techniques that will be used during the different phases of the training plan.

We then precede in Action 2 to register in detail the needs of the firms in order to create a training program as specific as possible. The needs assessment will be carried out during the Audit using different data acquisition techniques. This will include the participation of the firms' employees and will see individual, teams and collective activities.

From the available studies it is clear that a unique model to evaluate/measure a firm's creativity does not exist. Since every firm has its own defining characteristics, it is necessary to evaluate creativity in different ways according to the type of organization. Our methodology uses different techniques, in some the participants are actively involved and others are based on observation of individual and/or group dynamics.

The goal of Action 2 is to gather information on the competence, interest and use of creativity on individual, group and whole firm levels, considering as well previous competencies, needs, desires and requirements of the participants both individually and as part of the firm. Theory, and some empirical evidence, suggest that when people experience positive interaction, lower levels of stress, and feel valued, they are more likely to engage in creative behaviours, generate creative ideas, and solve problems creatively (Fredrickson, 2001; Cohen-Meiter, Carmeli & Waldman, 2009). When employees feel a deeper sense of engagement and experience a climate conducive to creativity, numerous business benefits result, including higher levels of innovation (Harter, Schmidt & Keyes, 2002; Vincent, Bharadwaj & Challagalla, 2004).

The needs assessment will be carried out through surveys, mind maps, word-storming and focus groups in order to map data and information about the current level of competences and opinions of the employees in terms of creativity and innovation applied to product development processes.

The starting idea is to answer the following questions though non-directive techniques to obtain qualitative data:

What do they know? What do they expect? What would they like to know? What do they fear, what do they not want?

The goals of creativity evaluation through different techniques are:

- analyse creativity and innovation within the firms;
- understand the crucial role of the key factors that impact individual and group creativity;
- find parameters and scales to quantify and measure the level of creativity in the firms;
- study the data do identify the main critical areas;
- submit the training plan to improve work creativity.

Several research programmes concerning the creative climate have used questionnaires with rating scales for valuing companies' members' perceptions of climate conditions. Often, the company internal climate has been considered 'objectivistic' (Ekvall, 1987), an intrinsic reality of the company where recurrent patterns of behaviour, attitudes and feelings are what characterize its life. The rating scales aggregation of values, usually mean scores of the climate dimensions identified, allow for the measurement of climate (Isaksen and Ekvall, 2010).

In Action 2 datas are collected in two different ways:

- a first "emotional" way, with a dominant graphic component that creates an expressing mood in order to represent a photo that emerges directly from the participants through Give&Take maps, word-storming and mind maps;
- a second "critique" way: it is developed from key words/areas emerged from the data, the surveys, the focus groups (such as space, time, techniques&instruments, daily activities and so on) and from the assessment activities.

The maps allow collecting information on the concepts of creative thinking and creativity in relationship with innovation, taking into consideration perceptions from individuals, groups and the whole firm.

Give&Take in particular allows gathering individual and group information while highlighting how the preferences and specific abilities of each person might contribute to the group, the class and the firm. The process of what emerges from this instrument leads to the creation of a "flower map" in which no petal/topic has a priority over the others. The analysis of what spontaneously emerged from the participants is followed then by a categorization of the terms through a convergence phase carried out by the research team.

Previous experience shows it was possible to determine that the words expressed on impulse by the participants can be easily tracked to creativites fundamental parameters: breaking of consolidated schemes, improved creativity, apply creativity on the job and so on. The "flower map" created from the parameters emerged from the activity Give&Take is then used as a layout for the processing of the focus map.

Word-storming is an instrument characterized by a series of evoking moments on creativity. It is based on the human mind capacity of associating concepts and information in non-linear patterns. Through an immediate and fast diverging phase it is possible to overcome an initial judgmental phase and dive into the perception of creativity. Suspension of judgment leads to completely new and unexpected connections. Word-storming is also a perfect instrument to introduce the idea that creativity is the union of two important moments, divergence and convergence.

The idea that “divergence alone is not creativity” is highlighted again in the return phase when the words are displayed graphically in order to underline the importance of the divergence phase (many new concepts) in relation with its elaboration and consequential convergence phase. The convergence phase is consolidated with a group activity, leading to the production of a poster representing the meaning of creativity.

After this, during the Audit, we proceed using two interconnected instruments: the Focus Group and the Mind Maps. During the Focus Group people are invited to speak, discuss and confront, expressing their opinions freely on a specific topic emerged previously during the earlier maps.

The Focus Group is visualized in a branched mind map where the main idea, CREATIVITY, is represented in the centre and connected to its related concepts via hierarchical branches. The ideas documented in the map are divided using different colours for the main branches (Firm, Innovation, Context and Environment, etc.). The principal braches have darker colours while the smaller branches have progressively lighter colours. The use of colour provides a new dimension of the information and helps the brain interpret the data in a more efficient way.

Then a new map is made through the overlapping of the areas of interest on which the training will be focused. Such a map is created on the basis of the “petals” from the Give&Take, redistributed in a way to make them overlap the main branches of the Focus Map, allowing for a cross processing of the emerged information in order to better define the training program.

Figure 1. “Flower map” and graphic representation of its overlapping with the main branches of the Focus Map.

The instrument that allows for the collection of quantitative data is the survey, structured in four sections respectively dealing with:

- what creativity and innovation mean for the firm's employees;

- how the firm encourages creativity and innovation from the internal employees point of view;

- how the firm has structured the development process of new products/services from the internal employees point of view;

- which tools for the approach to creativity do the employees know and/or use.

From the information and data emerged from the surveys we proceed to focus the employees' view on the covered topics with the goal of verifying their perception in terms of feasibility, moments/spaces for internal discussion for development and cross diffusion of innovation.

The final assessment allows continuing the direct observation of the group during the activity. We proceed with grids of different dimensions (Environment/Behaviour/Sharing) and observe what the participants do, how they organize themselves, how they deal with the problem and how they react to the solutions proposed by other participants.

From the analysis of the data and their cross reprocessing we proceed to returning the information in the form of a detailed definition of the training program.

We then move on to Action 3: defining the training program in specific intervention areas, case studies, goals and results and timeframe.

Individual training interventions are the answer to the needs and the desires previously emerged and that need to be trained. The interventions are designed to define the educational objectives and considering the participants' characteristics and their role within the firm. The training plan is then fully defined by articulating each activity in terms of educational objectives, contents, receivers, duration, training methods and abilities to achieve. The processing of all the data collected in Action 2, in relation to the specific needs of each firm, allows the generation of the program for the development of the innovative project taking to the definition of the "Creative Lab" model.

Approaching Action 4 the program is aimed at the implementation of the model indicated as "Creative Lab", which is a working environment enabling the participants to express their creativity. The main topics that compose the core of the program are:

IDEActivity and Gamestorming, entry-level Creative Problem solving + expo events; IDEActivity/CPS with instrument development; IDEActivity/CPS with introduction to the project "adaptive and dynamic environment"; Creative Leadership and Team Building; Advanced techniques and creative sessions.

In this paragraph we will focus only on the two methods IDEActivity and CPS. The intent is to validate the structure that enables the firms to learn and experiment with techniques to seize the real potential of the methods introduced and applying them directly on real issues that are relevant to them.

The two methods are basically similar in the approach to problems and allow creative processes to develop. They are aimed at different applications: IDEActivity is more oriented towards innovation and product development while CPS is more suitable for strategic planning, optimization of services and process management.

The integrated method IDEActivity is designed to be a fluid and flexible instrument that adapts to the needs of companies with different objectives and structures. With an integrated method we can create a structure that brings together different known techniques. Such method has a core part of "play", intended as the ability to accept challenges, to cooperate, to become a team and to look at things from a different perspective with the help of others.

Given the large number of available techniques, they are grouped according to the main phases of the idea generation process: definition of the problem, generation, selection and implementation of the idea, evaluation.

Some of the techniques described in this paper, should only be expanded in order to give examples. The program of the creative session must be structured considering specific objectives, available resources, budget and many other factors that the team has to manage during the ideation phase.

IDEActivity counts on 3 macro-steps:

1. Fact finding and Set up

Objectives, brief analysis and definition of teams

Selection of approach

Definition of groups for creative sessions

2. Creative sessions

Preparation of creative session and design of instruments

Idea generation session

3. Selection and validation of ideas

Analysis and ranking of generated ideas

Selection of ideas to develop

Fact finding and Set up

The goal of this step is to *set up* the entire process. It is necessary to provide all the methods needed to define a work environment that will allow the participants to express their creativity, to create "creative groups", to support the people that will act as catalysts of creativity and facilitators of the creativity process to emerge.

A first fundamental step consists of a preliminary research of: context analysis, historic references, benchmarks, state of the art innovative materials and technology, as well as all other aspects connected to the analysis: receivers, conditions of use, possible competition in order to define the objectives and/or a briefing.

Creative Sessions

This step is focused on the actual production of the tools to be used as incentives during the creative sessions.

To develop these sessions IDEActivity uses a different combination of methods of knowledge-elicitation-tools such as mind map; card sorting; brainstorming; storyboard.

According to the objective and to the firm's reality we can choose not only the different techniques but, also the kind of incentives or the sceneries to be used during the sessions. These are chosen in relation with the observations and analysis based on the information collected in the previous Actions.

The preparation of the creative session starts from a graphical elaboration of the problem together with the definition of the objectives to be explored during the activity.

The participants are introduced to tools used by designers to translate concepts into diagrams or storyboards: the main idea would be placed in the centre of the diagram while the other information and in-depth details would be connected on the sides.

After finalizing the formalization of the objectives and after visualizing the problems and/or the requirements follows the introduction of IDEActivity. The production of the IDEActivity Cards is central for managing the phase of ideas generation during the brainstorming. In this context game is surely an important component for involving people, breaking preset mental patterns and trigger new reactions and new thinking connections. The Cards become an important and flexible tool able to support information gathering, user involvement and lateral approach to problems. The Cards can be produced each time according to specific aims/objectives.

They are divided in 4 categories:

1. Ask: recruit people to have information useful for the project;
2. Look: observe people to understand what they really do instead of believing what they say they do;
3. Learn: analyze collected information to identify models and possible intuitions;
4. Try: simulate activities to try and identify with people and evaluate suggestions or possible design directions.

IDEActivity requires the realization of at least one card for each category and a few more for Try. More relevance is given to the Card Try because particularly effective in facilitating a shift of prospective and enabling a wider vision of specific issues.

It is necessary to have all material ready before the beginning of the brainstorming session. The aim is to use the Cards together with materials for prototyping in order to enable the participants to visualize their ideas using a practical approach.

In the end of the brainstorming phase an appropriate method of evaluation of the ideas generated during the creative session is selected. This method depends on the critical level that needs to be reached, using a simple ranking technique or using an in-depth evaluation such as De Bono's 6 hats technique.

After the planning and the preparation of the material, the participants in the training will move to the idea generation phase. Before starting the creative sessions rules and suggestions for the correct implementation are reviewed.

The creative session is composed of two phases: divergence phase and convergence phase. The former (divergence) is of quantity generation of ideas, not filtered in any way. The latter (convergence) is of evaluation and the selection of the ideas collected.

It is fundamental to all the creative techniques to:

- Avoid evaluations;
- Create analogies and metaphors;
- Invent the ideal solution starting from imagination;
- Relate concept and things that were not related before;
- Generate different solutions to the problem.

Selection and validation of ideas

The convergence phase, where ideas are spotted, evaluated and limited to those more that are interesting, needs to be carried out, setting first of all the criteria of selection.

The steps planned for this phase are:

- Classification of ideas;
- Formalization and rationalization of the ideas generated and of the eventual concept;
- Integration of ideas into possible scenarios.

The Creative Problem Solving (CPS) is a methodology that allows working individually or in a group in a creative and efficient way increasing the ability to find innovative solutions to problems bypassing the more conventional ones. This methodology allows for improving analysis abilities, identifying the problems and the solutions. Furthermore it allows for evaluating the efficiency, the possibility of implementation, and finally choose the most appropriate solutions.

The Creative Problem Solving (CPS) is a structured process for identifying and solving problems and/or detecting new opportunity spaces where new and useful solutions are a priority. The CPS is a form of deliberate creativity, built on people's natural creative attitudes. It can be used to go beyond conventional thinking in order to generate creative solutions.

The model ideally counts on 3 main areas of intervention: Fact-finding, Idea-finding and Solution-finding. Each area is then approached in trough 3 consequential steps.

Step 1: Clarification. This step intends to identify what needs to be resolved and includes a phase of exploration of the vision and formulation of the main challenges.

Step 2: Transformation. This step intends essentially to identify ideas and translate them into solutions. It includes a phase of exploration of the ideas followed by the formulation of solutions.

Step 3: Implementation. During this step solutions are refined and an operative work plan is created. It includes a phase of exploration of acceptance and the formulation of the work plan.

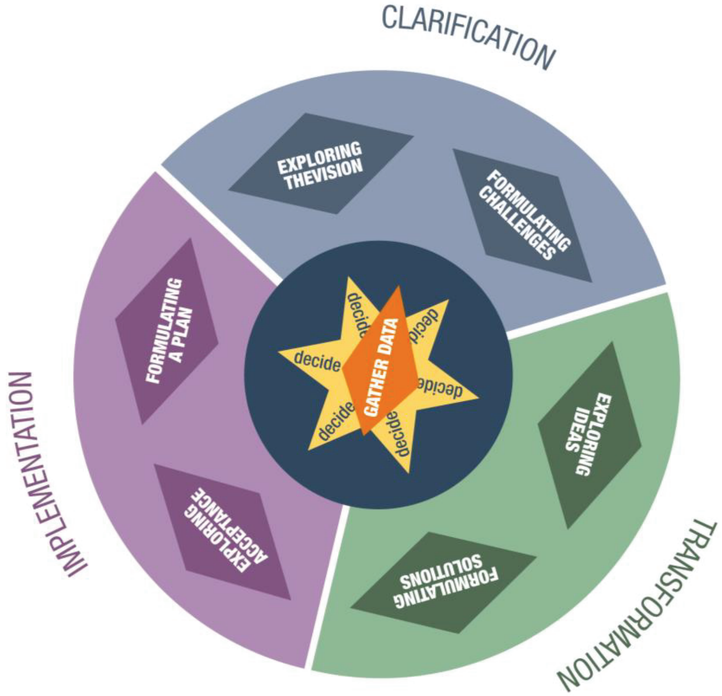

Figure 2. Creative Problem Solving (CPS) model elaborated by Puccio, Murdok and Mance (2007).

The model includes both cognitive and affective skills (Puccio, Murdok and Mance, 2007). The areas and the steps characterizing the process are essential to the various aspects of the process. In every step of the process there are both divergent thinking (generation of a broad number of new ideas) and convergent thinking (selection of the options and evaluation of the alternatives). The areas and the steps might be ideally followed in sequence, but not necessarily. CPS steps might not be used in sequence due to specific considerations on the problem to be solved.

Affective Skills that Support CPS

Affective Skill	Definition
Curiosity	A desire to learn or know; inquisitive
Dreaming	To imagine as possible your desires and hopes
Sensing Gaps	To become consciously aware of discrepancies between what current exists and what is desired or required
Playfulness	Freely toying with ideas
Avoiding Premature Closure	Resisting the urge to push for a decision
Sensitivity to Environment	Awareness of your physical and psychological surroundings
Tolerance for risk taking	Not being shaken or unnerved by the possibility of failure or setbacks

Thinking Skills Associated with CPS

Thinking Skill	Definition
Diagnostic	Making a careful examination of a situation, describing the nature of a problem and making decisions about appropriate process steps to be taken
Visionary	Articulating a vivid image of what you desire to create
Strategic	Identifying the critical issues that must be addressed and pathways needed to move toward the desired future
Ideational	Producing original mental images and thoughts that respond to important challenges
Evaluative	Assessing the reasonableness and quality of ideas in order to develop workable solutions
Contextual	Understanding the interrelated conditions and circumstances that will support or hinder success
Tactical	Devising a plan that includes specific and measurable steps for attaining a desired end and methods for monitoring its effectiveness

Figure 3. CPS Thinking Skills and Affective Skills. Source: Creative Leadership: Skills that Drive Change Puccio, Murdock, Mance (2007)

Conclusions

As a result of what is outlined in the above paragraphs, it is necessary to involve companies in new creative process to raise their awareness and abilities in creating and promoting a creative environment able to influence innovation through both the creation of new ideas and the optimal use of available know-how.

As it is shown in the Figure 4, generating a creative atmosphere in the firm is fundamental to build an effective link between creativity, innovation and design, and to shape the companies’ competitive edge through innovation.

A first pilot project was started with the participation of three different firms that are experimenting at the moment with the new methods, but above all trying to achieve a continuous creative attitude. This Training Plan, tailored in every implementation to the needs of the participating company becomes our flexible and innovative format for permanent in-house training.

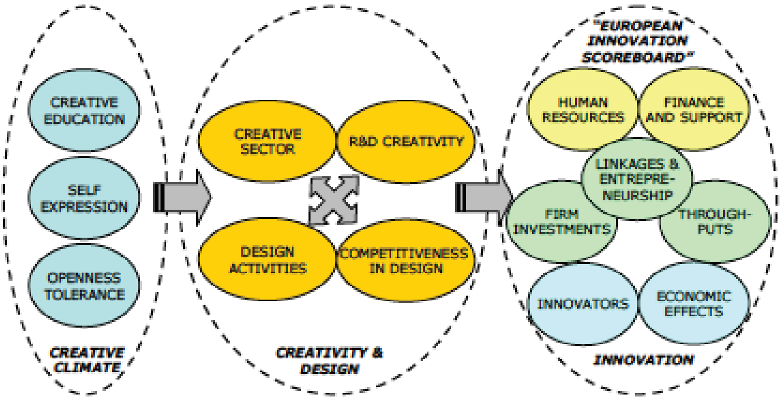

Figure 4. Diagram showing the importance of creative atmosphere in relation with creativity & design in order to achieve innovation (Hollanders and van Cruysen 2009).

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HCID: Who is an interaction designer?

Alma Leora CULÉN*, Joshi Govind SUHAS and Atif ABDELHAKEEM
University of Oslo

Abstract: *The development of technology with all its ubiquity and pervasiveness provides new opportunities and new challenges for the interaction design practitioners, both those coming from the design tradition and computer science tradition. An increased level of problem solving and creative thinking is needed when designing for interactions with new technology. In order to develop the skills and methods for dealing with increased complexity and connectedness of technology, human computer interaction design (HCID) education needs to embrace to a larger extent design practices and design thinking. This paper aims to answer two main questions: 1) why is it necessary to teach HCID students design thinking skills and 2) how to actually implement the changes in HCID curriculum. The second question is answered based on our experience and the solution we adopted. Subsequently, we discuss the success of our approach.*

Keywords: HCID, interaction design, education, design thinking, project-based learning, practice, cool, possibility design.

* Corresponding author: Department of Informatics, University of Oslo | Norway | e-mail: almira@ifi.uio.no

Introduction

Just days ago we returned from a major human-computer interaction (HCI) conference. Good atmosphere, good papers. During presentations, we all refer to ourselves as interaction designers. During breaks, while chatting with newly acquainted colleagues, we ask each other: “What is your background?” This question reveals that there is a multitude of ways to become an interaction designer and acknowledges us all as such. Yet, the kind of education one received still implicitly defines what we are according to the “old” classification by discipline: a computer scientist, a psychologist, an industrial designer, an artist, an engineer or an architect. Owen (Owen 2007) further simplifies this classification into “finders” and “makers”, essentially scholars, working through understanding (science thinking) and those who synthesise their knowledge into new constructs, patterns, concepts etc., building our living environment in the process (design thinking, see (Brown 2008)).

While this view may be useful in explaining design thinking, it may not be equally helpful with interaction design (ID) as a discipline. We believe that interaction design may be positioned as shown in Figure 1. A few interaction designers may view their work as science thinking only; some may view it as predominantly design thinking, but the majority of interaction designers do both to varying, but substantial, degrees and proportions.

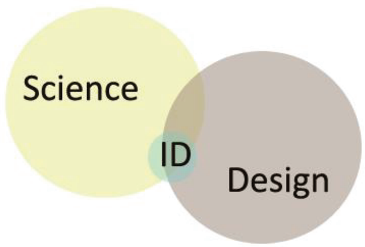

***Figure 1**. Interaction design is a multidisciplinary field, placed between science and design.*

This paper contains some reflections by a group of interaction design practitioners and students upon the above classifications from the perspective of science and design thinking simultaneously. Our education could be classified as that of “finders” as we all have computer science background. Within the computer science department, we are occupied with design, use, and interaction with technology. In this paper, we argue that we actually belong in the ID circle as shown in Figure 1. However, we do not have any formal classes in design thinking, form or materiality. We do have extensive course work in HCI or rather what is sometimes referred to as Human-Computer Interaction Design HCID (Faiola 2009), perhaps to make it distinct from interaction design at institutions such as design schools, schools of architecture or art. We will showcase our design practice through some student and research projects. We aim at making a case for HCID education within university settings that is closer to that of studio design practices. We also hope to show that our education is getting closer to meeting that goal. It remains to be seen whether the question about the background will eventually become less important and that the kind of work we do will become the determining factor in the “new” classification by our practice.

The paper is structured as follows: in the next section we establish a framework for the discussion of our approach by describing some trends in the field and providing a framework for further discussion, both in terms of where research in the field is, and where education is, making a point that there is a gap between the two. Thereafter, we provide some examples of how we work and what we learn through student projects, research projects, master theses and exhibit design. These examples aim to show that interaction design for us embraces experience design, emotional design etc., and is also concerned with the form of tangibles (with design of the tangible technological products). Discussion whether this is a "finder", a "maker" or an education that is both of these, is followed by a conclusion and future work.

HCID and design: research and educational gaps

Human-computer interaction (HCI) emerged from computer science as a new area of research and practice in the early 1980s. Over the course of the past 30 years, HCI has evolved as a field. From the first wave of HCI often described as an era of usability testing in 80´s, through the second wave with the "human" in the center, HCI is currently in its third wave with experience, emotion and context in focus (Bødker 2006). There is more talk about socio-materiality, phenomenology, design thinking, dialog etc. and much less talk about the design-as-engineering approach from earlier waves of HCI. The name widely used for the discipline today is not the third wave HCI, but rather HCID or simply interaction design. The latter will be used interchangeably with HCID throughout this paper. The "interaction design" also indicates the change in technology: it is no longer interaction with computers that is central, but rather interaction with ubiquitous and pervasive digital objects or emerging areas such as cultural computing, technology supported co-creativity etc. The major conference in the field, CHI, has added cultural computing and digital arts to the set of its focus domains and the audience at the conference is more diverse than ever.

The interaction design practice is undergoing enormous changes. This is largely brought about by fast and vast technology development. When designing for interaction with new technology, we need to understand emerging interaction design practices and digital materiality. Based on those understandings, we need to offer new theories, models and frameworks that will better suit future researchers and practitioners of interaction design. This, naturally, also implies changes in educational content and style.

Goodman, Stolterman and Wakkary advocate designerly practices that are resonant with everyday work of interaction designers:

> We believe that empirically grounded descriptions and critical analyses of design practice activities will offer frameworks for reflection on practices that designers can find useful. Such a research enterprise could then help create opportunities for HCI researchers to build long-term engagements with design practice that make sense to practitioners. (Goodman 2011, p. 2)

Many attempts have been made to bridge the diversity of practices within the field. Some notable ones are HCI design as radically interdisciplinary dialogue (Wright 2006), convergent - divergent questioning (Dym 2005), models, theories and frameworks toward a multidisciplinary science (Carrol 2003), and research by design, see (Forlizzi 2008; Fallman 2003; Zimmerman 2007; Zimmerman 2010).

Our theoretical position is influenced by that of Klemmer, Hartmann and Takayama:

> Our physical bodies play a central role in shaping human experience in the world, understanding of the world, and interactions in the world. ... We introduce aspects of human embodied engagement in the world with the goal of inspiring new interaction design approaches and evaluations that better integrate physical and computational worlds. (Klemmer 2006, p. 1)

Our bodies are indeed the ultimate instruments for collecting knowledge. We experience the world through our senses; we interact with it using those senses. We also learn by doing (Piaget 1952). For interaction designers, it also makes sense to talk about thinking through doing (Klemmer 2006).

Many have expressed their opinions based on the nature of design practices that HCID should be a design discipline.

> Subject disciplines like sociology, psychology and English literature may offer the best grounding in understanding the human in human computer interaction, and craft disciplines together with engineering science and visual and performance arts may offer the best grounding in designing and building interactive environments, products and services. (Wrigth 2006, p. 13)

However, designers need to understand both opportunities and challenges that various kinds of technology provide. Pervasive and ubiquitous technology is permeating physical objects around us and offering new experiences and interaction modes, from interacting with touch surfaces to radical atoms. The kind of knowledge required is more complex than the eternal question designers so often ask: should designers need to know how to program?

> Many design schools have begun to introduce courses on computation to prepare students for these new challenges. These approaches are usually based on adapting and simplifying courses developed in computer science schools, such as teaching students the basics of programming, or introducing the general principles of a particular computing technology. ... Such approaches do not recognize that two radically different education models need to be bridged. Design and craft schools generally follow the experiential learning paradigm, in which knowledge is acquired mainly through doing and working on practical projects. Computer science education, on the other hand, has its roots in mathematics, often emphasizing formal methods and models, articulation of general principles, and a top-down approach to problem solving. (Obrenović 2012, p. 1)

Obrenović continues towards offering a model for experiential teaching of advanced computational concepts and techniques for design students.

Our point of view is that somebody trained as a computer scientist may also learn the design thinking and design oriented practices in order to work with, and make, better physical products with embedded technology. Agreeably, this may not always be easy, as the following anecdote illustrates vividly: students in a HCID class were given the assignment to do observations of the use of technology at a place of their choice. Somewhere in the assignment text, they were also asked to draw the place of the observation. Several students delivered the assignment without a drawing of the site, and one student wrote, obviously disturbed: “We were not told that drawing skills are required in order to take this class.” However, those students that do decide to continue with graduate education in interaction design are also ready to accept more design-oriented practices in their work.

A more constructivist learning practices for early learners may change the above attitude and help youngsters, and eventually the rest of us, feel more at ease with traditional design tools such as drawing (MindShift 2012). The physical space, flexible and creative, such as the school in Figure 2, offers support in that direction. This is not a trivial aspect of the problem we are discussing, as traditionally, computer science educational programs, including HCID, are taking place in traditionally looking classrooms, which are not fostering the kind of exchange that studio-based practices do.

Figure 2. Multiple usage environment supporting creative learning practices. Vittra School, design Rosan Bosch Studio. "The Mountain" is the central point of the school. Photo: Kim Wendt.

In their paper on creativity in computer science Cennamo et al. discuss and compare the creative practices in industrial design, architecture and HCID (Cennamo 2011). Several disciplines within computer science, such as HCID, graphics and visual programming, information design and information visualization, may be substantially supported by learning about design and design thinking. When presented with problems to solve, both industrial design and architecture students focused on experimentation, while HCI students focused primarily on idea refinement. The authors state:

> Although we need software designers who can follow rules when presented with technical and rational problems, we also need designers who can make good sense out of those problems that are not technical or rational: that is, designers who are aware of multiple possibilities for solutions, who can make good choices, and who can reflect on the choices they make to determine if their goals have been met. (Cennamo 2011, p. 1)

Buxter implies that various skills will be necessary to tackle problems: “We need coverage of the larger skill set distributed among a heterogeneous team, not the individual” and follows with “for that team to function well, the players must have at least a basic literacy in each other's specialties, if not a high level of competence" (Buxter 2007, p. 230).

Fry (Fry 2006) reflects upon this and concludes that in order to avoid collaborative difficulties within multidisciplinary teams, computer science, or at least HCID, needs to introduce creative design skills and knowledge as part of their education.

In her article advocating a new paradigm for design education, Wang sees a potential for great synergy between design and HCI educations and states:

> The possible new paradigm offered by complexity theory not only promises to make pedagogical methodology of design studio education more academically respectable, but it also promises to provide a new model of understanding how HCI can become indispensable to design education. (Wang 2010, p. 8)

We do not find much evidence in literature as to how, even when the need is clearly identified, education in computer science, and in particular HCID, implements design thinking and design oriented practices into curriculum. The next section shows our approach.

How to include design practices in HCID education

We present two examples illustrating our approach prior to discussing both why and how design oriented practices could become a part of the HCID curriculum. The first example shows how research projects can be transformed into project-based teaching which includes the design thinking. The second example shows how introducing design thinking cognitively, through published works and lectures, may lead students towards better understanding of what design thinking is. Consequently, it seems to be easier for students to apply it in their work and projects. The first approach is used in an undergraduate course and the second in a graduate course.

The case of designing for a children´s museum using research and project-based teaching

Six years ago one of the authors of this paper participated in making of the master plan for a large children's museum in Oslo. An international, multidisciplinary design team carried out the design process. The team included interaction designers from both design and HCID communities. When the funding for the project became a problem, the research through design enabled at least parts of the project to be realised. The project was by its nature a perfect platform for research on embodied interaction, hands-on, touch and experience interaction styles, including whole body interactions. For the past five years, the undergraduate course in interaction design has been used in order to design and build functional prototypes of the exhibits for the museum. A total of thirty-eight student projects were carried out in this context. As researchers, we have experimented with ways to engage children in the design process. A mobile children's museum was born and is operational on a small scale, visiting local schools and kinder gardens, and providing children with possibility to participate in the museum design process.

Student groups working on children's museum projects have used design approaches ranging from genius design to participatory design, and have always involved children in roles of users and testers in their design processes. On occasion, the children were involved to a much larger degree, contributing to the process as informants to design or even design partners (see (Druin 2003) for the roles of children in the design of technology).

The students have learned by doing, by making tools for creative engagement of participating children and identifying a wider range of design possibilities. By thinking through doing, sometimes seemingly repetitively, we have gained a deeper understanding of how to work with children, how to involve them in the design process most effectively, and how to give them influence and power in participatory design settings when they are unable to represent their views adequately (Culén 2012; Culén 2013). Working in this way, the interaction design students certainly got a taste of design practices. In addition, they were required to be able to reflect upon what they do, to be "reflective practitioners" (Schön 1983) and deliver reports on their design process.

The design process in these efforts could be described as shown in Figure 3. Clearly, there are still iterative cycles present. However, at the start, there are also explorative workshops with the design team and an explorative workshop with the target group, in this case young children. The process embodies both "finder" and "maker" approaches.

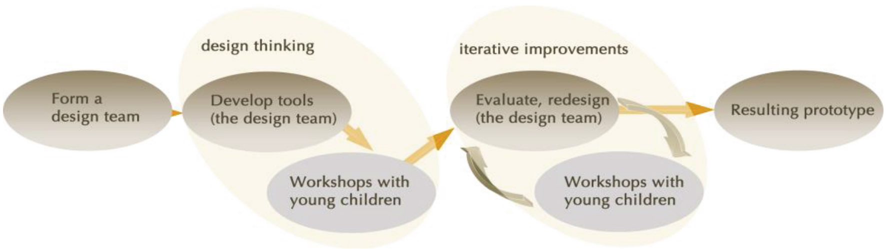

Figure 3. *The design process followed by design teams, employing both "maker" and "finder" approaches.*

Figure 4 and Figure 5 show some examples of prototypes made by students. The prototypes are rough, but clearly showing interaction modes and functionality. We argue that this is part of the HCID value system: when things function well, are made simple and enables the person participating in the interaction to have a sense of joy, this approaches the experience of aesthetics or beauty. A more traditional approach to the form and materiality is considered, but the time frame for the projects is short and thus getting a working prototype is more valued than obtaining a more "finished" look. The students do have a studio, or rather a lab as we call it, at their disposal (see Figure 7). They work in groups of 3-5 students per project. Almost all projects employ paper prototyping sessions, some generative tools, brainstorming, mind mapping, user observations and contextual inquiry. Sketching, story boarding, making of personas and scenarios are also often used. Alternative approaches to problem solving are always considered (and are a required part of the course, as is the decision making process). In this first phase of the process, the approach is very much designerly. Once a choice is made, most groups switch to a high fidelity prototype making and iterative improvements until the product does what the interaction design students intended it to do.

The project-based teachings coupled with genuine research interests, the aspects of which may be defined as design briefs involving some form of technology, have given very good results with HCID students. Both the faculty and students feel positive to this way of working and we feel that we are getting better at it, i.e. we truly are both learning and thinking through doing.

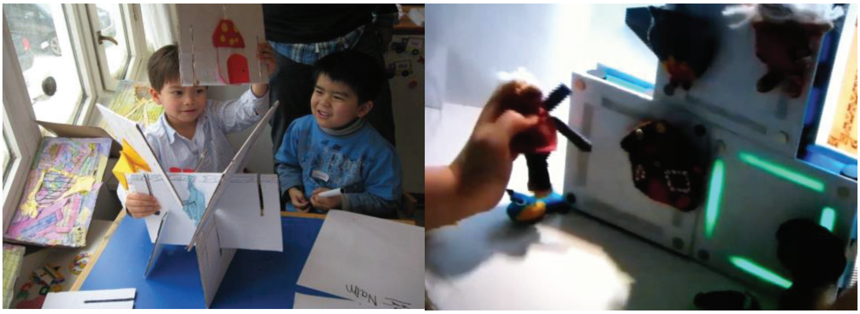

Figure 4. Making 3D books with children (left), and an early technological prototype (right).

Figure 5. These pictures were taken during the exam in the class and show two different projects: model of the tangible solar system (left) and, for the youngest children, what octopus eats (right). Note that the adults need to bend down; the models are scaled down to a child of 2 - 4 years.

The case of the exhibit design, a graduate course project

The graduate course in interaction design introduced the students to design thinking concepts through in class discussions of articles such as (Fogg 2009; Fallman 2003; Höök 2012; Desmet 2012; Holtzblatt 2012). The class project for the semester was a co-arrangement of a UX exhibition where students were entirely free to select the exhibits. Here is how one of the participants described the project:

> We wanted to showcase some experience design items. It turned out that there were implicit adjectives that I myself had not thought about before; in my head a user experience, when designed properly, is always a positive one. There were

several other adjectives, such as “novelty” and “breadth”. The user experience should be more than novel, it should be cool, and, if possible, should broaden people’s view of what UX is.

The students involved in this project were paired up and encouraged to consider several different perspectives when thinking about the exhibit. These perspectives included the architectural lens, the cognitive lens, emotional lens, ludic etc. One of the goals was to consider the visitor´s experience from before they walk into the building, until they are long back into their everyday lives. To design for from the moment the first social media or other announcement about the exhibit is given to a visitor. They should also have something that can bring back the memories of the exhibit any time. The design process though quickly changed from a goal and problem oriented process to a possibility driven design process (Desmet 2012). This is how the class described this process, as part of their reflexive statement:

> The problem driven process would have stopped at merely designing a user experience. We had a couple of ideas, ideas that would definitely have solved the problem phase and created a novel user experience - we discarded those in favour of fewer experiences that were simply guided by a desire to make people happy at the moment, by providing cool and new hands on exhibits.
>
> The design process started with a brainstorming session and followed the process of inspiration, ideation and implementation (Brown 2008). We discarded the ideas that were not feasible or not interesting and left around 10 concepts to continue working with. During the brainstorming session, a suggestion was made to select based on how “cool” the concept is. Cool is a recent topic in the HCI community, see (Holtzblatt 2012; Culén 2012). Thus, the 10 concepts were all having a “wow” factor for us and they were all feasible within the given time frame. The final selection that was consequently implemented consisted of an augmented reality weather window (using iPads), privacy screens (using polarized glasses), artsy colourful QR-codes and brain-computer interface (BCI) which we used to control toy trains.
>
> In the prototyping process we used all the tools we could place our hands on. We created the privacy screen using old discarded LCD-monitors, by taking the screens apart and removing the built in polarized filters as shown in Figure 6. We experimented with different materials for the polarized glasses, both for the filter that actually filtered the light and for the frame. The first iteration was to print our cool design on a 3D printer, but settled on modifying existing 3D cinema glasses frames for the project as shown in Figure 7.
>
> The BCI-controlled train concept started out with brainstorming around what could be done with it that is cool and nobody has seen yet. To move something physical, using thoughts only, sounded cool. Cars, trains, planes, helicopters were all possibilities to consider. The choice fell on a train. We bought a basic train-set and decided to control it using Arduino and a motor shield.
>
> Once the BCI unit was connected to the train and it was every bit as cool to control it as we hoped it would be, we decided that we should have two sets so that people could compete against one and another.

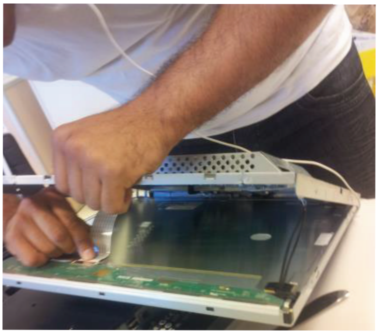

Figure 6. Re-using material. Old screens are being modified so that they can show the information in new ways – through privacy glasses.

Figure 7. Making polarized glasses in order to display some interesting documents with "secrets".

However, it was not until the reflection process that the students came to realize that the process had been a combination of both design thinking and HCID. They could not categorize the process as either "finder" or "maker", but only somewhere in between and there was a unanimous consent that using only one of the two approaches could not have led to the eventual success of the exhibition.

The conclusion from the reflection process amongst the students was that the design is in fact all about practice, not about background. Despite their computer science background they participated in arranging and successfully carrying out an exhibition using a combination of design thinking and HCID practice. Their background is still from computer science, but by expanding the traditional design process from HCID with design thinking, they have experienced designing with technology in a new way and with a new awareness of the process.

Discussion

Based on our experience from both graduate and undergraduate courses in HCID, we can only argue in favor of continuing to combine the practices from design and HCID disciplines. The "finders" approach can be successfully supplemented with a "makers" approach and design thinking in order to enrich the design process and allow students to solve problems in new ways that have previously not been thoroughly explored within the HCID community. We thus strongly advocate expansion of our HCID curriculum with design thinking and practices and development of a strong multi-disciplinary competence. Most interaction design projects are carried out today in a framework of multidisciplinary teams and there are compulsive reasons for the education to support the students in being able to work in such teams effectively.

The way students used to approach the design of technological solutions or products in traditional HCID often limited the creative space by choosing a viable solution prematurely, without real exploration of alternatives. Using the design thinking and designerly practices makes the initial processes more free and allows the students to properly explore the ideas and concepts with a more hands-on approach.

As mentioned, our students have worked with all sorts of design methods, from genius design, user centered design, or co-design to participatory design, involving the users to a varying degree in the design process. We find that the design thinking may be successfully applied in conjunction with a whole range of methods and techniques within HCID, regardless of the level of user involvement.

These are not revolutionary findings, they are fully in line with work of Winograd, Mathiassen, Nelson, Löwgren and Stolterman (Winograd 1996; Mathiassen 1999; Nelson 2003; Löwgren 2004) among others. Their work and reflections answer the question *why should design thinking be part of information technology* from different perspectives.

We would like to join in and say yes, design thinking should be part of the HCID student's education. We find that, in our context, the learning process becomes more hands on and embodied. In addition, we can observe that the quality of student's work is improved. Finally, we note that the HCID students will not become designers by having design thinking as part of their education. They will be simply better equipped for working in multidisciplinary teams. Their personal contribution is stronger, the communication barrier is lower and their joy in the process is higher. We agree with:

> Design competence allows individuals to become causal agents of the real world. This competence is an embodiment of the foundations and fundamentals presented in this book and subsequently acted upon with the values and principles of a design culture. Anyone who so chooses can become design competent. (Nelson 2003, p.301)

When trying to answer how the design practices and design thinking could be integrated with HCID practice, we believe that we have found a good way of engaging the students. Our exhibit design example is a good example of how the integration of design thinking has helped us achieve the desired effect. The exhibit was regarded as very cool, not only by us, but by our visitors as well. Our visitors included students, faculty, research collaborators and representatives from the industry. We especially believe the inspiring effect the exhibition had on the students further demonstrates why the HCID discipline needs to learn from design thinking.

Conclusion

Based on the results our students achieved after being introduced to design thinking, we can conclude that for students in "finder" schools, a competence in "making" makes them both better finders and makers. Their work becomes better, and their thinking broader. Their confidence in their understanding as well as being able to contribute to the process gives them a better basis for being successful as members of multidisciplinary teams.

Our examples show how we integrated design thinking with HCID both at undergraduate and graduate level. At undergraduate level we use hands-on approach, but base the student projects on real research projects or industry cases. At the graduate level, a cognitive approach is used at the start, followed by a design project and finally, a reflection. In both cases, students achieve deeper levels of understanding of what design is and how they can apply this new knowledge and skills in their work and in their lives.

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Technology and Design as part of a public school from 1st to 10th grade

Liv Klakegg DAHLIN[*a], Liv Oddrun VOLL [a] and Anne-Gunn SVORKMO[b]
[a]Oslo and Akershus University College of Applied Sciences; [b] National Centre for Mathematics.

Abstract: *Technology and Design was introduced as a multidisciplinary subject in Norwegian school in the context of the new curriculum in 2006. The topic should be a collaborative effort between the subjects of Science, Arts and Crafts, and Mathematics. In working with Technology and Design students develop a composite competence on product, process and context that we call Technology and Design expertise. There has been, and still remains, challenges associated with practicing the subject Technology and Design. The complex and many-facetted areas of expertise cause teachers within the traditional school subjects to experience the subject as strange, and it's challenging to establish a well-functioning multidisciplinary cooperation. In the desire to contribute to better practices in the subject the National Centre for Science, the National Centre for Mathematics and the National Centre for Arts and Culture in Education have in collaboration with the Oslo and Akershus University College of Applied Sciences developed teaching programmes in Technology and Design. Based on these challenges we will describe one of these teaching schemes and point to the challenges we met and still meet in our work with Technology and Design. Technology and Design expertise is a type of compounded knowledge that is in great demand in the labour market. We believe the subject would be a valuable contribution to the overall design education in primary school.*

Keywords: Technology and Design, Education, Design, Curriculum.

[*] Corresponding author: Faculty of Technology, Art and Design | Oslo and Akersus University College of Applied Sciences | Norway | e-mail: liv.dahlin@hioa.no

Introduction

In Norway, Technology and Design as a multidisciplinary subject was introduced into the school curriculum (LK06) in 2006. The curriculum emphasizes that the topic should be practiced as an interdisciplinary cooperation between the subjects of Arts and Crafts, Science and Mathematics. Technology and Design is in today's curriculum (LK06) a separate main topic of science, while design is a main focus in the curriculum of Arts and Crafts. The description says that the subject is a multidisciplinary subject where Arts and Crafts play a big role, and where Mathematics will provide support tools. The introduction of the subject Technology and Design in Norway is part of an international process that has taken place over the last 20-30 years. In most countries, the introduction of technology has been central and design has only been included in a few countries (de Vries 2006).

As a mandatory multidisciplinary subject Technology and Design is a newcomer in the curricula, in Norway as in many other countries. This means that the topic lacks the identity and long tradition of a well-established subject. It has become obvious that one needs a framework and a fundamental idea for the subject in education. It needs to have a separate identity that defines what the topic is and what it involves. De Vries (2006) points out the need to develop a common understanding of the subject. If you get into the situation where neither teachers, teacher trainers nor curriculum developers can answer the question what the subject actually contains or provides, it will have great difficulty surviving.

The situation of Technology and Design in Norway today is the background for the work we describe here. We will describe our idea of the subject of Technology and design. We will also provide a description of the introduction of the new theme, the background for the work and a description of a work in progress in order to implement the multi-disciplinary collaboration across Science, Mathematics and Arts and Crafts. This is based on the understanding of the concepts of Technology and design, the intention of the subject in schools, the contents of today's curriculum as well as learner and society needs. We will present what we believe the subject should contain and point out which learning potentials are inherent in activities within Technology and design.

Describing an actual case of work with electronic communications systems, we will highlight the potential we see in interdisciplinary work for strengthening the work with design in primary school. We consider that Technology and Design has value in its own right and is a special kind of knowledge at the same time as the topic helps to enhance the overall design education.

Technology

Technology comes from the Greek word *techne* usually translated as art (as in carpenter's art), craft or skill. Aristotle distinguished between real-world knowledge, which he called *episteme* and action knowledge which he called *techne* (Hansson 2007). In the term technology, *techne* is joined with *logos*, which means "word" or "reason". *Logos* is also used as a term for all expressions of reason: thought, speech, learning, wisdom, etc. (Aschehoug, Gyldendal 1981). One can thus say that technology is the study, speech or thought of action.

There are several definitions of technology. Here are some examples:

> *Technology is the study and knowledge of the methods and tools used to transform raw materials into finished products. More in general, technology is defined as the application of science to the solution of practical tasks. Technology is the study of techniques and problem solutions"* (Wikipedia 2012).
>
> *"Technology is methods people have developed to achieve its objectives, work more easily and collaborate better. Technology provides utilities for creating and making things – cultivating soil, weave clothes, build houses, heal illnesses or travel by land, water or in the air*(LK06 2006).
>
> *The application of scientific knowledge to the practical aims of human life or, as it is sometimes phrased, to the change and manipulation of the human environment* (Encyclopaedia Britannica online version).

These definitions give a varied picture of what technology is. The Wikipedia definition focuses on technology as the process of transforming raw materials into finished products. The second is taken from the curriculum of the Norwegian “Kunnnskapsløftet” (LK06) (Knowledge Promotion), where the first part of this definition makes technology a nearly all-encompassing subject. In its ultimate consequence it may include non-tangible "innovations" such as democratic elections arrangements or municipal parking regulations. In the second part of this definition, however, the term is more towards technology and utilities. The last of the three definitions associates technology to the application of scientific knowledge for practical purposes. One could say that technology is considered to be applied natural science. But to look at technology purely as applied science provides a very limited and sometimes inaccurate picture of what technology is (Bungum 2003).

Design

Design is an international word and comes from the Latin *designare* means to designate or appoint. It is also translated into the concepts "fabricate" and "image". At the mention of the main topic design in the curriculum for Arts and Crafts the concept of design is associated with design of artefacts and the handicraft tradition.

> *“Design includes both work directly in materials and working with sketches and models. Creation of working drawings, ideas, products, and usage are central. Knowledge of materials, problem solving and production can form the basis for innovation and entrepreneurship“(LK06 2006).*

The concept of design was first introduced in Florence around 1560ad to differentiate between drawing or planning of a product and the execution and production of the product. Today design encompasses both the creative part of the process behind an invention and development of a product (Aakre 2011). The aim is that the product should be both functional and aesthetically pleasing. The term is often used in crafts, industry and art industry, and has traditionally been placed at the intersection of craft and art *(Wikipedia 2012)*. Design involves creation of man-made things in terms of survival, relief and pleasure, sometimes all three things at once. The designer works in the conflict between the practical necessity and aesthetic opportunity (Møllerup 1998).

Design work is characterized by several subjects and disciplines coming together. This means that the term is used in different ways (Lundequist 1992). It can be a verb that means to create; it can be a noun referring to a specific shape. *Design* has become an "in-term" and covers everything from graphic design, designer furniture, designer hair, designer drugs, service design, etc (Nielsen 2009).

Earlier, design was an integral part of other activities and was not identified as a separate activity or linked to an occupational group. Industrial design appeared around 1950 when some practitioners began to use the English term *Industrial Designer* as a professional title. The Scandinavian countries have adopted the term, but there were such professionals until the mid-1970s. Industrial design is a process aimed at two goals:

1. To adapt a new product to the user and the environment
2. To give the product an expression of wholeness and context, individuality and personality.

In recent years the word design has also been adopted by creative professionals to raise awareness of skills and status of the profession. Interest for design is growing and there is a plethora of different directions in the field of design. These are e.g. industrial design, furniture design, interior design, fashion design, product design, web design, m. m. (Michl 2004). These professions are relatively new. The development of new technologies, attitudes and needs brings new design professions develop, such as experience design, interaction design, service design, packaging design and design for all.

In summary we can say that the concepts of "Technology" and "Design", despite their differences, are related and deal with much of the same. Both revolve around developing and creating tools that solve a functional problem to the user. Both build upon a development of the handicraft tradition. Specialists and practitioners in the two professions must apply their knowledge of techniques, materials and shape in order to solve the problem. The school depends on expertise both in Arts and Crafts, Mathematics and Science in order to cover the breadth of the subject matter content.

Introduction of Technology and Design in schools

One mission of the school is to educate and prepare students for the tasks and challenges they will face in life and their career. Teaching shall qualify for productive efforts in work, and provide the basis for later in life to be able enter professions that have not yet been created (LK06). This is nothing new in today's curriculum. In preparation for future professional life the school has since long time offered education in Technology and Design in the form of traditional crafts. The work consisted of textile craft and carpentry, and was aimed at practical benefit and future employment, both from an individual and a public-benefit perspective (Aakre 2005, Brænne 2011). This has been a non-academic, vocational aspect of a traditionally much gendered education. The first time we know of that the term technology was used to refer to a part of vocational education was in 1861. Then technology was proposed as a name for a topic within the Finnish teacher training in carpentry (Kananoja 2006).

In line with the technological development and diffusion of technological products, the need for education changed. The old handicraft subjects no longer reflected the modern society's technology. They gained lower status and problems with recruitment. Therefore, technology in a number of countries has been introduced as a compulsory subject for all pupils (Bungum 2006b). One of the main goals of technology education is to contribute to the economic development of a country. Technology education was seen as a means to develop knowledge, skills, attitudes and values that make students flexible and adaptive to a future workplace (Pavlova 2006). In the United States, for example, it is argued that technology education is "*vital to human welfare and economic prosperity*" (ITEA, 2006 p. 1).

An important factor in technology education and in all activities related to design or technological development is creativity and ability for problemsolving. Problemsolving is strongly related to innovation, entrepreneurship and economic development (Robinson 2012). Technology education, training in problem solving, and working with design is considered an important tool in a country's technological and economic development (Starkweather 2006).

Technology education is not only justified by the importance of the economic development of the country. Technology skills are part of the general education and society needs a certain level of knowledge amongst the population in order to manage the technological knowledge as good as possible (Pavlova 2006). The general education perspective can be summed up in the English language term "*Technological literacy*". The International Technology Education Association (ITEA) provides the following definition of technological literacy:

> *Technological literacy is the ability to use, manage, assess, and understand technology (ITEA, 2006:7).*

Technology or *Technology and Design* is a newcomer in school context. As we have seen, the concepts of "design" and "technology" also have no clear definition. Together, this leads to the subject Technology and Design showing a high degree of variability, developing a different profile in the individual countries. Some countries put most emphasis on technology as a career preparatory practical subject closely related to the craft traditions. Others place most emphasis on the creative process from idea to finished product (design process). In yet other countries, such as United States, technology is seen as a public educational subject with strong emphasis on awareness of technology and society.

Multiple parallel development prosesses led to Technology and Design being introduced as a multidisciplinary subject in the curriculum in Norway (LK06) in 2006. The different prosesses had different development agenda and argumentation. Below we outline the development of three different processes:

- The need for technology in schools as initiated by engineering and business organisations
- The development of the Arts and Crafts subject
- The need for innovation and entrepreneurship

Technology in schools

In 1996/97, NITO (The Norwegian Society of Engineers and Technologists) established a primary school project Technology in schools. The project was established with contributions from industryorganizations, The Research Council of Norway, NHO (The Confederation of Norwegian Enterprise), Ministry of Education and Research and educational institutions (Smith 2007). The reasoning was, among other things (ibid):

> *Technology makes up an increasingly large part of our daily life, and today's technology is so advanced that many feel alienated from it. It is therefore important to increase the knowledge about everyday technology. At the same time it turns out to be necessary and useful to create a better understanding of the relationship between technology and natural sciences. Mathematical, scientific and technological expertise are key factors for future value creation and employment. Therefore, technology should be included as part of general education.*

The project was inspired especially from the English subject Design & Technology that had been compulsory since 1991. It was also in liaison with Sweden, which had Teknik on the curriculum as a separate subject from 1994.

In working with the new curriculum in 2006 it was proposed to create a new subject from 1st to 10th grade. However, this proposal did not receive support. Instead a solution was chosen in which Technology and Design was introduced into the Norwegian primary school as a new multi-disciplinary course (Aakre 2011).

NITOs motivation for getting involved in a project for technology in schools was the concern for the future value creation and employment. The recruitment for studies in the field of science and technology was declining and it was expected that introduction of Technology and Design in schools would improve this. The ministry and the Norwegian Parliament pursued this line of argument. A key argument for the introduction of Technology and Design was that it would serve as a research tool, which would help improve learning in Mathematics and Science and improve recruitment to technological studies. The subject's educational character was pointed out, but the strengthening of science subjects and better recruitment of science and technological studies were evident in the front line of argument.

Development of the Arts and Crafts subject

The technological development also has also impacted the Arts and Crafts subject. The rapid developments in ICT led to a reinforced and clearer appreciation that the subject should be revised. For the Arts and Crafts subject, two lines of development in particular prompted work with Technology and design.

Increased focus on design and architecture

Over several decades an *increased focus on design and architecture* had evolved. We find e.g. architecture and architectural related topics in the “Normalplanen av 1939” in study of local history and lore (the Ministry of Church Affairs and Education in 1965), and the plan from 1974 (the Ministry of Church Affairs and education 1974). In the 1990s, architecture was more strongly emphasised with the introduction of Arts and Crafts (Ministry of Church Affairs, Education and Research, 1996) (Fauske 2009). This was further reinforced with LK06 when both architecture and design became independent main topics in Arts and Crafts (Ministry of Education 2006).

Work with practical skills

Another development line stretching all the way back to the subject's origin is *the development of practical skills*. “Before the various handicraft subjects entered in the public school in 1889, the home was the main provider of practical training for children. Crafts were part of the work in the home. The kids got to learn working skills through participation in family self-sufficiency and in some cases even in homebased industry" (Nielsen 2009). "The introduction of the subject in school was characterised by utility value and importance of developing practical skills for practical life." (Nielsen 2009). Developing good working habits, accuracy and diligence, eye-to-hand coordination as well as knowledge of the materials and tools were important elements of the work, although various trends have characterised the long-term development of the Arts and Crafts profession we see today.

One factor that may have had an impact on the introduction of Technology and Design is the change of the name of the subject from Forming to Arts and Crafts in 1997 (KUF 1997). Although art as experienced by many is far removed from the technological developments which have taken place, the name change of the subject from Forming to the Arts and Craft opened for a wider understanding of the subject, and has thus given room for a greater diversity in ways of expression, topics, techniques, and ways of working.

The need for innovation and entrepreneurship

The Technology Council also worked to strengthen technology in schools with the following starting point:

> *Norwegian youth is growing up in a high-tech society, but technology is not very visible on the school agenda. The school should provide an understanding of and experience with the development of technology to show that the technological products and systems are created by people who make conscious choices within the given contexts. This can stimulate students to appear curious, creative and critical towards technology* (Technology Council 2004: 1).

An important starting point for working with the new curriculum in 2006 was the Quality Committee's report "Quality first and foremost. Enhanced quality in a basic training for all" (NOU 2003: 16). The report recommends the introduction of Technology and Design as a separate subject at secondary level reasoning with the need for an innovative and creative youth. The report says, among other things:

> *The training system has a particular responsibility to promote young people's ability to think creatively and innovatively. Not to mention that innovation through the use of technology will be a requirement for future workers. In this case, the course content and organisation reflect these requirements.*

The same perspective appears in the Parliament white paper (Stortingsmelding No. 30, Kultur for Læring) where it is emphasised that the most important factors we have in society is no longer the capital, buildings and equipment, but the people and their knowledge, skills and attitudes (UFD).

Work today

An essential prerequisite for establishing good practice in a new topic is that teachers have an understanding of what the topic should include and the belief that it can contribute to valuable learning for students. Well-established school subjects have a long tradition to build upon, both in terms of content and justification for the subject. Those teaching the subject are socialised into the profession for many years, partly through own education and professional life, and know this subject. They have a reasonably common understanding of the subject and an understanding why exactly this content has been selected as part of the general education. A new topic in the school such as a Technology and Design must create its own content and establish a common understanding of its didactics. Subject didactics deals with the considerations behind the selection and structuring of content, building a bridge between education and pedagogy.

What is Technology and Design as a school subject?

Earlier, we discussed the concepts of "*technology*" and "*design*", their basis and how they are being interpreted today. Both terms can be associated with craft tradition and describes the function and form of objects that surround us. But what is "*Technology and design*" as a school subject, and what capabilities do we want students to develop through working with this subject?

Technology and Design expertise

The goal of technology is to develop products or utilities to solve practical problems (Sjøberg 2009). The same objective applies to working with design. "Technological literacy" means to *be able to act*, *create* and *produce something* and *use*, *evaluate* and *understand* technology. The purpose of all technological operations are to expand human opportunities to satisfy needs and wants, solve practical problems or function as expression of creativity and artistic urge. To get the product to work or solve a practical problem it is necessary to draw upon knowledge and expertise from different disciplines. We have, according to a model from Sjøberg, divided Technology and Design skills into three different *dimensions*. These are *products* and knowledge about their behaviour, *processes* with methods and ways of working, and finally the societal *context*.

Product

Characteristics of technological and design products are that they have a function and they have been given a physical form or structure. The physical structure has been designed, produced and used by people to meet a need and realise a function. Knowledge about a technological product consists of knowledge both of physical form and function.

Knowledge of the physical design of a product includes knowledge about assembling items, techniques and materials. One must e.g. decide whether to use gluing, soldering, welding or screws to assemble the product. Should it be a casting or woodwork, be light or heavy? All of these choices must be based on knowledge of the physical shape of the product, but also on the use of the product.

A technological product cannot be described from the physical design without also including the function the product shall fulfil (Kroes 2002). Product knowledge includes understanding function in view of design. Thus we understand that a pitcher can be filled up with something and that the handle is to carry it around. We also realise that we get light when we press a light switch if it’s designed the right way.

Process and method

The design process is central to Technology and Design and is about transforming an idea or a task into a concrete and physical product. The end result may be in the form of a prototype, a model, a description or drawing. Knowledge of process and method encompasses the choices you make in the process of solving the functional problem, it be technical solutions, design, working techniques and choice of materials. You must have sufficient knowledge and skills to make choices in a good way. Or use existing skills and apply them in a novel way. This can be illustrated by the story of how Jac. Jacobsen designed the famed Luxo-1 lamp. Ordinarily, he produced the textile machinery in Oslo when he in 1937 received a box of equipment for sewing machines. In one of the boxes were two crane-like spring balanced armatures. Jacobsen had good knowledge of process and method and thus was able to fabricate and develop a brand new lamp with new functional solutions. The Luxo-1 lamp was so successful that it became a big international seller and has since inspired other technological products. In 2012, the original Luxo-1 lamp was re-launched as a 75th anniversary celebration of what has been perhaps one of Norway's most internationally renowned design icons and today also has become part of the film company Pixars logo.

Context

Technology and technological development has great significance for our social structure and way of life. Technology plays a major role in economic development and has a number of consequences for our society. The starting point for technological development is to resolve a functional problem, but this development is in a societal context and often has consequences beyond resolving the problem as such. For example, the introduction of machines for spinning and weaving during the industrial revolution had major consequences for development of other mechanical industry, transport, settlement, population density, economic development, social structures, etc.

A core part of the Technology and Design expertise is also to know the consequences of the technological development. There will always be a trade-off between what is practical and what is socially desirable. In addition, new ethical discussions and positions are raised. This includes, for example, environmental impact and pollution. We have now become more aware of the harmful effects of some kinds of production, e.g. textile production. And we have gained insight into how our ever-increasing production and consumption impacts energy use, global warming and climate change.

Various forms of knowledge

The three dimensions in which we can view Technology and Design skills are all based on compounded knowledge. In the following we call this knowledge of action.

In his time Aristotle also spoke about several types of knowledge that can be linked to action. These forms of knowledge, as we see it, both complement each other and overlap. Aristotle emphasized the types of knowledge by giving them separate names as for instance: Khrêsis, Praxis and Pathos (Eikeland 2006). Aristotle’s forms of knowledge are necessary and relevant in Technology and Design, and we use the forms of knowledge more or less consciously in our daily chores. We highlight four knowledge forms related to concrete issues in Technology and Design and give a short description:

Khrêsis, or usage skill, is being able to use different tools, know the names of similar tools and know when they should be used.

Poíêsis comprises the knowledge of various types of materials, being aware of properties and uses of the materials, how they behave and how they can be processed and joined together. In order to form a material one should be able to use various tools. Here the Poíêsis knowledge overlaps Khrêsis.

Episteme in Greek means "to know". This is knowledge how to acquire various theories such as reading facts. Epistemic knowledge is a direct form of knowledge and could be described as theories of one thing or another. Such knowledge may be stored and transferred from one person to another. Episteme in many contexts can be translated as knowledge of understanding or scientific knowledge, i.e. the true knowledge about the world.

Praxis or performer and competitor knowledge is knowledge that is the result of training at something over and over again to be a knowledgeable and good performer. The skill lies in the ability to practice. When both techniques and skills are rehearsed and practiced several times, the skill becomes more and more automated.

The forms of knowledge we have described here, are all essential in varying degrees and at different times in the different work phases in Technology and Design. A goal must be that the school helps students develop multi-faceted and versatile Technology and Design expertise. This means that students both acquire a degree of knowledge of action and that they gain knowledge of technological products and their behaviour. Furthermore that they are trained in problem-solving and design processes and that they are given an insight into the social contexts of these.

We summarise the Technology and Design skills in the following manner:

- be able to develop utilities which fix an issue or cover a specific need
- be able to translate a functional problem into a concrete, physical and practical solution (design process)
- be able to apply materials, behaviour, mechanisms, tools, techniques, etc. which are needed in order to obtain something to work well
- meet the functional requirements without too many side effects and with the required safety for the user
- be able to assess societal context and consequences

Technology and Design as a multidisciplinary subject – Challenges in the face of traditional academic cultures.

We have seen above the broad and complex skills we desire students to develop through working with Technology and design. Technology and Design expertise is complex and multidisciplinary in nature. Through LK06 the school has solved this by introducing Technology and Design as a multidisciplinary subject integrated into the subjects of Science, Arts and Crafts, and Mathematics. It is not necessarily a clear correlation between Technology and Design expertise and the contents of the three subjects which have been given responsibility for the multi-disciplinary subject.

Arts and Crafts teachers are familiar with much of the knowledge of action we have named Technology and Design knowledge. But they have little experience with behaviour and mechanisms related to e.g. transmission and electricity and feel unfamiliar with the concept of "technology". Engineering organisations have been key drivers to introducing technology into the school, and in this context the Arts and Crafts subject does not have experience as a key player. Engineers and artists/designers have probably also different cultures and approach product development in different ways.

Science and Mathematics are absolutely central subjects as the basis for technological education. But traditionally technology had no place in the school's science subjects and therefore involves new subject material. Teachers have primarily education in a scientific tradition and therefore have little experience with technological principles. One cannot expect the science teachers to be familiar with the practical use of materials and tools. Science and Mathematics has been an important basis for technology subjects, but not vice versa. Technological principles have to little extent been part of the basic science or mathematics education. Thus, both science and mathematics teachers will be largely alien to the compounded and practical Technology and Design expertise.

Development of teaching programmes in Technology and Design

It is obviously challenging when different cultures work together to introduce a whole new range of knowledge. This was the motivation for collaboration between the three National Centres; for Art and Culture, for Science, for Maths, and the Oslo and Akershus University College of Applied Sciences, where the authors took part from the beginning. The partnership was established in 2008. The intention of the collaboration was to develop cross-disciplinary teaching programmes in technology and design, and to facilitate a real, practical, interdisciplinary cooperation in Technology and design, where each discipline is represented by its academic content and its traditions and values.

In this collaboration teaching material for the various competence goals of Technology and Design in the science plan has been developed and tried out. These have been coupled with appropriate competence goals of Mathematics and Arts and Crafts. The aim has been to develop programmes that build on each other and lead to progress in the development of Technology and Design expertise, with the intention that the projects should be included as part of the regular school subjects and so contribute to academic learning. For more information on these training schemes, see The Science Centre’s (Naturfagsenteret) website, the Science Centre’s magazine “Naturfag”, and the blog of the National Center of Art and Culture in Education. One of our projects in the multidisciplinary cooperation, related to electronic communication systems, was employed as a tutorial in Science, Technology and Design at 10th stage.

Goals for the tutorial are that the student should be able to:

- Account for an electronic communications system at the system level and discuss societal challenges related to the use of such (Science)
- Design products based on specifications for form and function (Arts and Crafts)
- Describe the various solution options in the design of a product using sketches and computer software (Arts and Crafts)

Most teachers experience the competence goal regarding electronic communication systems as difficult, and that has been the background for developing and piloting this educational program.

The educational program was tested at Alværn comprehensive school, 7th to 9th November and 2nd December 2011. The students were introduced to various topics and issues in Technology and Design and in electronic communication systems. This included:

- What is an electronic communications system
- How does an electronic communications system work, what are the consequences for the environment, sustainable development and value creation
- Design and concept development
- Introduction and drawing in GIMP
- Presentation of the development of digital presentations and brochures

The students designed a three-part folder containing narrative text, facts and digital artwork for their product, a future mobile communications device, in addition to the digital description of the network map. The students delivered a presentation of their work, with assessment, at the project days at Alværn comprehensive school.

Through the project, we found that there was a lot new material for the students to relate to. Students had no notion of the concept of specifications and were unsure of its contents. They did not have sufficient drawing skills nor sufficient experience with the drawing program used. In addition, all knowledge of communications systems and networks was new to them and had to be communicated during the project period. The result was that there was too much new information for the learner to deal with. The project should have been better placed in a learning chain of systematic preparation in the subjects, particularly science and arts and crafts. Students should have been introduced to parts of the material earlier. Then the students could have concentrated on the product they were designing - namely, the new communications equipment. And we could have challenged them to go further and possibly experiment with new forms.

Our experience shows that the project has great potential to integrate various aspects of a topic that is important in today's society. We will continue to work to improve the program and try it out.

Summary

Technology and Design has existed as a subject in schools only since the introduction of the Knowledge Promotion in 2006. The intention of the topic was to give students experience from our technological world and strengthen the work of design and problem solving in school. Also the students should gain experience in exploiting knowledge in Science and Mathematics in a practical context.

In working with Technology and Design you apply knowledge and skills from multiple disciplines and areas of expertise. We speak of the compounded expertise that is developed for competence of action. This type of combined knowledge is in great demand in the labour market.

There has been, and still are, challenges associated with the practice of the subject Technology and Design. The complex and many-facetted areas of expertise cause teachers within the traditional school subjects to experience the subject as strange, and it's challenging to establish a well-functioning multidisciplinary cooperation. Still we strongly believe that there is a large unexploited potential for developing valuable skills through multidisciplinary collaboration in Technology and Design. And the topic will be a valuable contribution to the overall design education in the primary school.

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Learning from co-designing

Hua DONG[*a b] and Shu YUAN[a]
[a] Tongji University; [b] Brunel University

Abstract: *A designer-focused approach is often taken when observing co-design processes and the designers' learning is reflected rather than the users. This study takes an all-inclusive angle in observing an inclusive design workshop which involved five professional designers, five users from a diverse backgrounds, and five design researchers. Questionnaires were distributed to the designer and user participants, before and immediately after the workshop, to gather data about their opinions on broader issues relating to inclusive design. The design researchers carried out observations during the workshop, gathering detailed notes and audio-visual data. Follow-up interviews were conducted to identify any issues relating to the workshop, and to let participants reflect on their experiences. It was found that the participants interpreted inclusive design and user-involvement in many different ways. The designers were not necessarily 'user-centred', but the fact that they were brought together with the users in the workshop did make them think more inclusively. Challenges for co-design were identified and suggestions were made to improve the co-designing process.*

Keywords: Co-design, inclusive design, workshop.

[*] Corresponding author: School of Engineering and Design | Brunel University | UK | e-mail: hua.dong@brunel.ac.uk

Introduction

The underlying driver for co-design is that the design team will be better at designing if they have an empathic understanding of the people to design with and for (Mattelmäkia et al 2011: 79). To embrace co-creativity requires that one believes that all people are creative (Sanders and Stappers 2008). The questions are: do designers naturally empathize with people? Do designers believe users are creative?

Ideally, in the co-design process, ‘users’, or ‘design partners’ are equal participants as designers. Fixperts (fixperts.org), the recently introduced co-design initiative which is rapidly expanding globally, emphasises this aspect by stating that the design process (documented in short films) should “place emphasis on the equally important roles” between Fixpartner (e.g. an end user) and Fixpert (e.g. a designer). In reality, do designers and users play equal roles in the co-design process?

The research aims to investigate these questions while focusing on inclusive design.

Method

A popular method for co-design is workshops, which can take many different formats. A half-day workshop was organized for this research, with the following objectives:

To introduce designers and users to each other

To understand design from the participants’ perspectives

To organise co-design activities and observe interactions between the designers and the users

To evaluate the co-design workshop

The workshop took place at Tongji University in Shanghai, China, in August 2012. Figure 1 shows the environment. The workshop had a focus on inclusive design, which refers to the “design of mainstream products and/or services that are accessible to, and usable by, people with the widest range of abilities within the widest range of situations without the need for special adaptation or design” (British Standard Institute 2005). This focus allows users to be chosen from a diverse background, thus giving an ideal opportunity to observe the interactions between designers and different types of users.

Figure 1. Co-design workshop environment

Participants

The workshop participants were recruited through the researchers' existing networks with local designers and users/user organisations. The criteria for selecting designers were that they must have worked in the industrial design/product design fields as professional designers for more than five years; this was to ensure that they reflect the real-world design practice. The selection of users was aimed to cover a wide range of different types of abilities and age groups; this was to ensure all aspects of 'inclusion' were considered in the co-design process.

When the design researchers first contacted the designers and the users, they briefly introduced the aim of the workshop, asked the participants to prepare for the workshop (e.g. bringing self-introduction materials such as photos and their most liked and least liked designs), and answered any questions raised. The users were visited (at their preferred venue) to establish mutual trust between them and the researchers. The profiles of the participants are shown in Tables 1 and 2.

Table 1. User profiles

ID	Age range	Gender	Education	Profession	(Dis)ability
Ua	15-25	M	Middle school	Jobless	Cerebral palsy
Ub	36-45	F	Primary school	Community volunteer	Deaf
Uc	46-55	M	High school	Jobless (used to be a chef specialised in making disserts)	Poliomyelitis
Ud	61-75	F	University	Retired lecturer	Healthy
Ue	76-85	M	High school	Retired worker	Healthy, with vision declining

Table 2. Designer profiles

ID	Age range	Gender	Education	Professional experience	(Dis)ability
Da	26-35	F	Postgraduate	12-year design	Healthy
Db	26-35	M	Postgraduate	7-year product design	Healthy

Dc	26-35	M	Postgraduate	10-year product design	Healthy
Dd	36-45	M	Postgraduate	20-year product design (General Manager)	Healthy
De	26-35	M	University	10-year product design	Healthy

In addition to the ten 'formal' participants, two junior designers and two carers/guardians also attended the workshop. Five design researchers observed the co-design session, with a few postgraduate design students helping with recording and logistics.

Questionnaires

Both designers and users were asked to fill out a short questionnaire before they attended the workshop, and immediately after they had finished the co-design activities. The pre-workshop questions aimed to illicit the participants' existing knowledge and practice relating to design.

The pre-questionnaire for the users and the designers were similar, and they both included the following questions:

What are your criteria for judging good design and bad design?

What is your understanding of the design profession? (e.g. what do designers do? What responsibilities do designers have?)

What role do you think you can play in the design process?

The post-questionnaire asked the same questions again to see whether there were any changes to people's answers before and after the workshop (i.e. whether the co-design activities contributed to people's understanding of design, designers and their own roles in the design process). In addition, more open-ended questions were asked in the post-questionnaire. i.e.

What are your comments to today's workshop?

What relationship do you think should be established between designers and users?

What suggestions do you have for our future workshops?

Observation

In-situ observations were conduced. The design researchers were allocated to each group, and they sat among other participants, focussing on recording everything happened in that group, such as the interactions between the designers and the users, the activities and the decision-making process. Notes were taken, and annotations were made to help interpret the situation. Figure 2 shows a typical scenario where one design researcher was observing the co-design activities and taking notes, and another capturing visual data.

Figure 2. A typical co-design scenario

Follow-up interviews

Follow-up interviews were arranged with the participants within two weeks of the workshop. The aim of the interviews was to identify any issues that were not shown in the workshop and to help the participants reflect on their co-design experiences.

The interviews took place in the participants' preferred venue (in most cases, user's home or designers' studios). The interviews with users were informal and open ended, and the interviews with designers were semi-structured. Specifically, designers were asked to explain their typical design process and comment on how users were consulted in their existing practice. They were also asked to comment on whether they think there is a need for designers to get to know the users, what inclusive design meant to them, and what methods and tools could support inclusive design.

Results

Questionnaires

The answers to the first three questions in the pre- and post- questionnaires are summarised in Tables 3a-3b, 4a-4b and 5a-5b. The differences between the answers are highlighted.

Table 3a. Users' answers to the question "What are your criteria for judging good design and bad design?"

	Pre-workshop	*Post-workshop*
Ua	Functionality	The combination of aesthetics and functionality
Ub	Functionality	The integration of functionality, appropriateness, durability, and low-carbon
Uc	I do my best in any job (misunderstanding of the question)	Not aesthetics, the only thing matters to me is appropriateness for purpose.
Ud	Simplicity, economy, appropriateness, aesthetics, plus 'newness and uniqueness'	Simplicity, economy, appropriateness, aesthetics, plus 'newness and uniqueness'

Ue	Functionality, aesthetics, novelty	Functionality, safe and convenience, novel style, and attractiveness

Table 3b. Designers' answers to the question "What are your criteria for judging good design and bad design?"

	Pre-workshop	***Post-workshop***
Da	The smaller the ratio between price/use time, the better the product	The same as before
Db	Outstanding in any of the following aspects: multi-channel, feeling and emotion, experience, or functionality	The same as before
Dc	Seamless experience	Depends on contexts. 'appropriate design' is good design, but from whose perspective?
Dd	Basic requirements: easy to use, appropriate appearance, comfort ergonomics – all are important. Higher-level requirements: taste – depends on individual, and difficult to standardise	The same as before
De	Functionality + aesthetics	Good design strives to meet the needs of the mass population

The results show that a key criterion of 'good design' from the users' perspective was concerned with 'functionality', while designers had more criteria. The users' criteria for judging good design changed more than those of the designers, after participating in the workshop.

Table 4a. Users' answers to the question "What is your understanding of the design profession?"

	Pre-workshop	***Post-workshop***
Ua	Aesthetics and functionality	To design perfect products.
Ub	To understand user requirements and their specific needs. To design better, more appropriate, more practical products.	To listen to users more, to understand users' specific needs. The designers' responsibility is to understand people's real needs and to design for the real needs.
Uc	Designers will encounter difficulties in their process which is understandable. I hope designers will design convenient items for disabled people. (misunderstanding of the question)	It's good to see that designers are considering the clients/users in their design process.
Ud	It is designers who make decisions of whether products will be liked, accepted, or used.	To synthesise existing ideas, to adapt current social context, and to upgrade those out-of-date products.
Ue	Design should be human-centred. Designers should study people's needs, and design easy to operate, convenient,	Designers should build their knowledge through studying people's life, and create more needed, more convenient and

	and safe products.	safer, functional products.

Table 4b. Designers' answers to the question "What is your understanding of the design profession?"

	Pre-workshop	***Post-workshop***
Da	To make good design available to more people; at the same time to create profits for businesses. To create more, better designs.	Designers are only a small part (of the whole system), but to do our job well will reduce potential problems.
Db	To plan, to create artifacts.	Had some reflections during the workshop, but due to the limited time, failed to develop new understanding.
Dc	1. to communicate users' needs. 2. to identify users' needs.	Designers can take more responsibilities than creating profits for the commercial world. They can influence design specifications. Good improvements without extra cost have the potential to let more people benefit from the design.
Dd	To integrate all elements and resources. Designers' responsibility is to improve people's life and to create new life styles.	The same as before. Designers materialise products and mediate the relationships between technology and people. He has responsibilities in several levels: personal value, clients' profits, users' ease of use, and ethics and environmental responsibilities.
De	To better meet consumers' needs for different products, to pursue higher and better life standards.	The designers' responsibility is to meet mass consumers' needs.

The results show that users' understanding of the design profession is more 'product-focussed', while designers' understanding of the design profession is less 'product-focussed'. After the workshop, three out of the five users emphasised the importance of designers' taking consideration of people's needs into the design process.

Table 5a. Users' answers to the question "What role do you think you can play in the design process?"

	Pre-workshop	***Post-workshop***
Ua	To express my humble ideas and inspire better ideas.	To beautify objects. (The user likes drawing and he's good at drawing)
Ub	To explain user needs to designers, to help designers better understand users. To provide feedback to existing products.	To help improve products, e.g. make them easier to use.
Uc	If I want to do something, I'll do it well and try to achieve the ideal.	If I have good ideas and suggestions, I'll try to have more, and do better.
Ud	To learn from existing designs.	You can design when you have a "Eureka" moment.
Ue	To express my ideas.	To provide my ideas for (designers)'

		reference.

Table 5b. Designers' answers to the question "What role do you think you can play in the design process?"

	Pre-workshop	***Post-workshop***
Da	To provide in-depth insights and suggestions.	The same as before.
Db	To investigate and explore from many different means and channels.	From problem solving to problem-healing.
Dc	To find where to start.	In my viewpoint, designers play the role of a facilitator in many cases. He needs to have good communication skills to influence the process and help to define the direction (of product development).
Dd	To integrate self-knowledge and all resources in order to lead design towards the direction that I believe is right.	The same as before.
De	To help businesses to pay deep-attention to consumers while helping create added-value to their products.	To make decisions on design. To provide guidance to clients.

While several users regarded their role in design (before the workshop) as 'providing information to designers', designers tended to see themselves in design as 'providing solutions and creating added value'. Interestingly, after the workshop, four out of the five users started to realise that they could be actively involved in the design process beyond merely providing information for designers.

The findings relating to the last three questions in the post-questionnaire will be incorporated in the Discussion section.

Observation

In-situ observation results were captured by notes. Here is an example of such notes in its natural sequence.

> Designer e: Took the hand-made tool – a multifunctional peeler made by User c – from the table and studied its blade, observing its adjustable feature and its flexibility in peeling vegetable skins at different thicknesses, commenting: " This is a rather good feature. Chinese people sometimes think it is a waste when peeling too much skins off."
> User c " Yes, the tool I made, when you press the blade in, you only peel off very thin skins, and bend it this way will avoid hurting the user…"(stopped as Designer e started to talk again)
> Designer e: "But I'm concerned with the durability of the blade, in addition, the material is not comfortable to hold."
> Designer c: "I've seen a peeler made of silicon."…

Conversations on specific topics were also recorded by notes, and the following is a selection of the notes (not in their natural sequence) from one group about the participants' discussion on 'inclusive design'.

Designer a: "We have to find a focus which reflects inclusive design principles; it should be used by any human being. "
Designer e: "But it is not necessary for children to use the kitchen. We should consider accommodating left and right-hand use. "
Designer a: "For older users, they need to be able to hold the weight."
Designer c: "I think another inclusive concept would be to make one thing that can peel skins of many different vegetables. "
Designer a: "The hand size of male and female users are different. "
Designer e: "If we can make an ordinary person to cook food as good as a chef through our design, would this be considered as inclusive design? "
Designer a: "If the user does not have an index finger, how could this tool be attached to his hand?"
Designer c: "Inclusive design is not necessarily related to disability."

The implications of these notes will be discussed in the Discussion section.

Interview

The interview with users suggested that although all the users appreciated their participation in the workshop, especially the opportunity to get to know designers and the design process, some of them were not comfortable in the co-design session as they felt that designers were dominating the process and were proposing "nice-looking but not practical" solutions to the problem.

Tables 6-9 summarise the key findings from the interviews with the designers.

Table 6. Are users involved in your company's typical design process? Why?

ID	Answers
Da	Yes. Because they know better the needs.
Db	Yes, mainly involved in earlier stages. The aim for user involvement was to clarify the problem and identify a focal point.
Dc	No, users are not much involved. Only when we design something we are less familiar with, clients will provide design specifications, including the input from potential users.
Dd	Relatively little user involvement, mainly because of the considerations of cost. Clients often do not want to spend time and money on user research. They tend to think that they are the expertsof the product. They know better than anybody else. They pay attention to the sales, but are not interested in the reasons behind.
De	Yes, users use products, and designers cannot represent them, if the schedule and budget allow, we always get users involved and would like to involve them throughout the process. We also make use of our own networks and resources, such as relatives and neighbours for testing our products. Sometime we advice clients to conduct user research, even at the cost of ours.

User involvement varies in the existing company processes, from little, to a certain extent (e.g. earlier design stages), to as much as possible within available resources.

Table 7. Do you think designers themselves need to get to know users? Why?

ID	Answers
Da	Yes. We need to know who buy our products, our target users.
Db	Yes, but not every time. Designers are not designing for themselves, and direct contact with users is not always the best way to understand users.

Dc	Yes, it is important to get in touch with different types of users. Research reports are not sufficient; the process of contacting users contributes to the final design solution.
Dd	Yes. There is a need for designers to get to know users in person, but this also depends on projects. Different methods should be adopted in different projects. If it is a less familiar field, or if there are “extreme users”, we must do user researchourselves. However, if it is something we are already familiar with, there is no need for user involvement.
De	Yes, different types of products correspond to different needs of people.

All the designers think it is necessary for them to get to know the users, but not necessarily for every project.

Table 8. Please explain what 'inclusive design' means to you.

ID	Answers
Da	Designs that more people can use, can afford, and are fond of.
Db	Based on “human-centred design“, emphasising humanity and responsibility of design.
Dc	Do design broadly: broader target users, broader environments, and broader time span. But I doubt the practicality of inclusive design in commercial worlds. Not all the designers need to do inclusive design. On one hand, design can address broader audiences, on the other hand, design can be done in greater detail and depth.
Dd	I still do not know the differencesbetween inclusive design and universal design. They do not differ much. They both aim to make products more convenient to use for more people. There is a need for universality, but not necessarily for every product.
De	Design to include more people, design to reduce the demand on user capabilities, design that everybody can use.

Designers interpret inclusive design in different ways, and some do not think it is necessary for every product.

Table 9. What methods and tools do you think would support inclusive design?

ID	Answers
Da	Through campaigns and promotion, as we promote sustainable design. Try to change people's mindset; no longer just focus on the new and the different, no longer just pursuit fame and profits.
Db	Empathy, inclusive process.
Dc	Workshop, prototyping and testing on site.
Dd	Communication with users, involvement of users, prototyping and simulation, visual recording.
De	1. Simplifying use 2. Iterative testing 3. Taking consideration of end users 4. Taking into account other stakeholders and factors, such as clients and cost 5. Putting designers' feet in other people's shoes; always trying to think from a different perspective.

Designers list a number of methods and tools, ranging from prototyping, testing with users, to changing people's mind set.

Discussion

The research is an in-depth study of co-design from both the designers and the users' perspectives, in the Chinese context. Although the numbers of participants were small, and by no means representative of the population, interesting insights were gained.

Insights

Designers and users see design differently. This is first demonstrated by the items they brought to the workshop as their liked and disliked designs. The items brought by the users were predominantly individually made arts and crafts (e.g. hand-knitted hat, scarf, decorations made from recycled materials, and hand-made kitchen utensils), while the items brought by designers were all mass-produced industrial products (e.g. cameras, milk/water bottles, lamps, mobile phone chargers, chopsticks, a comb and a pill dispenser). This might be because ‘design’ meant different things to designers and users. All the designers had an industrial/product design background; they tended to think ‘design’ from their professional perspective. The users tended to associate design with style, decoration, or tools.

Co-design did not seem to be a ‘natural‘ process for either the designers or the users. The observation suggested that designers were more interested in listening to other designers, rather than the users; and they sometimes ‘forgot’ the users. Although designers did consult the users from time to time, mainly through asking generic and abstract questions such as “what is your opinion on this?” they did not seem to take users’ comments seriously. One of the design researchers added a question in his notes: “are designers really listening to the user? ” On the other hand, users did not speak much in the co-design session, and they were only engaged when there was a topic that they were familiar with, for example: ‘peeling skins of new potatoes’. Sometimes users did not seem to know how to contribute to the conversation, and they started to use general terms such as ‘functionality’, ‘aesthetics’ to describe their needs.

The fact that designers and users were brought together in the workshop did make them think more inclusively. This can be seen from the selection of notes (Observation section) about the participants’ discussion on ‘inclusive design’ where they talked about ‘left and right handed use’, ‘older user’, ‘including different vegetables’, ‘male and female hand sizes’ and ‘disabled persons’.

Opinions had a degree of change after the participation of the workshop, both for users and the designers (see Tables 3a, 3b, 4a, 4b and 5a, 5b), although no consistent patterns were observed.

Back to the questions:

Do designers naturally empathize with people?

The observation suggested no. Design empathy requires designers not only be informed and inspired by users, but also be able to observe and feel for the users (Ho et al 2011: 96). The co-design session did not show such empathy. The designers used professional terms a lot, such as ‘material’, ‘ratio’, and ‘usability’, which were difficult for the users to understand. Sometimes the designers interrupted while the users were expressing an opinion. No detailed questions were asked about the users’ experience. When confronted by a different opinion from the users, the designers simply made a comprise, rather than investigating why the users said that. Here is an example:

> Design b: “In terms of aesthetics, we’d better adopt a low-profile style, not too unique, because different persons have different tastes”.
> User d: “I disagree. If the product is not unique, it won’t sell. We cannot adopt the low-profile.”
> Design b: “Let User d decide on the aesthetic criteria then.”

User a: "I agree to respect senior persons' perspective."

In this case, Designer b made a compromise, either because he did not have effective ways to communicate with the user, or because he was not interested in the user's opinion.

Do designers believe users are creative?

Again, little evidence from the study suggests that designers believe that the users are creative. Users may innovate if and, as they want something that is not available on the market and are able and willing to pay for its development (Von Hippel, 2005). A good example of this is the peeler brought by User c who used to be a chef. The peeler has a lot of advantages over the similar products on the market, but the designers criticized it a lot. While they were brainstorming new concepts, little considerations were taken from the user's redesign of the tool, as if it did not have much value.

In reality, do designers and users play equal roles in the co-design process?

It proved to be a challenge for designers and users to play an equal role in the co-design session, as users seemed to be less confident. This might be because there were fewer users than designers (junior designers also participated in the co-design session, and the design researchers were regarded as 'designers' by the users) or because the environment and the working method were more familiar to designers, and less familiar to users. One designer made a suggestion in the post-questionnaire:

> We should go to the users' environment to design. Discussion and sketching might not be a familiar method for users, maybe we can do something different, for example, let designers and users cook a meal together. In that kind of situation, users will perform more like themselves, and designers may be able to capture more design focal points.

Suggestions

When asked for suggestions, users tended to give very positive comments on the workshop, and suggested that more such workshops be organised in the future. Designers provided more constructive suggestions, for example,

Involving more users of similar (dis)abilities in the workshop

Giving opportunities for designers and users to get to know each other better

Providing more information about the aims, focus and the logic of the workshop, and giving more time for the co-design activities.

Briefing designers in advance to come to listen more, talk less.

Based on the observational data and the insights obtained, the following suggestions are proposed for consideration in organising such workshops in the future (Table 9).

Table 9. Suggestions for future workshop: key points to brief designers and users

	Designers	***Users***
Attitudes	Listen to the users, respect users' knowledge and expertise of using products. Be patient, and pay attention to users' real feelings.	Trust designers' abilities in design and communication. Listen to designers, especially when designers talk about topics that users

		are not familiar with.
Communication	Try not to interrupt while users were talking, avoid jargon.	Use plain and natural language, avoid unnecessary 'complication' or 'decoration'.
Dealing with disagreements	Explain with patience. Give convincing reasons.	Express one's viewpoints and provide convincing reasons.
Design process	Try to propose more practical, less conceptual solutions.	Be brave; express one's design ideas.

Sufficient time should be given for designers and users to interact with each other, and to establish a comfortable working relationship. Other more specific suggestions include:

Briefing designers and users in advance

Both designers and users need to be briefed in advance, so that they understand the value of co-design, and are prepared to respect and listen to each other more.

CREATING AN APPROPRIATE ENVIRONMENT FOR CO-DESIGN

The environment should make the designers and the users both feel confortable. The studio environment for the co-design workshop was too unfamiliar to the users. If the co-design focuses on 'insights searching', it would be useful to use a familiar place for the users where they can talk and behave naturally. If the focus is on 'concept generation', the environment can be a materials workshop where lots of materials are available for co-design. It is also important to note that users (and manufacturers) tend to build prototypes of their innovations economically by modifying products already available on the market to serve a new purpose（von Hippel，2005). In the future, idle items from everyday life may be brought to the co-design workshop as materials for prototyping to engage users.

USING VISUAL LANGUAGES FOR EFFECTIVE COMMUNICATION

Visual languages and tools, e.g. 'generative tools' proposed by Sanders et al (2008), could be used to enhance communication between designers and users.

Conclusions and future work

The co-design workshop brought designers and users together, and provided basic materials and tools for them to interact with each other; this has allowed the researchers to observe the whole process as it naturally happened. Key findings include:

The designers were not necessarily 'user-centred' or naturally empathetic with people, but the fact that they were brought together with the users in the workshop did make them think more inclusively.

It proved to be a challenge for the designers and the users to play an equal role in the co-design session. The designers showed more confidence and control in the process.

Suggestions were made to improve the co-designing process. More co-design workshops were planned for the future, to apply the knowledge learned from this study, and to investigate how designers and users can collaborate more effectively to achieve optimal design processes and outcomes.

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Design Minds: An online design education platform for non-designers to enact cultural change

Christian DUELL[*a], Natalie WRIGHT[b] and Joanna ROXBURGH[c]

[a] State Library of Queensland; [b] Queensland University of Technology; [c] Queensland Government Arts Queensland

Abstract: *Education in the 21st century demands a model for understanding a new culture of learning in the face of rapid change, open access data and geographical diversity. Teachers no longer need to provide the latest information because students themselves are taking an active role in peer collectives to help create it. This paper examines, through an Australian case study entitled 'Design Minds', the development of an online design education platform as a key initiative to enact a government priority for state-wide cultural change through design-based curriculum. Utilising digital technology to create a supportive community, 'Design Minds' recognises that interdisciplinary learning fostered through engagement will empower future citizens to think, innovate, and discover. This paper details the participatory design process undertaken with multiple stakeholders to create the platform. It also outlines a proposed research agenda for future measurement of its value in creating a new learning culture, supporting regional and remote communities, and revitalising frontline services. It is anticipated this research will inform ongoing development of the online platform, and future design education and research programs in K-12 schools in Australia.*

Keywords*: Design thinking, digital technology, K-12 schools, distance education*

[*] Corresponding author: Asia Pacific Design Library | State Library of Queensland | Australia | e-mail: Christian.Duell@slq.qld.gov.au

Introduction

With an understanding of design as the link between creativity and innovation (Cox 2005, p.2), more recently, the incorporation of design and design thinking across all levels of education has been acknowledged as a method of fostering the agency and capacities needed to support the transition away from the postindustrial economy, towards an emergent knowledge-based creative economy (Design Commission 2011). An international analysis of design education policy highlights Finland's Design 2005! program as a dynamic example of utilising design for national innovation and cultural change (Design Commission 2011, p.39). This program was underpinned by a conceptual structure in which design process skills connect cultural and social factors to business, around a central core of technology (Figure 1).

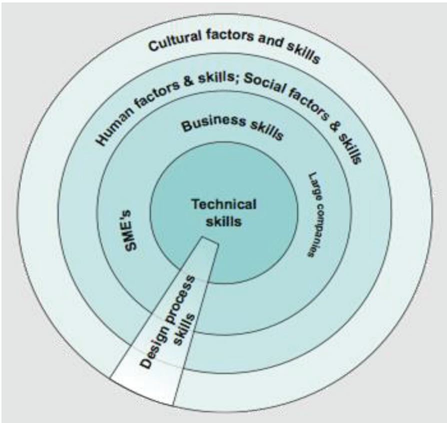

Figure 1: Conceptual Diagram - Finland's Muoto 2005! Source: Drawn by Juha Jarvinen, original design by Juhani Salovaara and Ilpo Koskinen (Koskinen et al 2011, p.157).

Significant investment (Macleod et al 2007) in design research, education and promotion, had a dramatic positive impact on the country's global competitiveness and its rating as the top performing education system in 2006 (Ministry of Education and Culture of Finland 2007), and later its ranking in the top three for mathematics, reading and science in the OECD 2009 Programme for International Student Assessment (PISA) tests (OECD 2010).

If indeed "using creativity and design-based thinking to solve complex problems is a distinctive Australian strength that can help meet the emerging challenges of this century"(Australian Government 2012, p.8), there is a need to cultivate this strength by establishing a similar design-led culture in Australia. Australia also statistically rated significantly above the OECD average in the 2009 PISA assessments. However, the introduction of design awareness at a school level, and provision of incentives for students and teachers to build open, cross disciplinary, collaborative learning networks servicing Australia's vast geography, is needed to ensure future generations are empowered for business innovation and active citizenship.

This paper highlights the challenges and current deficiencies surrounding design education in Australia in a new culture of learning, in particular the ability of online design education platforms to build community and enact cultural change. It details the provision of a framework for incorporating design thinking (as a generic capability) in K-12 education in regional areas of Australia. A future research agenda pursued through the *Design Minds* online platform (State of Queensland State Library of Queensland 2012a) case study is outlined. It is anticipated that the findings of this research will encourage policy makers to see the value of design-led innovation and online design education platforms in strengthening community resilience in regional areas, and developing strong economic and social ties with the Asia Pacific during the "Asian Century"(Australian Government 2012).

Australia's shifting economy and learning culture

From a commodity economy to a creative economy

In coming decades Australia faces a significant challenge to adapt to a shifting global economy, lead by an emerging Asian middle class (Hajkowicz et al 2012, p. 11). As identified in the "Australia in the Asian Century White Paper" (Australian Government 2012), this challenge represents an opportunity to shift from a commodity economy to a creative economy. Asia Pacific countries such as Singapore, Korea, Hong Kong and China are also actively realigning design education to ensure effective delivery of a workforce positioned to support future industry innovation (Design Commission 2011). These countries also rated amongst the top-performing school systems in the 2009 PISA tests (OECD 2010).

If education is seen as the key foundation for seizing the opportunities of this new global era, perhaps the greatest challenge facing Australia is the geographic isolation of its regions. This is most evident in the state of Queensland. Collectively, there are 1,239 state schools in Queensland, incorporating pre-schooling, primary, secondary and special schools. Approximately half of these schools cater for almost a quarter of the state school students in rural and remote areas, equating to approximately 616 rural and remote schools in Queensland (The State of Queensland Department of Education, Training and Employment 2010). In 2011, 18% of Australian primary schools were in Queensland including 72% government and 28% non-government schools (Australian Bureau of Statistics 2011). It is notable that Queensland has a higher proportion of small regional primary schools than other states in Australia (McCollow 2012, p.5). While Queensland's geographic isolation is not a new challenge, new technology is more recently providing greater opportunities to connect, while also destabilising traditional models of knowledge exchange.

Design and the new culture of learning

The 'information age' has seen the emergence of a number of related knowledge movements including 'open data', 'open source', DIY (do-it-yourself) / DIWO (do-it-with-others) and hacker/activist cultures. Each of these movements thrives on constant change and the collective exchange of continually up-to-date information. This represents a shift toward what has been termed "a new culture of learning" (Thomas and Brown 2011, p.17). Education in this new culture of learning therefore requires a new environment for appropriating information in the face of rapid change, "moving from learning through *instruction* to learning through *doing*", particularly in areas of social information. "This environment is called a collective; a collection of people, skills and talent that produces a result greater than the sum of its parts" (2011, p.52).

While limitless access to information and collectives is exciting, it is important that this new culture of learning is established through a curatorial approach. Design in an educational sense, becomes a structured framework for these new forms of learning to take place. The term "design" (also referred to in this paper as "design thinking") in this context is interpreted as a verb and defined as a process:

> …of imagining something that does not yet exist. And then arranging all the elements required to make it a reality. Design is equal parts embracing constraints, challenging the status quo, and summoning courage. (Yamashita 2012, p.1)

With a focus on fostering curiosity and developing inquiry-based thinking, the design process provides a useful model for exploring "a new culture of learning", by focusing on the identification and creative exploration of complex problems.

Government Investment in Design Education for Cultural Change

In an Australian context, the role of design in education has attracted various forms of Government attention.

Federal Government

The Australian Government seeks to improve the education system so that it ranks as one of the top five performing OECD countries in the world (for education) by 2025 (Hattie 2012). Australia's history of progressive education positions it well to compete with its Asian neighbours in all education spheres, however this is dependent on emphasis being placed on a creative and democratic production of knowledge, focusing on inquiry and critique, rather than a narrow, linear reproduction (Hooley 2012). This paper argues that design as a process is not an isolated area of study limited to the creative industries, but is rather a necessary and ideal framework for establishing "a new culture of learning" and capitalising on Australia's emerging creative economy opportunities. As Bentley suggests, this is a broad shift in the perception of education's role within society:

> This vision involves shifting the way we see education from a separate sector of society to a culture which infuses every sector, linking together individuals, communities and institutions through diverse, overlapping networks of learning relationships. (Bentley 1998, p.187)

Three significant national programs present implications in terms of responding to the challenges posed by cultural change in education, geographic isolation and the "Asian Century":

- The National Broadband Network (NBN); a federally-funded ten year program that seeks to overcome geographic boundaries by connecting 93 per cent of Australian homes, schools and businesses through fibre optic networks, capable of providing broadband speeds of up to one gigabit per second
- The Australian Curriculum; a nation-wide reconfiguration of learning to create efficiencies across states and recognising 'higher order-thinking' and complex problem-solving abilities

- National Design Policy (proposed) (Australian Design Alliance 2012); currently under development (including a key recommendation for Design Education) in pursuit of legislation

These programs sit within the context of a range of state led initiatives to support cultural change through design.

State Government

The Queensland Government has a very successful, internationally recognised "Queensland Design Strategy 2020" (Arts Queensland 2009) dedicated to positioning design at the heart of Queensland life, while making Queensland a leading centre for design excellence and innovation in Australia and the wider Asia-Pacific region by 2020. The "Queensland Design Strategy 2020" has four key objectives: (a) Strengthen the Queensland economy; (b) Foster a design culture; (c) Build design knowledge and learning; and (d) Support public sector innovation. Alongside Queensland Government investment, design momentum is also supported through the Visual Arts and Craft Strategy – a bilateral funding agreement of the Australian, State and Territory governments - with an allocation of $0.6M over 4 years (2011–12 to 2014–15) Initiatives that have emerged from the Design Strategy include The Edge (The State of Queensland State Library of Queensland 2013); Asia Pacific Design Library (APDL) (The State of Queensland State Library of Queensland 2012b); Unlimited: Designing for the Asia Pacific 2010, Queensland-Smithsonian Cooper Hewitt Design Museum Fellowship (The State of Queensland 2012), and the Queensland Design Council (The State of Queensland Arts Queensland 2011) which has also established design endorsement initiative QUEENSLANDERSIGN™ (2013).

The Queensland Design Council, a multidisciplinary strategic advisory group comprised of high-profile leaders from the design industry, commercial enterprise and academia, was established in 2011. It champions good design, promotes its benefits to the broader community, advises on the direction and priorities of the "Queensland Design Strategy 2020" and provides design led responses to the economic, social and environmental challenges facing Queensland. The Queensland Design Council believes:

> The role of design thinking and practice in education is critical. The National Education Policy should dovetail with the National Cultural Policy and National Design Policy to legitimise design, culture and creativity. To acknowledge design thinking as part of our learning approach, no matter what level, can foster productivity while simultaneously serving as an access bridge to the core arts. (Queensland Design Council 2011, p.19)

Towards these objectives, it demonstrated national leadership in May 2012 by hosting a National Design Policy Forum for industry leaders, peak bodies and other governments.

Design Minds is an online platform for design and creative led learning and skill development resources, endorsed by QUEENSLANDERSIGN™, and promoted through The Learning Place (Education Queensland's online channel) (The State of Queensland Department of Education, Training and Employment 2012). It is another key delivery initiative of the strategy as part of the "Build design knowledge and learning" objective to "improve creativity and design in education and learning at all levels". A key action of Arts Queensland "partnering with the Cooper-Hewitt and the State Library of Queensland to develop online design education resources" with the aim to "encourage knowledge and skills exchange in design education and to increase the capacity of Queensland teachers to teach creativity and design"(Arts Queensland 2009, p.38) was implemented, to be delivered by the APDL.

Design Minds in the Context of Global Online Design Education Models

Establishing Design Minds

With the commencement of the Queensland-Smithsonian Cooper Hewitt Design Museum Fellowship in 2008 and the establishment of the APDL in 2010, the delivery model for *Design Minds* was formalised in November 2011 and an investment agreement established for the delivery of Stage One by 30 June 2012. This involved planning of the methodology model for the online education platform and the construction of the *Design Minds* website with basic functionality.

A key component of the planning stage was the evaluation of various existing online design education models, as well as design methodologies employed by leading businesses, universities and educators. It was determined from an early stage that rather than adopting and replicating an existing model verbatim, it was necessary to develop a model that synthesised global best-practice in terms of design thinking, and responded to the geographic and cultural qualities unique to Queensland.

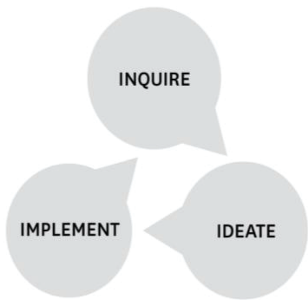

Figure 2: Design phases as part of the Design Minds methodology. Source: (The State of Queensland State Library of Queensland. 2012a)

In April 2012, the Design Minds project delivery team held a 'Content Methodology Workshop' to explore the challenge: "How might we utilise design thinking to improve student learning outcomes within the context of the existing education framework and benchmarks?" Various methodology models were evaluated (Table 1) including the Cooper Hewitt's "Ready, Set, Design!" (Smithsonian, Cooper Hewitt Design Museum 2011), d.school's "Stanford Design Program" (Hasso Plattner Institute of Design 2010) and IDEO's "Design Thinking for Educators"(IDEO 2012).

It was observed, that while each of these processes allow opportunities for flexibility and fluidity in exploring a problem, they tend to operate linearly, and focus on practical outcomes, rather than emphasising educational theory. It was argued that a 'design-for-education' approach that advocates designing as way of empowering 'non-designers' in resolving and reframing complex open-ended problems (Ambrose and Harris 2009) should be favoured over a 'design-for-business' approach that concentrates on adding value (Brown 2008, 2009; Lockwood 2009; Martin 2009). The former recogises that:

> central to studio based learning is the positioning of work in a critique space that renders the work never complete, always on a pathway toward better iterations (Brocato 2009, p.142)
>
> It also acknowledges Thomas and Brown's observation that:
>
> Only when we care about experimentation, play and questions more than efficiency, outcomes and answers do we have a space that is truly open to the imagination. And where imaginations play, learning happens. (Thomas and Brown 2011, p.118)

A simple, fluid, non-linear process was devised, focused on developing higher order thinking skills, and creating an environment to facilitate experimentation and innovation for non-designers across non-design subject areas. It was based on the model of 'Inquire, Ideate & Implement', supported at each stage with structured 'Reflection'. (Table 1 and Figure 2)

Table 1: Comparative evaluation of design thinking methodologies. Source: State Library of Queensland, Asia Pacific Design Library

Methodology	**Design Stages**									
Cooper Hewitt	Identify	Investigate		Frame / Reframe	Generate		Develop		Evaluate	Re-evaluate
iDesign Thinking	Intending	Defining		Exploring	Suggesting		Innovating	Goal-getting	Knowing	
D School	Empathize	Define		Ideate			Prototype	Test		
IDEO	Discovery	Interpretation		Ideation	Experimentation		Evolution			
Design Minds	**← Inquire →**		**Reflect**	**← Ideate →**		**Reflect**	**← Implement →**		**← Reflect →**	

This three-phase approach flexibly encompasses the various activities and modes of thinking inherent in other design methodologies, and communicates them in a simple and accessible way to non-designers.

The Design Minds model

Design Minds aims to create a neutral space for "a new culture of learning" to take place in Queensland, within an Asia Pacific context. It utilises design thinking to develop 21st century capabilities, within existing Queensland and Australian education benchmarks. It achieves this by presenting information on three levels by 'explaining' design, 'inspiring' through resources and 'empowering' through design thinking toolkits. These three levels of information are intended to gradually introduce non-design educators and students to the concepts of design thinking, and encourage deeper curiosity-lead investigation.

DESIGN PHASES

In evaluating the various precedent methodologies (Table 1), and seeking to simplify and synthesise the overlap in the various identified design process phases of 'inquire', 'ideate' and 'implement', it was proposed that each phase could cultivate different behaviours and utilise different modes of thinking, both creative and rational:

- Inquire: exercises related to research, identifying/defining a problem, developing background understanding, and setting objectives
- Ideate: exercises related to brainstorming, generating ideas and solutions to a problem, experimentation, risk-taking and play
- Implement: exercises related to testing developed ideas, prototyping and communicating an end result

Considering the overall process as fluid and non-linear, it is possible for a problem to be explored by shifting back and forth between phases (see Figure 2). This can be transformative if the behaviours and modes of thinking unique to each phase are adopted. It is evident from this approach that a large percentage of the *Design Minds* methodology is not purely creative, but involves modes of thinking utilised in both the Sciences and Humanities (Table 2).

Table 2: Comparative modes of thinking in education. Source: (Seif 1998)

Sciences	**Design**	**Humanities**
What is	What Ought to Be	Human Experience
Classification	Pattern-Formation	Metaphor
Analysis	Composition	Criticism
Rationality	Creativity Innovation Imagination Ingenuity	Intuition
Objectivity	Purposefulness Practicality	Subjectivity
Expression of Facts	Expression on Behalf of the Other	Self-Expression
Truth	Reality	Justice

While the popular use of the term 'design' and its association with creativity is evidently misleading, the apparent opportunity in this observation is the potential value of the design thinking process to inform and extend subject areas outside design, allowing opportunities for design-led creativity and innovation in areas which have traditionally not been perceived as creative, such as literacy and numeracy. As described by Lloyd (2012), students learning design at a distance, have the opportunity to acquire knowledge through a process of induction, "iterating through structures that slowly become intuitive".

EXISTING LEARNING BENCHMARKS

Design Minds therefore seeks to promote to non-designers, the value of the design process in developing a broad range of creative *and* rational thinking skills. A key theme that emerged during the planning process, consistently reinforced by teachers, was the importance of closely integrating *Design Minds* content within the context of existing learning benchmarks. As one teacher suggested:

> While it is great you are getting involved in design education, an alternative framework to what will be developed for the Australian Curriculum is unlikely to gain much traction in schools and the teacher education preparation I am involved with. (Anonymous)

This feedback lead to the incorporation of existing learning benchmarks including Naplan (N*ational Assessment Program for Literacy and Numeracy)*, Australian Curriculum (a standardised national approach to school curriculum), C2C (resources assisting teachers in implementing the Australian Curriculum in the classroom), and Professional Standards for Teachers (Queensland-based professional development standards for teachers) within *Design Minds* toolkit content. It was perceived that this would further enable the enthusiastic adoption of resources by teachers in K-12 classrooms throughout Queensland, particularly for those unfamiliar with the design process.

Preliminary Evaluation, Knowledge Gaps and Opportunities

Preliminary evaluation of knowledge gaps and opportunities was undertaken during the Stage One planning process via discussion with members of the *Design Minds* Project Delivery Team. This team included Smithsonian Cooper-Hewitt Design Museum Fellows representing primary, middle school and secondary school sectors, and selected representatives from academia, relevant government departments, The State Library of Queensland, The Learning Place and Josephmark (Website Design). An 'Early Adopter' Network was also consulted. After the successful launch of *Design Minds* on the 28 June 2012, a Stage One Evaluation Report complying with the investment agreement, included data compiled from website views, visitations and total toolkit downloads. Key outcomes are summarized in Table 4.

Table 4: Performance measures established during Stage One evaluation. Source: State Library of Queensland

2012-13	**Page visits**	***Target***	**Page views**	***Target***	**Non metro (views) %**	**Toolkit download**	***Target***
July	920	*750*	2443	*2084*	34%	17	*17*
August	506	*750*	1289	*2084*	35%	34	*34*
September	354	*750*	924	*2084*	50%	47	*51*
October	302	*750*	735	*2084*	34%	57	*68*
November	256	*750*	768	*2084*	30%	67	*85*
December	249	*750*	544	*2084*	64%	76	*102*
January	560	*750*	1506	*2084*	69%	109	*119*
Total/Year Target (by July 2013)	**3,147**	***9,000***	**8,209**	***25,000***	**30%**	**109**	***200***

Three key insights and subsequent opportunities have been identified from the preliminary evaluation. These form the basis for a future research agenda.

Community partnerships and engagement model

Beyond the investment agreement's initial success requirements of basic functionality and resources, many additional outcomes were achieved, including a successful pilot community partnership project, the "Sit-Art 60 Chair Challenge" (The State of Queensland State Library of Queensland 2012c). "Sit-Art" invited senior design students from Kelvin Grove State College to create customised seating designs for 'The Myer Centre', a commercial inner city shopping precinct in Brisbane, Queensland, and compete for a 'People's Choice Award'. The completed designs now feature on 60 chairs installed in the refurbished central atrium of 'The Myer Centre' food court. While "Sit-Art" was initially conceived as an isolated project for the purpose of generating initial content for *Design Minds*, the success of the project has lead the project delivery team to further investigate the value of this model. By engaging students in a real-world challenge that extended beyond the traditional boundaries of their classroom, "Sit-Art" serendipitously presented a successful model for "a new culture of learning", as advocated by Bentley:

> Schools will need to transform themselves to become the hubs of learning networks….brokering learning opportunities with people and organisations in the communities around them. (Bentley 1998, p.183)

Beyond successful community engagement that comprised a network of over seventy individuals, including stakeholder representatives from retail business, design/architecture practice, a university School of Design (tertiary design student mentors and lecturers), a state secondary school (school students and teachers), and The State Library of Queensland, anecdotally students and facilitators celebrated the benefits of learning through this community network via video recordings and a survey completed at the end of the project (currently pending ethical clearance). The importance of the real-world challenge focus of this type of community learning project is also recognised by teachers:

> All these competitions are a means to engage kids in creative learning. All it comes down to is a teacher saying this is great, I'll build this into a class room (……) What makes one person better than another? Practice, day-in-the-sun, practice. It is a design process. (Wright et al 2012)

An opportunity now exists to develop a *Design Minds* model for challenge focused, community learning projects, which can assist in generating community partnerships in schools across Queensland. Based on the 'Sit-Art' project, this model may incorporate the following components:

- a local problem, challenge or competition involving a community group or business (framed as a "How might we..?" question);
- project facilitator/s, e.g. classroom teacher;
- a professional design consultant and a group of design mentors to support the learning/problem solving exercises; and

- resource and facilitation support from the Design Minds team.

Early adopter network

Kvan (2011), when considering the pedagogical aspects of virtual design studios, notes that there are additional obligations for the ‘tutor’ in facilitating and managing discussion online, and building trust between remote peers in a group-based learning setting. In an effort to recruit ‘tutors’ in the lead up to the Stage One launch of *Design Minds*, approximately sixty educators from across Queensland were engaged to provide feedback on content, participate in professional development workshops, and access and promote the pilot content. This group was identified as the ‘Early Adopter’ network. Initial website statistics suggest that this network has been responsible for driving the majority of traffic to the site to date. 38% of toolkit downloads have been accessed by users in non-metropolitan locations across Queensland, demonstrating broad geographic reach.

An opportunity exists for the APDL to continue to measure, geographically track and develop the ‘Early Adopter’ network across Queensland. Federal government investment in the National Broadband Network in the coming decades will ensure that regional communities will not only have the opportunity to digitally connect to each other but also to other global communities. It is therefore a priority for *Design Minds* to expand and connect these networks with learning communities across the Asia Pacific. To this end, the APDL has commenced correspondence with a global network of likeminded organisations in Finland, the United Kingdom and Singapore. These global relationships will be developed in the future to continue the exchange of knowledge and international best practice in design education.

Impact evidence and feedback loop

Having met the initial success measures of the investment agreement, subsequent targets for *Design Minds* have been established to monitor future engagement and growth (Table 4). While this data is useful in measuring the reach and growth of the platform, it does not meaningfully evaluate the extent to which *Design Minds* is developing desirable behaviours and capabilities, having cross-curriculum impact and integrating within existing learning benchmarks. There is an opportunity for *Design Minds* to create an ongoing communication feedback loop that informs content development to meet the design education aims of the platform and the broader “Queensland Design Strategy 2020”.

Future Research Agenda

The opportunities identified in the preliminary evaluation have informed the development of a proposed future research agenda, which will significantly underpin the procurement of ongoing public and private sector support for the platform, and more broadly contribute to the extension of current theory on online design education. This will involve qualitative and quantitative research facilitated as an integral component of the online platform, and also conducted as part of community partnership project case studies, employing action research.

Community partnerships and engagement model

Building on the success of “Sit-Art”, *Design Minds* will continue to promote a community partnerships/engagement model through facilitated projects and in-direct support. There is an intention to identify potential partners within the model framework to directly facilitate a minimum of five metropolitan community challenge case studies per year, with the *Design Minds* team providing in-kind support and in some cases a limited financial contribution to these projects. Indirectly, *Design Minds* will aim to support a minimum of five self-managed regional community projects per year. While it is unlikely that on-the-ground support can be offered for these projects, the *Design Minds* team will provide online professional development, support in documenting the project, and mentoring to assist in the execution of the project. This model presents a valuable opportunity to activate regional communities, as former Queensland-Smithsonian Cooper Hewitt Fellow and regional Queensland teacher Kevin Collins explains:

> If you can find something that your town or your community thrives on, you get people involved in your school, the kids get excited, the community get excited and things start happening and people love it! (The State of Queensland, State Library of Queensland 2012d)

One key method for supporting these regionally focused projects will be the creation of a *Design Minds* toolkit that provides a guide for teachers on how to facilitate community partnerships and how to record the success of the program for principals, teachers and community partners, through an action research methodology. Further, the execution and documentation of these projects will be incentivised by providing up to five 'micro-grants' to assist in video documentation of the projects and data collection via surveys. The videos and relevant research outcomes will be showcased on the *Design Minds* website to inspire other regional schools to pursue community partnership projects and ongoing action research data collection.

A range of community partnerships have already been identified and developed for 2013. Additionally, the first steps toward enacting partnerships between regional Queensland and the Asia Pacific have been established through the discussion of *Design Minds*' involvement in the ARMI Forum initiative, based in Helsinki, Finland and connecting with partners in Hong Kong in 2013. For each of these projects, it is intended that similar action research will be undertaken with partnering local institutions/researchers, to measure engagement and geographic reach through the development of meaningful impact evidence and a feedback loop.

Impact evidence and feedback loop

A central tool in demonstrating the value of *Design Minds* is the ability to measure its positive impact in meeting the challenges of "a new culture of learning" and enacting cultural change. One key response addressing existing gaps in knowledge is the development of a standardised questionnaire proforma to be included as an addendum to all future toolkits. This broad ongoing feedback loop will provide valuable ongoing access to data to support the future development of the platform. The completion of this questionnaire will be incentivised by offering a book reward for the school, provided by the State Library of Queensland. The questionnaire will include a range of performance measures including:

- age, location and number of participants;
- feedback on the success of the toolkit in aligning with existing learning benchmarks;

- feedback on usability of toolkits, particularly in regard to the design phases and language used;
- anecdotal feedback gauging levels of student enjoyment/reward in relation to traditional learning programs and environments; and
- an option to be contacted to provide further ongoing feedback, to volunteer as an Ambassador for the program, or to author future toolkits.

More directly, the challenge for design thinking to have a greater cross-curriculum impact is currently being addressed through a project to develop a year-long design thinking foundation subject and aligned action research project, in conjunction with Pimpama State Secondary College, to commence in 2013. The design thinking foundation subject, unique within the Australian education system, will introduce the *Design Minds* methodology and demonstrate how higher order thinking skills developed in the design process can be applied to other non-design related subjects as part of the overall curriculum. The design thinking foundation subject will be fully documented and made available for download from *Design Minds*, allowing *Design Minds* to have a stronger cross-curriculum impact across the State. This will be supported by a coordinated research agenda coordinated in conjunction with academic assistance.

Design Minds Ambassadors

The ongoing growth of the *Design Minds* community will be supported through expansion of the early adopter network. The current role of the early adopters will be reviewed and formalised with the title of *Design Minds* 'Ambassador'. This role will include a range of responsibilities for actively promoting and developing the *Design Minds* platform. Selection of *Design Minds* Ambassadors will seek to identify educators who possess the 'effective qualities of a 21st century citizen' and have a broad network of influence, ideally through a teaching association or member organisation. Up to twenty *Design Minds Ambassadors* will be selected each year, broadly representing the vast geographic spread of the state.

To support the strengthening of this network and the dissemination of the *Design Minds* platform amongst the networks of each individual ambassador, a range of professional development opportunities will be facilitated each year. One professional development session will be held each year allowing the *Design Minds* Ambassadors to gather in a central location to share the latest design education knowledge and support its dissemination throughout the regions. One additional professional development session will be offered each year through an open invitation to teachers across the State, with some support offered to finance regional teachers' attendance. This targeted training, complemented by an open invitation to all teachers, aims to support the strategic, as well as organic growth, of the platform across the State. *Design Minds* Ambassadors will also be expected to facilitate one professional development session per year amongst their member association or organisation. *Design Minds* will provide mentoring support and resources to assist the facilitation of these sessions, and action research survey instruments to allow data capture for ongoing development of these important sessions.

The success of the development of the *Design Minds* community will also be measured by tracking participation in professional development and capturing data on geographic reach and engagement with the *Design Minds* website.

Implications

The initial aim of *Design Minds* was to provide resources to increase the capacity of Queensland teachers to teach creativity and design (Arts Queensland 2009). However, given the surprising lack of international evidence-based research on the impact of design education on national innovation and education systems, and the role of design thinking in K-12 classrooms (McGimpsey 2011; Miller 2011), there is a huge potential for this program to also facilitate a long term research agenda with internationally significant outcomes.

While the initial focus of this research is short-term, it is not finite and is expected to expand in scope and direction over time. It is therefore essential to establish yearly evaluation points where research to date can be gathered, synthesised and presented for the purpose of seeking further support for the platform. It is hoped that the data and evidence gained through this future research agenda will support public and private sector investment in the platform. In pursuing the 'Community Partnerships and Engagement Model', requests for future funding and support should also look to focus on opportunities for mutual benefit in key areas of the project that will strengthen and support sustainable growth. This allows for various funding models, not only through government investment, but also private sector project-based support of the following priorities:

- Resourcing ongoing regional engagement
- Investment in further evidence-based research
- Investment in ongoing professional development and capacity building amongst educators

Beyond the short-term focus of this future research agenda there are obviously areas of significance outside the scope of this study that will have medium to long-term implications within "a new culture of learning". For example, what role might *Design Minds* play in facilitating student collectives? How might students use *Design Minds* as a secure and safe 'third place', separate from the school and teachers, to create their own learning networks?

Additionally, the medium-term research agenda should aim to explore the impact of school design education in the uptake of design education at a tertiary level. The long-term research agenda should further aim to measure the impact of school design education at a business and GDP level, measuring and assessing the degree to which design contributes to Australia's shift from a commodity to a creative economy.

Summary

The continually expanding impact of technology is having an increasingly destabilising effect on traditional models of education. Globally, it is becoming widely recognised that a shift toward "a new culture of learning" is required to operate successfully within 21st century paradigms. In an Australian context, a parallel shift is required in the national economy, as demand decreases for commodity exports and opportunities arise to develop a creative economy in response to the demands of the Asian Century. In terms of education and business, Australia faces the challenge of enacting deep cultural change to grasp these opportunities. Within this context, Queensland faces a unique challenge in connecting remote and disparate communities through technology, and mobilising and empowering the next generation to benefit from the opportunities of the Asian Century.

Design, a process for creatively and rationally exploring complex challenges, provides an ideal framework for facilitating this cultural change. *Design Minds* represents a key initiative in changing the culture of learning in Queensland and connecting geographically remote communities. Building on the success of a participatory design process used to create the platform, and the growth of its user community through the establishment of a community partnership model and an ambassador network, the program provides rich opportunities to extend current theory on distance design education, in particular the value of community engagement, through case study methodology, employing action research. The challenge in sustaining the platform and having a genuine impact in enacting cultural change lies in the successful measurement and demonstration of its value and reach, in order to seek further support from government, in the form of Federal and State policy and funding. This requires the development of a coordinated and integrated research agenda for the platform, enlisting assistance from an aligned research community.

While a 'top-down', Government approach to cultural change is necessary, the future research agenda outlined in this paper builds on emerging evidence that cultural change can also be facilitated in a 'bottom-up' way through community engagement. *Design Minds* therefore seeks to enact cultural change by empowering a 'bottom-up' network of community partners, while advocating through evidence-based research, for future 'top-down' support from Government.

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Hooked on peers' drawings: Learning through the visual wildfire

Nina Scott FRISCH*
Queen Maud University College

Abstract: *Children's drawing activity has been theorized as traces of cognitive and biological development, with cultural variations as minor sources of visual and traceable influence. Even though present, less research has been done on documenting the social aspect of drawing; seeing drawing as visual communication between children. This aspect of drawing development, or learning, is visually traceable, but is still often neglected because children´s drawings can be seen in light of a discourse emphasizing the individual solitude and expression of the professional artist. Collection of drawings, observations and interviews took place in one elementary school art room for one academic year among students of 9 to 12 years of age. In a case study sociocultural theory was used to investigate children's formal and informal drawing activity; a segment of the findings is presented in this lecture as a narrative analysis of parts of the data. The result indicate that meaningful drawing activity among these children formally (in drawing classes) and informally (outside formal drawing teaching) included "hooking up" with parts of peers` drawing focus, explained as the visual wildfire. These processes are seen as dialogical and therefore valuable for children developing their ability to communicate visually through drawing.*

Keywords: Peer, learning, drawing, sociocultural, visual.

* Corresponding author: Queen Maud University College, | Norway | e-mail: nsf@dmmh.no

Introduction

Seeing-drawing practices as pedagogy in formal and informal contexts are the focus of this text. These practices are seen as part of developing basic visual competence. But drawing covers many human agencies (Arnheim 1974; Bamford 2006; Ching 1990/2006): To draw can be to tell a story, to teach, to learn, to explain, to create, to feel, to describe, to observe, to register, to explore, to connect, to communicate, to imagine, to develop, to recollect and to think. Researchers, mainly in the art education community and in the community of psychology have been intrigued throughout our recent history by human pictorial tracing. This paper rests in various ways on pioneers such as Brent and Marjorie Wilsons', Christine Marmè Thompson, Kristian Pedersen's, John Matthews, Anna Kindler and Bernard Darras contributions on seeing the social aspect of drawing, among others. They are all seen as important theorists in the research field of drawing as human social activity.

Visual competence is becoming more and more important in our contemporary society as we rely on an increasing number of sources of information that are dependent on the receivers' visual skills; what is called visual literacy (Baca and Braden, 1990). We are talking here about the ability to read but also to make symbols. As literacy in general is understood as reading and writing (UNESCO 2004: 12-13), visual literacy would then include the ability and skill of making pictures, communicating through a pictorial language (Nielsen 2000; Nielsen 2009: 89). In a drawing context this means to find meanings and to create and communicate meanings by making figural traces on a two-dimensional surface. Looking at pictures and finding meaning, and creating pictures or symbols to communicate meaning, requires involvement, skills and agency, for example, the production process of taking pictures and processing them electronically, filming, composing web-pages, painting, making collages, using various graphic techniques, and making drawings with various media, such as coal, pencils, pastels, felt pens and the like. To become a visual-literate as a communicator, not just a receiver, is part of the compulsory art and crafts school subject in Norway (Nielsen 2009). Another important part of the art and crafts subject is the making of objects. The functionalities of the constructed objects should be those intended by the students but at the same time the subject requires the students to think about the aesthetics of the forms of the objects. If the students are to visualize their ideas of functional objects, they must be able to produce a credible drawing on paper of the object they want to make, and from there they can develop the object's aesthetic qualities. To develop and exchange ideas and discuss what they are making, the students need good drawing skills so they can communicate their intentions precisely. The drawing of objects as common knowledge is not an "old-fashioned" skill that belongs to the past, but rather a necessary skill for the future, a tool in product development, such as designs in architecture, object making, and the electronic and digital industry. It is a tool for communicating everyday ideas. It can also be a skill for expressing feelings, ideas, and concepts in art. The realm of art making is one of several arenas for form making in society.

An Art discourse and visually controlled drawing in art education

According to Fineberg (1997) the art education field and the field of art making have reciprocally influenced each other. In an art education context, there has been a tendency to praise modernism as visual expression, holding on to a non-figurative, symbolic or simplified "child-like" figural form as visual language (Fineberg 1997; Nielsen 2000; Wilson 2004). In the art world, with the ready-made and concept- art movements (including pop-art), dadaism and surrealism as exceptions (Glambek 1990), these features seen as traces of individuality are valued commercially and praised professionally. Victor Lowenfeld, one of the main discourse- holders in art education in the last decade (King 1991), expresses this view as follows:

> Never give the work of one child as an example to another! Never let a child copy anything. (Lowenfeld 1957: 15)
> I have heard many teachers and parents say, "But my children love coloring books." This is quite true. Children in general, however, do not discriminate between things good for them and things detrimental. That they love things is not always an indication that those things are good for them. Most children prefer sweets to vegetables, and without doubt would always prefer them. This, however, does not mean that we should adjust their diets to sweets. (Lowenfeld 1957: 18-19)

The "look-and-draw" learning process, that is visually controlled drawing processes (Frisch 2010), then seem to be of less value than the above described visual utterances. I claim that the ideas in the quotations above, even though from the late fifties, are still prevalent as a tacit underlying notion or value-scale. Several researchers within the art education community (Kindler and Darras 1997; Pariser and van den Berg 1997; Pariser 1995; Pariser 1999; Wilson and Wilson 1977; 1982a; Wilson 1985; 2004) claim that the art-making field has also influenced the field of art education as to what is seen as valuable trace-making during childhood. The simplified, naïve, and presumed individual expressive drawing has been, and still is valued above tracemaking as social and visual expression.

My research focuses on children in elementary school in Norway, from nine to twelve years of age. Statistics show that children and early youth are from eleven to thirteen when the frequency of drawing in a school context declines markedly. Girls draw more that boys in this age-group, but the frequency in making drawings declines in both genders (Nielsen 2000: 45- 47). Therefore it is especially interesting to shed light on pedagogical experiences in drawing within this age-group. The developmental theorists Lowenfeld and Brittain (Lowenfeld 1947/ 1957; Lowenfeld and Brittain 1979) have focused on the self-criticizing tendencies in this age- group as a major reason for this decline in pictorial production. Chapman (1978) and Nielsen (2000) follow this up by focusing on the lack of adequate teaching and learning as a plausible reason for the gap between the children's skills in drawing and their own expectations of how the result should look. The students` visual assessments in judging what their drawings look like, comparing with the object drawn or with other drawings, are part of their self-criticism. In other words, it is strongly suggested that it is crucial at this age to be able to draw what one sees.

Wilson and Wilsons' (1977; 1980; 1982b; 1985) research consisted of analyzing children's informal drawings and drawing processes. They have shown how and to what extent children learn to draw from other children and from an image culture oriented towards children. Their extensive research and the theoretical grounding for their research is comprised in the article Child art after modernism: Visual culture and new narratives (Wilson 2004). The Wilsons view the acts of learning to draw as social in process and cultural in content by focusing on the mediating aspect of drawing; that is communication using a socially and culturally developed visual language. It is therefore appropriate to base the research on a sociocultural theoretical framework which includes and rests on Wilson and Wilsons' research. This inquiry assumes that we learn in both formal and informal arenas, and that children have an informal, children-learned competency in drawing. My curiosity is focused on looking for this competency and describe it. The following research question has therefore guided this inquiry:

How can peer influence among nine- to twelve-year-old children be understood in the context of a visually controlled drawing class in school?

Theory

One of the most important contributors to what we today call post- modern constructivism; as part of the constructivist paradigm in pedagogy, or the "third way", was Lev Vygotsky (1896- 1934). This third way is the explanatory space for human development and learning between positivism and cognitivism, referred in Vygotsky's work *Thought and Language* as "constructive principles of higher functions", explained as developing and taking into use signs and tools, the core understanding of "higher functions". Vygotsky's interdisciplinary theoretical contributions within the paradigm of constructivism can be detected not only in pedagogy, but also in philosophy, sociology, psychology, semiotics, anthropology and art interpretation (Strandberg 2006).

The core contribution derived from sociocultural theory, in my opinion, is the understanding of the mediating aspects of drawing processes. Analytical concepts within sociocultural theory, such as activities in "the zone of proximal development" (ZPD) and "the more competent other" (Vygotsky 1978), fall into place and explain basic processes that can contribute further to the pool of knowledge in art education. One learns in social space, connecting with others or other things that can teach us more than we already know and master, we connect with a more competent other in our ZPD, the zone where learning takes place. If we look at children's development in drawing through sociocultural glasses with mediation as a focus, the drawings are often signs on paper communicated as symbolic meanings or representations. They can be categorized as semiotic mediation (the mediated activity of meaningful symbols or signs) and become what Wilson and Wilson (1977) call configurational signs, what Goodnow (1977) calls equivalents, or what Darras (2000) calls a simile. A drawing of a cloud is a configurational sign, an equivalent or a simile of a cloud.

"To mediate" is defined in the dictionary as "to act as a go-between" or to put it in sociocultural terminology; to work or communicate through artifacts. If we look at equivalents, configurational signs, or similes made as mediating signs since the early days of humankind, we can understand them as "go-betweens" to be understood by "the other/others" (Hopperstad 2002; Matthews 2004). Hence, mediation in this inquiry is understood as communication of meaning from one person to "the other" that forces us to master an understandable common visual language. The subject making the visual signs has to ensure that his or her purpose or drive to communicate is understood by others in his or her context. This does not, however, imply that there is no individual-psychological dimension in the making of signs or similes, such as drawings, as this is also an aspect of visual expression; that is the making of signs or similes as sociocultural processes.

Michael Bakhtin (1986) develops the dialogical aspect of all utterances into theory also applicable to visual communication, in my opinion. The Sovjet Russian philosopher

Michael Bakhtin (1895-1975) claimed as Vygotsky, that our mind and consciousness mainly is shaped by semiotic mediation in social space, by the use of signs. Bakhtin emphasized relations, and claimed that everything is in dialog or in a relation to something else. He claimed that existance in itself is dialogical and manifest itself through utterances. He explained the dialog as consisting of an utterance, a response and a relation between these two, where the relation is the most important, without the relation the two others are without meaning.

Bakhtin claimed that we always are in dialog with our others and our physical and cultural contexts. Everything we say is filled with others voices, utterances are multi-voiced. But we are placed in this world, we are addressed by our surroundings, and we are capable of responding according to our unique point of view, colored by the contexts we live in. We are therefore active, creative persons, not passive recievers, according to Bakhtin (Bakhttin 1886; Holquist 1990; Postholm and Frisch 2013). An understanding of Vygotsky and Bakhtin has been presented as theoretical references underlying the process of making sense of the data.

Method

A collection of drawings as the only source of data has been used by researchers in the search for the many facets of pedagogy around children's drawing development (for example by Kellogg 1971; and by Lowenfeld 1947/1957). In this inquiry this is one of multiple sources of data; observation notes, the transcriptions of the video recordings (observations), and the drawings. In the sequence presented in this paper, the collection of drawings and observations provide the database used to present the results.

Observation is a method used to look for the essence of a phenomenon, or to find patterns of behavior in cultures and individuals (Adler and Adler 1994; Erickson 1986; Postholm 2005), and was therefore chosen to look for the main features or patterns in children-learned competency in drawing.

Observing is to be present as an "I" or an "eye" (Gudmundsdottir 1998; Merriam 1998: 153; Peshkin 2000) in a classroom where everyday life evolves, using all the senses, videotaping and noting incidents that are seen as essential for explaining the phenomenon then and there. Observing is also to choose situations to technically record more randomly what might be intriguing and interesting to the focus of the inquiry without necessarily being able to see these possible implications then and there, on site. There is a deductive and inductive side to observation; on the one hand, looking for confirmation of temporary hypotheses or assumptions and on the other, seeking the unknown and unexplained and to make sense of this (Postholm 2005: 57). These videotaped recordings, that visually capture the actions of drawing and at the same time recording verbal and non-verbal social interaction, are to be reviewed over and over for analysis. As observer in the classroom I chose the role of the passive participant (Spradley 1980) or what Adler and Adler (1994) label the peripheral-member-researcher. Angrosino (2005) questions Adler and Adler's (1994) concept of levels of involvement and "objectivity" as an observer, referred to above. The peripheral-member-researcher is a non-involved, detached, passive observer, registering with camera and writing down what is going on. The ideal is then to be as objective and un-involved as possible to obtain an overview of what is happening - as if the researcher was not there. From a post-modernist point of view, according to Angrosino (2005: 734), observation can be defined as context for interaction among those involved in the research collaboration, where the participants negotiate their roles as the observer and the observed and acknowledge their mutual coloring of the scene, or arena of observation.

My main official purpose for being in the classroom as an observer was to look for the teacher\s teaching strategies. I also had been given written consent from the students and their parents to observe and use their drawings for research purposes. The teacher and students have all been anonymized. Observation by noting ang videotaping, and the collection of drawings to be presented, has been the main method for gathering data in the drawing class to be presented. The timeframe of the classes was 2 x 45 min., and the incident in focus in this paper took place during the last of these two classes. I observed during these two academic hours, took notes and videotaped 19 minutes randomly. Apart from collecting the drawings made, I later photographed them, and together with the teacher on the basis of the videotapes, I made a class chart. The drawings of each student were then placed in the chart. The findings presented bellow as a narrative were therefore quite surprising.

Narrative analysis

Donald E. Polkinghorne (1995) provides us with an understanding of narrative analysis – contrasting this particular approach to analyze and present data against the paradigmatic analysis of narratives, where often stories are analyzed. The data will then in most cases be stories or narratives gathered through interviews. Here I use what Polinghorne labels the narrative analysis, I present a storied episode as a plot anchored in the data and the theories presented above. The theories are therefore implicit in the narrative, and not referred to in the story; as one usually would do in an analysis. By telling this story (or narrative) as a researcher, I present data, and analyze data simultaneously with the presented theoretical framework as an underlying point of view (Bruner 1986), to present a plausible story of a particular situation as the results of this inquiry (Polkinghorne 1995: 18-21). In the discussion and conclusion I will again connect the story with the presented main theoretical references

Results: A narrative about the visual wildfire

We are situated in an elementary school in rural Norway, the age group is eleven to twelve year old children in a class of 9 students. The teacher is instructing the students at the beginning of the second class after the students have been practicing Chinese ink and pen in the first class. During the first class of exercises on the practice sheets of paper a student, Martin, has made a tree on his own (Figure 1). The teacher is fascinated by the drawing, and asks Martin to show the other students what he has made. Martin does not want to show his drawing of a tree to the class so it can be used as an example for others. The teacher then draws a tree (Figure 2) as a model for the other students.

Figure 1: Martin's model 7th grade

Figure 2: Teacher's model

The teacher instructs the students, giving them information about the material they are going to use, chalked paper. The teacher wants to use a student's drawing as a model for the other students, but the student does not want his drawing to be shown in class. The teacher respects this decision and uses the student's drawing as a model to make his own drawing. He gathers the students around him and makes the drawing so that they can see how he draws, he also explains and demonstrates the technique called hatching.

Copying (herme) - and the visual wildfire

When continuing the drawing class, on a student's request, the teacher gives them permission to mimic or copy his drawing. In Norwegian the word used by the student is *herme*. The term herme (2012) is suggested derived from the Greek mythological deity Hermes who was the messenger god between gods. And between gods and humans, repeating and interpreting the messages. This is also the origin of the word hermeneutics.

The students are working with the assignment of making a drawing of a three-dimensional tree from a two-dimensional drawing, using the technique of hatching with Chinese ink on chalked paper. We can see that one student even mimics the instructional arrow drawn by the teacher on the model drawing to show where the light comes from (teacher's drawing, figure 1 and Gina's drawing, figure 5).

In the following sequence we will see how traces of the frame for teaching hatching by copying a tree is played out a group of nine 7th grade students.

The students` drawing processes

Figure 3 Evy´s tree

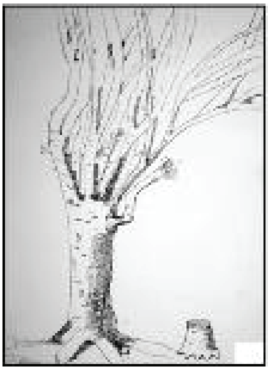

Figure 4 Greta´s tree

Figure 5 Gina´s tree

Figure 6 Hanna´s tree

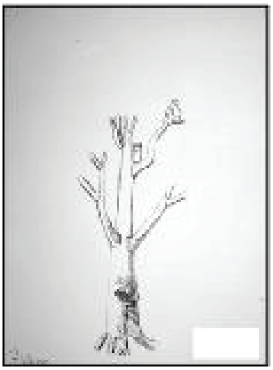

Figure 7 Norman´tree

Figure 8 Martin´s second tree

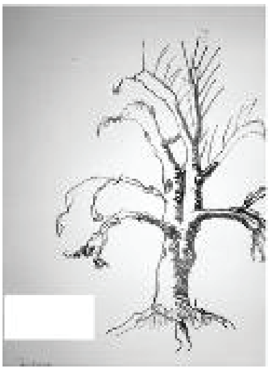

Figure 9 Gabriel´s tree

Figure 10 Isak´s tree

Figure 11 Martin´s 3rd tree

Figure 12 Erna´s tree

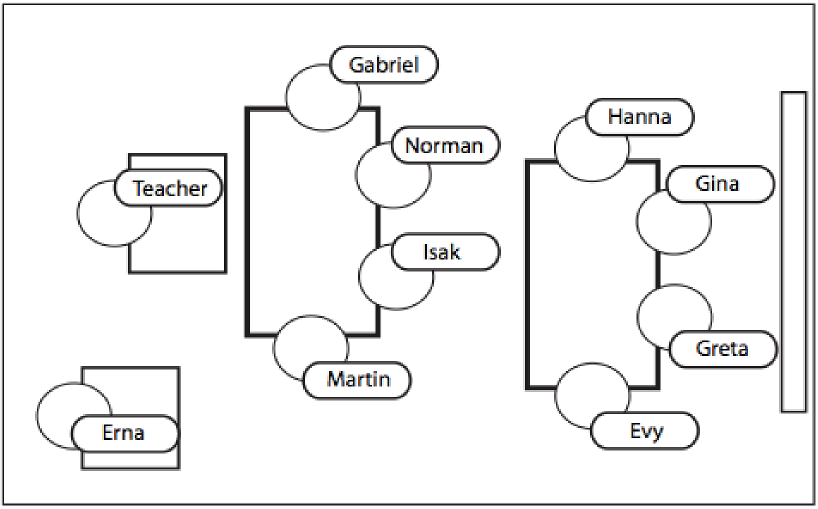

Figure 13: Classroom chart

If we look at the trees drawn in this class as visual traces of group dynamics (figure 2-12), we can see that students as peers sitting beside each other (see the class chart, figure 13) have the possibility to take part in visual and verbal interactions. It is likely that the makers of figure 3 and 4 have copied each other by marking the trunk with small horizontal lines and a tree-stump on the right side of the tree. We can see that figure 7, figure 8 and 10 have small birds, bird-houses, cats, and a swing on a branch as attributes added to the strict and bounded assignment of copying the teacher's model of a tree, practicing hatching. These students were all sitting at the same group table. We can assume that peer influence was at work when the drawings were made; one student "answering" graphically the other; confirming their peers' visual expressions by copying them. The social situatedness (physically and most likely also emotionally) of visual expression is reflected in the drawings. Solving a formal drawing assignment in these groups also involved informal drawing processes among peers. The drawing of trees shows the traces of mutual inspiration and learning based on social and visual interaction or modeling, or what Palmer (2007) labels a social “wildfire”. Here, in a drawing situation, these processes are labeled *visual wildfires,* or the wildfire effect (Frisch, 2010). This effect is traceable by the results of visually controlled modeling of each other’s drawings/drawing behaviors or part of each others’ drawings. Here we see informal drawing strategies, kids copying each other, merge with the teacher’s teaching of how to hatch the shadow on a tree, and it has a great impact on the result of his teaching; the drawings.

The makers of figure 9 and 12 had a direct visual model of the teacher’s drawing while they were in process, we can see that these drawings are close to the teacher’s tree-drawing. The shape of the tree, the roundedness and shape of the branches, and the hatching are made in similar ways. Gabriel’s drawing (figure 9) was made in a hurry, with a lot of help from the teacher, because Gabriel had a dentist appointment during this drawing session. His drawing does not show any signs of being hooked up with the other boys in his group.

The bounded fixed assignment of drawing a tree according to a two-dimensional model and peer influence in class still leaves us with 10 drawings that all are made by young individuals solving the assignment differently. There are, for example, variations in size and form of the trunk, the use of hatching, the pressure on the ink-pen, and the shape of the branches. Still, there are traces of visual communication, children looking at each other, learning to draw from each other.

Discussion and conclusion

Looking at the drawings we can see and interpret these as traces of the assignment, peer learning and individual creativeness. They are multi-voiced (Bakhtin 1986) with several different sign references in social space, but they are also traces of the individual’s expression. Wilson and Wilson’s (1977) term *configurational signs* covers in my opinion these processes. The teacher’s sign of a tree is configured by the students working in social space with their expression of the tree. They not only *herme* the teacher, but also find inspiration and learn from each other, expressing their learning with their own traces.

The Norwegian verb *herme* can mean copying something or someone, but according to the dictionary, it can also mean mimicking something or someone (Kirkeby 1999: 184). It can then also mean making fun of someone by mimicking, or to do the same as someone because you are not able to do something on your own. If you *herme,* this could be a sign of a lack of imagination, independence, self-reliance, and self-sufficiency. In other words, this term can also have negative connotations. Here, we can see the students use the word in the sense of copying the picture of the tree, using a visual model. The teacher allows the students to copy/mimic or *herme* him in their ZPD in this assignment, something he does not always allow. Here, mimicking/copying his two-dimensional drawing is a drawing strategy used by the teacher when teaching hatching, but the *herme* does not stop there. The visual dialog continues with significant others they have visual access to.

My curiosity has been on children-learned competency in drawing. This inquiry aimed at showing the interpersonal, social aspects of visual expressions; that is the making of signs or similes as sociocultural processes, as mediated activity. The interpretation of the processes of drawing trees in a group with Vygotsky and Bakhtin as underlying theoretical framework made a narrative about visual wildfires appear. The children are learning to draw a tree from the teacher but another main reference visually is their peer student (s). The students do not only learn from the teacher in their ZPD´s but also from their peers. They are learning from each other as more competent others (Vygotsky 1978). By "herme" or mimicking / copying, the mediation through drawing expresses a connection not only with the teacher, but with peers hooking up, and learning to draw (Bakhtin 1986). They are in a visual dialog with their peers.

Even though one could argue that there can be models, commercial, visual and / or personal, in an empowered position as models that not always should be encouraged from a pedagogical point of view, I would still argue that these peer-governed social and visual processes seen here as mediated activity between peers, are of great value to help establish drawing as a basic way of communicating in society.

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What is Industrial Design? Providing a Guide for University Applicants

Michael GOATMAN* and Louise MOODY
Coventry University

Abstract: *There are currently a wide range of Higher Education Industrial Design courses available in the UK. In the present era, a wider breadth of narrative has developed within the subject, and as a result the content of industrial design educational offerings varies considerably. The paper assesses the industry view of Industrial Design as a discipline from the perspective of those employing university graduates. These views illustrate a change in the discipline, and this is considered in respect to current education practice. The choice of entry courses for the student wishing to embark on a career in the subject has also widened. It is argued that at present, the access to courses offers a haphazard informational stream to the potential applicant. An approach to developing an online facility to enable potential students to apply for the right course is discussed. It is suggested that a consistent and comparable platform of guidance is needed by which potential students can identify and match the course offering against their aptitudes and aspirations. Given that course choice will ultimately define the nature of their career opportunities this would be a useful and productive asset.*

Keywords: Industrial Design, Design Thinking, Learning style categorization, University Applicant

* Corresponding author: Department of Industrial Design, | Coventry University | UK | e-mail: m.goatman@coventry.ac.uk

Introduction

Industrial design as a profession emerged when competition in the market place gave consumer choice, and is generally dated to the beginning of the 20th century (Heskett 1980). The idea of Industrial Design as a mingling of form and function and the need to meet business expediencies is well established and quoted in its history (Ulrich and Eppinger 2000).

Industrial designers' require knowledge and skill in aesthetic design practice informed by ergonomics and engineering. An understanding of technical processes and requirements for manufacture; marketing opportunities and economic constraints; and distribution sales and servicing processes are also important (IDSA 2013). The balance of these subject areas, course content and the teaching and learning approach adopted however, will vary based on the undergraduate degree course completed.

Potential students are drawn to degree courses by a range of factors including geographical location, university and departmental reputation, facilities and equipment available, personal recommendation, and impression gained by open day. These criteria for selection may not provide a good match between the student and course, potentially leading to student dissatisfaction and drop out. In order to attract and retain the best students, universities need to consider other selection tools for use by students beyond marketing material, prospectuses and reputation.

The current system for university entrants is based on subject choice and level of attainment. The student will have undergone a substantial program of examined education through which their abilities and aptitudes will potentially have been diagnosed. It is assumed therefore that they have had an educational experience across the science and artistic spectrum, and that their results will be an accurate representation of their aspirations and abilities. However, there are a number of limitations to this information including the influence of the schools and teachers, the match between the examination contents and the abilities and aptitudes required by the profession, and the match between the school –level subject of design, and degree level design. The National Curriculum Design and Technology program as taught in secondary schools and regarded as the educational pathway at secondary school level for Industrial Design focuses on the skills/manufacturing aspect of the discipline, which may not accurately represent the subject at undergraduate level.

Degree-level design education is largely studio based and experiential (Lawson 2006). Generally, designers' learning tends to be exploratory and flexible and is well matched to the adaptable, project-based methods of teaching typically employed that involves a large amount of personal tuition. In the traditional design studio pedagogy '…*certain phenomena appear to be chaotic or random, they are actually part of a coherent process'* (Kuhn 2008 p178 cited in Wang 2010). Wang describes and compares the 'positivist' science based teaching of design, sometimes referred to as the 'road-map' approach; and the 'atelier' system, based on free creativity. He suggests the second can be criticized for its potential lack of parity, and influence of individual teachers, such that one experience may not be the same as another. However this has been the usual system of design teaching for over a hundred years. Wang (2010 p173) notes ' *There is a feeling among many design educators that today the discipline has reached a crisis in its development, and that change is needed immediately in the way that design educators articulate their epistemology and their methodology*'.

This paper argues that in recent times, there has been significant change in the Industrial/Product Design sector with design's application becoming broader (Keinonen, 2008). This has inevitably been reflected in the pedagogies being taught at different institutions. University applicants to degrees in the discipline are to some extent victims of this change. It is the responsibility of the sector to give greater clarity to prospective students on the nature of the subject they are to study. The necessary first step to this is, for the sector itself to identify the categories of curriculum being practiced and to make these more explicit to potential students.

The aim of this research is to assess the industry view of Industrial Design as a discipline from the perspective of those employing university graduates. These will be used to comment on whether there is a change in the discipline, and the nature of this change in respect to current educational practice. These views will then be considered in respect to the requirements of the future profession, and a suggestion made for an online facility to enable potential students to apply for the right course.

Exploring the views of design professionals

Method

A written narrative analysis approach was used to collect and compare the views of established designers on the current focus of Industrial Design as a discipline. Five experienced designers were selected, all of whom are business leaders, to represent a range of different organizational sizes and areas of industrial design. As potential employers the participants could provide a reference to the desired future career destination of graduates. The sample is summarized in Table 1 below:

Table 1. Summary of participants

Participant	Years experience	Job role	Size and type of organization
1	18	Director	1-5 employees, contemporary
2	34	Director	1-5 employees, established
3	38	Senior Partner	15-20 employees
4	30	Principal, Product Design	35-50 employees
5	32	Design Manager	200+ designers

The designers were contacted and invited to take part. Upon agreement they were then asked to provide a considered written narrative to the title 'What is Industrial Design?' They were not given a specified number of words to provide. Thematic analysis of the resulting data was undertaken. 5 key themes were identified through the analysis and the importance of these 5 themes was identified based on the frequency with which they were referred to during each narrative.

Results & discussion

The text lengths varied between 439 and 1042 words. The analysis revealed 5 key themes that were used to describe Industrial Design within the collective narratives, these were defined as follows:

- **Business:** Words referring to the business aspects of an Industrial Design company, e.g. commercial, dialogue with clients, managing client expectations.

- **People:** Words referring directly to human investigations e.g. ergonomic tests, customer insight investigations, ethnographic research, market analysis.
- **Operation:** Words referring to the design process as carried out by the design company itself, application of techniques and tools such as CAD, presentation techniques, consultancy offer frameworks.
- **Function:** Words relating directly to designing as an iterative activity of exploration and experimentation to find solutions to a brief that has been constructed to create artefacts to perform a purpose.
- **Cognitive:** Words referring to intangible thought and emotion based activities e.g. dream, innovate, inspire, ingender.

For each narrative the words linked to each key theme were identified and counted. Table 2 below summarises the number of word references in each of the 5 design themes produced by the participants.

Table 2. Table of keyword segmentation taken from texts of 5 design company leaders

Design Company	Business	People	Operation	Function	Cognitive
Contemporary 1-5	3	3	13	6	8
Established 1-5	11	1	6	2	10
15-20	9	12	2	4	23
35-50	8	1	8	1	19
200 plus	3	1	7	1	30
TOTALS	34	18	36	14	90

The results show that the most words used to describe Industrial Design fell in the cognitive theme (n=90) that is ‘words referring to the intangible, thought-based activities’. The proportion of ‘cognitive’ keywords used appears to increase with the size of the business (this is not consistent since text length varied). Some of the statements given include:

‘The Industrial Designer can visualize his dream he can define it and share it and inspire’ (P3)

‘Industrial Design is not what it was 20 years ago! It is far more intellectually rigorous’ (P5)

Cognitive attributes referring to thought and emotion based activities took a prominent part in all of the narratives. ‘*Innovation’, ‘design thinking’, ‘vision’,* and ‘*culture*’ are referred to as explicit aspects of the industrial design offering to clients;

'We create dreams, we develop themes, we provide direction, we provoke discussion and we engage in discourse. And we like to disrupt..'(P4).

Industrial Design as presently described varied considerably from a traditional skills/task analysis base to a cognitive emotional activity base. The focus of the narratives was found to differ based on the type of organisation that the participant represented. The small businesses had a less clear focus on cognitive activities and were found to refer more to the operation of their business, and the meeting of outcomes for their clients businesses.

Thematic analysis of the statements indicates the move towards '*the globalisation of design*' and the increasing importance of human and therefore intangible skills on the part of the graduate Industrial Designer. The role of the designer to *'create dreams' and 'disrupt'* and balance this against practical delivery of a design solution was clear.

The results suggest that the current view of professional practise does not just lie in a traditional Industrial Design domain. The leading statements by four of the five designers were not concerned with the Industrial Design framework of form, material, production, market place, aesthetics, and costs that have traditionally formed the primary content of industrial design practice. Instead the drive at senior level is for cognitive capabilities such as visualisation and communication.

Industrial Design has always straddled the two camps of rationality and free creativity, and the observations of the five texts of the professional designers suggest that both ways of thinking are applied in the professional discipline and should therefore be reflected in the education. In observing the dominance of these cognitive qualities it would be wrong to suggest that the categories of business , people (ergonomics), operation and function were not still significant, and teaching in these areas equates more with Wang's 'positivist' methodologies. However, the most striking observation from the texts is the dominance of references to cognitive words describing intangible qualities. The term 'Design Thinking', which has strongly engaged the interest of practitioners and educators in the design sector in recent years embeds methodologies that relate to a non-regulated approach to Industrial Design. Its methodologies are already being explored in various centres of design education, and its explicit inclusion into the declared curricula of undergraduate Industrial Design degrees.

It is argued here that the relevance and role that these skills now play in degree courses is not made sufficiently explicit or understandable, to potential students who have been exposed only to school level design education. Evidence from the employer's side supports the expansion of the Industrial Design narrative and indicates the need for communication and clarification to the teenage applicant whose experience is only within the secondary school system.

This paper therefore scopes out a potential tool for matching students to available courses based on their personality and learning preferences. It aims to identify the key components of industrial design in order to inform improved matching of students to degree courses in a way that is accessible and useful to the applicant.

Developing a system to match students to degree courses

It is proposed that in order to address the changes in the practice of Industrial Design and to cater for future development and diversity in degree course offering, that a system should be developed that better advises student on their course options. In the following sections, the inclusion of thinking and learning styles are considered in addition to the accepted criteria of academic experience and achievement.

Design Thinking

The paper will make reference to the work of Owen (2007 p 17). Owen identifies the presence of design and scientific thinking in the design process and considers: '*Design thinking is in many ways the obverse of scientific thinking. Where the scientist sifts facts to discover patterns and insights, the designer invents new patterns and concepts to address facts and possibilities'.*

Owen identifies two ways creative people work. He recognises *'finders'* and *'makers'.* Finders exercise their creativity through discovery and are driven to understand and find explanations. Professionally they typically become scientists or scholars. Makers are creative in a different way and demonstrate this through invention, construction, composition and developing new concepts. They typically become designers, engineers and artists.

Finders are driven to understand, to find explanations for phenomena not well understood. In professional life, they usually become scientists or scholars and are responsible for much of our progress in understanding ourselves and our surroundings.' (Owen 2007 p 17). Expanding on these views, Owen identifies other factors that differentiate professional fields and further defines design thinking. Figure 1 illustrates a framework to distinguish the activities based on mental activity and culture of operation:

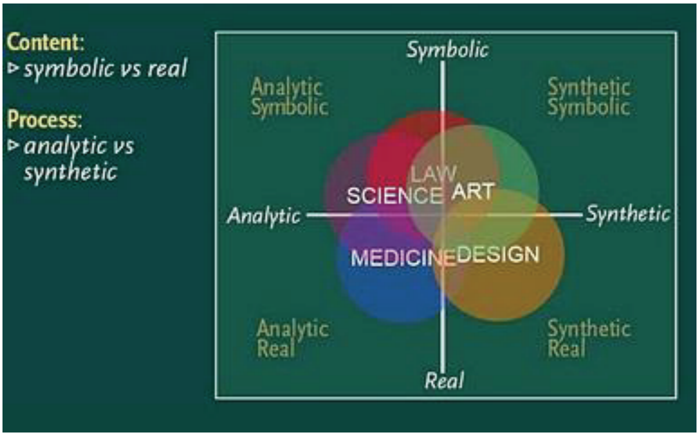


Figure 1. Map of creativity (taken from Owen 2007 p18)

Owen's map positions design in the lower right quadrant associated with making and inventing, and focused on the real world and the synthesis of artefacts and systems necessary for managing the physical environment (Owen 2007 p 18). This is in contrast to the position of science. Owen argues therefore that a combination of science and design thinking, rather than just one, is the strongest approach.
This spread of mental (and possibly emotional) activity required through the breadth of

different Industrial Design activities, demonstrates the need for a guide for potential applicants to identify the right degree course among a range of offers that focus on different areas of this map. Owen goes on to propose a progression of need/goal to values to measures, and gives word descriptors associated with each area. The following table lists descriptions of the focus of different disciplines:

Table 3. Descriptions of disciplines (constructed from Owen 2007)

Field	Need/goal	Values	Measures
Science	Understanding	Understanding Testability	True/false Correct/incorrect Provable/unprovable
Art	Expression	Insightfulness Novelty Stimulation	Thought provoking/banal
Design	Form	Cultural fit Appropriateness Effectiveness	Elegant/inelegant Better/worse Sustainable/unsustainable

It can be seen from Owen's methods of comparison that contrasting qualities can be identified regarding the different aspects of Industrial Design in which all these categories are represented. The proposal is that these measures can be used to illustrate the balance of course content and focus of an Industrial Design course. This can be utilized in a reflective exercise or questionnaire by a student seeking a degree course to map their skills.

Learning Preferences & Design

To further enhance student understanding of their own aptitudes, psychometric tests may be appropriate. Carl Jung's theory of psychological types illustrates preferred ways of adapting and learning. Based on Jung's theory, the Myers-Briggs Type Indicator (MBTI) is a psychometric tool for assessing 16 'types' and their associated learning styles (Myers and McCaulley 1985). It operates by categorization under 4 comparisons as summarized in Table 4 below. These comparisons gives rise to 16 constructs, e.g. ESFP, each of which has a personality description.

Table 4. MBTI personality preferences (MBTI® Manual: A Guide to the Development and Use of the Myers-Briggs Type Indicator®)

Do you prefer to focus on the outer world or on your own inner world?	Introvert (I) / Extrovert (E)
Do you prefer to focus on the basic information you take in or do you prefer to interpret and add meaning?	Sensing (S) / Intuition (N)
When making decisions, do you prefer to first look at logic and consistency or first look at the people and special circumstances?	Thinking (T) / Feeling (F)
In dealing with the outside world, do you prefer to get things decided or do you prefer to stay open to new information and options?	Judging (J) /Perceiving (P)

The MBTI has been used to evaluate the learning styles of various different groups. Work by Durling et al. (1996) identifies that designers as a group are quite different to the general population and to other subject disciplines in relation to their learning preferences (see Figure 3 below).

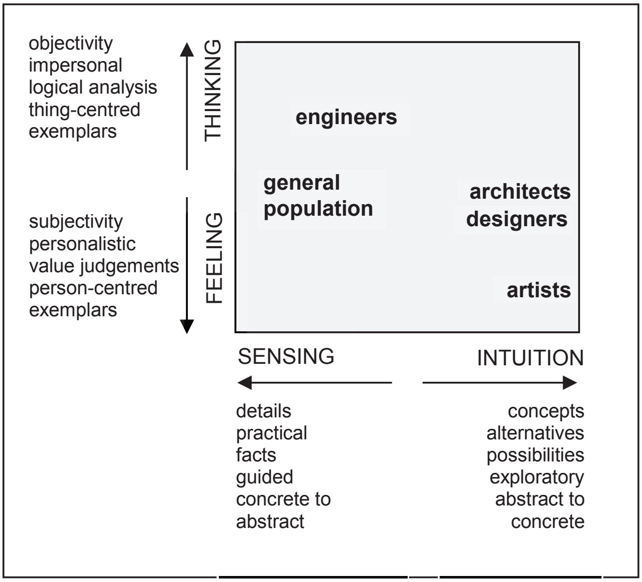


Figure 3. Learnin preferences based on MBTI Types (Adapted from Durling et al.1996)

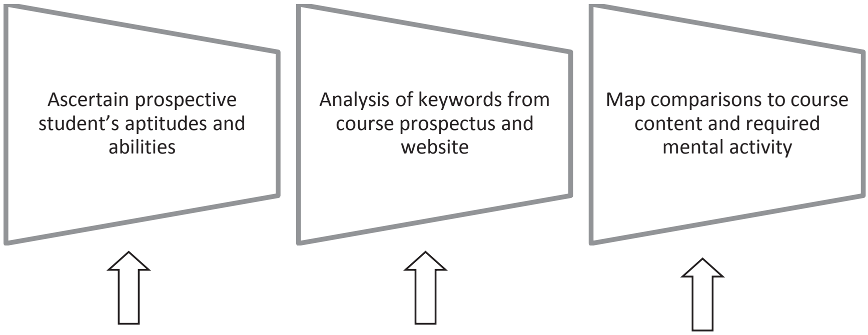
Broadly speaking designers prefer teaching which begins with the big picture and then explains details, focuses on future possibilities and gives alternative view-points. It has a lightweight structure, allowing for guided exploration, and predominantly shows objective data, is logical and analytical, and is based on demonstration examples (Durling et al. 1996).

The disparity between engineers and designers is highlighted in this research. Durling et al. (1996) point the difficulties of teaching some designers subjects such as engineering, ergonomics and computing, particularly when taught by a non-designer / subject specialist who is likely to have a different style. Designers tend to have a natural leaning towards intuition and away from facts and a guided approach. This discord will be relevant therefore and influence success when a student enters a course that is design engineering rather than design thinking oriented. Having a means to assess students learning preferences through a test such as the MBTI, would provide another tool to equip students to match themselves to the content and style of a degree course.

A Proposed Model

Using a combination of personality testing and subject interest (alongside traditional metrics of capability and examination achievement) a guide to Industrial Design courses could be offered. Bringing together the work of Owen and the MBTI profile, allows construction of a detailed model of the designer and their way of thinking and feeling. The following three stage process is suggested:

Figure 4. Model for mapping a student to a degree course



STEP 1 **Candidate Action**	**STEP 2** **System Action**	**STEP 3** **System output**
Answering a brief set of online questions in an established and verified simplified form of the Myers Briggs Preference Indicator (MBTI) and based on Owens' measures of creativity	A 'find courses' request will prompt computer analysis comparing keywords from prospectus and website scans and relating these to the individual profile words.	The user will be presented with a quadrant map visual mapping individual characteristics to demonstrate subject and course suitability and providing hyperlinks to relevant courses

It is assumed that the system would be computer-based and accessible on a wide range of platforms including smartphones and tablets to potential students. The system would require inputs from the user of learning style and subject preferences as well as traditional indicators such as predicted grades and subject choices.

The success of this model would be dependent upon an accurate picture of university courses to allow the automated comparison. It is not an unreasonable expectation that a keyword analysis of a University course prospectus and website will give a useable representation of the course's focus and content. These words are generally constructed with integrity, safeguarded by the published nature of the material. It would not be generally in the interest of the university or department involved to publish synopses of its courses that are fictitious or inaccurate since this will inevitably lead to problems when the student is enrolled. However, these descriptions tend to focus on facilities and equipment available and less on the characteristics of the students that succeed well on the courses. On that basis they may need re-visiting and updating with the aims of the system in mind.

Whilst courses have their unique selling points, they are also likely to thrive on a mix of students from different backgrounds and experiences. Psychometric tests are not intended as a mean to create a homogenous group but to allow applicant reflection on their aptitudes, abilities and career options. The aim is to educate the student to the nature of the discipline of Industrial Design to enable them to make accurate and useful decisions within the subject area to which at that stage they are making a probably tentative early investigation. It would serve as a signpost for the student, and function also as an introduction to the contemporary breadth of the discipline, broadening their knowledge correcting limited or inaccurate perceptions of the discipline of Industrial Design.

Conclusions

This paper has arisen from an awareness that the field of Industrial Design has broadened to encapsulate a variety of perceptions of the subject that are influencing the nature of courses offered at higher education level. This is leaving the investigating potential applicant with an information gap that can result in their enrolling on an inappropriate course of study. This is disadvantageous to both the student and the institution.

A small initial study from the position of career destinations has been undertaken. Five successful practitioners in the discipline, from a range of design companies have provided a description of Industrial Design. The findings have been used to argue a development in the nature and perception of the practice of the subject in the UK. The investigation suggested that the understood boundaries of 'Industrial Design' have developed in recent years. The emphasis towards descriptors of intangible, cognitive activity, such as behaviors and emotions that contrast with the words describing practical skills and knowledge that characterize the content of the secondary schools curriculum regarded as the preparation for a degree in Industrial Design. The findings suggest a need for cognitive skills, when school education is focusing on skills/manufacturing aspects of the discipline.

An independent aptitude indicator was then considered to guide candidates to Industrial Design university courses, and ultimately a career path that would be appropriate to their personal abilities. For this purpose the work of Owen (2006, 2007) was considered, and the role of psychometric tests such as the MBTI to identify learning preferences. A model was proposed whereby the mapping of candidate capability through a short computer-based questionnaire against course categorization based on keyword analysis of prospectus and website descriptions is undertaken.

It has been argued that there is a value in an online indicator that provides a guide to potential applicants to the nature and focus of the variety of university courses offered under the titles 'Industrial' and 'Product' Design. Through simple measures of that this provides the prospective university student with an indication of suitable courses, and like Industrial Design aims to '..*help users cope with the increasingly complex world they live in'* (Wang 2010).

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Sketching design thinking: representations of design in education and practice

Colin M. GRAY* and Martin A. SIEGEL
Indiana University

Abstract: *Research on design pedagogy has shown that students progress through a variety of barriers on the path to becoming a successful design practitioner, and that frameworks for explicit reflection can be beneficial to the development of design students. Schön uses the concept of reflection-on-action to describe one form of reflection on design practice, with the eventual goal of improving design processes and judgment. In this study, sketching is used as a form of reflection-on-action in a first semester intensive course in interaction design (IxD). This sketch reflects the student's current understanding of the "whole game" or holistic view of design in IxD. Current practitioners in IxD companies were asked to draw the "whole game" sketch as well. Parallels among the sketches and areas of divergence are discussed. In summary, students shifted from abstract, linear representations of process early in the semester to more concrete, iterative representations by the end of their first semester. Practitioner sketches were more abstract and linear, but also included representations of business terminology and design teams.*

Keywords: Reflection, sketching, human-computer interaction (HCI), design practice.

* Corresponding author: Indiana University | USA | e-mail: comgray@indiana.edu

Introduction

Reflection has long been implemented as a feature of educational practice, both in mainstream education (Rogers 2001) and in design education (Ellmers 2006; Schön 1983, 1985). Reflection as a classroom activity is often centered on journaling, blogging, discussion forums, or post-hoc evaluation of projects, and is generally discursively focused on documenting the past and present. While various forms of reflection prompts have been used to stimulate thinking—ranging from abstract to concrete—these prompts can be seen as an integrated measure of the overall curriculum, intended to stimulate individual thinking around synthesis, and to provide an additional evaluative measure of student performance.

In this paper, we will structure our discussion around visual forms of reflection applied as an evaluative measure to design students and practitioners. These reflections focus on a holistic way of thinking about a discipline (Perkins 2010) and the student's relationship to that discipline. The process of reflection is also treated as an evaluative measure that can be used in conjunction with models of design expertise (Dreyfus 1981; Lawson and Dorst 2009) and schemas or processes (Dubberly 2004; Nelson & Stolterman 2012) to understand what and how the student or practitioner is thinking about design—what they prioritize in their process and how they visually represent these elements.

The "Whole Game"

The concept of "playing the whole game" is derived from Perkins (2010), who notes the importance of viewing education in a holistic, action-driven way. Rather than teaching components of a process without putting it together (described as "elementitis") or learning "about" a subject without ever applying it, students learn through the process of engaging in the activity. This approach melds with Schön's conception of the design studio—a place where education and praxis are linked—in a profound way.

In educating non-designers (or non-traditional designers), it is vital to keep a clear conception of the terminal objective of design education: preparing students to become successful design practitioners (Brandt, Cennamo, Douglas, Vernon, McGrath, and Reimer 2011; Shaffer 2003). Assuming this terminal objective, understanding the connections between the realities of practice and the pedagogy that links the student to future practice is critical.

Reflection-on-Action

Schön (1983) discusses the role of reflection in education and practice, noting the complementary roles of *reflection-in-action* and *reflection-on-action*. Reflection-in-action is a tacit process whereby the designer considers and evaluates available information to make a design decision "in the moment." In contrast, reflection-on-action is an explicit act, whereby the designer formally reflects on a designed artifact, experience, or process (Schön 1983, 1987). Both processes are critical to the functioning of the studio mode of education—the former as a habit of the individual designer in building their design judgment, and the latter in understanding design practice in a more abstract, meta-cognitive sense. This study addresses the role of formal reflection—or reflection-on-action—in design education and practice as a tool for stimulating tacit reflection on processes, beliefs, and tools.

Modeling of Expertise

In studying various levels of competence in design practitioners, expertise becomes a significant concern. Dreyfus (1981) proposed a generic model of expertise, spanning from novice to expert. These five stages include: novice, advanced beginner, competence, proficiency, and expertise (Dreyfus 1981). In a more recent version of this model, Dreyfus (2003) extended this work to include six stages: “novice, advanced beginner, competent, expert, master, and visionary” (quoted from Lawson and Dorst 2008). These levels suggest, from a perspective of generic expertise, that as a designer increases in competence, their overall awareness of their design actions decreases, with informed intuition taking the place of explicit rules or directed patterns of thinking. Meyer and Land (2003) also argue for this evolution based on expertise through their notion of “threshold concepts.” In this framework, the authors posit that once core concepts of a discipline are learned, they transform the individual and are largely irreversible—“the change of perspective occasioned by acquisition of a threshold concept is unlikely to be forgotten, or will be unlearned only by considerable effort.” (Meyer and Land 2003, p. 416). Taking these two views of expertise and learning together, along with work done explicitly within the domain of HCI (Siegel and Stolterman 2008), it seems that an increase in design expertise decreases awareness of design decisions, and may lead to a holistic picture of practice, rather than a comprehensive, detailed process.

Methods

This study is informed by the artifacts of educational and professional practice, using *reflection-on-action* to reveal patterns of thinking about design. The “whole game” sketch can be seen as a diagnostic tool that makes tacit assumptions about process explicit, and allows the design practitioner or beginning design student to build and reflect on their process as a developing schema (Nelson and Stolterman 2012), engaging in explicit and tacit reflection.

Data Collection

The data for this study is drawn from two primary sources: the pictorial reflections of beginning interaction design students, and the reflections of interaction design practitioners working in the field.

Student Reflections

Student reflections were captured from an immersive first-semester course in the Master’s-level Human-Computer Interaction design (HCI/d) program at a large midwestern university. Students were asked to complete a “whole game” sketch at three points in the semester: during the first, fifth, and fifteenth week in order to provide the instructor an idea of what kind of schema students were generating as they progressed through the course. These sketches were a required assignment, and were requested from students using the following prompt:

> **First Sketch:** “Draw a picture of the “whole game” of HCI design. Do not do research on this! Draw what is your intuition and understanding today.”
> **Second and Third Sketches:** “Each person must draw and submit a picture of the whole game of HCI design. You may discuss your diagram with others, but it should be your picture in the end. This is your current understanding of how to “play the game” of HCI design.”

No constraints in terms of size, components, or medium were imposed. The course enrollment during the semester of data collection was approximately 60 students, comprising undergraduate students (taking a cross-listed course), Master's students in the HCI/d program, and graduate students from other programs taking this course as an elective or program minor. HCI/d Master's students represented approximately 60% of the course roster, and this ratio is reflected in the final set of reflection sketches selected for analysis. The HCI/d program, in particular, recruits students from backgrounds that would be considered non-traditional for design education, including computer science, sociology, education, journalism, and cognitive science.

Practitioner Reflections

Interaction design practitioners were selected to be interviewed as part of a larger study. Six practitioners representing six different companies were recruited. These companies included interaction design (IxD) consultancies, IxD agencies within larger companies, and web startups. The practitioners had a range of 4-20 years of experience; one was a graduate of the same HCI/d program as the student participants, and all worked in interaction design, user experience design, or user research. During the course of a larger interview, each practitioner was asked to describe their process or "whole game" which they sketched on paper or a whiteboard:

> "Draw a picture of your design process as it actually occurs versus how you might portray it to a potential client. We're interested in a picture of [company name's] design reality."

Analysis

Student Reflections

Student reflections were analyzed as intact sets, with all three sketches from each student grouped together to be evaluated as an evolutionary sequence. Each set was then iteratively sorted based on formal characteristics and organizational paradigms (e.g., flowchart, storyboard, naturalistic sketch, word cloud). From these initial categories, 16 sets were selected from these provisional categories for further evaluation and analysis, and were chosen to represent the variety of formal and textual elements of the entire data set. These 16 sets represent the approximate ratio of undergraduate, graduate, and graduate HCI/d students present in the course, and were also balanced for gender and ethnicity. The findings that follow are based on themes observed across all sets of student reflections, but examples are limited to these 16 sets for simplicity.

Formal and conceptual characteristics were used to code each reflection sketch, including: organizational style, tools used, number of nodes, terminology, connectedness/iteration, and sequence (see Table 1).

Table 1. Emergent characteristics used to code student and practitioner reflections.

Organizational Style	Flowchart Word Cloud Concept Map Storyboard Naturalistic Sketch

Tools Used	Pen Pencil Colored Marker Crayon/Pastel Whiteboard/Dry Erase Marker
Number of Nodes	4 to 100+
Terminology	Tools (e.g., Axure, Omnigraffle) Data (e.g., interview, empirical) Concepts (e.g., readability, usability, the problem) Activities (e.g., usability testing, coding, development, sketching) People (e.g., boss, user, designer)
Connectedness/ Iteration	Single arrow Bi-directional arrow Iterative arrow (arrows pointing to multiple points in a process, forming a loop) Stacked elements Holistic
Sequence	Linear Amorphous (no clear beginning or end) Concept map (clear beginning, but no clear end)

Practitioner Reflections

All six practitioner reflections were evaluated in isolation from the student reflections, then all reflections were evaluated together to form a cohesive system of characteristics. These combined characteristics are presented in Table 1.

Findings

The findings from the student and practitioner reflections are presented separately. Student reflections are documented by a longitudinal grouping of sketches, as well as an evolutionary sequence.

Student Reflections

A wide range of student perspectives, skill levels, and views on design are represented in the reflection sketches chosen for analysis. Ten of the selected sets were from HCI/d Master's students, 3 were non-HCI/d graduate students, and 3 were undergraduate students. Each sequential set of sketches (e.g., first round, second round, third round) was evaluated separately, using the coding system presented in Table 1.

First Round

In the first round, a wide range of interpretations of the "whole game" sketch were observed. From the utter simplicity of Figure S1.1—design as an abstract activity—to the post-apocalyptic interpretation of Figure S1.5. A range of approaches fit in between these two extremes, including many iterations on a linear process model (e.g., Figures S1.3, S1.4) or concept map (e.g., Figure S1.6). Terminology was generally focused on high-level, abstract concepts (e.g., research, prototyping, problem solving, design) or categories (e.g., design aesthetics, design research, methods, people). The number of nodes were relatively low, with a few exceptions (e.g., Figure S1.6), focusing on a simplified process (e.g., Figures S1.3, S1.4) or collection of related, yet disconnected concepts (e.g., Figure S1.7). In this first week of the course, students appeared to be grappling with the field of HCI, either as beginning designers in the most general sense, or designers approaching this field from another established design perspective (e.g., graphic design).

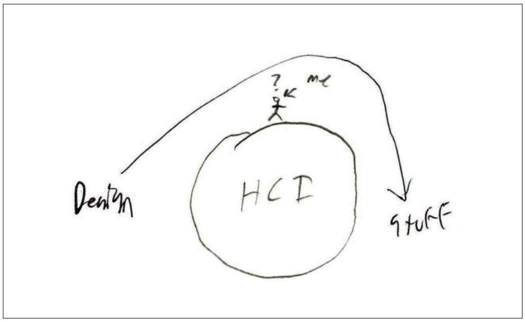

Figure S1.1. Student sketch, first round.

Figure S1.2. Student sketch, first round.

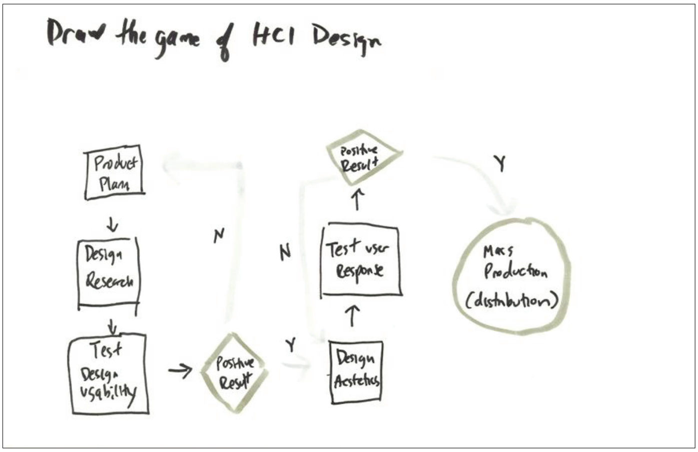

Figure S1.3. Student sketch, first round.

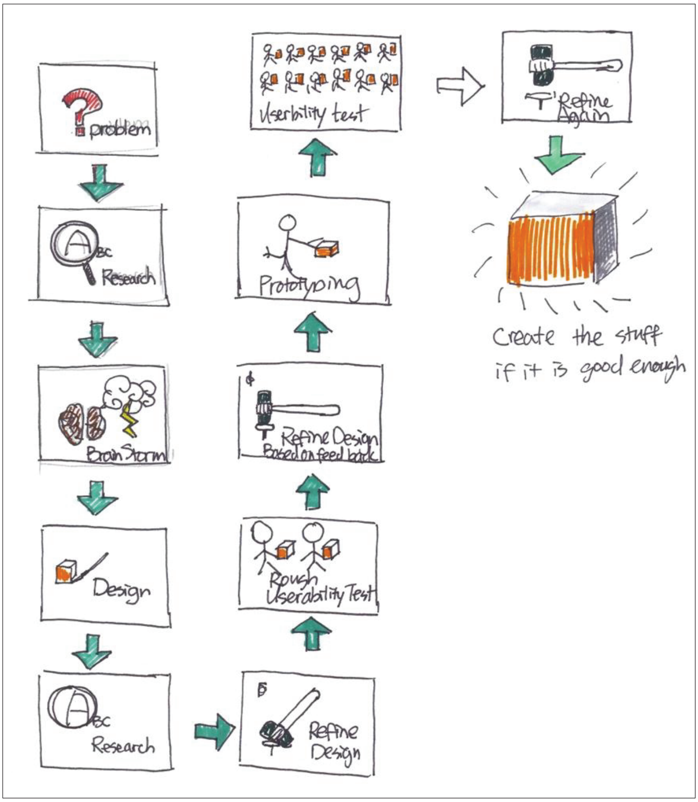

Figure S1.4. Student sketch, first round.

Figure S1.5. Student sketch, first round.

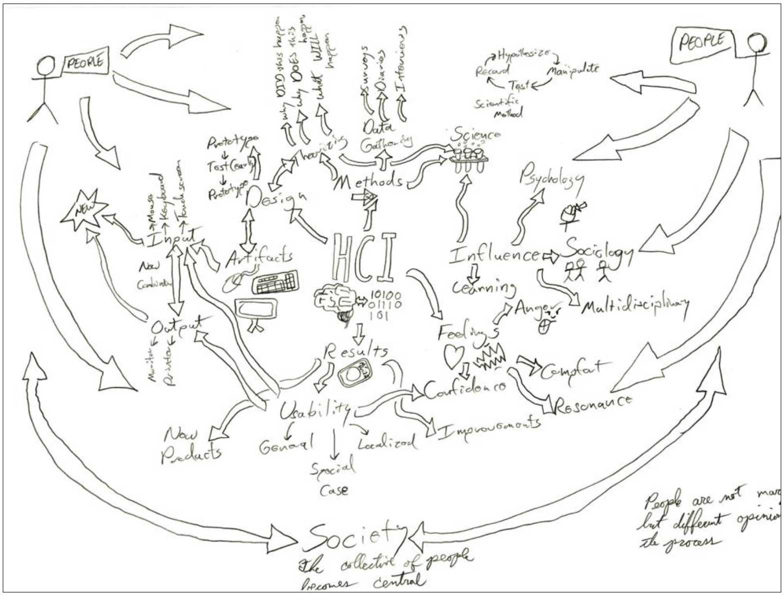

Figure S1.6. Student sketch, first round.

Figure S1.7. Student sketch, first round.

Second Round

In the second round, division between approaches became even more clear, with some choosing to continue to develop additional complexity within a linear paradigm (e.g., Figures S2.2, S2.4), while others moved to more iterative constructions (e.g., Figures S2.1, S2.5), and still others pictured their whole game in metaphorical terms (e.g., Figures S2. 3, S2.6, S2.7). This sketch was produced after the students had completed two significant design projects, and this stage in their education seemed to have an impact in these reflections. The more complex flowchart or concept map approaches attempted to document the influences that HCI draws upon (Figure S2.4) or the specific process steps that have been utilized in that student's design process (Figure S2.2). Meanwhile, other students recognized the iterative, interconnected nature of their process, represented in bi-directional arrows and looping (Figures S2.1, S2.5), even indicating where shortcuts may occur in the process (Figure S2.5). Metaphorical interpretations of the "whole game" ranged from personas of various approaches with instructions to "form whatever story you'd like" (Figure S2.6) to a marker sketch of light in darkness (Figure S2.3) to a visualization of beauty in the "swamp" of designing (referencing Schön 1983).

Use of terminology was quite varied, but shifted slightly from abstractions (e.g., research, prototyping, problem solving) in the first phase to more concrete human activities (e.g., generate ideas, create solution, usability testing, production). This round also focused more strongly on elements of these various activities, including elements of group dynamics (e.g., mantra, peers, mentors) and methods (e.g., affinity diagramming, ethnography, usability testing). As the creator of (Figure S2.4) noted at this stage: "Right now I see complexity[.] This is where I am, vs. where I want to be."

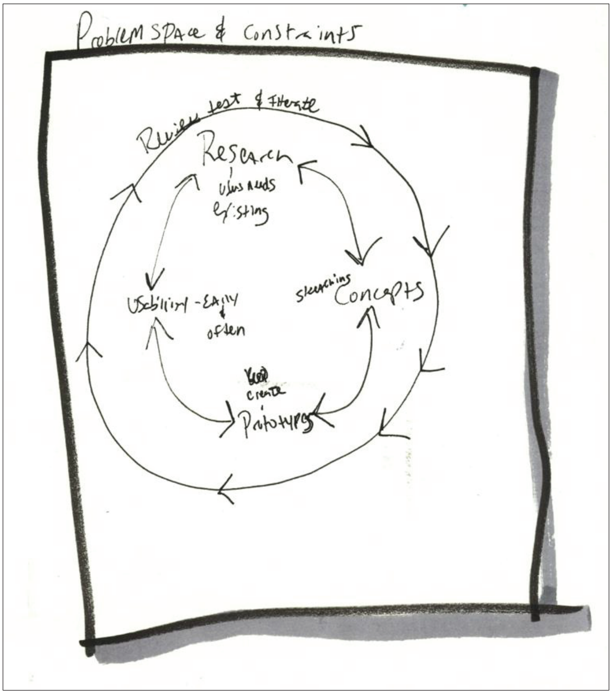

Figure S2.1. Student sketch, second round.

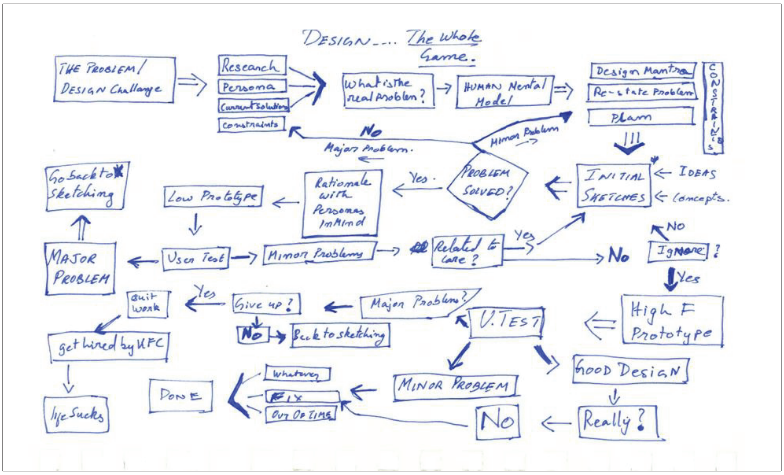

Figure S2.2. Student sketch, second round.

Figure S2.3. Student sketch, second round.

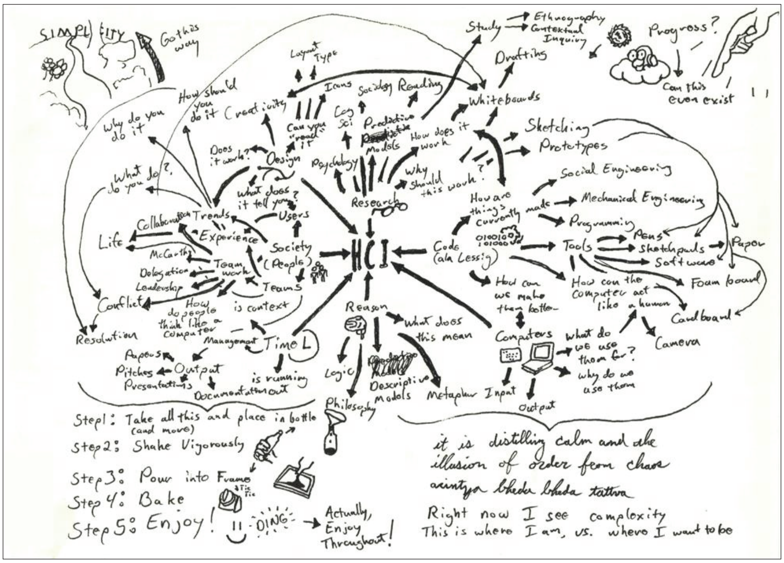

Figure S2.4. Student sketch, second round.

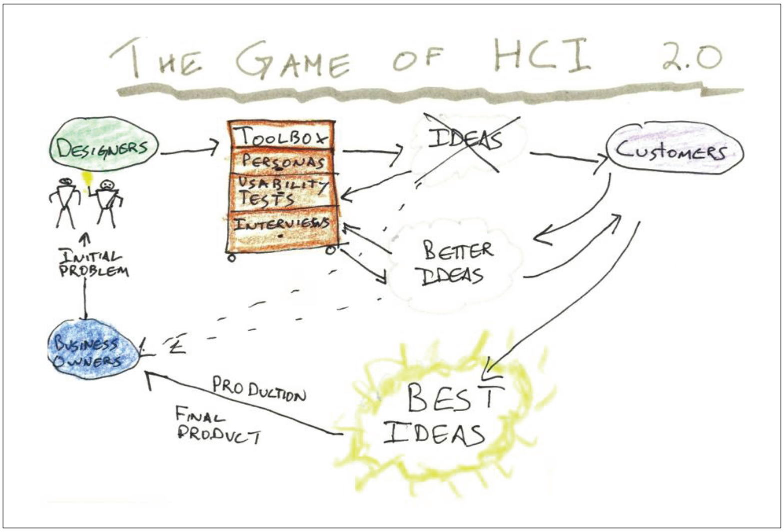

Figure S2.5. Student sketch, second round.

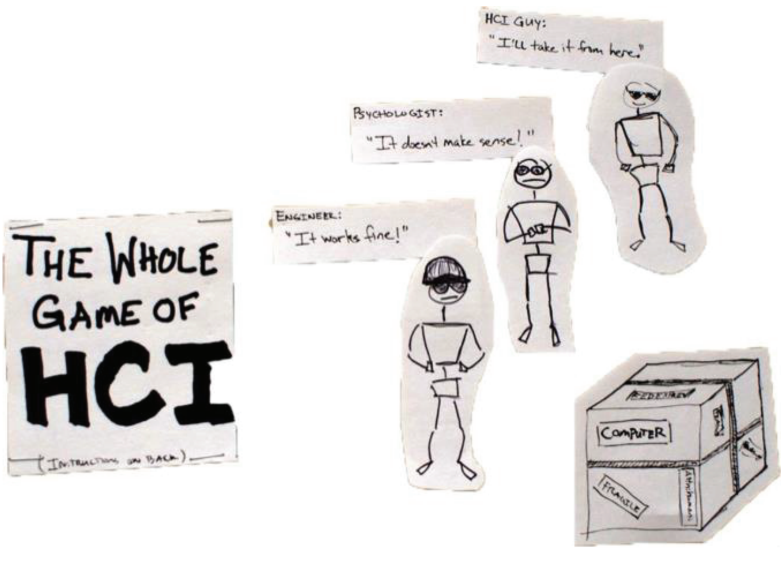

Figure S2.6. Student sketch, second round.

Figure S2.7. Student sketch, second round.

THIRD ROUND

In the third round, sketches made an even bigger leap to concrete representations of the design process, grounded in human activities and complex in presentation of process. These reflections were often more narrative in quality than previous rounds, presented as a series of storyboards (e.g., Figures S3.1, S3.5) or as a metaphorical journey (e.g., Figures S3.2, S3.3). Some sketches included a more abstracted component of process, either as a parallel attempt to explain their process (e.g., Figures S3.4, S3.7) or as a reductive mantra (e.g., Figure S3.6). Terminology followed the trends of round two sketches, with a utilization of concrete activities (or categories of concrete activities), seemingly to represent various parts of the lived experience of the individual designer. These reflections were highly connected, either in proximal relationships (e.g., the stacking of Figures S3.1 and S3.3) or in overt connectivity (e.g., Figure S3.2). Some sketches represented a sense of linearity, but often drawn as a cycle or iterative loop (e.g., Figures S3.4, S3.5, S3.6), as compared with the precise beginning/end construction of round one.

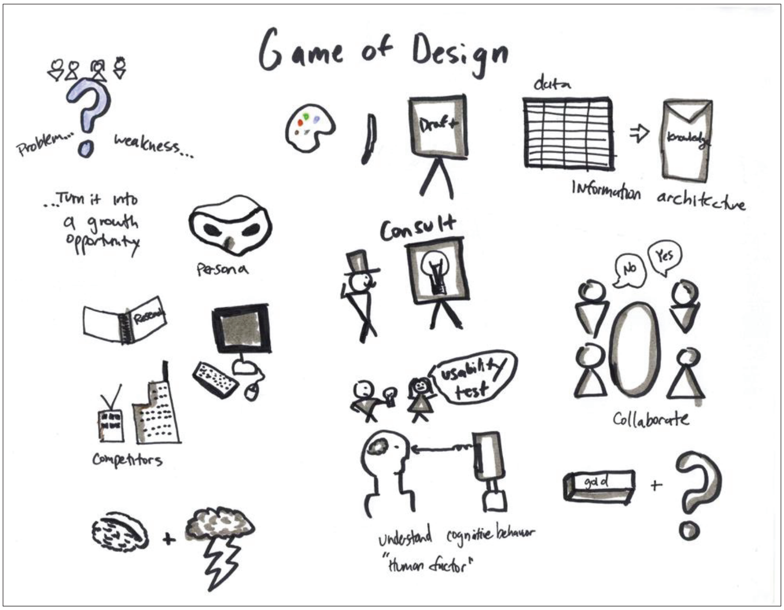

Figure S3.1. Student sketch, third round.

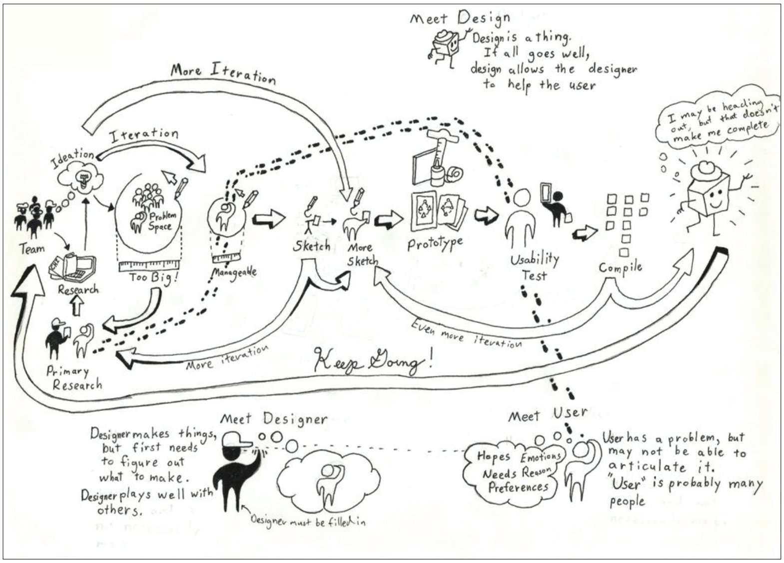

Figure S3.2. Student sketch, third round.

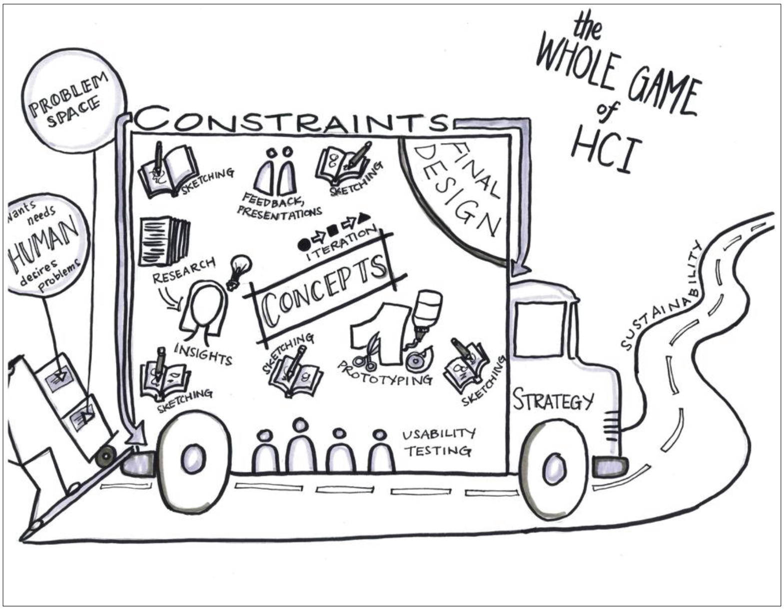

Figure S3.3. Student sketch, third round.

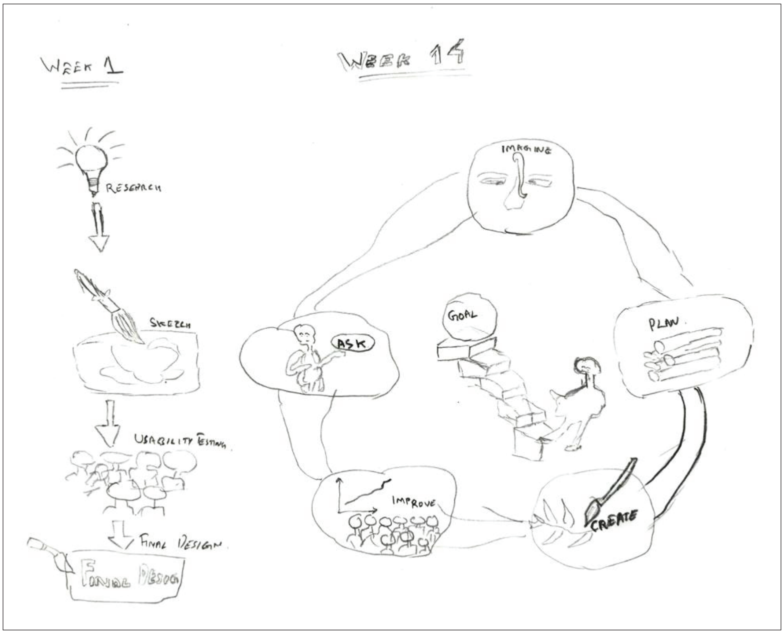

Figure S3.4. Student sketch, third round.

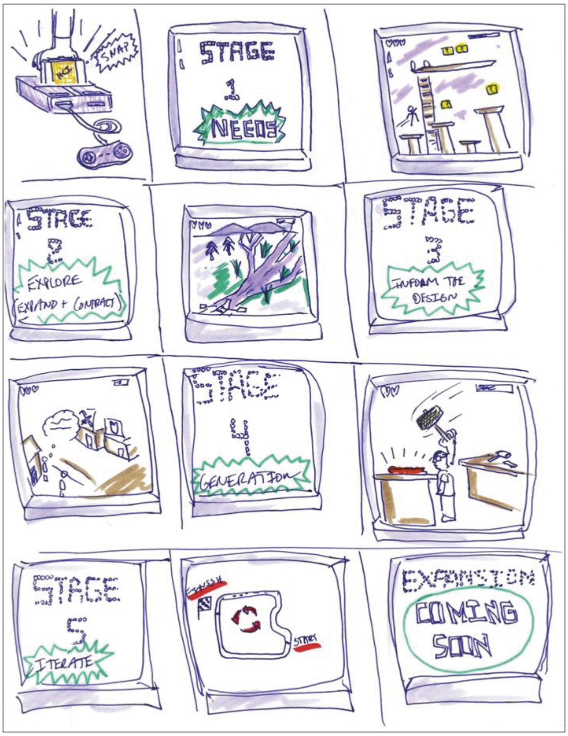

Figure S3.5. Student sketch, third round.

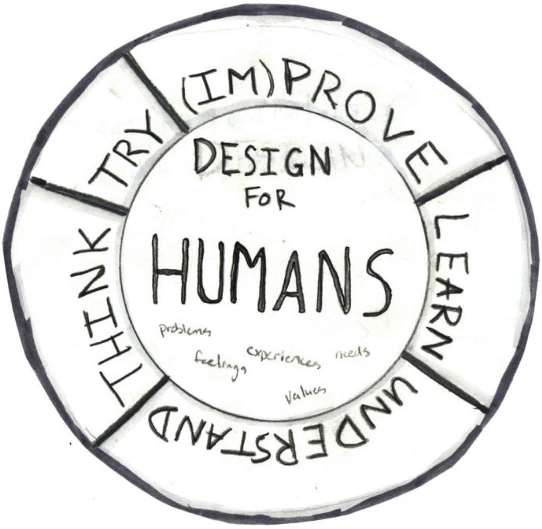

Figure S3.6. Student sketch, third round.

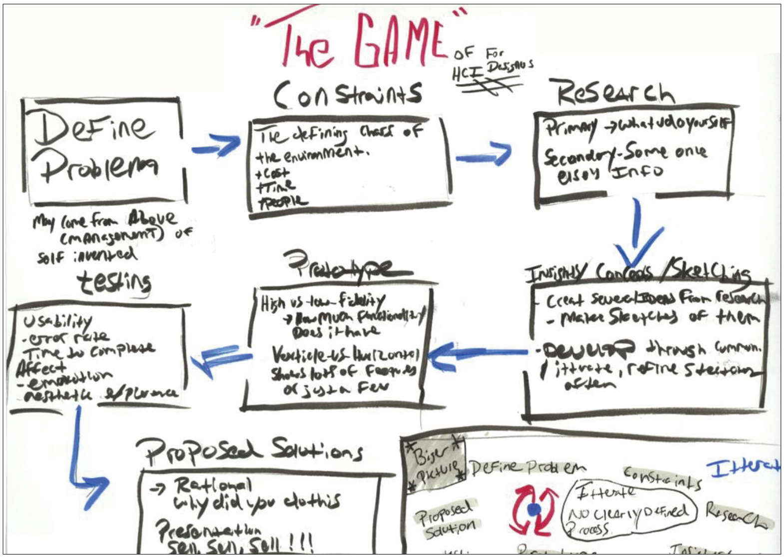

Figure S3.7. Student sketch, third round.

Practitioner Reflections

The practitioner reflection sketches were completed in real time, as a way of discussing processes and methods used in everyday practice. Therefore, they reflect more immediacy, both in execution and in lack of planning or preparation. These sketches represent a wide variety of stylistic choices and organizational paradigms, with the majority drawn on a whiteboard and the remainder completed using a ready-at-hand sketchbook.

All of these sketches represented chaos, messiness of process, or uncertainty using visual and/or textual devices (similar to formal representations in Dubberly 2004). These representations ranged from layering of lines and artifacts (Figures P1, P3, P6) to visual expansion of space (Figure P5) to textual cues (Figures P2, P4). Interestingly, these sketches were relatively simple, with the most complicated sketches containing less than 30 nodes. Complexity was implied, however, in a number of ways, including: categories of work, references to the client relationship, and business justification for the final design.

Categories of Work

While the first aspect of complexity—categories of work—was present in the student reflection sketches, it generally included work germane to design actions in particular, ignoring outside workflows or the involvement of other designers or management. In contrast, these sketches imply the entire lifecycle of the design process, including project management, collaboration with the design team, issues of oversight, and evaluation/validation of the final design.

Client Relationship

The majority of these sketches reinforce the importance of the client in the success of the overall design process. This ranges from design empathy (Figure P3) to engagement (Figure P4) to clients as the origin of the "assignment" or design problem (Figures P1, P2, P6). All of these references, often placed at multiple points in the process, ensure a sense of connectedness and communication between the design team and the client/stakeholders. This communication seems to range from internal responsibility and scheduling (roadmaps or scoping in Figure P1) to assessment (user testing in Figures P4, P5, P6) to engagement ("tell and show how to deliver things simpler in a future/current environment" in Figure P3).

BUSINESS JUSTIFICATION

The relationship of business goals is less clear when looking at these sketches in isolation, but the difference is striking when comparing the scope and character of terminology in these sketches vis à vis student reflections. The majority of the terminology used in this set relates directly to team or management (producer, front-end, lead users, stakeholders, project manager, client), but also relates strongly to the work processes of the individual workplace (roadmapping, build, release, visual design, branding) that are invoked when discussing a general design process or approach.

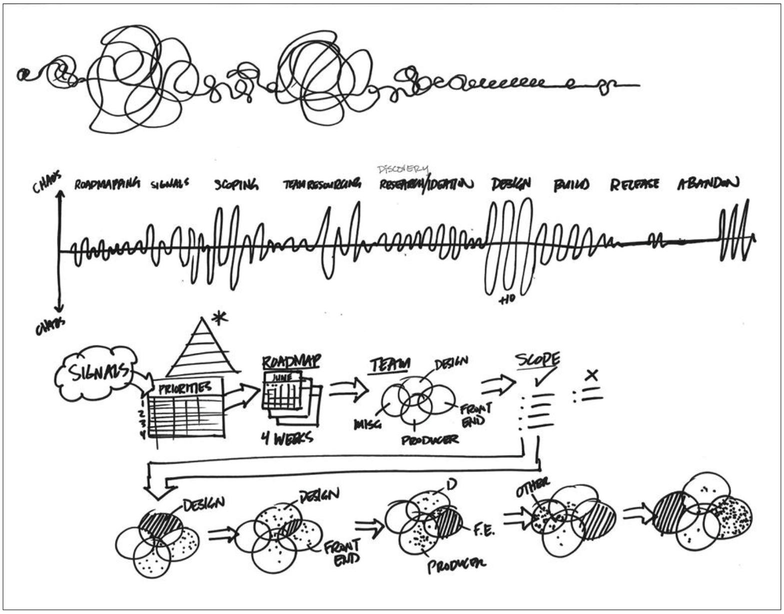

Figure P1. Practitioner sketch.

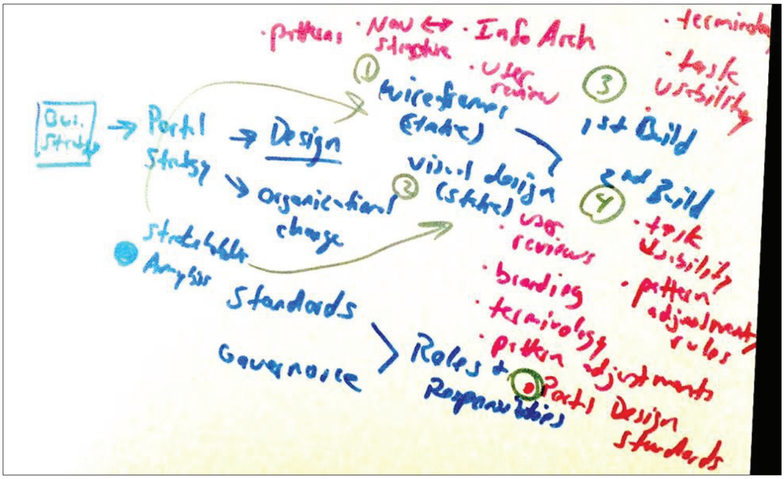

Figure P2. Practitioner sketch.

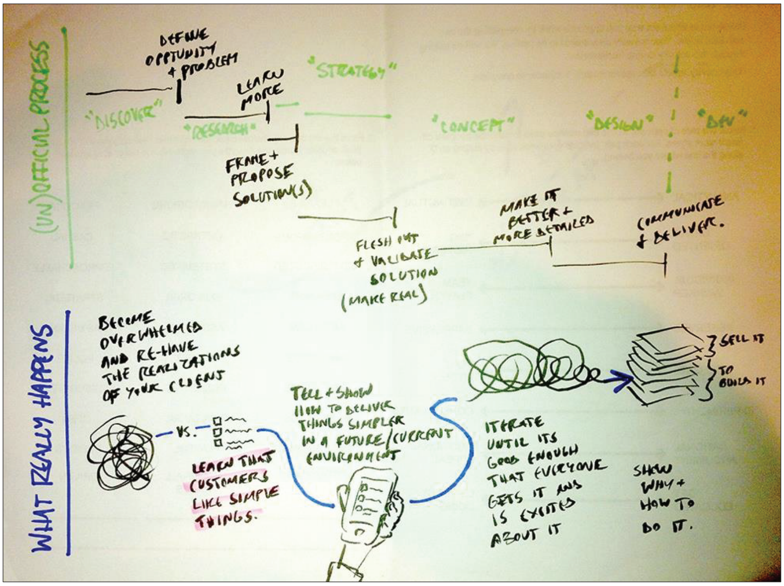

Figure P3. Practitioner sketch.

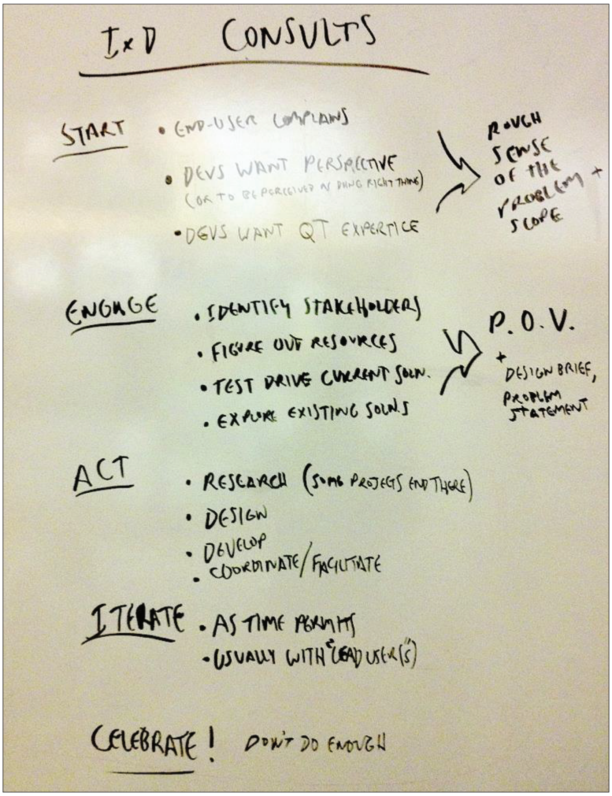

Figure P4. Practitioner sketch.

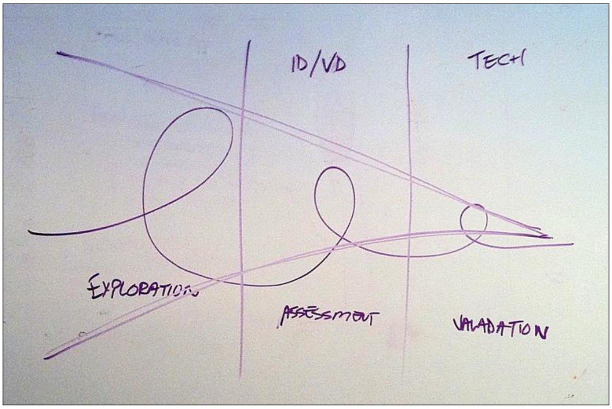

Figure P5. Practitioner sketch.

Figure P6. Practitioner sketch.

Discussion

There seems to be an effort from these beginning design students to re-compartmentalize, re-categorize, and re-synthesize their conceptions of design over time. This meta-cognitive *reflection-on-action* may indicate a general shift in their design thinking—in their thinking about design in general or design in the specific domain of HCI. A few general trends are apparent, including an increase in number of representative "nodes" as the semester progressed, a move from linear to cyclical/iterative representations, and a move from abstract/categorical terminology to concrete/task-centered terminology. This increase in concrete representation is consistent with a student confronted with messy, ill-structured problems, and could reflect the student's thinking about design in general. From an abstract notion of the practice of design with little grounding at the beginning of the semester, to concrete representations of actual design process informed by 4-5 large scale design projects completed in teams. This transition seems to indicate an increasing awareness of the scope of the design challenge, the inability to create a process model that incorporates all of their design activities, and the multiplicity of paths that may be used to lead to a design solution.

The practitioner sketches reflect a hardened professional—action and results driven, with recognition of potential challenges and chaos that must be overcome during the design process. This description of a design practitioner is quite stark when compared to the risk-averse, simplistic representations of the student designers. Not only was chaos included and accepted in the design process (Figures P1, P3, P6), it was featured as a primary component. Unlike the student sketches, which gradually moved away from a linear model, almost all of the practitioner sketches were formed in some linear, directional way. This may reflect the importance of solution-focused design, or creating ideas that "ship" which drive professional IxD practice. The awareness of other designers and team members was also a significantly different between the student and practitioner sketches. While none of the student sketches comprehensively included other design team members (even though they worked on group projects) or clients, the practitioner sketches showed a high level of awareness of other players in the design process, including engineers, graphic designers, marketing, sales, or management. This inclusion of business processes and multiple people involved in the design process is a critical element that seems to evolve over the period of design education or shortly after entering the workforce.

Synthesis of Student and Practitioner

Interestingly, when comparing practitioner and student reflection sketches, the practitioner sketches seem more in keeping with the early student sketches, rather than the late ones. The practitioners seem to explain their process in highly abstract, often business-laden terminology, using a definitively linear representation. Why is this seeming reversal of direction found in the student reflection sketches present?

We propose that an individual designer's representation of design, at least in a domain-specific sense, is bound to their level of design expertise (see Figure 1). Early in their socialization to design concepts, it is easy to view design in highly abstract, not-yet-explored terms. This conception is often linear, using large categorical terminology to describe large sections of the design process. As the design student becomes more familiar with design processes and methodologies common in their design field, they must adjust their process to account for the felt complexity of their process. This simultaneously becomes more iterative and "messy," while increasing in complexity and concreteness of activities, tools, or methods. As the student continues to mature as a designer, we propose that they develop an ability to synthesize this complexity into tacit design judgment; for example, "discovery" becomes a shorthand for a complex set of research techniques and processes, all contextually integrated in the practitioner's mind. By the time these students become design practitioners, we expect they will return to relatively abstract, linear representations of design, even though their design activities represent the more complex, iterative processes similar to the student's third phase reflection sketches, albeit more layered and nuanced.

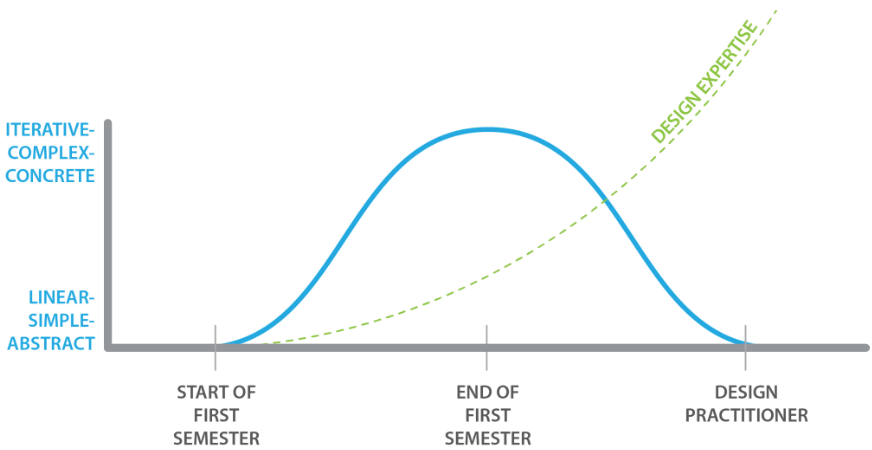

Figure 1. Complexity of reflection compared with the development of design expertise over time.

Figure 1 is a model of design expertise, tracking a designer from Dreyfus' naïve to expert stages. The naïve designer understands little about the design process. Terms, if any, are abstractions and linearly arranged. As the student gains experience with team-based authentic design challenges, the student's representation of the design process becomes more necessarily complex; as new methods are introduced and practiced, the method is integrated into the first design process drawings. The once naïve drawings take on a more iterative and detailed view of design. However, as the student gains more experience and moves into the world of practice, the methods become nuanced abstractions in the practitioner's mind; the various "design moves" become contextually based, less rule-driven, and increasingly tacit. This ultimately leads to a return to a more business-driven, linear and simple abstraction, but unlike the naïve student, this abstraction is filled with nuanced and layered understanding. For the practitioner, a mere squiggle as in the top-half of Figures P1 or P5, represents a great deal of meaning.

Implications for Future Research

This study presents a number of possible directions for future research, including further development of a design pedagogy, understanding of design expertise, thresholds between student and practitioner thinking, and the dynamics of design thinking in professional practice.

For instructors of design, encouraging students to draw a picture of their process understanding has two pedagogical goals: 1) the act of drawing solidifies the student's understanding of the design process, and 2) the resultant artifact becomes an object of discussion for instructor-student dialogue about the process. The act of sketching, like all design sketches, invites conversation and debate, forming a shared artifact that could constitute a form of distributed cognition (Hollan, Hutchins, and Kirsh 2000). Whether the engagement is for improved learning or for a critical review of an existing process, the whole game sketch provides value at multiple points along the naïve-expert design continuum. Future investigation into the efficacy of sketching as a way of representing design thinking could help to formalize visual reflection and the resulting dialogue in a more holistic way. This tool may also be helpful to judge the effect of other interventions within the curricular system; for instance, how students are connecting new concepts or methods being utilized in the classroom environment.

Additional work on design expertise, building on the work of Dreyfus (2003), Lawson and Dorst (2008), and Nelson and Stolterman (2012) is also an important area of opportunity for future research. As noted in Figure 1, tracking expertise over time is difficult due to the increasingly tacit nature of design knowledge. Further expansion of the work shown in this preliminary schema could expand knowledge of critical thresholds, including the transition from academia to practice.

When looking more closely at design practice, it is important to note that the practitioners in this study often initially resisted drawing the "whole game". Yet, when they did so, they found it to be an artifact worthy of discussion and reflection—and potentially a re-examination of their company's process. In this respect, sketching as a way of reflecting may be helpful as a tool to make design processes more explicit and tractable in a business context. When investigating the patterns of thinking of design practitioners, it is important to investigate their tacit assumptions and business translation of design concepts. This remapping seems to occur seamlessly over time, so it is difficult to track evolution of changes without artifacts of explicit reflection.

The comparisons between design students and practitioners also surface a number of issues related to design expertise, articulation of design thinking, and recognition of factors that affect an individual's design process. These factors could forge additional connections between research and practice—including our knowledge of how practitioners work, what things they care about in their process, and how this knowledge may inform future design pedagogy. Any attempts to inform changes to the pedagogy directly from these findings would be premature, but future work in understanding how design students and practitioners think about and articulate their conceptions of design could strengthen the connection between pedagogy and practice in a more generative way. In particular, the underlying structures of teamwork and business language that dominated the sketches of practitioners could represent a terminal goal for design education to progress toward, even if these skills are not directly taught as part of the formal design program, and further work into these connections could provide additional insights on changing the formal and informal pedagogy, working toward changing both surface features and epistemological features of the studio (Shaffer 2003).

Conclusion

In this study we asked two different groups—naïve interaction design students and expert interaction design practitioners—to respond to the prompt "draw a picture of 'playing the whole game' of HCI Design—the real game." For the students, we analyzed at their drawings across three different time points during their first semester of design education. The practitioners made a single drawing in the context of a larger interview about design processes and use of design methods. Our analysis of both sets of sketches shows that naïve designers move from a limited, largely linear, and abstract notion of the design process to a more richly detailed, concrete, and iterative understanding of design. In contrast, the practitioners created sketches that reflected their integrated and tacit understanding of design practice in a situated business setting, including an awareness of multiple players contributing to the success of a given design project.

For design students, drawing the whole game of HCI design allows them to make explicit their understanding of the design process as a schema, and, in particular, reflect as their understanding of design changes over time. For the practitioners, drawing the whole game allows them to reflect on a process that has become internalized and situated in a particular context of practice. For the researchers, the drawings represented longitudinal artifacts, reflecting an imprecise yet non-trivial indicator of learning. These drawings varied across time from naïve to expert views. The student drawings show what was learned over a one-semester engagement with a series of team-based design challenges, while the practitioner drawings show a business-driven and integrated view of a situated design process.

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Teaching 'design thinking' in the context of Innovation Management—from process to a dialogue about principles

Monika HESTAD* and Jamie BRASSETT
Central Saint Martins College of Arts and Design

Abstract: *There has been increased interest in design and 'design thinking' in recent times. This has led to the development of a number of interdisciplinary courses where non-designers have the opportunity to learn so-called 'design thinking'. However, 'design thinking' is an ambiguous concept, which is challenging when trying to apply it in non-design learning and teaching contexts: notably, for this study, innovation management. The aim of this study has two aspects: first, a conceptual one, to articulate what 'design thinking' means in context of a design-driven approach to innovation management; and second, a more practical one, to consider how it could be taught in this context. In this paper, a seminar called 'Design Thinking' is analysed along with key texts within the range of design thinking discourses. This paper concludes by identifying the principles underlying 'design thinking' and develops a teaching framework based on these principles, by using the model of action research. This study is therefore the first stage in an on-going action research project.*

Keywords*: Design, design thinking, teaching, innovation, management, action research*

* Corresponding author: Central Saint Martins College of Arts and Design | England | e-mail: m.hestad@csm.arts.ac.uk

Introduction

Design and 'design thinking' have proven valuable in engaging with problems that are ill defined or that relate to the 'fuzzy' goals often found in innovation (Lockwood 2010). This has led to an interest in design from those in non-design fields and to the development of crossover courses in both design and business schools. One such course is the MA Innovation Management [MAIM] at Central Saint Martins College of Arts and Design. Its handbook explains:

> This course focuses on the need to develop professionals who have the ability to critically analyse, creatively synthesise and successfully manage innovative opportunities, which benefit from the ability to cross a range of different disciplinary and discursive boundaries. In order to do this you will need to be able to work collaboratively, to identify these opportunities using a number of different methodologies and to communicate them coherently and persuasively. (Brassett 2010b, p. 4)

This course comprised of students from both creative and non-creative backgrounds and offers a *design-driven* approach to innovation and it's management. It is important to highlight that this is not a design course, but has emerged from teaching, research and practice (both pedagogical and subject-specific) within a college of art and design. In this course, collaboration between different practitioners, their ability to engage with the world (intellectually and practically) and their creative response to research are of key importance. Furthermore, MAIM deals with its investigation of innovation, management, design, business and culture autopoetically. 'Design Thinking', among others, is not just a method or methodology that can be adopted, but an integral part of working as an innovation manager.

Such an approach came about through the evaluation of outcomes from one of the constituent projects of this course, the 'Uncertainty Project' (Brassett 2011); a critical reflection that led to a change in the curriculum of the whole course. This evaluation showed that we needed to strengthen the students' understanding of design and thereby the ways in which it could drive a different approach to innovation. To meet this demand a series of seminar-workshops, named 'Design Thinking', was planned. The aim of this series was to give the students a basic introduction to design and the thinking underpinning design. However, planning and defining this seminar series was not straightforward, for a number of reasons. First, the multiple perspectives on what design *is*, such that it has no normative definition (Poggenpohl 2008; Verganti 2009), means that there is a concomitant lack of clarity about what *is* 'design thinking'. 'Design thinking' will change its meaning according to its circumstances (Buchanan 1992) and the contexts in which it is being deployed. As Poggenpohl states (2008, p. 221), the lack of a normative definition of design—and by extension, 'design thinking'—allows for the possibility for design, as a practice, to metamorphose into many different guises over time allowing for as many creative opportunities for the use of design, as there might be ways practicing design itself. She finds this liberating. Other writers (notably Verganti 2009) do not.

Secondly, although there exists extensive research into design and 'design thinking', and even its importance to non-creative sectors (Berger 2009; Martin 2009; Neumeier 2010), *how* this could be taught in a management context is not defined (Kimbell 2011). The teaching of management and design are approached differently and teaching strategies developed in and for creative disciplines are still, to a great extent, driven by an approach that foregrounds the intuitive, both in the delivered content and style of the teaching and learning activities (Wisdom 2006).

The aim of this paper is therefore twofold: first, to articulate more clearly what 'design thinking' could mean in the context of innovation management. This will entail examining key texts in the current discourses of 'design thinking'. Secondly, to develop a framework of how 'design thinking' could be taught in this context. In developing this framework we will introduce a more structured approach to teaching through the use of action research as a teaching strategy. This is achieved through reflecting on past seminars and current teaching practice in the 'design thinking' seminar and testing it against both the theoretical critique carried out before as well as some pedagogical theory. This will help us to identify underlying principles and values that constitute our current teaching framework. We hope, therefore, to open a dialogue of what design and design thinking may be in the context of Innovation Management, with the aim of developing an understanding what will be important in this teaching and learning context. These are the first words, we hope, not the last ones.

Design thinking and why it is relevant

'Design thinking' as a concept has been used both to understand what kind of knowledge design consists of (Buchanan 1996) and to 'demystify' the design process by looking into how designers are 'thinking' when working (Lawson 1997). Recently it was reintroduced in the field of design as a concept on its own. The design and innovation company IDEO, uses this term to describe its own human-centred approach to innovation (Brown 2008). The management and branding consultant Marty Neumeier states that business leaders need to think more like designers to gain a more flexible and adaptive approach to business development (Neumeier 2009, 2010). This is a perspective shared by Roger Martin, Dean of the University of Toronto's Rotman School of Management. Martin (2009) forecasts: "the most successful businesses in the years to come will balance analytical mastery and intuitive originality in a dynamic interplay that I call design thinking" (2009, p. 6).

It is not first time that *design* is suggested as an alternative to the linear or analytical approach seen in professional disciplines (Simon 1994 [1969, 1981]), Schön 2011 [1983, 1991]). Martin (2009), Neumeier (2009, 2010) and design and innovation researcher at the University of Cincinnati, Craig M. Vogel (2010), all build their understanding of design thinking on Nobel economics laureate Herbert Simon's understanding of design. Simon presents a solution for professionals who have to deal with 'how things ought to be' in his book *The Sciences of the Artificial* (1994 [1969, 1981], p. 133). He is one of few people to provide a normative definition of design, by suggesting that a designer is anyone involved in actions to change existing situations into preferred ones (1994 [1969, 1981], p. 129)[1]. Furthermore, design is not a process and practice that concerns itself only with analytic reasoning, but rather posits materially constructable futures and does so in expansive and connecting ways using 'abductive logic' or 'abductive reasoning'[2]. In this way, design offers a far more

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[1] Management professor Roberto Verganti (2010) finds Simon's a welcome statement of clarity in an otherwise fuzzy practice, in his book examining design-driven innovation.

[2] See Neumeier (2009, p. 39-41) and Martin (2010, p. 62-8), who use this concept following Charles Peirce. Philosopher and Social Theorist of Science and Technology, Bruno Latour, adds

qualitative approach than management in general, and innovation management in particular.

Another scholar whose work has been influential across design, management and pedagogic theory is Donald Schön. In his work on the 'reflective practitioner' (Schön 2011 [1983, 1991]), Schön showed how, before even engaging with buildings, architects engaged in a dialogue with themselves and others, wherein they presented their visions, worked through scenarios and encountered trial and error in a virtual world. This process of reflection in action in the name of materialising possible futures resonates well with management practice, providing a way of capturing trials and errors made in practice, reflecting upon the knowledge that is developed, transmitting it through ones organisation and iterating the outcomes back into the original process. It remains to be seen, then, how some of these key, and 'fuzzy' elements of design can impact upon 'design thinking'.

Design thinking an ambiguous concept

Roger Martin was asked in an interview presented in an article in *Academy of Management Learning and Education* (Dunne and Martin 2006) whether 'design thinking' could be seen as a 'fad': a pejorative term for something with even less endurance and depth than fashion. His answer was that *design* in management may be a fad, but that there still was a need for wholesale changes to management practice (2006, p. 516). Nevertheless, the prominence that 'design thinking' has enjoyed in recent years has led to its critique from management and from the design community. A former advocate for 'design thinking', Bruce Nussbaum, argues that it is a failed experiment (Nussbaum 2012): that 'design thinking' promised to deliver creativity but is too often turned 'into a linear, gated, by-the-book methodology that delivered, at best, incremental change and innovation.'

'Design thinking' meets critics within the design community as well. Industrial designer Kevin McCullagh (2010) questions whether designers are the best examples of balancing analytic thinking and intuitive originality, referring to one of Martin's definitions of 'design thinking' (Martin 2009, p. 6). From McCullagh's perspective, analytic rigour is neither highly valued in design companies nor an important part of design curriculums (McCullagh 2010). The different attitudes marketers and designers have to research supports this argument. While traditional marketers emphasises an objective, quantitative approach in research, design is far more subjective and qualitative, 'based,' Holm and Johansson explain, "on the designer's skill and an intuitive approach to making decisions". (2005, p. 38)

Furthermore, McCullagh's fear is that to reduce design to a workshop in 'design thinking' for non-designers will lead to the misunderstanding of what design as a practice is and the resultant devaluing of design practitioners (2010). The reduction of design to 'design thinking' thus becomes the training session equivalent of business card machines at railway stations positioning their users as graphic designers. This parallels a criticism raised of Herbert Simon's account of design, for in positioning all professionals as designers he devalues the singular skills and expertise of designers

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nuance to this distinction by regarding design today as a "matter of concern" and no longer as just a "matter of fact" (Latour 2008).

Figure 1. *Design thinking DMI 2008. Source: Hestad*

(Edeholt 2003): the championing of their transferrable skills necessitates a denigration of their particular ones. This is an important concern and to deal with it demands not only a rethinking of design as a practice, but a repositioning of ‘design thinking’ away from the status of a methodology—something that can be taken up or discarded with ease—, towards it being one of a set of principles according to which practice can be expressed—and therefore any engagement with it demands a deeper encounter with the very conditions of its value.

It is not always easy to see what the differences are between design as a practice, ‘design thinking’ and design process. And when this is the case, we are led to the possibility of questioning the necessity of ‘design thinking’ as a concept in itself: why not just talk about ‘design’ or ‘designing’? When the Design Management Institute (DMI), a leading professional institution for the design management sector, organised a conference in 2008 to look at ‘design thinking’, the 100+attendees quickly came up with a range of explanations (see Figure 1). It is significant that this activity also included an examination and outlining of definitions of design. As design focuses less on the nature of its outcomes—as products, images, services and other creative outputs—and more on the principles and processes (Cooper, Junginger and Lockwood 2010), and even about a wider set of issues in which practice and principles are contextualised (Latour 2008), design becomes more important in other areas: for example, in business.

In her analysis of ‘design thinking’ the design researcher Lucy Kimbell questions the ignorance of ‘design thinking’ practitioners to the large body of literature and research already existent in design practice (2011). Kimbell (2011) suggests a move away from a generalised ‘design thinking’ towards design as a set of principles that emerge out of a particular context and can express singular activities in any situation. This is insightful and aligns with our view that any ‘design thinking’ should not merely instruct in how to use a set of prescribed techniques or methods, but should be open to both a range and depth of situated intellectual and practical acts. As its advocates champion, ‘design thinking’ thus articulated could provide an insightful activity for many of us in a multitude of sectors and professions: not least managers.

An action research project

In developing a teaching framework that is less based on an intuitive approach to teaching, the current academic development of teaching towards a professional paradigm is important. A professional paradigm describes a teaching environment where what is taught is in constant and reflective dialogue with institution, self and society (Light, Cox and Calkins 2011). This sense of professional paradigm fits both with how we would like the teaching and learning experience on MAIM to be and how we would like students from MAIM to relate to a professional context.

In education, Action Research is a method that involves enhancing teaching practice by planning an intervention and reflecting upon the outcome (Smith 2007; Koshy 2010) and was chosen as our approach when considering the role and place of 'design thinking' in the MAIM curriculum. This approach allows us to meet the need for a structured development of our teaching practice, to be open to the many ways in which our curriculum could evolve and to open a dialogue into some key discourses in our subject area itself. Action Research is a style of researching within the social sciences that is not only about application of what is researched within a practical setting, but deals with bringing about change. Norman Blaikie, in his book *Designing Social Research*, defines Action Research as having the "joint purposes of increasing knowledge and changing some aspect of the world at the same time" (Blaikie 2010, p. 73). It is therefore characterised by the role that the researcher takes in this process: as a facilitator helping the group being researched to 'change their own situation from the inside rather than acting as an outside expert forcing change through "external" intervention' (Blaikie 2010, p. 73).

In this paper we will include reflections on the 'design thinking' seminar series during the 2010/11, 2011/12 and the beginning of the 2012/13 academic years. In 2010/11 the action research was not yet defined but will be included as this formed the basis on which the 2011/12 seminar was developed. The action research is still on going and the reflections shared in this paper are presented as the current snapshot of our learning. These seminars will be evaluated based on which paradigms they sit within, which principles and values are identified as of importance when developing the seminars and how the students understood the seminars based on what was presented.

An important part of defining the teaching framework for MAIM was the need for a clearer articulation of 'design thinking', this will make it possible to evaluate the learning with intended teaching in this seminar and be an important step towards teaching informed by pedagogy. In transport and product design fields, the theory of threshold concepts has been a promising framework to identify hidden agendas or underlying assumptions of what the students are supposed to learn in the field (Osmond *et al.* 2008). One of the characteristics of threshold concepts is that they are irreversible, which means that once the students 'get them' they cannot go back to their previous view of the world. In this way they are transformative in nature, to the degree that they change values, attitudes and even self (Barnett 2004 and 2007). Moreover, the integrative nature of threshold concepts means that they must be related to the context in which they operate, otherwise their abstract nature could be challenging for students to comprehend thus obviating their transformative powers. Further Meyer and Land (2003) show that some threshold concepts might have a bounded nature. This defines their relation to other disciplines, thus identifying passages to new conceptual areas. Threshold concepts are sometimes seen as synonymous with what syllabuses label 'core concepts' although 'core concepts' in a field are not necessarily transformative, therefore not threshold concepts proper (Meyer and Land 2003)[3].

To begin with, not only will we analyse the current structure and execution of the seminar series, but we will also examine through the lens of threshold concept theory five texts selected for analysis during this seminar series (Brown 2008; Martin 2009; Lockwood 2010; Neumeier 2010; Vogel 2010). As stated, the theory of threshold concepts aims to unpack assumptions underlying pedagogic practice and we sought to identify these by asking what might be the core concepts of 'design thinking'. Once we know what assumptions we might be making in our teaching of 'design thinking' and use such knowledge to help us identify those transformational concepts any 'design thinking' seminar might offer for students of innovation management. Based on this we will identify principles that will be implemented in year 2012/2013 and bring new insights into future developments.

Possible threshold concepts from five key texts

Perhaps unsurprisingly given the ambiguity around the term 'design', 'design thinking' is presented in a number of different ways: as a process to be followed, as an approach or way of thinking about a subject (area) (see Table 1). Lockwood presents 'design thinking' as an innovation process that is 'human-centred' (2010). Martin (2009), Neumeier (2009) and Vogel (2010) all present it as a particular design approach, although with different perspectives of what this might be. Martin highlights three components that define this approach: (1) 'deep and holistic user understanding; (2) visualisation of new possibilities, prototyping, and refining; and (3) the creation of a new activity system to bring the nascent idea to reality and profitable operation' (Martin 2009, p. 88). Neumeier's focus is on design and argues that managers need to think like designers; he argues that a design approach is an answer to solving 'wicked problems' (2009) and references Martin (2009) heavily in asserting his argument. Vogel (2010) analyses the ways that both design and 'design thinking' have evolved through time. His emphasis is on 'design thinking' as a practice that demands the integration of multiple perspectives: especially, but not exclusively, it should encompass customer experiences and stakeholder needs. Vogel here presents a systematic and contextually specific design approach. Brown (2008) emphasises the importance of thinking like a designer: this will demand dealing with particular methodologies and methods, in a certain way, as well as engaging in a particular process. Notwithstanding their slight differences of focus, one thing that comes across from all their perspectives on how it is to think as a designer is the importance of a human-centred approach.

Furthermore, if we compare the identified potential threshold concepts in this literature with the threshold concepts highlighted in the studies of design in automotive and spatial design sectors, we also see the importance of viewing design as a practice in a context. This is also a key consideration for MAIM as a whole. One of the key course learning outcomes is the ability to 'research and analyse the discourses of business, culture and design and translate between them'. Any process and practice of innovation management—especially a design-driven one—must take note, always, of

[3] Collier and Esteban (1999) highlight many issues that cut across creative, business and pedagogic practices. Their focus on the creative and human benefits of open, dynamic and critically positive feedback on practices, processes and principles seem apposite not only for the innovation management, design and business subject areas, but their pedagogical paradigm too.

the cultural contexts in which it sits. This seems to be less important in traditional approaches to innovation management.

Table 1. *Unpacking design thinking from five key texts.*

Text and page	What it is	Important key words
Lockwood 2010:xi	*A process.* *A method of innovation.*	*Human-centred, collaboration, observation, visualisation, rapid concept prototyping, imagination tool.*
Vogel, 2010:11-12	*Design approach.*	*Integrating stakeholders needs, connecting.*
Neumeier, 2009:18, 22	*Design approach.* *Think like a designer.*	*Design of processes, systems and organisation, solve 'wicked problems'.*
Martin, 2009:6	*Interplay between rational and intuitive.*	
Martin, 2009:64		*Wondering, coming up with something different, user understanding, visualisation and prototyping, creating systems and processes.*
Martin, 2009:90		*Tools to engage, creative , practical.*
Brown, 2008:1-2	*Thinking like a designer.*	*Full spectrum of innovation activities, human-centred design, people needs, sensibility, methods, people needs v technology/strategy.*
Brown, 2008:3		*Empathy, integrative thinking, optimism, experimentalism, collaboration.*

From an intuitive approach to teaching to introducing pedagogy

The first introduction of the 'design thinking' seminar series in the curriculum was in 2010/11. Design thinking was interpreted as 'thinking by doing' and the title of the seminar was presented as 'Design Thinking - Design Doing'. In this we focused first on a range of activities and methods used in design and introduced these to the students in a workshop form. This was driven by an intuitive approach to what should be taught and what the students in an innovation management context could need. This series was planned as a combined lecture and practice workshop where different perspectives on what design is would be presented first, before asking the students to engage in various design-led activities. The tutor who developed and led this series comes from an academic and practical industrial design background, and theoretical and historical discourses from design studies and her experience of practicing design and strategy in a commercial setting, played an important role in shaping what this seminar series. In a way which deals with the Kimbell's (2011) concerns, mentioned above, it was clear that the experience from design (including historical and theoretical issues) should be brought to bear on this 'design thinking' series. For us, it was also important to emphasise from the beginning the manifold nature of design as a set of practices and theoretical discourses was difficult to homogenise. Not only does this convey the contemporary condition of design, but is a key element of its practice too (Poggenpohl 2009).

The following year (2011/12) this 'design thinking' series was informed more rigorously by teaching pedagogy particularly the notion of 'constructive alignment' (Biggs and Tang 2007). The core idea of constructive alignment is that activities are planned from intended learning outcome and this is aligned with how, and on what, the students are assessed. An important principle in planning the learning experience is that the focus shifts from what the teacher would like to teach, to students' needs in learning. The thinking by doing approach was kept but the change led to a further streamlining of the series, where less material was included in the workshop and what remained was more aligned to support the learning needs of the students. These seminars were also planned as an action research project that allowed us a structured approach to reflecting upon the seminar.

In 2011/12 the 'design thinking' seminar series was structured to take place over three, three-hour long sessions (see Table 2). The first of these was itself broken into three parts: 1-1 presented an introduction to the practice of 'design thinking', by investigating some of the core definitions of design itself and was structured to follow a simplified version of the product/industrial design process. In part 1-2, the design process was still used but the focus here was on developing a concept into a brand. In part 1-3 the focus was on how to launch this new brand they had developed. Through this first seminar the students was first introduced to the concept around design thinking and also explored how this could be used to develop a concept for a brand and a plan for launching this to the market. The second seminar (Table 2: 2-1, 2-2 and 2-3) was constructed to provide support to a particular project that the students were engaged in, called the 'Uncertainty Project' (Brassett 2011). In this the students explored more in depth key stages in the design process: mapping of information, prototyping as a tool to ideate and importance of identify a vision in the process. The third seminar (Table 2: 3-1, 3-2 and 3-2) is focused on unpacking the concept 'design thinking.' In this last session the students engaged more with the literature on 'design thinking' and worked on defining their own position in relationship to this field. All of the activities supported a thinking by doing approach.

Table 2. *Unpacking core principles in 'Design Thinking' seminar 2011/12*

Title of seminar	**Key words describing the activities**
Seminar 1-1: Design	*Group collaboration, tools, visualisation, integrating stakeholders view, empathy, analytical and intuitive reasoning.*
Seminar 1-2: Branding	*Wondering/imagination, group collaboration, tools, visualisation, integrating stakeholders view*.

Seminar 1-3: Launching	*Wondering/imagination, group collaboration, tools, visualisation, integrating stakeholders view*.
Seminar 2-1: Visual mapping	*Group collaboration, tools, visualisation, analytical and intuitive reasoning.*
Seminar 2-2: Prototyping	*Prototyping, Group collaboration, tools, visualisation, analytical and intuitive reasoning, experimentation.*
Seminar 2-3:Visions and values	*Wondering/imagination, tools visualisation, analytical and intuitive reasoning.*
Seminar 3-1: Design thinking part one	*Wondering/imagination, tools visualisation, analytical and intuitive reasoning.*
Seminar 3-2: Design thinking part 2	*Group collaboration, tools visualisation, analytical and intuitive reasoning.*

The 2011/12 was in general perceived by the staff team as an improvement upon the 2010/11 seminar and one-step further to engage with 'design thinking' both for designers and non-designers. However, our critical analysis of the design of this whole seminar series shows that the focus in these seminars was still on the specific processes and the tools introduced in the seminar. This could make it challenging to transfer the learning to other areas as the tools are introduced for a specific purpose. This reflection was supported by students' feedback showed as they saw 'design thinking' *as* an innovation process and as a 'toolkit'.

When evaluating current teaching framework, it became clear how the activities, structure and the content delivered drove the students' perspective on 'design thinking'. This was particularly evident the last seminar. The first day (Table 2: Seminar 3-1) the focus was on each of the students' individual understanding of 'design thinking': their descriptions of 'design thinking' positioned themselves as 'design thinkers' in its discursive and practice context. The second day (Table 2: Seminar 3-2) all of the activities were group-related. These activities changed the students' perspectives on 'design thinking' from being an isolated, personal creative activity to a collaborative, group one. This transition from an individual to collaborative activity highlights a threshold concept we identified in MAIM and thus helped drive the approach to 'design thinking' that would be taken in the future.

Overall, our reflection on the seminar was that the underlying principles that led the teacher in designing the teaching activities—identified by teasing out the threshold concepts—, are key in articulating 'design thinking' and therefore should become the focus of the *point* of doing 'design thinking' in an innovation management context. To insist that certain activities, processes or even methodological approaches are necessary in 'design thinking', we concluded, would be too dictatorial. Furthermore, to create greater transparency in what is taught, there is also a need to deal with the underlying values and assumptions more openly. We were able to tackle both a subject-specific and a pedagogical issue in the same act. Our conclusion that a defining of these principles when engaging in these activities is when 'design thinking' will happen. The reflective activities that are demanded throughout the whole process may request change and be adapted differently than previously imagined. So what we even offer as "principles" are not written in stone: how could they be? Surely 'design thinking' acting in "fuzzy", uncertain, complex areas needs the opportunity to adapt dynamically to these.

Principles informing the teaching framework

The reflection upon the former 'design thinking' seminar series, along with discussions with colleagues and the analysis of current texts within the 'design thinking' field, have led to a better awareness of how 'design thinking' could be taught in the context of MAIM. For 2012/13 academic year, 'design thinking' on MAIM has been introduced, in the way we state above, as a *design approach* to innovation that is driven by key principles, rather than as an *innovation process.* This is to shift expectations from learning a process, to learning how to adapt an approach (and an adaptive approach at that). Design thinking as thinking by doing and reflection in action has been kept, however, identifying the underlying principles allows us to specify what design thinking could mean in the context of innovation management. The design process will be introduced, as it proved valuable to engage with the 'design thinking'. However, the emphasis in the discussion will be on the principles and not on the process or specific tools. We will also stress that the context of the challenge will set the terms of the action needed; so that given the set of principles, their expression in action at a particular time may determine how 'design thinking' may operate and these, of course, could change. A teaching framework based on action research allows the creation of a dynamic learning context. (See Figure 2) In this the principles will need to be defined in order to plan the activities for the seminar. However, in the teaching space we open up for a dialogue around current understanding and how the activities are intended to engage with the principles. An important part of the teaching will be reflection upon the principles, both in the teaching space and after seminars. The reflection will be an important part of defining future seminars.

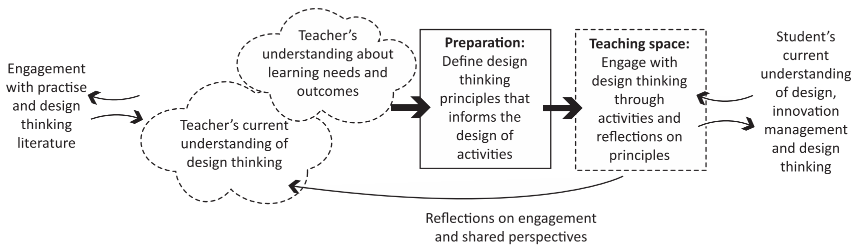

***Figure 2**. Action research as a teaching framework for the Design thinking seminars*

The principles that we will focus upon in 2012/13 will be as following:

- Thinking by doing and reflection in action
- Group collaboration
- Emphasise both analytic and intuitive approach

- 'Zooming in' on details and 'zooming out' on the bigger picture
- Have empathy for people in the context
- Integrate multiple stakeholder views
- Driven by wondering and imagination, by experimentation and prototyping
- Use multiple tools for opening up challenges
- Reducing to core idea and continuous iterations
- Assessment towards criteria that are defined by the context

These principles will be displayed continually from the beginning of the first session of 2012/13 and they will be presented as open for discussion and revision (See Table 3 – Seminar 1-1). We hope that this will be relevant not only for the 'design thinking' seminar series, as we have outlined here, but for the whole masters course too. Not only do we see this exercise refining how 'design thinking' may be of use to innovation management (its practice and teaching), but also how we see innovation management being expressed in an art and design higher education context. We envisage, then, that in moving the discussion

Table 3. *Outline of 'Design Thinking' seminar 2012/13*

Support to student learning	**Title of seminar**	**Description**
Introduction to design thinking.	Seminar 1-1: Immerse Seminar 1-2: Ideation &Concept development Seminar 1-3: Prototype & Presentation	Key principles introduced, reflections on these through out the process and after the students have been through the design process.
Supporting Uncertainty project.	Seminar 2-1: Visual mapping Seminar 2-2: Research Seminar 2-3: Prototyping	Mapping information, group collaboration From research to ideas. Exploring experimental research. Prototype as ideation technique and to create a shared vision.
Examination of design thinking literature	Seminar 3-1: Design thinking, 1 Seminar 3-2: Design thinking, 2	Critical engagement with key texts, reflection. Reflection upon principles in relation to seminar and other projects. Group collaboration, positioning

about 'design thinking' away from a focus on how designers 'think' and how this thinking can be installed in other contexts, we can focus upon the principles key to the practice of innovation management irrespective of the background of the practitioners. Consequently, as this is happening also within the context of a reflective teaching practice—which necessitates constant dialogue with our students, our colleagues and the practice of innovation management outside of the college and the myriad changes in concepts and theories of many related subjects—it is likely that we are still a little way away from the finished article. If it is possible ever to reach such a thing. As it is, we are treating this seminar series (as it is currently and might be in the future) as part of an action research exercise: which in itself encompasses some of the key principles of dynamism, reflection, prototyping, experimentation, dialogue and collaboration that we find in the value of 'design thinking' to innovation management (See Figure 2). Furthermore, one might see in Schön's process an account not only of the perfect action researcher, but also the perfect 'design thinker' and, we might add, the perfect innovation manager: for in the act of reflecting, we can see operating the drive to improve the future, advance knowledge and improve (teaching) practice by considering present and past actions.

The beginning of the journey

The aim of this paper was to bring clarity to the concept and practice of 'design thinking' especially in the context of innovation management and to construct a teaching framework for a seminar series relevant to this.

An important part in crafting this framework has been to engage with some teaching as research and using pedagogical theories to identify underlying values and principles in our teaching approach. An outcome of this activity has been to clarify for us the underlying values of our course and the elements that make it up. We have found that the use of the theory of 'threshold concepts' has made it possible to develop this seminar series in a systematic manner. It also made more transparent, to the students and us, what was taught in the seminar series and how the different activities it contained made it possible to engage with the seminar. The threshold concepts we encountered have helped us to focus on the key learning outcomes of the series on 'design thinking' in particular and of MAIM as a whole, as well as the positioning of 'design thinking' within this course and the subject at large. In the follow-up discussion on MAIM we will need to look at all components of the degree together. By identifying the principles in this one area, it has also opened-up the question whether this seminar series is the best way of strengthening the design-driven approach to innovation management, or whether we need to take a different approach entirely and to embed 'design thinking' in other projects.

However, as we have intimated, the threshold concepts of 'design thinking' will always need to change because the context in which they are, or can be, used is always changing; and even in one particular context, in our case innovation management, this too is a complex and constantly mutating area. It is therefore no surprise that we have implemented action research as our approach to developing a teaching strategy: the teaching framework is developed by the same core principles as what is taught. A teaching strategy based on action research is therefore important combination with the defining of the threshold concepts. This allows us to introduce activities in the seminar with clarity and the underlying values and principles that emerge are always open to reflect upon, to discuss and to change. It seems that it should not be a vain hope for the innovation of our teaching to follow the same principles that we were teaching. Teaching and learning are as ripe for an innovative engagement with their management as any other subject of course.

In the light of the current critique of 'design thinking' (McCullagh 2010, Nussbaum 2012) and still regarding that there is a need for 'design thinking' (Kimbell 2011, Dunne and Martin 2006), this current study has made us more aware of the pedagogical benefit in focusing on 'design thinking'—rather than 'design'—for our group of students. Notwithstanding the possible philosophical problems in the term (Brassett 2010a), 'design thinking' does distinguish itself from the questions of style that may still abound in the discourses related to the design disciplines, especially as they coalesce around material object or other visual (re)presentations. We should also beware of 'design thinking' being used to replace designers designing (McCullagh 2010). We hope to have shown that even though it is generated from thinking about design, 'design thinking' is not a replacement for designing. It should be used as a way in which non-designers and designers can share the discourses (theoretical, practical, conceptual, intuitive) of design, both in order for non-designers to connect better with designers, and to allow everyone to design systems that are able to adapt to changes. To focus on 'design thinking' and not on 'design' emphasises for our students that we are not training them to become designers, but rather immersing them in the multiplicitous discourses of design by focussing on some of their key principles. Albeit principles which are dynamic and under constant change. It may be that we end up just talking about innovation management—or something else entirely.

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Practically Creative: The Role of Design Thinking as an Improved Paradigm for 21st Century Art Education

Delane INGALLS VANADA*
University of North Carolina at Charlotte

Abstract: *Art and design education hold a unique role in preparing the kinds of innovative, balanced, synthetic creators and thinkers needed in the 21st century. This paper sheds shed light on how learner-centered art classrooms, that incorporate design thinking as a balanced process, can better develop the overall learning capacity of students. In a mash-up between mixed model research involving the impact of learner-centered pedagogies on visual art students' balanced intelligence and reviews of literature surrounding the promotion of depth and complexity of knowledge, new conceptual frameworks are offered. Towards a vision of fostering deep, connected, and independent thinkers, the author—as designer, artist, and art educator-- explores design thinking as an aesthetic, inquiry based process that integrates complex intelligence theories.*

Keywords: Design thinking, design pedagogy, balanced thinking, critical thinking, creative thinking, practical thinking, learner-centered, dispositions, successful intelligence, quality thinking, learning capacity

* Corresponding author: University of North Carolina at Charlotte | USA | e-mail: delane.vanada@uncc.edu

Teaching for 21st Century Skills

In this global economy, there is a critical need for training students to be more well-rounded, strong in collaborative skills and able to think critically, creatively, and practically. In order to develop tomorrow's change makers and problem solvers, educational systems would do well to capitalize on a balance of skills and dispositions that design thinking processes help to develop. As Powell (2012, para 5) suggests:

> "Our country and world are faced with challenges of an almost unthinkable scale… [A]rtists and designers—creative thinkers—are uniquely qualified to contribute meaningful answers to these critical social questions."

Today's students need to be more self-directed (Lipman 2003; McCombs and Whisler 1997), possessing a balance of intelligence which enables them to think independently and go beyond content knowledge toward anticipating creative solutions to problems. In preparing our students for big picture thinking (Pink 2005), art and design education may be better positioned from an approach that fosters balanced, interdisciplinary 21st century skills and habits of mind. Just as not all art and design classrooms train for creativity, many also do not facilitate a balance of skills and dispositions. In this light, it is important to document learning environments that focus on creativity and innovation balanced with criticality and practical wisdom (Craft, Gardner and Claxton 2007; Sternberg 2008).

Developing Capacity through Balance

The focus of this article is on how learner-centered arts classrooms, when taught for a balance of thinking skills and dispositions, can advance students' overall quality of thinking or capacity to learn. Learner-centered pedagogies and environments are those that support the primary indicators of inquiry, connection-making, and self-direction (Figure 1). Quality thinking is defined as a balance of critical, creative, and practical thinking skills and dispositions, applied with depth and complexity (Ingalls Vanada 2011). The research study reported in this paper investigates the impact of art classrooms designed to be more learner-centered, and it provides a design thinking model linked to the development of balanced thinking and cognitive research.

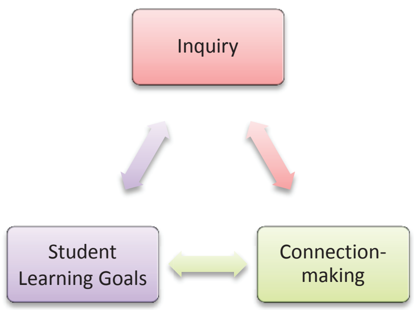

Figure 1. Balanced Learning Environments

There is a need in 21st century art and design education for new paradigms of teaching and learning which embrace more balanced and equitable expressions of intelligence (Gardner 2007; Ritchhart 2002; Sternberg 2008; Sternberg and Grigorenko 2004), yet studies rarely focus on links between creative and critical thinking (Bailin, Case, Coombs and Daniels 1999; Cunliffe 2007). Even less research exists on the development of a balance of creative, critical, and social/emotional thinking skills in the visual arts (Ingalls Vanada 2011), leading to concern that fostering students' creative thinking alongside problem solving competencies has been neglected in traditional arts classes. Dai and Sternberg's research (2004) on creative, cognitive, and affective dimensions of thinking, also highlights the corresponding need for balance within art education. It is proposed that a design thinking perspective promotes this balance, focusing on the supportive role of critical thinking to creativity and creativity to critical thinking, and leading to greater development between both processes (Bailin et al. 1993; Burnette 2005; Cross 2007; Burnette and Norman 1997).

Toward greater development of balanced thinking skills (creative, critical, and practical) in art and design education, this article addresses existing literature and illuminates the conditions within which students' quality of thinking may be enhanced. This article reveals how certain teacher pedagogies and curricula in visual art are important for developing design thinking, and it contributes to a call for research in inquiry-based and process-based art classrooms that contribute to overall student achievement (Burnette 2005; Burnette and Norman 1997; Winner and Hetland 2000). It is highlighted that the emphasis for this paper is on balance and quality thinking potentially developed through design thinking processes, with less emphasis on the business of teaching design in the art classroom (Bequette and Bequette 2012).

Design Thinking: A Needed Balance

Hokanson (2007) promotes design thinking practices which combine visual art and design thinking. The skills and dispositions inherent in a more balanced definition are supported by a design-based education which combines visual art with critical, creative, and practical modes of thought (Davis 1999; Norman 2000). Design thinking focuses equally on process, skill, and dispositional development; it is not the antithesis of visual culture education. The processes of design thinking are not just about industrial, modes of teaching formal principles of medium or technique which "trivialize art" or dumb down the "integrity and power of art for making connections and dealing with big ideas and complex issues" (Freedman and Stuhr 2004, p. 819). Instead, design thinking is an interdisciplinary theory for understanding art and a way of thinking that promotes the unique cognitive balance of creative problem solving, aesthetics, and conceptual practices in art and design (Davis 1999). Design-based learning experiences affirm a postmodern and critical theory point of view and may engage art students in empathic inquiries into solving problems of social interest. In this way, the focus is on creative, critical, and practical *thinking* processes; the barriers between studio and teaching are more melded (Daichent 2010). Empathy is also fostered by seeking for ways to meet human needs through design (RED lab 2012). This idea provides needed balance within the field of art education.

Nigel Cross (2007), design theorist and researcher, asserted that the discipline of design involves a specific awareness and ability, independent of the different professional domains. Just as other intellectual cultures in the sciences and the arts concentrate on underlying forms of knowledge that are particular to their domain, artists and designers are driven by "designerly ways of knowing," thinking, and acting, (Cross 2007, p. 17). Design thinking, while resulting in a creative outcome, is also understood as disciplined creative thinking.

As a mindset, design thinking processes can be used by artist-teachers for taking positive action and problem solving that can apply to the design challenges they face every day, from curricular planning and feedback systems, to creating cultures of thinking, and differentiating problem solving in studio art and teaching (Daichent 2010). Design thinking serves as a creative and reflective tool for approaching teaching as both artist *and* designer of thinking in the classroom, for collaboration, and as a model for designing learning experiences

Noddings (2007) addresses the importance of preparing teachers who make connections outside of their disciplinary silo—to other disciplines, to the ordinary problems of humanity, and to personal explorations of universal questions of meaning. Art and design education programs that include a 'design thinking' approach may answer this challenge, combining new paradigms of teaching and learning with balanced thinking, connection making, and empathic problem solving (Burnette 2005). Design thinking processes often connect big ideas or concepts surrounding broad, important human issues characterized by complexity, ambiguity, and contradiction. Students are led to apply creative and practical problem solving with an empathic view.

Design Thinking in Art Education

Daniel Pink (2005, p. 3) has promoted design thinking as a "high-concept aptitude" that will give designers the competitive advantage in 21st century life and work. Internationally, terms like 'design thinking,' 'innovation,' and 'creative problem solving' are as commonly used by MBAs, medical professionals, and policy makers as those in creative industries and education. While published research on the topic of design thinking alone is mounting (Razzouk and Shute 2012), scholarly work about art/design thinking as pedagogy in the visual art curriculum is still fairly limited (Bequette and Bequette 2012; Burnette 2005; Davis 1999).

Tensions exist between design thinking and traditional art education, with one of the biggest barriers residing in the opinion that design education aligns with formalist philosophies. Researcher-teachers who hold degrees in both art education and fields of design find themselves disconcerted at the lack of understanding between visual arts processes, pedagogies, and that of design (Davis 1998, 1999; Ingalls Vanada 2011). Equal concern exists for the lack of design or design history instruction in preservice art education programs (Davis 1998).

Design thinking has focused on aesthetic processes long familiar to students and teachers in schools of art and architecture: the posing of a problem which is likely ambiguous or open-ended, with some constraints (Kellogg 2006). Design thinking makes thinking visible through inquiry and creative problem solving, investigation of possible solutions, sketching and prototyping, collaboration and feedback, final 'products' or ideas, as well as reflection and redesigns if necessary (Razzouk et al. 2012). Design thinking is above all, an iterative process that requires flexibility; it can be incorporated into any discipline—science as easily as visual art or history.

Importantly, designing thinking is not "exclusively a tool for arts education, nor is it strictly technical" (Dow 2012, para. 6), refuting claims from art educators who are wary of the aims of design education in the visual arts curriculum or fear that the inclusion of design processes are linked to formalistic roots and Discipline Based Art Education (DBAE) of the 1980's (Gude 2007). Meredith Davis (1999, p. 30) attributes the wording of educational standards referring to formal "elements and principles of *design*" to notions that design pedagogies utilize visual and spatial organization alone. Davis (1999) believes that the term *function* should be linked to human or social need and context as the organizing principle for art experiences, in order to transform the traditional pedagogies that still exist in today's schools. Design should not be considered "a language of form disconnected from its use and context" claims Davis (1999, p. 30), who calls for contemporary art educators to take a leadership role against viewing design as:

> "…simply applying an aestheticized formal language to objects and environments of daily life as a means of elevating the ordinary from low to high art (e.g., a chair that challenges the boundaries of sculpture…). This is not to degrade those objects; but they represent only one aspect of design and not the issues deemed central to the problem-solving abilities necessary for success in the twenty-first century."

Design Thinking as Pedagogy

As pedagogic practice, design thinking processes help to foster students' abilities for creative problem solving (which involves both inductive and deductive reasoning along with intuition or abductive thinking), concept development through ideation and brainstorming, collaboration and risk-taking, and improved craftsmanship as attached to empathic, deep meaning (Kolko 2010). Kellogg (2006) says that designerly thinking advances students' "intuitive analytics," or the ability to combine ideas, analysis, and common sense into a new whole, which "bridges the gap between the subjective and the objective" and integrates "the soft stuff like aesthetics with the hard stuff like material science" (p. 12).

As of February 10, 2013 the IDEO design firm's website suggests:

> "Design thinking is a deeply human process that taps into abilities we all have but get overlooked by more conventional problem-solving practices. It relies on our ability to be intuitive, to recognize patterns, to construct ideas that are emotionally meaningful as well as functional, and to express ourselves through means beyond words or symbols… Design thinking provides an integrated third way."

Design thinking pedagogy in education encourages teachers to loosen the narrow, rigid processes of traditional learning and tap into brain-based strategies that capitalize on connection-making, inquiry, and self-directed learning (Caine and Caine 1997; Ingalls Vanada 2011). In learner-centered pedagogies, integration is essential (Marshall, 2005; Noddings 2007) as students build knowledge by problem solving, making mistakes, reflecting, and engaging reflexive practice.

Harvard, Stanford, MIT and other universities have worked to expand training programs into the educational realm in order to advance the knowledge of teachers and administrators in design thinking strategies (Dow 2012). Surprisingly, the field of art education has been hesitant to respond to this movement. Researchers at the Hasso Plattner Institute of Design (more commonly referred to as the "d.school") at Stanford University (Carroll et al. 2010) promote that the design process highlights learning in ways that are: 1) human-centered (an engaged and empowering process); 2) action oriented (real-world learning with purpose); and 3) process-oriented (creative risk-taking, ideation, and collaboration). The Innovation Lab, or I-Lab at Nueva School in California (an offshoot of Stanford's D-Lab), sees design thinking as a way to help students develop a different attitude about failure. Failure is seen as an opportunity to glean and incorporate important information, and students are less likely to give up (Gow 2010). Likewise, design thinking processes help students activate their abilities to form opinions, act upon their ideas, provide evidence to defend their choices, and become reflective in action (Argyris and Schön, 1996). Instead of being directed to create in ways that are really very similar to "finding the correct answers to fill-in-the blanks on standardized tests" (Carroll et al. 2010, p. 38), students in classrooms that incorporate design thinking processes are learning how to think over what to think (Resnick, 1999). This is key to unlocking student capacity (Ingalls Vanada 2012).

Stanford's Research in Education and Design lab (2012) promotes integrating design thinking in 21st century education and fostering student ability to not only solve problems, but to define problems with greater empathy and understanding. The RED lab (2012) focuses on developing design thinking (need finding, challenging assumptions, generating a multiple possibilities, and learning through iterative prototyping) as key to activating students' critical, creative, and practical capacities, and as a tool for learning that supports a diverse range of interdisciplinary academic content (Carroll et. al 2010).

In the U.K., McWilliam and Haukka (2008) hypothesize that in order to better connect art education and its emphasis on creativity with design practice and innovation, art educators will need to shift their focus from "content delivery to capacity building, from supplying curriculum to co-creating curriculum, from supplying education to navigating learning networks" (p. 23). Others argue that to build individual capacity, pedagogies must promote an equitable balance of students' critical, creative, and practical skills and sensibilities (Sternberg and Grigorenko 2004). Still others advocate for proactive curricula that incorporates deep and complex inquiries that are personally meaningful to students (Marshall 2005; Freedman and Stuhr 2004).

Design Thinking Frameworks

Many traditional art classrooms continue to promulgate back-to-basics approaches meant for the 20th century at the expense of preparing students to possess the balanced skills of creativity and innovation, critical thinking, problem solving, communication, and collaboration (Partnership in 21st Century Skills 2007). A deep need exists for developing thinking as connected to big ideas in order to build students' conceptual artistic practice, creativity, criticality, and social-emotional practicality.

As a pedagogical framework, design thinking represents four phases of the learning cycle: experiencing, reflecting, thinking and acting (Beckman and Barry 2007) and aligns with experiential learning process known to build innovative practice: "problem finding/problem selecting, solution finding/solution selecting, or storytelling" (p. 47). The Hasso Plattner Institute for Design identifies six key components of the design thinking process, as shown in Figure 2 (Carroll et al. 2010).

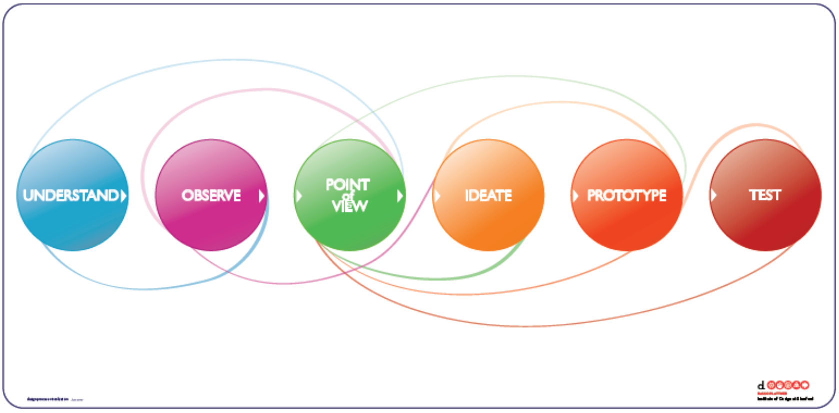

Figure 2. Overview of the design thinking process

Design educator, Dr. Charles Burnette (2005) defined “design thinking” as the following:

> “Design Thinking is what people do when they pursue their goals. Everyone focuses their thinking in order to satisfy wants and needs regarding a particular situation. They recognize and define information according to their purpose, consider alternatives, decide what to do, do it, determine if they are satisfied with the results, and if not revise their approach until they are successful, all while learning through the experience. This is designing. It is a process of creative and critical thinking that allows information and ideas to be organized, decisions to be made, situations to be improved and knowledge to be gained (para. 1).”

Burnette and Norman’s “Design for Thinking” model (1997) has been promoted for its value toward incorporating design thinking across disciplines, including art education. This model utilizes analytical thinking and creative problem-solving instruction to promote higher-level thinking skills by focusing on creative thinking, effective communication, cross disciplinary connection-making, and practical dispositions necessary for project-based outcomes. Supported by a state and national grant initiative, the project generated state-wide workshops on “Design Based Education” in Pennsylvania and instruction in over 500 schools. The project was labeled “iDESiGN,” an acronym that represents seven modes of design thinking identified as Intending, Defining, Exploring, Suggesting, Innovating, Goal-getting, and Knowing (Burnette 2005), with the learning process deemed as valuable as the final product. Other similar models have been developed, such as that of the research reported in this study (Ingalls Vanada 2012).

Aims of the Article and Study

The dual aims of this article are: (1) to summarize findings from a mixed model research study involving quality thinking in middle school art classrooms which frames design thinking as balanced thinking and dispositions (critical, creative, and practical), and (2) to offer a framework for design thinking and emerging theory for dynamic cultures of thinking that developed out of reviews of the literature and the research project. Again, quality thinking was defined as a balance of critical, creative, and practical thinking skills and dispositions, applied with depth and complexity (Ingalls Vanada 2011). Design thinking was defined as a cross disciplinary creative problem-solving process which combines higher-level thinking skills, knowledge of the visual arts, creative thinking, and practical skills.

Research reported in this paper illuminates connections between visual art education, balanced thinking, and design thinking, towards new frameworks that can advance thinking skills in the visual arts classroom. The reported study was directed by two research questions:

- Is there a difference in students' quality of thinking skills in classrooms that are designed to foster inquiry, connection-making, and self-directed learning and those that are less so?
- How do students perceive their intelligence and understanding of a subject in these classrooms?

Frameworks and Methods

Theoretical and conceptual foundations for this study were derived from thorough research in six areas: (1) critical, creative, and practical thinking and dispositions, (2) art education for development of thinking and dispositions, (3) inquiry-based, constructivist, and connectivist classrooms, (4) dispositions in quality thinking, (5) intelligence/ cognitive science, and (6) belief systems and affective aspects of learning. The theoretical framework of "successful intelligence" served as the principal informant for assessing quality thinking as a balance of critical, creative, and practical thinking skills and dispositions (Sternberg, 1999; Sternberg and Grigorenko 2004). Design thinking models were also integrated in the assessment of students' overall quality of thinking in the arts (Burnette 2005; Burnette and Norman, 1997).

This mixed model research study utilized a Sequential Exploratory Design (Plano Clark and Creswell 2008, p. 179) in order to explore the impact of learner-centered environments on art students' quality of thinking in terms of balance. Sequential analysis of both qualitative and quantitative data sources provided a richer elaboration of the variables and their relationships (Plano Clark and Creswell 2008; Tashakkori and Teddlie, 1998, p.126).

Data for Phase One of this study was for the purpose of site selection and was first gathered from surveys distributed to middle school art teachers within two school districts. Prior surveys had assessed the degree to which each art classroom valued and fostered high quality thinking and responses were assigned numerical scores, or "quantitized" (Tashakkori and Teddlie, 1998, p. 308). Classrooms were then rank ordered according to five factors of learner-centeredness: (1) connection making, (2) student self-direction, (3) inquiry-based practices, (4) depth of learning, and (5) content focus and balance.

In Phase Two, art students were assessed, using seven sub-'tests' in three domains: (1) analytical, creative, and practical skills, (2) analytical, creative, and practical dispositions, and (3) overall quality of thinking in the context of the arts. This matrix of assessments was administered throughout the course of a semester (approximately 16 weeks) and consisted of qualitative (observation notes, informal interview data, and initial surveys) and quantitative data, which were quantitized and merged toward an overall score for each classroom. Results of each classroom's compiled scores were compared against the rank orders of classrooms. Data for Phase Three (Research Question Two) was collected through a student-oriented questionnaire regarding students' self-beliefs about learning and intelligence. Burden's Myself-As-A-Learner Scale (MALS, 1998) was used.

Matrix of Assessments

The "Quality Thinking Assessment Matrix" (Figure 3) designed for this research aligns with the theory of balanced intelligence (Sternberg and Grigorenko 2004), Sternberg and colleagues' "Rainbow" test (for high school students), and "Aurora" exam (for middle school students) (Chart, Grigorenko and Sternberg 2006; Sternberg and the Rainbow Project Collaborators 2006). While Sternberg's Rainbow test measures quality thinking in a similar manner, Ingalls Vanada's matrix (2010; 2011) was developed to assess students' balanced/quality thinking and dispositions, as specific to art and design. Students' critical, creative, and practical thinking skills and dispositions were assessed using appropriate instruments for each sub-area, designed and developed after extensive reviews of the literature if pre-existing assessments could not be located (Ingalls Vanada 2011).

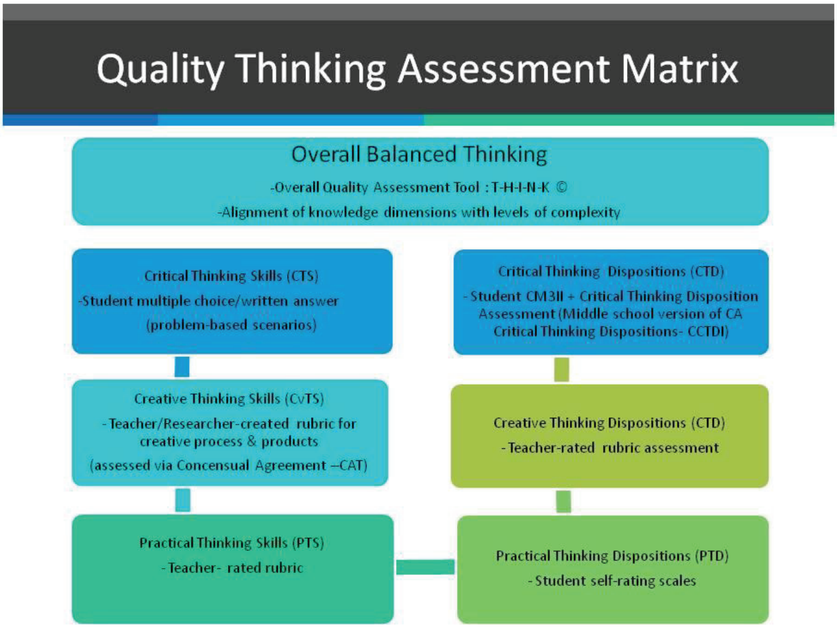

Figure 3. The Quality Thinking Assessment Matrix

For the matrix, research reviews led to the development of an Overall Quality Thinking tool (OQO), as shown in Figure 5. In order to operationalize quality thinking in terms of balance, complexity, and depth, it was important to view students' thinking as a complex and nonhierarchical process. The OQO acknowledged the overlapping properties of critical, creative, and practical thinking and the dilemma of separating out the critical in the creative and creative in the critical (Paul and Elder, 2006). This assessment also acknowledged research that indicates that assessing only single aspects of each category of intelligence or discrete skills puts at risk the success of capturing either the quality of that thinking or the relation of the identified thinking skill to the tasks being assessed (Moseley et al., 2005).

The OQO assessment tool takes into account the types of thinking students are engaged in, defined by Anderson and Krathwhohl (2001) as the **knowledge dimensions:** factual, conceptual, procedural, and metacognitive. The role of dispositions in acquiring knowledge is also considered, as the knowledge dimensions involve both thinking skills *and* the dispositions of strategic and reflective thinking (i.e. metacognition).

The complexity of students' thinking while engaged in art and design processes are known as the **cognitive process dimensions**, with Level 1being more about **information gathering** (perceiving and defining), Levels 2-3 involved in **gaining more understanding** (imposing/organizing structures), and Levels 4-5 as more **productive/complex thinking** (analyzing, supporting, elaborating). In the measuring of quality thinking, Webb (2005) refers to complexity of knowledge as *depth of knowledge* (DOK).

Kinds of Knowledge (as held to a standard)

	T- H-I-N-K Tool for Assessing Quality of Thinking in Visual Art				
	Cognitive Process Dimensions (degree of complexity)				
	Level 1: **Think** (1 pt.)	**Level 2:** **Have a Plan** (1 pt.)	**Level 3:** **Investigate** (2 pts.)	**Level 4:** **New Ideas** (2 pt.)	**Level 5:** **Know** (3 pt.)
Knowledge Dimensions:	*Determine the **alignment** between the level/depth of knowledge (DOK) (complexity) for each knowledge dimension.*				
Factual (Critical) Factual Stds: i.e. Elements & Principles, technical quality (ability to identify, use, apply, elaborate)					
Depth of Rigor *0 - 1 - 2 - 3*					
Conceptual (Creative) Creative Stds: i.e. Meaning-making; creative structure, communication					
Depth of Rigor *0 - 1 - 2 - 3*					
Procedural (Practical) Procedure/ skill Stds: i.e. Plan, set goals & self-direct (tools/process, etc)					
Depth of Rigor *0 - 1 - 2 - 3*					
Dispositions Dispositions observed: Self-motivation, curiosity, reflection, self-assess					
Thinking Culture Observed engagement, focused attention, Q's IN class/ thinking words used					
Total Points/ 24					Ingalls Vanada, 2010 ©

Figure 5. T-H-I-N-K assessment tool (OQO)

Data Results

When all sub-tests were factored into the matrix of assessments as an integrated whole and compared against a classroom's level of learner-centeredness, there was a statistically significant positive correlation (.935 at the .05 level) with a classroom's rank for learner-centeredness and students' quality of thinking (Table 1), while classrooms ranking lower in learner-centeredness had a lower quality thinking scores. Findings from this study led to the recognition that classrooms ranking higher in learner-centeredness correlated with students' higher quality of thinking in terms of balance.

Table 1 Correlations of Total Scores with Rank and Rank Scores

		LEARN	RANK
Total Scores	Pearson Correlation	.973(*)	.935(*)
	Sig. (2-tailed)	.005	.020
	N	5	5

** Correlation is significant at the 0.01 level (2-tailed).
* Correlation is significant at the 0.05 level (2-tailed).

The open coding qualitative analysis led to an emerging theory of "Quality Thinking Systems" (Ingalls Vanada 2011). Quality learning environments were described as those that foster (1) Cultures of thinking and learning in which inquiry, risk-taking, connection-making, and deep understanding are 'visible'; (2) Dynamic learning that is active, constructivist, self-directed and foster respect and community; and (3) Belief systems that value students as a whole persons (body, mind, spirit) and support all students' capacity for learning and achievement. Research Question Two addressed students' self-perceptions regarding their learning and thinking in the classrooms of this study. In correlational analysis, a significant positive relationship existed between the Myself-As-A-Learner scale (MALS, Burden, 1998) and classroom scores for learner-centeredness (.933 at the .05 level). This is no surprise.

Report of Findings

In light of 21st century aims for education that encompass broader views of student intelligence, this study indicates that students' overall quality of thinking should be viewed in terms of balance and that dispositional factors, depth, and the impact of the overall learning environment should be considered. As aligned with environments conducive to design thinking, students in more learner-centered environments may also be better at thinking in balanced ways. More research is needed in this area. Additionally, it suggests that static, passive philosophies of learning and knowing should be replaced with meaningful, project-based, and constructivist epistemologies which include social, contextual, and affective facets of learning (Gadsden 2008; Resnick, 1999; Zemelman et al., 1998). The results of the reported study provided support for the importance of improved learner-centered practices in the art classroom; it suggests that student's quality of thinking, when measured in a balanced way, can be noticeably *different* in classrooms that embrace balanced, design thinking practices.

The T-H-I-N-K Model Mash-up

In the development of quality thinking assessment tools for the reported study, the T-H-I-N-K framework (Figure 4) emerged. It was important to articulate quality thinking in terms of complexity and design thinking processes. The T-H-I-N-K model shown is a revised format (2013), as the original linear format did not adequately represent the cyclical and complex nature of design thinking.

Figure 4. The T-H-I-N-K Model (Ingalls Vanada, revised 2013)

As a part of emerging theory, the framework is a mash-up representing depth of knowledge (Webb 2005), complexity of knowledge as supported by the commonly known Bloom's taxonomy (Anderson and Krathwohl 2001), and design thinking paradigms. The model dovetails with cognitive theories that view intelligence as complex and integrated (Bransford, Brown and Cocking 2000; Caine and Caine, 1997; Gardner 2007; Perkins and Ritchhart 2004; Posner 2010; Sternberg 2008).

> The T-H-I-N-K design-thinking model is tied to cognitive research that merges the kind of knowledge to be learned (Anderson and Krathwohl 2001), depth/complexity of knowledge (DOK) being used (Webb 2005), and former design thinking models in art education (Burnette, 2005). As with six key components of the design thinking process developed by the Hasso Plattner Institute (Carroll et al. 2010), the T-H-I-N-K model is not intended to be hierarchical in nature. Rather, the processes of design thinking may fold back upon themselves or operate in tandem.

Summary and Discussion

In this article, connections were made between quality thinking, defined in terms of balance, and the pedagogical approaches of learner-centered art classrooms that enable students to think and act in balanced ways. More specifically, pedagogies that include inquiry, connection-making, and self-direction are encouraged to enhance students' design thinking skills within the context of critical, creative, and practical modalities. Design thinking is one such pedagogy.

By improving students' balanced thinking skills, we are in essence, improving their design thinking abilities. It is offered that learner-centered art classrooms that incorporate design thinking as a balanced process can better develop the overall learning capacity of students. In a mash-up between research involving the impact of learner-centered pedagogies on students' balanced intelligence and reviews of literature surrounding the promotion of depth and complexity of knowledge, new conceptual frameworks and assessments have been shared. Towards a vision of fostering deep, connected, and independent thinkers, the reported study was further extended to advance design thinking as an aesthetic, inquiry based process that can advance art education's footprint and leadership in 21st century education.

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The imaginative approach: Characteristics of craft artisans’ and design trainers’ in-depth cognitive levels during a design training program

Deny W. JUNAIDY* and Yukari NAGAI
Japan Advanced Institute of Science and Technology

Abstract: *This paper investigated and discovered the differences that exist between craft artisans’ and design trainers’ in-depth cognitive levels during the use of the imaginative approach in a design training program. We employed a concept network method based on the associative concept dictionary to extract the verbalized thoughts of four craft artisans and four design trainers. We then identified semantic relationships based on factor analysis. Our findings revealed that craft artisans tended to activate lower in-depth cognitive levels and design trainers tended to generate deeper in-depth cognitive levels. Our study demonstrated that craft artisans tended to place greater focus on aspects of an artifact, such as operation (replace, reduce, and so on); shape (waist, body, and so on); proportion (length, size, and so on). Alternatively, design trainers gave more consideration to the presence of surroundings issues such as scene (silverware, custom, and so on); companion (fruit, bagel, and so so on); and appeal (fresh,salad, and so on). We discovered that the employment of widely used design methods for training tended to keep craft artisans in a mental state that created perceptual barriers and obstructed their imaginative approach.*

Keywords: Creativity, cognition, imagination, craft artisan, design trainer.

*Corresponding author: School of Knowledge Science | Japan Advanced Institute of Science and Technology | Japan | e-mail: denywilly@jaist.ac.jp

Introduction

Many developing countries have begun to focus on rural industry development because of its potential for new job creation and to maintain national and cultural identities. They have begun to implement technical assistance programs, such as design training, to improve traditional artisans' skills and creativity levels. However, there is currently a lack of capable design trainers who possess the ability to understand indigenous cultures and environments and to translate these cultural values into improved designs (Suzuki 2005). In addition, gaps in the design thinking process during the idea generation stage can occur between traditional craft artisans and design trainers. Often, artisans may become uneasy if problems develop. They may also feel sceptical about unconventional design concepts (Nagai 2012). We use the following terminologies in this paper:

- *Design Training* consists of a nationwide governmental HRD program that operates in developing countries. It provides in-studio type design and creativity training for traditional craft artisans. It aims to improve product quality.
- A *Craft Artisan* is a traditional master craftsperson who resides in a developing country. He or she may possess less formal education. However, he or she has acquired special artisan skills and gained expertise in his or her local village's traditional crafts that have been passed down from one generation to another.
- A *Design Trainer* is an industrial or architectural design graduate who possesses work experience as an instructor in a design training program aimed at the promotion of traditional crafts.

Creativity and design training

In some cases, the teaching of design and creativity to traditional craft artisans can be a difficult task because traditional artisans often possess conservative viewpoints and lack an understanding of the creative process. However, scholars believe that creativity can be learned by instruction and training. Efforts have been made to provide direct instruction that involves the students' cognitive abilities and processes (Ripple 1999). At a basic level, creativity and design training hopes to introduce widely known design methods. Its purpose is to encourage creativity. During training classes, craft artisans receive an introduction to Design Principles (e.g. balance, proportion, and so on). They begin the course by engaging in Creativity Icebreakers. They then participate in design exercises and develop prototypes. A typical training program may last between five and seven days.

In this paper, we assume that differences in creative cognitive abilities exist between traditional craft artisans and design trainers. Perceptual barriers or fixations are obviously rooted in each individual's unique experiences, interests, biases, and values (Davis 1999). Gaps that may develop in the conceptual design process that occurs between craft artisans and design trainers during a design training program (Nagai 2011) may correspond to the most obvious barrier to creative thinking: habit. The term habit refers to an individual's well-learned ways of thinking and responding (Dodds 1999). At the same time, a design training program cannot simply rely on the typical conceptual design process because this process may serve as another fixation. Hence, we believe that an investigation of the cognitive level of creativity that operates in craft artisans' design processes can provide fertile ground for the development of more effective teaching methods for design training programs.

Early Stage of Idea Generation

Idea generation is an essential step in the design thinking process. It involves the interplay between cognitive and affective skills that leads to the resolution of recognized difficulties (Houtz and Patricola, 1999). The general steps involved in design thinking are listed below. The most discussed step is the early stage of idea generation.

1. Imagination (early stage of idea generation): The stage during which artisans and designers observe and reframe the design problem.
2. Ideation (later stage of idea generation): The stage during which artisans and designers employ sketches, graphs, or paper models to generate visual ideas.
3. Prototyping: The stage of making rough models to convey ideas concretely.
4. Evaluation: During this stage, users' feedback is acquired by evaluations of affective preferences. (The step that occurs after the design thinking process consists of realization or production for commercial purposes.)

The early stage of idea generation involves observations by artisans and designers based on first-hand experiences. This stage is associated with a greater diversity of ideas (Leijnan and Gabora, 2010). In particular, this stage of imagination is associated with differences in creative cognition. Therefore, it is reasonable to assume that an individual's fundamental thoughts are captured to a fair degree at this point. This is an appropriate stage to examine artisans' and designers' first-hand experiences as they observe and reframe design problems.

Cognitive aspects of creativity

No concrete references exist that provide methods to be used to teach skills during design training programs. Design training programs are often devised to develop crafts that will meet consumers' needs. Trainers are often solely concerned with the appearance of the crafts. Strong evidence has revealed that design trainers tend to recycle whatever information they learned at university to create design training programs. Many design trainers report a lack of clear understanding of the tasks involved. They may miss opportunities to enhance creativity (Suzuki 2005).

In general, cognition is considered a major factor in the creative process (Finke, Ward, and Smith 1992). Most of the conceptualization of creativity in the design process is based on exploration of the cognitive aspects of creativity (Casakin 2011). Extensive studies have been conducted to capture the cognitive levels of creativity used during the design process. These studies attempted to understand users' affective preferences, such as taste, and the feelings they may experience that can result in successful impressions of products (Cross 2006; Nagai 2011). However, only a limited number of studies have explored the cognitive level of creativity that occurs during the design process at the very early stage of idea generation. This stage is associated with a greater diversity of ideas (Leijnan and Gabora 2010). In particular, this stage is associated with differences in creative cognition that occur between traditional craft artisans and design trainers.

Surface cognitive level and in-depth cognitive level

It can be difficult to explicitly describe our thoughts. Our explicit expressions and/or words may result from shallow analysis. Therefore, these expressions and/or words are referred to as being on the surface cognitive level. However, the term implicit impression refers to that which is not explicitly recognized or verbalized (Reingold, Colleen 2003). This underlying form of cognition may be difficult to express. Thus, it is referred to as the in-depth cognitive level (e.g. feelings, tastes, and impressions) (Taura 2010; Nagai 2011; Georgiev 2011). Implicit impressions are implied beneath explicit impressions that are related to deep impressions. This process establishes extremely rich metaphorical concepts that become key features of cognition that occurs during the creative design process. Additional studies have focused on the use of metaphors to enhance creative design solutions. These studies hoped to discover how rich metaphorical words formed the basis of creative design (Goldschmidt, Tatsa 2005; Lugt 2005; Yamamoto et al. 2009).

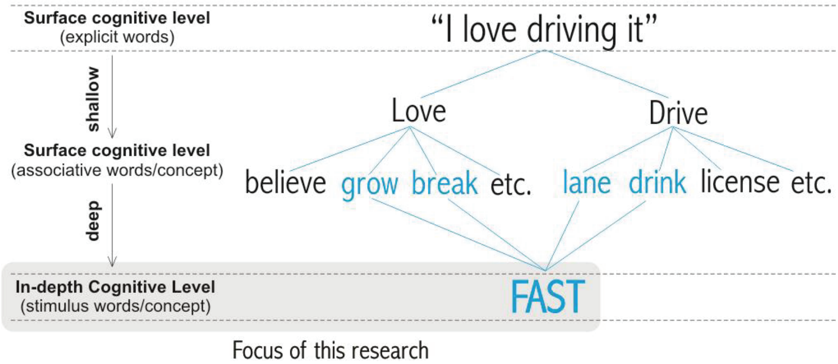

Figure 1. Capturing the in-depth cognitive level using an Associative Concept Dictionary

To examine cognitive levels based on subjective experiences, researchers may employ think-aloud method as part of protocol analyses that can be applied to produce verbal reports of thinking processes (Ericsson, Simon 1993) (Figure 1).

Associative concept network analysis

An associative concept is a representation of an individual's expression. It is a stimulus that can lead to another associative meaning. It is comprised of six sub-types: connotative, collocative, social, affective, reflected, and thematic (Mwihaki 2004). The conceptual network depicts human memory as an associative system, in which a single idea can contain multiple meanings (i.e. it is polysemous). A concept network employs a computational model to reproduce observable aspects of expressions associated with an individual's mental state. It is a suitable tool for associative analysis that can be used to explore latent links that exist among concepts. The concept dictionary utilized in conceptual networks originated at the University of South Florida Free Association Norms database (USF-FAN). It consists of free associations, rhymes, and a word fragment norms database. It is the largest database of free associations ever collected in the United States (Nelson et al. 2004; Maki and Buchanan 2008).

Aim

In this paper, we investigated the different characteristics of in-depth cognitive levels that occur in craft artisans' and design trainers' imaginative approaches during the early stage of idea generation. Our goal was to develop an effective design training program that might provide effective teaching methods and resources for design trainers. We hope that our results will provide a more reliable and understandable approach to the training of traditional craft artisans.

Method

In this study, we used a concept network method based on the associative concept dictionary described above to extract verbalized thoughts. The framework for this research consisted of the steps listed below (Figure 2).

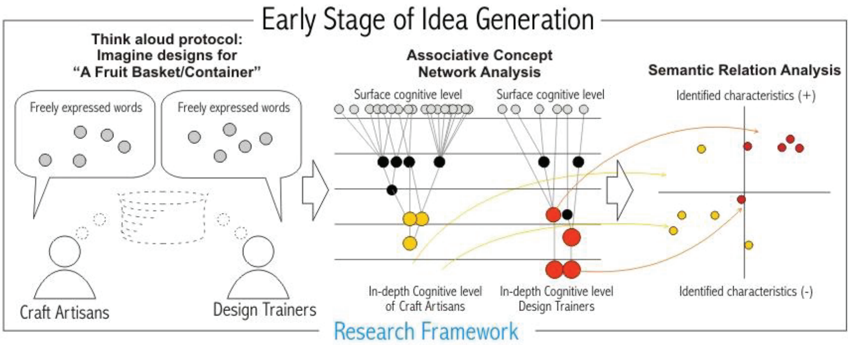

Figure 2. Research framework: Identifying the different characteristics of in-depth cognitive levels

Participants

We chose eight subjects to participate in this experiment: four craft artisans and four design trainers. They ranged in age from 27 to 51 years. Each of the four craft artisans are known as master craftspeople who possess special skills in artistry. Their special expertise in their local village's traditional bamboo crafts has been passed down from one generation to another. The four design trainers were graduates of industrial design programs. Each had experience as an instructor in a design training program.

Procedure

The participants were not required to engage in specific activities, such as drawing or observation of stimuli. They were deliberately conditioned. We provided the minimum instructions they required to understand fundamental associative concepts. Factors such as background, tradition, culture and context might influence the verbalized thoughts, therefore this study focus only at the very early stage of idea generation (imagination). This stage is believed provide a neutral, fundamental and fair playing field. In addition, we avoided rigid instruction about determinations of design themes, market segmentation, or design functions because we believed that the provision of excessive information might be unfair. The provision of minimum instructions created a fair playing field. It allowed us to observe craft artisans' and design trainers' responses and motivations as they reframed design problems. We placed no constraints on the subjects when they verbally expressed their ideas and engaged in spontaneous thinking that mirrored their process when they searched for new design ideas.

The main instructions for the think-aloud protocol experiment asked participants to imagine designing a fruit basket/container. We encouraged free expression of their ideas. The direct instructions are listed below:

'Please imagine designing a fruit basket/container.'

'Please freely express any ideas that arise.'

No time limits were imposed on participants during the think-aloud protocol experiment. On average, participants took about six minutes to express their imaginative thoughts. All procedures were recorded as verbal data that would be sorted later.

Participants were instructed to imagine designs for a fruit basket/container and they were encouraged to freely express their ideas (i.e. think-aloud protocol). All procedures were recorded as verbal data. This data was sorted based on grammatical rules that addressed connecting words, such as prepositions, a few general verbs, articles, and pronouns. We omitted other less relevant explanations. Finally, we transcribed the sorted verbal data that consisted solely of nouns, adjectives, adverbs, and verbs into English. Furthermore, the data was visualized by the use of Pajek 2.05 based on 2D layers in Y direction. The data was analysed according to the concept network method based on the USF free association dictionary. The resulting visualization presented an observable conceptual network that displayed low or highly weighted associative words indicated by the out-degree centrality score (ODC). The concept network depicted the structure of participants' surface and in-depth cognitive levels. Next, we identified the concept network by analyzing semantic relationships.

Analysis

During the first stage of the analysis, we obtained 201 sorted verbal expressions (i.e. nouns, adjectives, adverbs, and verbs) from craft artisans, and 213 sorted verbal expressions from design trainers. At that point, it was difficult to identify the tendency of these expressions (Table 1). The sorted verbal data was further visualized as graphs of the conceptual network (Figure 3 and 5). Craft artisans' conceptual networks generated 2991 vertices (nodes), and design trainers' networks generated 2760 vertices (nodes).

Table 1. Sorted verbal expressions (partly shown)

CRAFT ARTISANS	DESIGN TRAINERS
above, abundant, add, adjust, angle, appear, apple, apply, artistic, asia, attach, ball, bamboo, base, basic, basket, beak, between, big, body, booming, boss, both, box, businessman, buy, buyer, capable, capacity, capital, category, centimeter, ceramic, choose, circle, coating, colour, combine, concern, consistent, consumer, contain, container, corner, correspond, cost, count, cover, craftsman, curve, cut, dark, decor, delivery, demand, depend, design, develop, diameter, dice, differ, different, difficult, dimension, duck, easy, economy, edging, egg, end, europe, experience, extraordinary, five, flat, flower, food, form, frame, free, fruits, fulfill, function, gambier, general, glue, good, goods, grape, grip, handle, head, height, heron, high, hobby, idea, ideal, imagine, income, increase, insert, international, etc.	accommodate, according, added, aesthetic, age, appeal, appear, apple, apply, appreciate, artificial, attention, attractive, available, bamboo, banana, base, basket, big, bowl, box, bread, break, buy, ceramic, chance, character, children, clean, clear, coating, coiling, colour, combine, commercial, community, concern, consider, contain, container, conventional, craft, craftsman, create, crowd, crush, culture, curve, cute, cutlery, damage, decorate, delicious, design, develop, different, dignity, direct, display, distinct, durian, dust, dye, easy, eat, environment, everyday, example, expensive, experience, explore, extraordinary, facilitate, factor, first, frame, fresh, fruits, function, general, grape, habit, hand, hang, hoe, hygiene, idea, identical, imagination, imagine, immediate, etc.

Craft artisans' associative concept network

Tables 2a and 2b display the craft artisans' highest score of ODC: 0.0397 with a total of 12 words. This figure describes the levels of their in-depth cognitive levels, based on comparisons with Figure 4a. This shows that most of the associated words are ranked at the level below 0.0200. This means that many words lie at the surface cognitive level. If we consider the range between 0.0300 and 0.0500 as a representation of highly weighted associative words within the in-depth cognitive levels, we can see that craft artisans generated 146 associative words (0.048%) and do not exceed range of 0.0400. These highly weighted associative words demonstrated their imaginative approach as illustrated in Figure 4.

Table 2a. Distribution of ODC scores

CRAFT ARTISANS		
Range	ODC Score	Words
≤ 0.0500		
≤ 0.0400	0.0341-0.0398	12
≤ 0.0300	0.0227-0.0284	134
≤ 0.0200	0.0114-0.0170	1039
≤ 0.0100	0.0057	1630
0.000	0.0000	176
Total		2991

Table 2b. Highly weighted ODC scores

HIGHLY WEIGHTED WORDS (FEW)		
No.	Associative Words	ODC Score
1	Clothes	0.0398
2	Shape	0.0398
3	Replace	0.0341
4	Curve	0.0341
5	Waste	0.0341
6	Grow	0.0341
7	Etc.	-

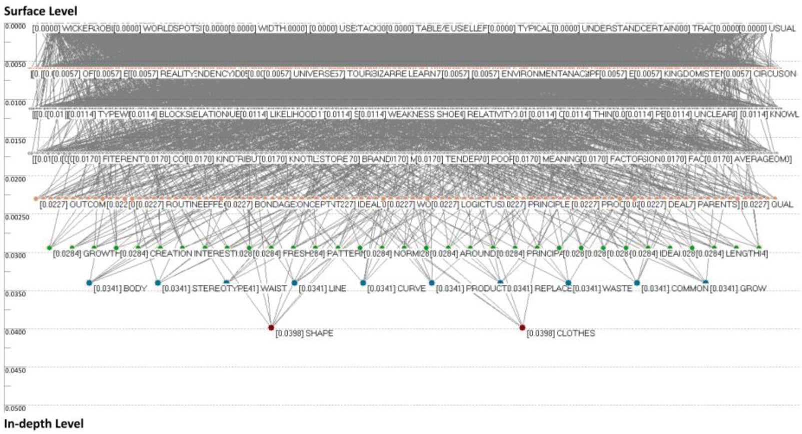

Figure 3. Associative concept networks of Craft Artisans

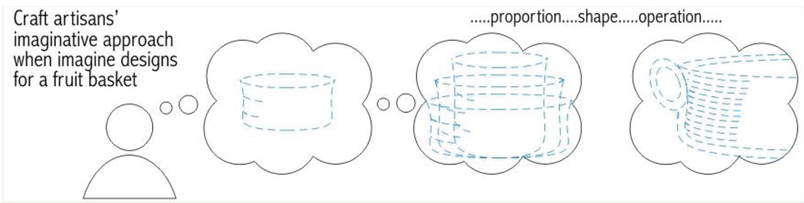

Figure 4. Illustration of craft artisan imaginative approach

Design trainers' associative concept network

Tables 3a and 3b display the design trainers' highest score of ODC: 0.0497 with a total of one word. This figure describes the level of their in-depth cognitive levels, based on comparisons with Figure 3. We can see that most of the associated words are ranked in the level below 0.0200. This rank is similar to the rank achieved by craft artisans. If we consider a range between 0.0300 and 0.0500 to be a representation of highly weighted associative words, then we can see that design trainers generated 112 associative words (0.040%). This result is slightly lower than the result achieved by craft artisans. However, the highest ODC score of 0.0497 achieved by design trainers ranked in the above 0.0400 range. This means that design trainers generated deeper in-depth cognitive levels, and their imaginative approach as illustrated in Figure 6.

Table 3a. Distribution of ODC scores

DESIGN TRAINERS		
Range	ODC Score	Words
≤ 0.0500	0.0497	1
≤ 0.0400	0.0331-0.0387	13
≤ 0.0300	0.0221-0.0276	98
≤ 0.0200	0.0110-0.0166	927
≤ 0.0100	0.0055	1540
0.000	0.0000	181
Total		2760

Table 3b. Highly weighted ODC scores

HIGHLY WEIGHTED WORDS (FEW)		
No.	Associative Words	ODC Score
1	Silverware	0.0497
2	Fruit	0.0387
3	Tupperware	0.0387
4	Focus	0.0331
5	Dish	0.0331
6	Dishes	0.0331
7	Etc.	-

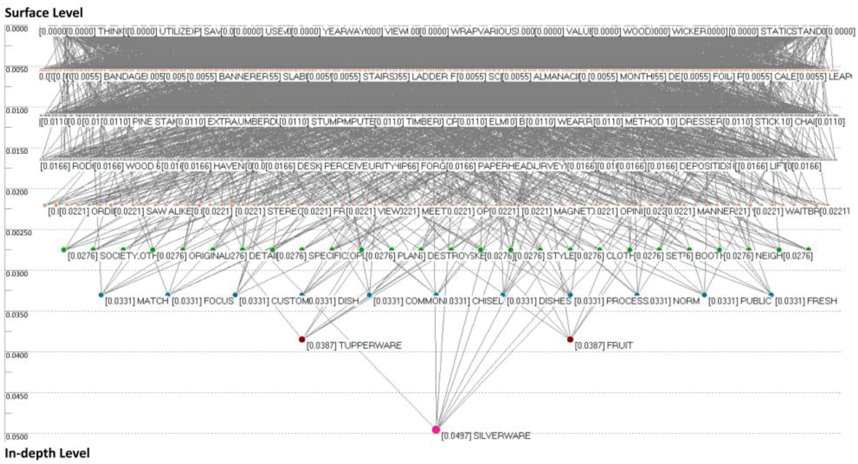

Figure 5. Associative concept networks of Design Trainers

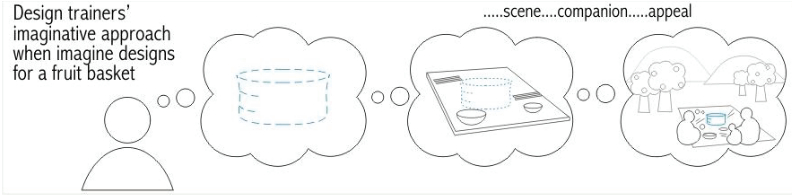

Figure 6. Illustration of design trainers' imaginative approach

Identification of the list of characteristics of associated concepts

Until this stage, data extraction based on the associative network revealed that craft artisans generated 0.048% words at the in-depth cognitive level. This was only slightly higher than the 0.040% words generated by design trainers. However, the design trainers generated a deeper in-depth level of cognition during the imaginative approach. To detect the distribution and tendency of these associative words, we first identified the craft artisans' and design trainers' collected generated associative words based on their characteristics (Table 4). Further, we intended that these identified characteristics would serve as variables to be analysed in the factor analysis we would perform to obtain semantic relationships.

Table 4. Generated associative words at surface and in-depth cognitive level (partly shown)

List of 2991 generated associative words (ordered by the highest ODC score)	List of 2760 generated associative words (ordered by the highest ODC score)
Craft Artisans	**Design Trainers**
clothes, shape, replace, curve, waste, grow, waist, product, stereotype, line, common, body, reduce, corner, creativity, balloon, round, sphere, stripe, standard, chest, growth, population, portion, hip, intestine, slender, principal, suggestion, around, oval, bond, interest, cloth, pattern, norm, normal, ordinary, basic, decision, fresh, sample, idea, length, creation, numbers, geometry, bite, green, rotten, continent, basket, bowl, cube, rubber, string, wicker, third, neutral, etc.	silverware, cinnamon, tupperware, focus, dish, dishes, match, fresh, chisel, public, custom, norm, common, process, gravity, produce, wicker, waste, elaborate, basket, porcelain, booth, destroy, replace, creativity, neighborhood, cloth, detail, perception, clothes, society, originate, people, pattern, original, specific, position, plan, set, style, mental, charm, wrinkle, cobbler, orange, peel, rot, natural, important, pretty, slender, apple, monkey, split, etc.

We discovered that *Scene, Companion, Appeal, Operation, Shape* and *Proportion* were the most closely identified characteristics of a number of selected words at the in-depth cognitive levels (see, Table 6). These characteristics are listed below:

Scene: A word that corresponded to the presence of surroundings (i.e. object, nature, customs, etc.);

Companion: A word that corresponded to the a ready-made counterpart, accompanying, matching to the presence of food (i.e. fruit, orange, bagel, etc.);

Appeal: A word that corresponded to the serving, preparation, processing, or presentation (i.e. juice, style, slice, etc.);

Operation: A word that corresponded to processing, or other physical activity (i.e. reduce, bond, etc.);

Shape: A word that corresponded to particular form or body-part, (i.e. waist, prism, body, round, etc.);

Proportion: A word that corresponded to physical elements or units of measurement, (i.e. length, size, rectangle, etc.).

The identified characteristics of crafts artisans' and design trainers' associative concepts are described below.

Table 5. Identified characteristics of associative concepts

List of identified characteristics
(Scene) silverware, tupperware, dish, custom, norm, booth, picnic, woods, etc.
(Companion) fruit, dishes, carrot, orange, apple, bagel, olive, lemon, pastry, pear, etc.
(Appeal) match, fresh, style, peel, rot, sauce, cooked, soup, slice, salad, juice, etc.
(Operation) replace, reduce, bond, elaborate, develop, detach, form, magnify, change, etc.
(Shape) curve, waist, prism, body, corner, round, sphere, chest, portion, hip, oval, etc.
(Proportion) length, size, tall, wide, rectangle, square, inch, diameter, weight, feet, etc.

Analysis of semantic relationships

We distributed 120 associative words that corresponded to the identified characteristics of associative conceptual structures. ODC scores ranged from the highest to the lowest (Table 5). The identified characteristics consisted of proportion, shape, operation, scene, appeal, and companion. We used these six variables in our factor analysis. Furthermore, the correlation among variables was extracted into two factors. The KMO score of 0.639 was significant. The factor matrix and corresponding names are listed below.

Table 6. Rotated factor matrix

Adjectives (+)	Adjectives (-)	F1	F2
Scene	Less Scene	,931	-,296
Companion	Less Companion	,916	,057
Appeal	Less Appeal	,910	-,164
Operation	Less Operation	,217	,942
Shape	Less Shape	-,339	,925
Proportion	Less Proportion	-,328	,914
Eigenvalue (After rot):		2,80	2,69
KMO:			,639

Table 7. Corresponding name

Factor	Adjectives	Eigenvalue	Factor Name
F1	Scene, Companion, Appeal	2,80	SURROUNDINGS
F2	Operation, Shape, Proportion	2,69	OBJECT-ORIENTED

For Factor 1, *Scene*, *Companion*, and *Appeal (*hereafter referred to as *Surroundings)* were associated with the presence of the fruit basket/container. For Factor 2, *Operation, Shape*, and *Proportion (*hereafter referred to as *Object-Oriented)* were associated with technical aspects of the fruit basket/container. Furthermore, factors were displayed on an orthogonal map to investigate the semantic relationships that existed between the identified characteristics of craft artisans' and design trainers' associative concepts (Figure 5).

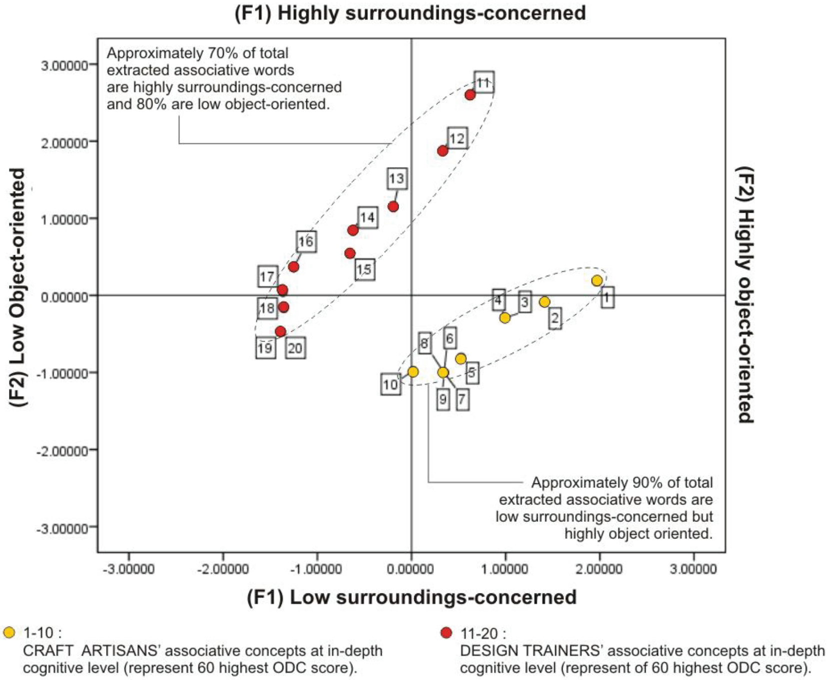

Figure 7. Semantic relation map

Discussion

In-depth Cognitive Level and Creativity

We identified the extracted words obtained from the concept network analysis revealed that craft artisans seemed to place greater focus on the appearance and technical aspects of the fruit basket/container. It featured such as shape, body, chest, waist, hip, size, tall, wide, reduce waste and so on, identified as characteristics of *operation, shape* and *proportion.* In contrast, design trainers gave more consideration to the presence of the fruit basket/container. It generated following associated words, such as silverware, tupperware, napkin, norm, soup, salad, cinnamon, kitchen, neighborhood, and so on, identified as characteristics of *scene, companion,* and *appeal*. This is confirmed by Figure 5, approximately 70% of total extracted associative words of design trainers were highly surroundings-concerned and 80% are low object-oriented. Whereas, approximately 90% of total extracted associative words of craft artisans were low-surroundings concerned but highly object-oriented.

We discovered that the craft artisans generated 0.048% words at the in-depth cognitive level. This was only slightly higher than the 0.040% words generated by the design trainers. However, the design trainers generated deeper in-depth levels of cognition during the imaginative approach (i.e. above 0.0400 range). Design trainers tended to use more highly weighted associative concepts (polisemous words). This was demonstrated by the highest ODC score achieved at the in-depth cognitive level that corresponded to remote association.

To explore these results, we referred to the Associative Gradient Theory. It proposes that more closely associated or 'stereotypical' representations may lead to lower creativity. The greater the number of associations, the greater the probability of reaching a creative solution, because remote associations (i.e. highly weighted associative concepts) are best suited to these solutions (Mednick 1962; Baer 1993; Eysenck 1997; Martindale 1995). Yamamoto et al. (2009) argued that the polysemy of a design idea is significantly correlated with its originality. This indicates that design trainers' deeper in-depth cognitive levels have greater probability of achievement of creative solutions. The creative process that produce the polisemy of a design idea which establishes extremely rich metaphorical concepts become key features of cognition that occurs during the creative design process (Yamamoto et al. 2009). Additional studies have also focused on the use of metaphors to enhance creative design solutions (Goldschmidt, Tatsa 2005; Lugt 2005). This study confirmed that there were significant differences of associative concept at the in-depth cognive levels between craft artisans and design trainers. Design trainers' associative concept comprised of deeper in-depth cognitive levels represented by more number of highly polysemous or methaporical concepts than craft artisans.

Our findings suggest that the roles of closely and remotely associated concepts at the in-depth cognitive level during the early stage of idea generation differ for craft artisans and design trainers when they observe and define design problems. Craft artisans' in-depth cognitive levels have fewer polysemous features. This may explain their concerns about more tangible issues such as proportion and shape. Design trainers' in-depth cognitive levels have more polysemous features. This may explain their concerns about intangible issues such as users' affective preferences (i.e. scene, appeal, and companion). The semantic relationship map confirms that the craft artisans tended to focus on physical properties of the artifact rather than on the surroundings and on users' affective preferences. Alternatively, the design trainers were much more attentive to issues related to the artifact's presence and less attentive to its physical properties.

This experiment demonstrated the weakness of the approach and content that used in a design training program. The approach that tended to dictating disallowed craft artisan's in-depth cognitive levels to be flexible and open. Again, this study focused only at the early stage of idea generation. In all likelihood, if the experiment was carried out at the later stage of idea generation will further demonstrated a much more significant result on low access to in-depth cognitive levels.

Evaluation of the imaginative approach

Numerous international forums have identified there are problems of craft promotion issue, including less effective design training program that operated for years in developing countries. In local Focus Group Discussion, the issue about lack of appropriate methodology and materials often appeared. Design training seemed to be merely a prototype-making training where artisans failed acquiring and exploring creative ways. Many participants or craft artisans admitted of the problem after the training was completed, they encountered difficulty to re-applying the creative approach that has been trained, and in the end, they return to the old ways. We must evaluate the contents and methods used in design training programs to develop effective methods to enhance craft artisans' creativity. The use of typical or widely accepted design methods may lead to unsatisfactory results (Suzuki 2005; Nagai 2012). Even if we modify the design object to make it easily understandable to craftspeople during training, these efforts may not address the real problem. As we learned in this research, the craft artisans possessed consistent ways of thinking and responding. When they considered an artifact, they tended to focus on tangible issues such as the artifact's technical and physical aspects. Their thinking differed greatly from the design trainers' considerations of the presence of users, their appeal, and scene.

This study demonstrated that these difficulties occurred because, during the design training program, the craft artisans were asked to focus solely on the object (i.e. the designed artifact). In fact, this focus was required by the systematic instructional materials. When the design trainers provided clear instructions about an intended object to be designed during the training, they placed the craft artisans in a status quo mental state. This status quo mentality is a state in which their perceptual sets are tied to their tendency to make quick decisions and jump to familiar conclusions. They were not asked to become flexible and discover alternatives. The craft artisans were given clear guidelines to develop a craft object (a fruit basket/container). These guidelines were intended to enhance their creative process. Yet, these guidelines failed to inspire them to observe and explore in different, creative ways. Design trainers must understand that craft artisans tend to execute these processes based on the heuristics required. Therefore, we propose that design trainers should offer looser and slightly more vague guidelines that may help craft artisans adopt broader perspectives. Rather than providing rigid or clear instructions for the design of a completely understandable object such as 'a fruit basket/container', we recommend that design trainers provide open-ended and rather vague instructions. For example, they could request that craft artisans design 'an object/artifact that would whet the appetites and awaken fresh feelings in family members'.

We suggest that design trainers not request that craft artisans design objects that are concrete or obvious. Rather, they should release craft artisans from this rigid approach by suggesting vague or less concrete design concepts. If design trainers can allow craft artisans to have experiences that inspire them to be more imaginative, it will be easier for design trainers to direct craft artisans to develop more concrete designs. We believe that this approach will free craft artisans from perceptual barriers that were created by their old ways of thinking and responding. In this way, during training, craft artisans can begin to detach from their fixations with familiar concepts, such as tangible or technical aspects (i.e. operation, shape, and proportion). Ultimately, training in creativity must focus on the enhancement of cognitive resources. This can be achieved by the development of teaching methods based on the different characteristics of the imaginative approach used by craft artisans and design trainers.

Conclusion

It can be difficult to describe the nature of the creative cognition that influences the conceptual design processes employed by craft artisans and design trainers. This study discovered the differences between in-depth cognitive levels found in the imaginative approaches used by craft artisans and design trainers. Further, these findings can be developed for use as reference for the co-creation of an educational program (a design training program) to enhance the development of craft artisans' creative cognition. It is currently believed that creativity must be taught by instruction and training. However, the imaginative approach that can free craft artisans from perceptual barriers to their ways of thinking cannot be developed instantaneously. Yet, efforts should be made to develop the content of design training program and teaching methods to be used to enhance trainees' (craft artisans) creative cognitive abilities. Hopefully, this new approach become critical attention that will exert positive effects on their creative cognition so that, rather than just thinking about beauty or attractive shapes, they will think more flexibly, broadly, and unconventionally. In the future, we hope to extend our research and apply this new approach in a design training program. We will measure results by observing the ways that an artisan's creative cognition is affected by new approach of open-ended and rather vague instructions.

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Visualising ideas: a camera is not enough

Liv Merete NIELSEN*
Oslo and Akershus University College of Applied Sciences

Abstract: *When photography was widely introduced as a tool for documentation, the art of mimetic drawing was challenged as a main activity in art education. This raised the question: Why bother with mimetic drawing in art classes when any object, person or event can be documented with a camera? The question of mimesis in painting and drawing existed long before the introduction of cameras, and it raised philosophical questions in relation to the ideals of pictorial representations. This paper problematises some issues that have constructed a counterproductive contradiction when it comes to training mimetic drawing in general art and design education. This topic relates to stakeholders with agendas for art education, which in some ways is different from the agendas held by stakeholders within design education. The issue of training mimetic drawing in primary and lower secondary education is seen as part of building design literacy as a future competence for all.*

Keywords: visualisation, mimetic drawing, design education, design literacy.

* Corresponding author: Department/School | Oslo and Akershus University College of Applied Sciences | Norway | e-mail: LivMerete.Nielsen@hioa.no

Background

Some years ago, I participated in a panel discussion on art and design education with other teacher-trainers where I—among other things—advocated the importance of strengthening visual literacy in general education. I argued that visualisation of ideas was a competence for the future and that the training of such skills was integrated into the primary and lower secondary education curriculum in Norway. This argument was based on a notion that decisions will increasingly be made on the basis of pictorial representations. Professional areas, such as medicine and engineering, use visualisation for decision making on a greater scale than ever before; furthermore, in a consumer context, ideas, politics and attitudes are increasingly being communicated visually.

After the session, a Nordic colleague came up to me and held up his compact camera and announced that he could use that piece of equipment to document any situation. He no longer needed the skills of hand drawing to document his experiences. His underlying point seemed to be that drawing is an old-fashioned tool and medium and that it is therefore no longer a skill that needs to be taught in schools. I agreed that indisputable advancements have been made in compact cameras, now also available on most cell phones. The question is, however, whether cameras have made drawing skills obsolete in primary and lower secondary education.

The comment from my colleague indicates that such ideas have some support within the community of Nordic teacher-trainers. Therefore, it is relevant to reflect upon whether or not the increasing use of compact cameras is an argument for a decrease in the teaching of hand drawing or if there are other possible explanations. According to a Norwegian study of drawings by youngsters over a period of five years (1992-1997), their interest in drawing declined from the age of eight to the age of thirteen (Nielsen 2000). This happened despite the fact that these children had art and craft classes in their core education, totally approximately three lessons every week. Cell phones with cameras had not been introduced at the time of the study, so there must be some other explanations.

In this article, I will focus on some repertoires of visual representations and discuss how they are connected to time and to philosophical questions related to how the real world can best be depicted. This issue existed long before cameras were introduced in the 1800s. I will discuss mimetic drawing from the perspective of educational ideas both within the art field and the design field of knowledge. Questions related to how conceptual drawing, which is central in design processes, is connected to the training of mimetic drawing will also be raised. These questions will also be discussed in relation to education for non-designers from the perspective of empowering the public to participate in design processes. Stakeholders from the art world seem to have different views about these questions in comparison to stakeholders representing the design perspective. In order to outline the ideas these different stakeholders build upon, we need to go back in history. I have chosen to discuss different forms of pictorial representations with a focus on questions related to mimesis and linear perspective.

Repertoire in pictorial representations

Today, we have several alternative ways to represent a three dimensional object on a two dimensional surface. Take a bicycle. We know that both a photograph and a mimetic drawing of a bicycle are distortions. They are both two-dimensional representations of a three-dimensional, real bicycle. The bicycle can also be represented as a projection drawing, with plan and elevation on paper or on a screen. It can also be represented by three-dimensional rapid prototyping in scale or as a 1:1 ratio. Projections and rapid prototyping are tools designers use in the design process to communicate ideas and solutions with their peers, future users, clients or producers. In an art context, the representation of a bicycle can be communicated and interpreted more widely. The artist's feelings about the bicycle can be conveyed by how he/she represents it in his/her work. Here lies the most significant difference between art and design. Art can be a comment or a feeling, while design deals with creating better solutions for our everyday life. The designer can design a better bicycle as a solution for a transportation challenge. There is no doubt that we need both comments and solutions for a better future.

The attitude from my Nordic colleague about drawing being old-fashioned needs to be understood from the perspective of the two fields of art and design. Art and design have a lot in common in terms of visualising ideas and creating artefacts. However, at the same time, they have different aims and values when it comes to ideas for education. Stakeholders from these two fields have different points of departure as a basis for their priorities in an educational setting. These stakeholders have had different influences at different levels in the educational system. In light of this, I have chosen to take a closer look at how mimetic representation has been promoted or inhibited.

Mimetic representations versus projections

The division between depicting what you know versus depicting what you see is well known and has been discussed ever since Plato wrote *The Republic*, where he used representations of a bed as an example. He discussed whether there was any difference in the bed when it was seen from different angles, or whether the bed merely looked different when seen from different viewpoints. He asked: 'Does painting aim at reproducing any actual object as it is, or the appearance of it as it looks? In other words, is it a representation of the truth or of a semblance?' (Plato 1992, pp. 64-65). Plato was opposed to producing paintings that resembled the visible world. If a rectangular table was represented in the way it appeared, the table could be perceived as not being rectangular, because the furthermost edge of the table would seem shorter than the foremost edge. In reality, the edges were of equal length, and a painting should show this equality; otherwise, the painting would be false. According to Plato, a representation of a semblance was false, while a representation of the idea of what an object really was depicted the truth about the object. Plato advocated the principle of true length and angles, which the Egyptians used in their painting style for more than 3,000 years, and he disagreed with the way Greek paintings were developing during his lifetime, which was towards a representation of the visible world (Markussen 1987, pp. 99-100). In contrast to the Greek style, the Egyptians presented a simultaneous frontal representation and a profile representation of the human body in their paintings. The Egyptian *canon* was based on values, wherein the figure was represented from its most distinctive side. It was based upon the principle of representing the world as it was, not as it was perceived. These two canons have widely influenced our Western way of representing objects and space 1) the Egyptian *canon*, which lasted for 3,000 years and 2) the Renaissance *canon*, which lasted from 1425 to 1900 (Markussen 1987, p. 93).

The Renaissance *canon* was based on the principle of representation of the visible world, and the invention of linear perspective overshadowed other ways of representation in paintings. The concept of representing the visible world as it appears has been understood as a mimetic approach of the visible world, and the laws of perspective from the Renaissance were considered to be the most sophisticated way of rendering such a representation. While the Greeks used foreshortening long before 1450, it wasn't until the Renaissance that foreshortening was given a mathematical explanation, thereby developing the theory of perspective as a tool for representing the visible world.

Figure 1. *Reconstructions of the Egyptian canon and the Renaissance canon of representation. In the Egyptian canon, the table filled with food was represented with the simultaneous use of plan and elevation: the table was represented frontally, while the top of the table was represented as an uplifted plan. In the Renaissance canon, the table was represented as a semblance where some objects overlapped others. Source: Laila Eriksen in Farstad et al. 1999, p. 95 and p. 98.*

The mathematical explanation of perspective drawing was significant to both architects and artists in the Renaissance when mimesis was considered important. In Britain, perspective drawing was at its peak in art education from 1860 to 1901 when art and science were still taught in the same department. However, after the final separation of art and science education at the turn of the twentieth century, perspective drawing in education declined, and, according to Stuart MacDonald it was moribund in the 1970s (MacDonald 1970, p. 53). MacDonald has described the rise and fall of perspective in art education in his book, *History and Philosophy of Art Education*, (1970). He emphasises that architectural education has a history that is different from the history of art education. Architectural education has been led by utility, using different concepts of representation, such as isometry and axonometry, in addition to plan, elevation and linear perspective. For the same purpose, axonometric projection was introduced in engineering schools in the late nineteenth century for its usefulness as an accurate technical tool (Pérez-Gómez 1997, p. 314). Axonometric projection contains true length but not true angles, and in a way it merges the two concepts of the visible and the known world.

One universal solution–or anything goes?

In 1927, Erwin Panofsky attacked the notion of linear perspective as a unique, valid method for representing visual reality. One of his main objections was that humans see through two eyes and not one eye, as the linear perspective presupposed (Panofsky

1991, p. 29). Discussions on whether linear perspective can provide a true copy of the visible world have appeared in the art, design and architectural fields, although there are major differences in the discussions concerning accuracy and purpose. The art historian Gombrich has defended perspective, referring to it as: '…the most important trick in the armoury of illusionistic art' (1992, p. 205). For this statement Gombrich was attacked by an American artist, Norman Turner, as late as 1992 (Turner 1992, pp. 139-50). But to claim that perspective is the most important trick of illusionistic art, as Gombrich did, does not mean that it is the *only way*. This searching for *one way* of representation must be seen in the context of a positivistic paradigm, where searching for what can be positive confirmed as universal knowledge is central. Most of us accept the obvious notion that there is *more* than *one* way to represent an idea or an object, and that context and purpose guides the choice of which solution to implement. The artists' revolt against linear perspective encompassed protests against the accepted way of representing the visible world. However, according to Lawrence Wright, the development of cubist paintings was also built upon the perspective tradition (Wright 1983, p. 308). About the same time, European artists developed an interest in children's drawings and in Eastern painting traditions. This interest in children's charming expressions and their mixing of plans has also influenced educational ideas at primary and lower secondary school.

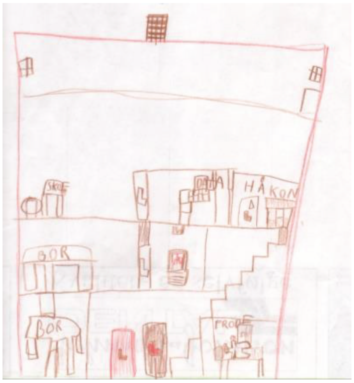

Figure 2. *A seven year old boy has made this drawing of his house, using. He has used a mix of plan and elevation.*

In the Draw92/97 study (Nielsen 2000), the youngsters struggled to draw a room the way it appeared to them when they were asked to do so at the age of 13. At that age, their interest in drawing had also declined compared to the interest they showed when they were asked to draw at the age of eight. Their struggle indicated that mimetic drawing had not been given priority in their art and crafts classes at primary and lower secondary school. Some of the youngsters had turned to parents, uncles or siblings when they wanted to draw the world as it appeared. This raises the following questions: Is there a conscious ideology behind teachers' choices not to prioritise mimetic drawing? Do teachers have a tendency *not* to teach *any concept* of representation because there is no agreement on one representation being superior to others? Is this a way of declaring anything goes?

Non-teaching promoted by art teachers

In Norway, the structure of Art and crafts in the national curriculum is different than it is in other Nordic countries, which are more like the rest of Europe where art classes are separated from design and craft classes. In 1960, art, textiles and woodwork (sloyd) were merged into *one* subject in Norway—today named *Kunst og håndverk* (Art and crafts) (Nielsen 2008). Now, this Art and crafts subject has four main topics: Visual communication, Design, Art and Architecture (Norwegian National Curriculum 2006). However, even if the Norwegian structure is somewhat special, youngsters in the Norwegian school system seems to have faced the same problems of non-teaching that students in other countries have faced. Angela Anning has described how youngsters are expected to learn visual representation in the art lessons in the UK, while at the same time their teachers neglect teaching them. About the youngsters in school, she says:

They are expected to learn the Western European conventions of base-line, occlusion, perspective and a single viewpoint – though nobody teaches them how. So by trial and error, rarely via direct instruction, children struggle to master the technical challenges of representing space, scale and perspective. Those who fail to master the technicalities assume from a depressingly early age that they are “no good at drawing” and quickly abandon it as an alternative mode of representation to speech and writing. (Anning 1999, p. 170)

Anning’s observations of the youngsters declining interest in drawing correspond with the findings from the Draw92/97 study. The explanation for this seems more and more obvious; the youngsters stop drawing because they are not helped in their struggle to represent what they want to depict. This seems to be a result of the chosen strategy of non-teaching of drawing in art classes. The teachers’ choices are probably done on the basis of good intentions, and they are probably seen as a strategy to conserve the children’s charming preschool way of drawing expressively using simultaneous plan and elevation. This strategy might have been aimed at maintaining the youngsters’ preschool enthusiasm for drawing. However, this has not been the case neither in Anning’s example nor in the Draw92/97 study. Youngsters are not comfortable with a preschool drawing style at the age of thirteen, even if their art teacher likes their drawings. This non-teaching strategy is a withholding of knowledge, and it does not promote the joy of mastery, contrary to what some teachers think. Viktor Lowenfeld, who has influenced the philosophy of art-education since the 1950s, was fully aware of the frustration, disappointment and even shock that youngsters could experience at the ages of eleven to thirteen when they became aware of their childish way of drawing. In *Creative and Mental Growth*, he wrote:

> As one of the consequences of this shock the child stops his creative work. He “can’t draw anything” because of his sudden critical awareness realises the “inefficient” childish approach. The drawing expression seems “childish” and “ridiculous” because of the sudden awakening of an adult attitude. (Lowenfeld 1957, p. 233)

Working together, Brittain and Lowenfeld developed their romantic concept about art education for youngsters. They are critical of teaching of mimetic drawing to youngsters from the ages of twelve to fourteen. In the fifth edition of *Creative and*

Mental Growth, they state: 'The representation of depth must be discovered by the student. To take this discovery from him by "explaining" perspective would deprive him of an important experience' (Lowenfeld and Brittain 1970, p. 262). Although it appears that Lowenfeld and Brittain regard perspective as unimportant, their questioning of the diminution of trees and the representation of space in the children's drawings indicates that they mean that diminution is important knowledge *if* the child discovers it for himself or herself (Lowenfeld and Brittain 1970, p. 262). This emphasises that the strategy of non-teaching is one of their issues.

Visual representations in education

I am not sure if Turner's attack on Gombrich has furthered the discussion in any meaningful way. However, it shows that some stakeholders within the art world still have problems accepting multiple attitudes about representation of space, in which the linear perspective is just *one* option in a wider repertoire. Technology that serves the computer entertainment industry and pilot simulators, which fascinate youngsters so much, build upon the principles of linear perspective to give an illusion of space. Hence, linear perspective does not seem to have gone out of fashion for youngsters or for the society at large.

If the argument against the teaching of mimetic drawing in school is that it has no relationship to the world the children experience, that argument is too simplistic. Perspective drawing with overlapping and diminution is perhaps the closest cultural conception developed to represent the visible world as it is seen and experienced every day through our eyes. It is also close to the way we see the world in photographs and on television. This does not mean that the images are a copy of the world: all images are distortions, as they are two-dimensional representations. The concept of plans and elevations is more abstract than perspective drawing. The question is whether this abstraction of plans and elevations is preferable to a concept of drawing with overlapping, diminution and, later, linear perspective. It does not benefit the child's development to prefer and protect one conception of representing space over another by hiding the cultural conventions and neglecting to teach the cultural concepts of drawing to the youngsters.

Lowenfeld could not see the consequences of his well-intentioned concept of art education as non-teaching. His concept was obviously a reaction to the existing paradigm of teaching right and wrong in art. In the same way, many teachers today might see their own teaching, or non-teaching, through the lens of self-expression and the 'child art' paradigm (Wilson 2004), which they themselves were taught at teacher training college. The question is whether the strategy of letting children and youngsters discover everything about spatial representation on their own is a strategy that makes them abandon drawing instead of continuing. The romantic ideals of Lowenfeld seems to supports views on art education where there is nothing to teach.

Design promotes a broader repertoire

To jump between the two conceptions of representation—drawing the world the way it is known and drawing the world the way it appears through the eye—does not seem to represent a big problem in the field of design education as it seems to do in the field of art education. Designers and architects use plans and elevations in some drawings and perspective in others because the type of representation is chosen to fit the intentions of the drawing. The architect's drawings that are intended for the authorities are different from the personal sketches he or she makes at the beginning of a project. The drawings made for the carpenter are different from those produced for the client during the planning process or from the drawings produced for the presentation. Sometimes the drawing explains how space *is* by using plans and elevation; in a different situation, the purpose might very well be to create a drawing of what a room *looks* like.

In reference to the comment from my Nordic colleague, I did not really understand why he was so eager to tell me about his camera, as if he had an insight that I did not have. His argument that the camera is superior to hand drawing would be valid if documentation was the main scope of visualisation in society and in education, but it is not. Visualisation of ideas and solutions not yet articulated by anyone else than the image's creator, requires someone who has the skills to communicate the idea visually.

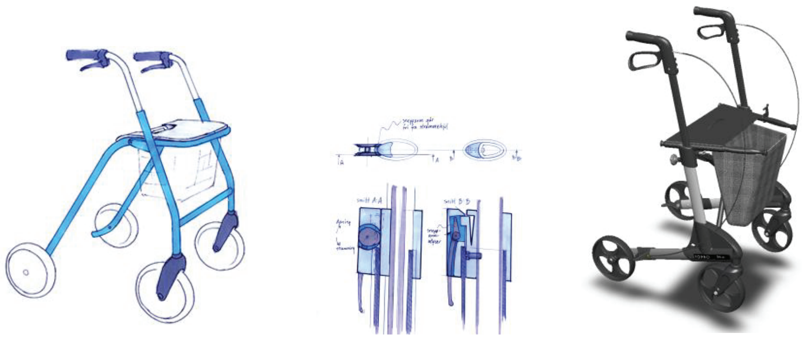

Figure 3. *Sketches by Per Farstad for his walker TROJA produced by TOPRO as. He has used perspective sketches to show the concept, and he has used projections to develop and visualise technical details. Photography is used in the final phase of the design process. This walker received a Norwegian award for 'Good Design' in 2002. Design: Per Farstad.*

It is obvious to designers, architects and engineers to use different repertoire of representations for different purposes. However, this is *not* as obvious to stakeholders within art education. The different viewpoints of stakeholders in art and design would not be a problem if they had equal influence in education at different levels. The Draw92/97 study (Nielsen 2000) indicates that the 'child-art' position, as formulated by Wilson (2004), has influenced education at primary and lower secondary in western countries.

Traditions move slowly in the education system. Educators at the Norwegian teacher-training institutions, with a background in mimetic drawing, have fortunately not yet retired from their positions. Therefore, in teacher-training different philosophies of art and design education exist, side-by-side. Bibbi Omtveit has studied how hand drawing has been taught at teacher-training institutions in Norway (Omtveit 2011). She describes two main positions among the educators: 1) mimetic drawing (observasjonstegning) and 2) conceptual drawing (forestillingstegning). She discusses how the two should not be seen as contradictions, but how the training of mimetic drawing is a *precondition* for clear and significant conceptual drawing. This raises further educational questions about the lack of emphasis placed on the learning of visual literacy, including mimetic drawing, in primary and lower secondary education compared to the emphasis placed on the learning of verbal literacy. There is no doubt that visual communication is increasingly used to communicate both facts, such as medical visualisation in scans of the human body, and illustrations, such as advertisements.

I see visual literacy as an essential competence for the future. However, the question of how to achieve this competence still remains. Some of the questions raised in this article have to do with different attitudes on what to teach in primary and lower secondary education. Teachers at these educational levels have been influenced both by ideas from the field of art and from the field of craft, and an unnecessary split between the two has been maintained (Brænne 2011). Design education is faced with the challenge of building upon the *best* from the art tradition and the best from the craft tradition to become a central part of the core curriculum in primary and lower secondary education. Both the education of non-designers and professional design education could benefit from a focus on design literacy in primary and lower secondary education where different concepts of visualising ideas are emphasised.

Summing up

It is not yet possible to take a photograph of an idea. A human being is needed to articulate ideas in one way or another. In this article the focus has been on visualising ideas and how visualisation is a point of departure for the communication of design solutions for a democratic and better world. For that purpose, skills in visualising are needed at different levels in education. Some training in mimetic drawing is a precondition for skilful rendering of ideas. Such a statement challenges the romantic philosophies of art education formulated by Lowenfeld and Brittain. Their philosophy of art education has been developed in a context where it was essential to neglect one right solution, such as in positivism. However, instead of allowing *different* concepts of drawing, they fell into a non-teaching ditch. There is no clear support for claiming that this romantic, non-teaching paradigm has advantaged the art and design education of youngsters. On the contrary, instead of continuing to draw, youngsters have stopped, and one of the reasons why, is that they do not feel comfortable with using a child-like drawing style when they are teenagers.

My Nordic colleague is right in this observation that youngsters take a lot of photos, and that is fine. The challenge, not only for those who will become designers but for all people, is how to educate a design-literate population so people will be capable of making good decisions that will create a better future for the world. In this case that means people must be able to visualise ideas in different ways—whether those representations be isometry or axonometry—in addition to plan, elevation, linear perspective and mixed representations. Future decisions will increasingly be made on the basis of visual representations, and this is a challenge for the educational society.

Romantic ideas connected to art still influence the practicing of drawing in primary and lower secondary schools in Norway. This happens despite the fact that the Norwegian national curriculum has a wider perspective with a focus on Visual communication, Design, Art and Architecture. Artistic expression is just one of several ways of visualisation. I think it is time to practice pluralism so as to avoid promoting a narrow art approach in art and design education in the primary and lower school levels. Doing so will benefit good design solutions for tomorrow.

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Digital design and creativity: A reflection on curriculum change in landscape architecture education

Heike RAHMANN and Jillian WALLISS*
The University of Melbourne, Australia

Abstract: *In comparison to the allied design disciplines of architecture and urban design, the creative potentials of digital media have been slow to influence landscape architecture. Many landscape architects consider digital media to lack the intuitive capability of more traditional means of design such as hand drawing. This paper argues for the creative potential of digital technologies in design pedagogy of landscape architecture. Drawing on the experience of the first year of the professional Master of Landscape Architecture program at the University of Melbourne, we outline a shift in design curriculum from planimetric design techniques to a focus on three- dimensional digital modelling including parametric design. We argue that immersing beginning design students within a three- dimensional understanding of space disrupts the linear problem-solving emphasis supported by conventional landscape architecture design techniques. We identify three avenues for creative exploration provoked by digital technologies –topographic form, creative unpredictability and a focus on experience and demonstrate how these moments encourage the beginning design student to develop a complex enquiry of program, form and experience.*

Keywords: creativity, landscape architecture, pedagogy

* Corresponding author: University of Melbourne | Australia | e-mail: jwalliss@unimelb.edu.au

Introduction

In 2008 the University of Melbourne began implementation of the Melbourne Model, its new vision for higher education in Australia. Six broad undergraduate university degrees were introduced and graduate schools created. This new structure revised the positioning of the previous undergraduate professional degrees such as architecture and landscape architecture where students completed a four or five-year undergraduate course. Under the new model, students may progress from an undergraduate generalist degree (with a major) to a professional Masters. Alternatively graduate entry is provided for students to pursue a professional qualification without prior experience in the discipline. Described as lateral entry, this pathway allows students with no design background to study landscape architecture in just three years. The adoption of a three year Masters of Landscape Architecture provided the opportunity to conceptualise its pedagogical foundation within an era of digital technology, with a particular focus on the ambitions of the first year of study. Two principles informed its development.

First, to adopt an accretive pedagogy that exposed students to the *complexity* of contemporary landscape architectural practice through a mixture of design, research, theory, history and exposure to the profession. This differs from 'foundational' knowledge that has been core to design education in architecture and landscape architecture. Design studios, considered the back bone of all design degrees, have generally been structured in a sequence of increasing complexity, beginning with design fundamentals and representational skills. Studios introduce more complex design issues as students advance through their degrees, and are supported by additional subjects focusing on theory, construction and history. This structure emphasizes a linear learning path with acquisition of the fundamental building blocks considered essential for more advanced learning.

An emphasis on complexity however acknowledges that a cohort of postgraduate students already has existing knowledge, skills and abilities that could be used and developed. This view profoundly influenced studio structure and reflects a constructivist theory of learning where students' backgrounds and knowledge are seen as the starting point on which to build; they are integral to not only engaging the students individually but also essential for students to learn, to construct meaning through confirmation or dissonance with the current state of their knowledge. As Pepin states, "All new knowledge must necessarily be constructed upon prior knowledge, either consolidating the latter, complexifying it, or deconstructing it "(1998,p.182). This departs from design curriculum that assumes students are 'empty vessels' in which to impart professional skills, with education positioned 'in between' the university and the 'external' profession (Crysler 1995, p. 211).

Second, an emphasis on digital technologies shaped the conceptualisation of design studios and technical subjects. We speculated that a shift away from planimetric techniques to embrace the potentials of digital technologies could provide a range of generative techniques for beginning design students. Importantly, it departed from framings of landscape architecture design, heavily influenced by landscape planning, that position design as a rationale 'problem solving' process, beginning with site analysis, conceptual drawing, presentation drawings and finishing with construction drawings. Within this model the two-dimensional plan is championed as the major design representation, considered to provide the basis for generating all other representations.

How the designer moves from an engagement with site (the existing) into creative and generative processes is hidden amongst a linear methodology of site analysis, conceptual design and design development. As Kathryn Moore states:

> Design is often characterised as a highly personal, mysterious act, almost like alchemy, adding weight to the dangerous idea that it is possible, even preferable, to hide behind the supposed objective neutrality implied by more 'scientific' technology-based, problem-solving approaches. (Moore 2010, p. 5)

Adopting a problem-solving approach to design does not by default inhibit creativity as demonstrated for instance by the discipline of industrial design which combines innovation and functionality in a creative process encompassing exploration, experimentation and discovery (Cross 2011). However we argue that in the case of landscape architecture it is the rigid *linearity* of the design process combined with a focus on problem -solving that restricts the level of experimentation and discovery within the creative process. Problem-solving within landscape architecture is weighted towards certainty and absolutes rather than experimentation and speculation (Seggern 2008). Further, review of publications on landscape architecture education offer minimal reflection and research on creativity and the use of digital technologies within the discipline (in contrast to allied disciplines such as architecture and industrial design).

We considered that the emergence of new digital technologies including the three-dimensional modelling programs such as Rhinoceros, parametric modelling through programs such as Maya and Grasshopper and new digital fabrication techniques of CNC milling, laser cutting and three-dimensional printing offer many potentials for reframing landscape architecture as a more creative design practice.

So how do we define design creativity within a new digital realm of landscape architecture? Lawson's discussion of 'fake' and 'real' creativity offers a useful starting point. Adopting Herman Hertzberger's definition of 'real' creativity which encompasses an engagement with the full complexities of design, Lawson (2002, p. 329) argues that architectural design within the digital realm has often fallen victim to the image making (fake creativity) at the expense of more complex design solutions. A review of recent publications in the field demonstrates that this development is equally evident within landscape architecture where the popularity of the Photoshop montage has led to a proliferation of hyper reality images which present an indicative design (see Amoroso 2012).

We position creativity as more than the creation of something new, instead also requiring an articulation of the value or contribution of this newness. As Gero (1996, p.2) argues "the introduction of 'something new' should lead to a result that is unexpected (as well as being valuable)." This understanding of creativity requires that we evaluate the results in relation to the normative concepts, ideas and practices applied in the respective discipline (Bruton & Radford 2012, p. 62). What we evaluate here is not only the product as the result of the design process. More interesting in this aspect is the study of the design process itself and the way the designer approaches and moves through a given task. It has been suggested that a creative design process is not based on linear rational decision-making associated with problem-solving strategies (Taura and Nagai 2010; Cross 2007; Seggern 2008). While it may rely on existing patterns, rules and concepts a creative design process challenges and restructures these information to generate new ideas. It is within this notion of creativity that we can start to explore new possibilities for creative design practice that emerge from the use of digital technology.

There are however challenges in delivering this new mode of design education which emphasises creativity, complexity and the digital. The diversity of student backgrounds creates no common starting point for design teaching. Up to twenty percent of students had no experience with digital technologies or design, while ten percent had advanced design skills coming from graphic design, architecture or interior design. This disparity of abilities places considerable pressure on the teaching abilities of staff to manage the different pace that student's understand design concepts and digital programs. There was also no room in the curriculum to offer 'separate' digital focused subjects. Instead digital technologies were imbedded with design studios which were taught for ten hours a week. While this immersion presented considerable time constraints, we believe it to be central to the success of student's understanding the role of digital technologies as creative exploration as distinct from purely a representational tool.

The reminder of this paper discusses the observed outcomes of the implementation of this new design curriculum. It reflects on a five-year transition from an initial emphasis on hand drawing and problem solving to the most recent experience in 2012 which offered a more exploratory approach to design primarily through digital tools.

This new curriculum challenges the positioning of design studio teaching which establishes design tasks commensurate to representational ability and knowledge. For example a common design exercise for beginning landscape architecture students might ask for a design of a defined space such as a simple residential garden, together with a linear design process, with a clear design brief and prescribed compositional rules and representational outcomes. In contrast, our approach establishes a complex design agenda which positions creative exploration a major objective. Within this model, we seek not to prescribe outcomes, but instead offer the student multiple representational platforms to explore their own agendas within a range of conceptual and theoretical understandings. This revision shifts emphasis from teaching skills, knowledge and applications to instead acquiring these attributes as part of a bigger pedagogical agenda reflective of a Masters level.

As we will discuss, this approach still encompasses the necessarily disciplinary content, however this alternative model no longer separates the rationale and the practical from the creative and the artistic. Through a critical review of teaching practice, student outcomes and experiences, we identify three major conceptual shifts in the way these students understand and practice design –topographic form, creative unpredictability and a focus on experience.

Studio 1: Topography

Within the dominant model of landscape architecture education which is premised on degrees of 4-5 years, design studio would be taught separately from a site engineering studio; establishing a gap between design as a creative practice and engineering as making design work. Our new foundational year challenged this division between design and engineering by integrating the design studio and technical subject. This revision was far more strategic than simply using a technical subject to support a design studio (which is also common). Instead we proposed a more fundamental re-conceptualisation of topographic manipulation as a creative practice. This shaped the beginning student's first engagement with landscape architecture design. Rhinoceros, physical and virtual modelling and Auto CAD provided the dominant modes of exploration.

As introduced earlier, plans have formed the dominant representational techniques in landscape architecture, offering the foundation to generate all other representations. Not only is the plan a highly abstracted mode of representation it also creates distance between the spatial configuration and experiential quality of the design. This is even more evident when it comes to the use of contours to represent three-dimensional landforms, which requires a “trained eye to visualize the shaping of the land” (Walker 2008, p. 9). Issues of site engineering are even further detached from the physical space, as slope manipulation and grading become mathematical problems.

This first introduction to design replaces the primacy of the plan and its representation of topography as abstracted contours with three-dimensional representation modes. Design exercises in both subjects were coordinated so that students simultaneously engage with the virtual and physical space in two and three dimensions at any one time. Together, they establish basic design and representation skills as well as a comprehensive understanding of a design project involving creative exploration, ideation, design development, site tectonics and grading.

The exercises were structured in two sequences. The first sequence focus on topographic exploration as an overlay of form and narrative using composite mapping and creative modelling studies. Engaging with representation and interpretation of cartographic material, the composite mapping shifts from plan representation into a physical contour model. Simultaneously, students explore generative processes of landform manipulation through a series of creative modelling studies in form of folding (paper) and moulding (clay). In the final study (digitising), the generative design techniques are translated into a digital model. Previously abstracted ideas and forms now materialise into concrete landscape features in the form of accurately sloped ramps, stairs, terraces and mounds, as shown in Figure 1.

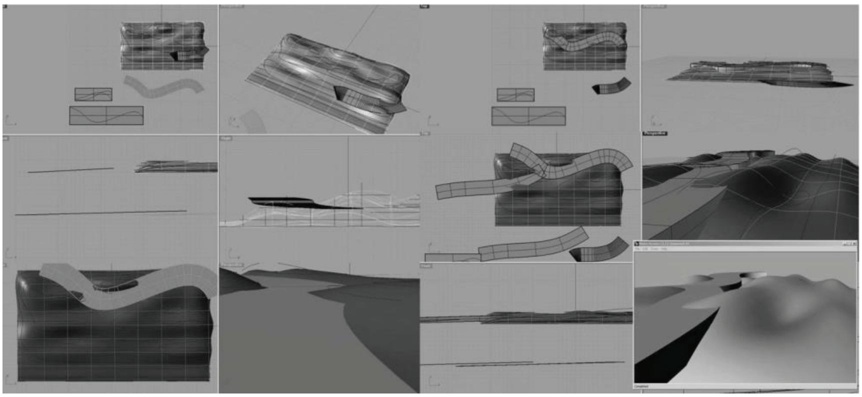

Figure 1. Translating form earlier explorations in clay and paper into digital models. Source: Author Frances Gaffney

The second sequence focuses on the exploration of experiential, functional, aesthetic and ecological aspects of landform manipulation. Developing a design proposal for a coastal park, students investigate program, material space, as well as temporality and natural processes through the lens of topography. The engagement with dynamic systems (coastal processes), challenges students to adopt speculative design approaches with the possibility to explore topographic and programmatic scenarios for sea level rise. The tasks are organised to foster creative slope interpretation while developing a sense of scale throughout the design process. At this point, three-dimensional digital modelling technology is interlinked with CAD technology and representation of contour plans and contour models, as demonstrated in Figures 2 and 3.

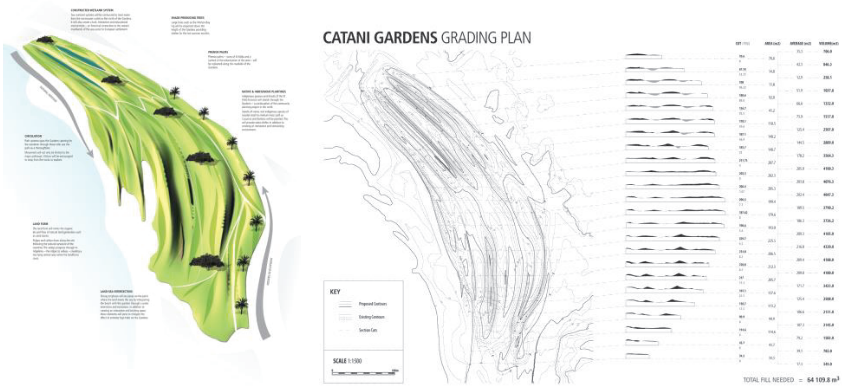

Figure 2. Working across multiple representations of space simultaneously –axonometric, two-dimensional contours and sections. Source: Author: Jonathon Chan.

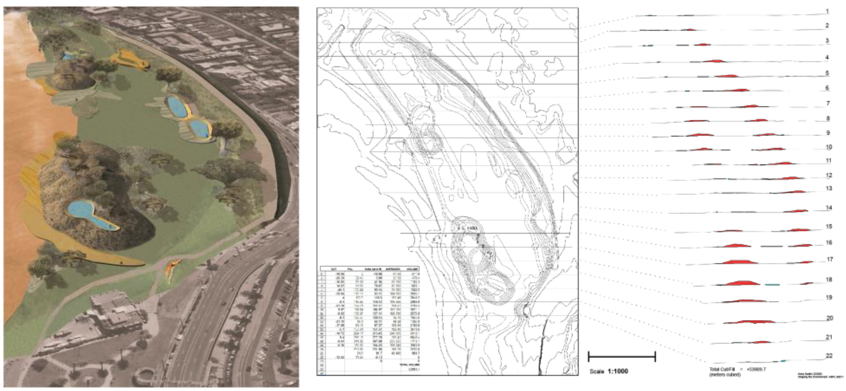

Figure 3. Working across multiple representations of space simultaneously –axonometric, two-dimensional contours and sections. Source: Author: Anna Durkin

While in conventional, plan oriented design processes the creative work has to be connected with the pragmatics of real life data through the use of slope calculations, digital technology now allows the designer to run the grading process concurrent to the design development. It is evident in the student works that the abstraction of contour lines and slope inclinations dissolves with the visualisation in three-dimensions. Working within the existing terrain model, students explore topographic manipulation and grading considerations from an intuitive perspective while maintaining scale and spatial accuracy. It is not necessary to calculate the amount of stairs or the length of a ramp needed to negotiate a height difference. A 1:14 ramp is embedded into the existing terrain and embankments are automatically adjusted. The consequences of each action (insertion, landform manipulation) is immediately visible. In this way grading considerations are not just a means to adjust the proposed to the existing terrain but rather become conscious design considerations.

Importantly this first experience of design introduces a creative practice that constantly moves between different digital and physical representations, informed by multiple ways of testing and understanding space. It is through this production that students begin to understand the different roles of representations, images and sections. This differs from studios were representational conventions are often presented as the starting point.

An increase in resolution and complexity is also apparent, driven by the primacy of the three-dimensional models (digital and physical) which require an engagement with the entire topography. For example a high degree of spatial depth, material resolution and experience is evident in the final renders produced by the students to complement the technical drawings and axonometrics shown earlier. The quality of these images, shown in Figure 4, differs markedly from Photo shopped montages used so prevalently by design professionals and students. These montages are generated by nominating a place within a plan to 'imagine' how it might look within a view. Often elements are collaged into a site photo, as shown in Figure 5, presenting an impression of a three dimensional space and perspective assembled within a two dimensional realm.

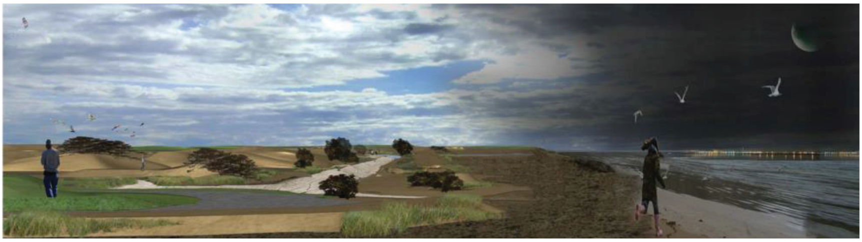

Figure 4. Images produced from Rhino three dimensional models. Source: Authors: Jonathon Chan, Frances Gaffney and Ruth Garry.

Figure 5. Photo shopped montage images produced within two-dimensional space. Source: Author: Chris Newman

The second studio of the foundational year introduces a further move away from plan driven design strategies through the introduction of parametric design, with a focus on experience.

Studio 2: Experience

This studio engages with form finding through defining and testing set parameters to inform an overall design proposition for a given site. Parametric design shifts emphasis from form to instead the identification of certain parameters or characteristics in which to guide design. While it can be argued that parameter-based decision-making can be found in every design process, there are specific possibilities digital technology offers to the design exploration and experimentation, particularly when dealing with complex systems (Salim et al 2011). As Oxman further argues "parametric design process is formational rather that compositional and formal. … In parametric design, the manipulation of associative geometrical relations of complex structural patterns can be further mapped to organizational and spatial concepts of the complexity of heterogeneous structures" (2008, p.109).

Parametric design processes are on the one hand highly structured processes when it comes to the selection of relevant parameters. On the other hand they also encompass a high level of uncertainty and complexity when considering the organizational nature and spatial outcomes. Oxman states:

> In parametric formation parameters of particular design are declared, not its shape; different configurations can be created assigning values to parameters. Parametric exploits associative geometry describing relationships between objects, establishing interdependencies and defining transformational behavior of these objects. (2008, p. 106).

The conception of the design process followed in this studio involves parametric considerations, where projects are explored through specific research questions focusing on procedural and performative aspects. The studio is structured into two phases. Phase one is an intense physical and bodily engagement with the project site through a series of on-site activities. Physical interventions, site writing, sketching, collecting, reading and mapping are tools through which student encounter tangible and intangible qualities of the site and its surrounding context. Figure 6 for example presents still images from a video exploring material qualities of the site. By the end of this phase students formulate their individual position brief, research question and response strategy for the site.

Figure 6. Exploring materiality and topography through physical intervention. Source: Author: Adrian Cook, Tim Luck and Jonathan Chan.

The bodily exploration of the site stands in stark contrast to the second phase of the studio where students entirely work in the digital realm. Here, the students' design positions are translated into a series of abstracted digital models that explore the spatial and systemic organization (topological variations) of their research question based on previous experiences and observations.

In the examples below the students explore how various three-dimensional circulation patterns can influence the pedestrian perception of the site and ultimately define a final design response for the site. The first project engages with a diverse range of visual interactions and explorations that would allow users the opportunity to respond to environmental conditions. Circulations will be achieved through the application of gradual landform elevations and paths, which will reveal a view or an installation. Sensory qualities, interactivity & performance of appearance are key parameters that drive this exploration.

Figure 7 shows a design that generated and tested fixed parameters, where only one parameter is changed at a time (fixed mode). Fixed mode operations are often applied when the designer aims to test specific experiential qualities such as view lines (revealing and hiding) or spatial experiences (enclosure and exposure) at a fixed location with in their site. For testing view lines, the vertical elevation remains unchanged while the horizontal parameter vary (e.g. moving of topographic location). Exploring enclosure and exposure on the other hand, requires that the horizontal parameter (location within the site) remains unchanged while the vertical parameter (elevation and landform) is manipulated, as demonstrated below.

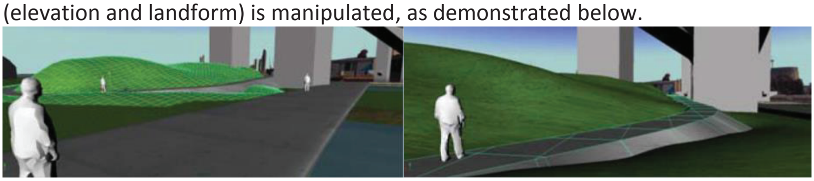

Figure 7. Testing landforms from a fixed location within the site. Source: Author: Veronica Carassco

The second project investigates how the layers of topography, hydrology, and circulation can be interwoven to construct a pedestrian experience and to develop a relationship between the urban fabric and natural ecosystems. By adjusting the pedestrian baseline rhythm through change in elevation and change in materials the student aims to stitch these disparate layers together and “repair” the disjointed landscape. In this project the testing happens through variable modes. This means that the design is generated based on variable dimensions within a defined spatial form. The variable mode allows a strategic exploration of systemic relationships, processes and performative qualities of a specific aspect of the design (Figure 8). In this example, all parameters that define the various layers of circulation (rhythm, elevation, topography, material) are flexible so that each overlay creates a new circulation system. The various overlays of circulation systems are then applied to the site and subsequently inform the overall design response.

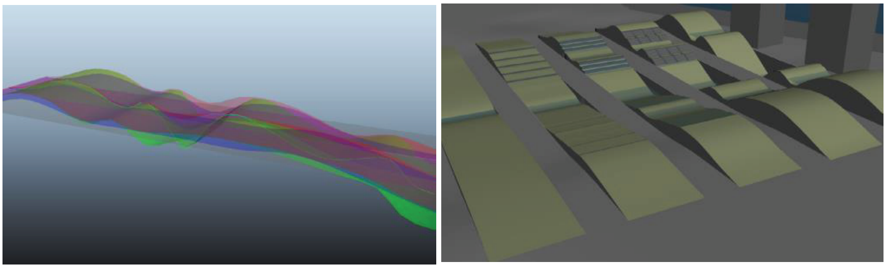

Figure 8. Testing vertical systems. Source: Author: Marc Rodriguez

Parametric driven design process breaks with the linearity of landscape architecture design processes. While the early explorations and interventions fulfil the objectives of site analysis they engage students in a very directive investigation of site, focussing on experiences and issues rather than all encompassing layering of (often redundant or insignificant) site information. By focussing on the generation of the design driving parameters the students start to engage only with relevant information and develop a depth and rigour of exploration that is difficult to achieve in beginning design students. Furthermore, despite the fact that these projects followed stringent parameters that were set very early in the design process there is a great deal of intuition and creative exploration involved. Guiding this process are open-ended observations of “what happens if…?” rather than outcome oriented statements such as “I want to achieve ….”. Aspects of intuition, such as the condition of flow, play, experimentation, following gut feelings, and conscious awareness are imbedded in the design exploration and stand in opposition to logic and rational decision making.

Consequences for Design Creativity

The act of importing and transferring design ideas between the different digital platforms also introduces a new creative moment within the design process, offering what philosopher Andrew Benjamin (2012) describes as the ‘presence of the unpredictable.’ A contemporary engagement with digital technologies encompasses multiple processes, moving from the material to the immaterial and back, and between different digital platforms. These moments of transition are not seamless, and are at times the source of frustration. However they also introduce elements of creative unpredictability into the design process, allowing the possibility to understand characteristics of space, form and program in different ways. At times 'a mistake' that might appear as a consequence of these transitional moments may offer a productive moment for moving forward.

According to Benjamin these unpredictable moments position digital technologies as a far more liberating design practice than that offered by other media such as drawing. This observation is supported by Lawson who argues that digital media is particularly empowering to people with limited design education allowing them to "express and explore ideas which their own drawing skills could not support" (2002, p. 176).

These arguments linking digital technologies and creativity are particularly challenging to the discipline of landscape architecture which has been slow to embrace the creative potentials of digital media. Instead many professionals and educators consider digital media to lack the intuitive capability of more traditional means of design such as hand drawing. This position is evident for example within Marc Treib's edited volume *Drawing/Thinking : confronting an electronic age* published in 2008.

Despite the use of 'electronic age' within the title, Trieb's collection of essays offers minimal discussion of digital media. Instead the essays present the merit of drawing rather than an enquiry into the value of drawing within an expanded technological context. Trieb argues that computer programs are bounded by limitations and suppress exploration. Those that have not been schooled in hand drawing are particularly vulnerable to these limitations. He states:

> Those that use the computer without understanding the practice and values of drawing by hand remain constrained by the default positions established by the programming team. The hand drawing, in contrast, comes with no default positions; we express what we want…In tandem, the hand and the computer offer astounding possibilities, but I still contend that the best computer-aided drawings are made by those who understand the systems of drawing manually. (2008, p. 15).

However as our studio experience demonstrates, new digital technologies (beyond Photo shop and CAD, which fundamentally stay within the two-dimensional realm) allow students to design directly within three-dimensional space, which we argue leads to an increased (rather than restricted) ability to comprehend and visualize complex spatial situations. The diversity of design proposals generated by the students clearly demonstrates that digital programs did not constrain outcomes.

Conclusion

While digital media has been accepted in landscape architecture within the realm of GIS, landscape visualization and landscape documentation, there is reluctance to embrace the potentials of digital technologies within creative practice. Our experience in shifting the design curriculum of a foundational year from planimetric design techniques to a focus on three- dimensional digital modelling however highlights the potentials for digital technologies and design creativity. This has proven especially valuable for the beginning design student allowing a direct engagement with three-dimensional space as opposed to modes of design education which emphasis the primacy of the two-dimensional plan.

In arguing for the new creative possibilities afforded by digital media, we do not proposing the abandonment of drawing and sketching, they still form an integral part of the design process. In fact many students employ sketching in their explorations almost as a bridge in instances where they feel stuck with their ability to handle the digital software. This occurs "naturally" even without formal instruction and suggests that the digital and analogue complement each other. However so far the real potential of the digital as tool for creative exploration, experimenting and testing has been largely overlooked in landscape architecture education and the profession. To many practitioners it remains a representational tool.

But as this paper has outlined, an engagement with digital technologies offers new avenues of design exploration which can elevate landscape architecture practice into a more dynamic field of creativity enquiry. Digital media can facilitate an increased engagement with complexity where the rationale and the practical are no longer separated from the creative and the artistic. To employ the potentials of the digital however will require a fundamental shift in landscape architecture design education and a critical engagement with how the discipline conceptualises design creativity.

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OutReach Initiative for Education of Future Industrial Designers

Claudia B. REBOLA* and Kevin SHANKWILER
School of Industrial Design, Georgia Institute of Technology

Abstract: *This paper discusses a program undertaken to educate high school students about the Industrial Design profession. An innovative OutReach program model is presented where design professionals, academic (college-level) and high school students are brought together to conduct a real life experience project. Urbanism is a designated topic for the program model. Findings are also presented, supporting success of the initiative.*

Keywords: outreach, industrial design, high school

* Corresponding author: School of Industrial Design | Georgia Institute of Technology | USA |
e-mail: crw@gatech.edu

Introduction

Growth of the industrial design discipline continues to grow in universities across the United States. Awareness of the Industrial Design Discipline among high school students, however, still remains compromised. Most high school students are not educated and presented about the function and impact of the discipline in society. Most high school institutions attempt to present the discipline through “shop” classes, if resources are available. Other institutions present the discipline through computer or graphics design courses (Henry W. Grady High School, 2013). Even though efforts are made towards educating high school students about Industrial Design, they are limited in the understanding about the scope and broadness of the discipline.

New innovative models for educating high school students are necessary to guarantee successful awareness of the Industrial Design discipline. Real life experiences and the opportunity of practicing design with experts in the field can have a significant impact not only on educating high school students, but also preparing them to respond to the needs of the profession. In response to these needs, an “OutReach” program was developed. Designed as a 2-week event, professionals, academic and high school students joined efforts towards designing products.

The OutReach program was sponsored by the Industrial Designers Society of America (IDSA) and organized by the local IDSA Atlanta Chapter, with the help of local higher-level institutions including the Georgia Tech School of Industrial Design, Auburn University and a local high school.

IDSA is the world’s oldest, largest, member-driven society for product design, industrial design, interaction design, human factors, ergonomics, design research, design management, universal design and related design fields [Industrial Designers Society of America, 2011). As stated in their website, “IDSA organizes the renowned International Design Excellence Award (IDEA) competition annually; hosts the International Design Conference and five regional conferences each year; and publishes Innovation, a quarterly on design, and designBytes, a weekly e-newsletter highlighting the latest headlines in the design world. IDSA’s charitable arm, the Design Foundation, supports the dissemination of undergraduate scholarships annually to further industrial design education.” Absent from that is the goal of educating high school students about the discipline. The significance of this OutReach program as part of IDSA is not only to increase the awareness of the discipline but also to promote industrial design specifically to students interested in design in general. As such, this program provides a needed venue for the organization to have an impact on and recruit young future designers.

About the Program

Design professionals, academic (college-level) students and high school students were brought together to conduct a real life experience project. The program was structured such that they worked together for 2 weeks designing products aimed at responding to a local governmental need, also involved in the program (see figure 1).

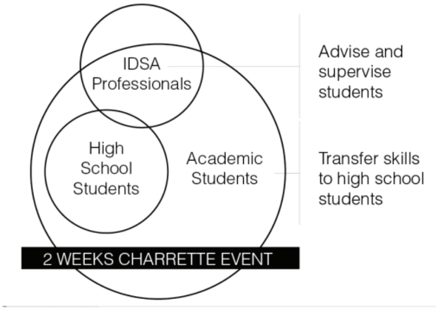

Figure 61. OutReach program model.

Design professionals were recruited from the IDSA Atlanta Chapter membership database. A total of 9 professionals from the Atlanta area volunteered and enrolled in the program. College level students were recruited from the School of Industrial Design at the Georgia Institute of Technology. Both graduate and undergraduate students were invited to participate in the program. A total of 9 graduate students and 7 undergraduate students volunteered and enrolled in the program.

High school students were recruited form a local institution. The high school is committed to excellence in public education, especially through one of the four small learning communities: Communication and Journalism. This learning community is highly interested in teaching students about creativity, design and design processes. Through one of the classes offered at the institution, 24 high school students were recruited for the outreach program.

Program Topics

Urbanism was a designated topic for the program. The project topic was chosen to address local urban needs. Moreover, it was an approach to work with local entities interested in improving the use of urban outdoor spaces. As such, the major goal was to expose students to designing devices for outdoor spaces with the intent of creating social impact. They were expected to design products and/or system prototypes that could potentially be implemented in order to have a positive impact in the city of Atlanta and promote better use of outdoor urban spaces.

The local entities included the Atlanta BeltLine Inc. (ABI), which is formed by the Atlanta Development Authority. This entity is tasked with planning and executing the implementation of the Atlanta BeltLine in partnership with the BeltLine team including City of Atlanta Departments. The Beltline project aims at providing “a network of public parks, multi-use trails and transit along a historic 22-mile railroad corridor circling downtown and connecting 45 neighborhoods directly to each other” (Atlanta Beltline, 2011). The Beltline is a work in progress project, where certain sections have been partially completed. Social awareness and involvement on these spaces is paramount for the success of the project.

The local High School campus was also included as an urban setting to design for. Their outdoor campus has been facing underutilization due to the impact of students using computers indoors. Likewise, the campus of the Georgia Institute of Technology was also included as another urban setting (Georgia Institute of Technology, 2011). New bridges to link east and west sides of campus have been developed with outdoor landscaping. Even though open green spaces are available, they remain underutilized.

Lastly, designing for the metropolitan Atlanta area was also part of this program. The Livable Communities Coalition was included as the fourth urban setting (Livable Communities Coalition, 2011). The Livable Communities Coalition aims at improving "the quality of life in metropolitan Atlanta by sharing and promoting smart growth principles, advocating public policy that promotes smart growth, and supporting projects that accelerate smart growth". The Livable Communities was formed in 2005 and it has been working with over 50 organizations to meet their goal. Projects are varied focusing on land use or density, transportation, housing choices, and conservation of open green space and natural resources or environments.

Design Drivers

Having identified the topics, a total of four aforementioned entities, the program set three shared main premises for the projects and urban settings. These premises operated as design drivers for participants to meet.

- Integrating communities and generations by design
- Motivating people to move by design
- Making cities more livable by design

Participants were divided into teams and randomly assigned one of the four urban settings. Professionals were briefed on the allocated urban setting in advance so as to be prepared to lead their teams at event kick-off. The high school students were introduced to the topic when the event started and groups assigned.

Team Composition

Program participants were divided into teams of mixed industrial design experience. A total of 8 teams were set up, comprised of one professional, one graduate student, one undergraduate student and three high school students (see Figure 2) (though some teams had more graduate students than others). The goal was to have half of the team members knowledgeable with the design discipline, and the other half to be taught about the discipline. Meaning, a ratio of one design related member for one non-design related member.

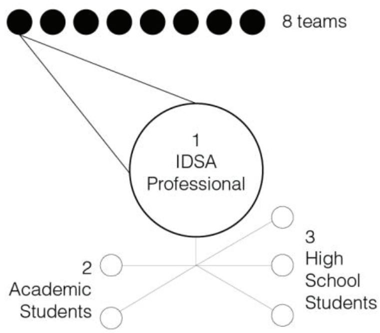

Figure 62. Team composition.

The program was structured such that design professionals functioned as their team's project leads. Their goal was to kickoff the program with brainstorming activities, lead the scope of the project and supervise the project development. Students had access to professionals but their availability was limited and reserved for major milestone meetings or via e-mail for other tasks. Industrial design college students worked directly with the high school students and facilitated day-to-day design development, supplementing the professionals. With this structure, high school students are exposed to the entire design process from conceptualization to execution.

Design Parameters

Design parameters were set up in advance so as to serve as a logical guide for professionals and students to operate under. The parameters presented included the following:

- The product(s) must be designed for the outdoors within the assigned urban setting.
- Design a product(s) with simplicity and major social impact.
- The product(s) design should address the program's "design drivers" issues:
- Integrate communities and generations by design.
- Motivate people to move by design.
- Making cities more livable (specifically the assigned urban environment) by design.
- Design a prototype(s) that can be realized with $500
- Design a prototype(s) that can be realized/replicated in a short period of time (e.g. 2 weeks)

Motivational guidance

Besides the aforementioned design parameters given to the teams, organizers educated teams with additional guidelines. These guidelines included a set of actions to be taken during the 2-week program, referred as to "motivational drivers" intended to encourage participants towards achieving a successful experience in the program. The motivational drivers included:

- Be curious
- Observe
- Sketch
- Photograph
- Keep a journal
- Don't discard wild ideas
- Discuss
- Communicate often
- Ask
- Collaborate
- Work hard
- Keep focused

Documentation of the project and work-in-progress was strongly encouraged. Teams documented their processes by taking pictures, having the high school students keep a daily journal, and using social media, such as facebook, for uploading project status.

Design Outcomes

Teams were tasked with following the entire design process from ideation to product fabrication. The outcomes of the program were functional prototypes. The goal was not only to expose students to the complete design process but also to potentially place their outdoor designs in the assigned urban settings. The designed products were to be produced on a small-scale using desktop manufacturing techniques, such as laser cutting. The rationale was to limit the need of specialized skills for fabrication. If special fabrication were needed, academic students and professionals would compensate for the skills needed.

Fabrication Support Capabilities

The Georgia Tech School of Industrial Design's fabrication capabilities were available to any of the teams wishing to fabricate design models and/or components outside of the high school student's classroom capabilities. Georgia Tech's design shop is outfitted to support product and architectural modeling and furniture production needs of students and faculty. The shop is divided into four areas: assembly area, paint area, modeling area and rapid prototyping area. The modeling area is equipped with the following capabilities:

- General hand tools
- Wood working (cutting, shaping, finishing and joining)
- Plastics cutting
- Some metal fabrication
- Spray booth for adhesives and material finishes

The rapid prototyping area is equipped with four 3D printing machines: two ABS plastic Dimension FDM 3D printers and two powder-based Z-Corp 3D printers.

Additionally, participants had access to laser cutting equipment for use on paperboard, chipboard, cardboard and wood veneers (up to 24"x36").

As a general guideline, only shop-approved personnel who had completed a basic orientation session at the School were allowed in the shop, for example academic students. Guests were allowed in the assembly area only, away from heavy-duty fabrication machinery.

Program Events

The Design Charrette started on a Thursday evening and unfolded over two weeks. Teams met the first day to start the project and concluded with a final event presentation of posters and prototypes. In addition, a special exhibit was scheduled to present the final designs during a local "Atlanta Design Week" event.

In detail, below are all event activities and milestones performed by the teams.

Week 1

On the first evening of the project, a Kickoff event was held at the high school. The kickoff event was an informative and educational public event open for all participants, parents and the general public. The kickoff educated the public about the design process and introduced inspirational work on urban outdoor products, products designed for social impact and product design employing desktop manufacturing. It also outlined the event structure, team compositions, urban settings assignments, activities/milestones and general expectations. Each program participant was given a handbook that detailed program scope, team contact information, urban settings specifications and schedule/due dates for all activities.

Figure 63. Group meeting during program kickoff.

Once all materials were presented, teams meet for the reminder of the session to perform brainstorming and mind mapping activities and preliminary problem identification of the assigned urban setting (see figure 3 and 4). Professionals lead the sessions, teaching high school students about brainstorming and mind mapping activities. They also brought materials to guide the session. At the end of the meeting, teams were tasked with delineating a set of directions in order to conduct focused ideation over the following days.

Figure 64. Team leader guiding brainstorming during program kickoff.

Over the course of the project, graduate and undergraduate students met with high school students during high school class times to help them ideate. On the fifth day of the program, teams (except professionals) were tasked to meet at the High School classroom to identify viable ideas/concepts. The goal was to set up a direction to start performing concept modeling and study modeling in the following days (see figure 5). High school students were given examples of what a study model looked like as well as given supplies to work on them.

Figure 65. Student study models.

By the end of the first week, all teams, including professionals, met for a mid - project review to assess the work done to date and get feedback for upcoming refinement and development phases.

Week 2

The design development and prototype fabrication were performed during week 2 of the program. Design prototyping was required to be completed by day 15 for presentation at a concluding exhibition event.

On the 8th day of the programs, teams started the concept refinement based on the feedback provided during the mid-project review. After 3 days of concept refinement under the supervision of graduate and undergraduate academic students, teams started the prototype construction (see figure 6).

Figure 66. Prototype construction.

Each team was given a budget of $200 for supplies. Materials were bought and prototypes were constructed using the high school students' classroom and support facilities from the School of Industrial Design at Georgia Tech (see Fabrication Support Facilities section).

Prior to concluding the program, teams were asked to dedicate a day developing a final presentation of their product and finalizing all details for the final delivery (see figure 7).

Figure 67. Digital modeling.

Final Delivery

All teams were required to have the following deliverables for the concluding event:

- 1 design prototype
- 1 digital presentation (e.g. PowerPoint) describing the product design and process.

Specific directions were given to develop the final presentation, including:

- Description of the final concept
- A statement and justification for each the “design drivers” issues
- Brief explanation of the process including imagery
- 3 perspective views of the concept making reference to the scale of the device(s)
- The concept in use
- List of materials
- Cost, budget justification for the device(s)
- Manufacturing schedule (personnel/time)
- Summary lessons learned in the event

The final presentation was hosted at the College of Architecture at Georgia Tech so as to motivate the high school students to feel part of an academic environment.

Products Special Exhibition

In addition to the final delivery, high school students were tasked to prepare deliverables for presenting their products at an additional special exhibition during “Atlanta Design Week”. They had an additional week to design a poster for a public event. Their posters needed to contain the following:

- A short description of the final concept
- An statement and justification for each the “design drivers” issues
- 3 perspective views of the concept making reference to the scale of the device(s)

- The concept in use
- List of materials

First time presented in the city, “Atlanta Design Week” was a concentrated sequence of events intended to promote the value of design and Atlanta’s vibrant design community. The goal was to challenge designers in Atlanta to consider their collective role in making Atlanta a better place. Participating in this week of design events was envisioned as a way for high school students to feel part of a growing design community.

Program Results

The program concluded with the expected outcomes, where teams presented their final prototypes and presentation. Eight inquisitive and distinctive products were designed and delivered. Two products per setting (Atlanta Beltline Inc., High School Campus, Georgia Tech Campus and Livable Communities Coalition/Metropolitan Atlanta) were showcased in a three-hour concluding event, described in the next paragraphs.

Team 1 developed “Trash n’ Smash”, an interactive trashcan that encourages high school students to reduce pollution at their school by offering an interactive disposal experience through music and by giving them something valuable in return. As students used the trashcan, they collected points to tune music of their choice.

Team 2 developed “Around the Blox”, an improved interface for the newly implemented Atlanta parking system. After user research, their concept was based on designing a better and friendlier interface, a shell which helps to resolve weather exposure, screen glare, visibility from a distance as well as street and side walk surrounding the box itself, making the path and information more apparent. Their proposition was an economical solution that used vinyl decals mounted in plastic and existing parking systems (see figure 8).

Figure 68. “Around the Blox” interface design.

Team 3 developed “History Station”, a platform to Atlanta’s past, located along the Atlanta Beltline. Their concept was based on providing a display box that showed the history of Atlanta’s trains (see figure 9), encouraging people to walk the beltline as an open-air public museum.

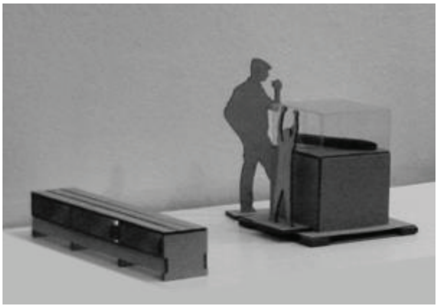

Figure 69. "History Station" concept design.

Team 4 developed "Tech Bench", a seating design for the Georgia Tech campus. Their focus was to create more social areas within the green spaces at the campus (see figure 10), and based their concept on the aesthetic properties of biological systems such as hives to allow multiple and flexible configurations. Integrated solar power and electrical outlets allow the seating system to accommodate plugging in multimedia devices outdoors.

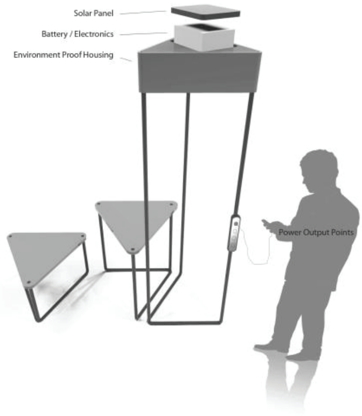

Figure 70. "Tech Bench" seating design.

Team 5 developed "Knight Life", a physical interactive display system for the High School. Their concept addressed the issues of poor advertising of school events and lack of school/student spirit. The interactive system was based on the idea of collecting tickets for a monthly raffle to win the opportunity to design and display unique ads in the display system called shields.

Team 6 developed "Walk Waves", a stylish barrier serving as a safety device found around metropolitan Atlanta. Their goal was to create a versatile product for the community that is modular, visually appealing and durable to be placed as safety barriers to the bridges of metropolitan Atlanta. In addition, they proposed the devices to operate as information system by allowing the incorporation of maps on them. Their proposition consisted of shape mold concrete materials.

Team 7 developed “Search and Seek”, an interactive game for the Atlanta Beltline. Their concept was based around an annual one-day scavenger hunt event. Their goal was to raise awareness about the Beltline through a learning game experience; getting people to moving through physical games around the Beltline; and connecting generations in a fun way.

Team 8 developed “The Leaf”, a seating design for the 5th Street Bridge at the Georgia Tech campus. Their concept was based on transforming the bridge into a destination. Their focus was to design a seating area that is inviting and comfortable to attract people to the area. Their proposition provided an aesthetical appeal alluding to the classic wooden bench swing (see figure 11).

Figure 71. “The Leaf” seating design.

Program assessment

A survey questionnaire was conducted to assess the overall performance of the program. The survey was composed of 10 questions completed online in approximately 10 minutes. The online survey was sent to all program participants including the professionals, the graduate students, the undergraduate students and the high school students. For the purposes of assessing the program, organizers were excluded from the survey. As such, a total of 49 participants were included in the survey. A total of 42 participants (86%) successfully responded to the questions. Out of all respondents, 60% were high school students, 17% graduate students, 13% professionals and 10% undergraduate students (see Figure 12).

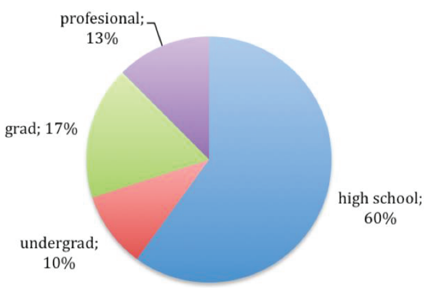

Figure 72. Survey participants.

Overall, 98% of the participants reported the program should be repeated next year. The majority of the thoughts about the program were positive (76%), where only 7% had negative comments. The majority of the comments towards the program were encouraging as respondents stated:

> "This was a wonderful experience. It opened an opportunity to us that every designer dreams of. Also, I learned many new things about the world of industrial design."
> "I loved working in the program and I loved working in a professional setting. Overall it was a memorable experience and got me used to working under a deadline."
> "The OutReach program was a good experience. Because I have never gone through the process of industrial design before, it was challenging. However, I learned a lot about the design process that I was not exposed to before the project. I enjoyed the program, and thought it was neat to learn from professionals and hear their feedback."
> "Great idea & very revealing to all levels of participants."
> "Education has found a valuable design ally. It was useful, effective, and awakening to all involved. To mentor, to guide, are the cornerstones of building enthusiasm for any profession."

Participants were asked to list three concepts that were learned during this program. High schools students reported different concepts from responsibility, sacrifice, presentations, making things, questioning, etc. Among all 10 identified categories of concepts, the most frequently described keywords were time management (17%), teamwork (14%), sketching/ideation (10%), brainstorming (8%) and production/constrains (8%). In general, students reported to learn "the full, intricate process of designing, and then mocking [up] a full sized industrial project as well as how to work efficiently under pressure and tight schedules".

Time constrains were reported to be inappropriate. The majority of the participants (76%) stated that 2 weeks was not sufficient for the program. Many recommendations included extending the schedule to 3 weeks. Other recommendations included scaling down the topic, where 76% reported the scope not to be appropriate for the allocated time and purpose of the program.

The majority of the participants stated that the program was well structured in terms of milestones (71%) and that team size structure was highly appropriate (95%). In terms of rating the program, high scores were given to the organizers availability as well as the program organization, settings, materials and resources (see figure 13).

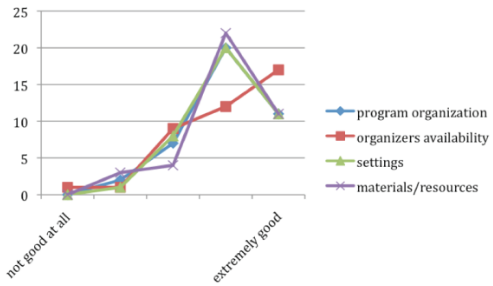

Figure 73. Program assessment.

Discussion

Overall, the participants at all levels of the OutReach program (organizers, professionals, college students, high school students and parents) considered the endeavor a success, with some changes suggested to be implemented for a second staging. The design professionals (team leaders) found valuable mentoring experience and learned to lead teams with a broad range of capabilities and maturity. Graduate and undergraduate college students saw design education from "the other side" and came away from the program with a greater appreciation for articulation of the design process and for teaching design concepts (much to the joy of a few participating professors!).

Additionally, by supplementing the design professionals, academic students were able to develop a rapport with the professionals and network for future job opportunities.

The structure of the program was found valuable, as mentioned previously, and serves as a model for other disciplines to implement outreach programs, such as: engineering, computer science, interaction design, etc. The key element is to include practitioners/professionals that can serve as a pragmatic guide to students, both academic and high-school. The second element is to integrate academic students into working groups with the high school students. In this role, the academic students clear the roadblocks involved with making and prototyping (transfering specific skills needed to realize the final product) and coach high school students through the design process.

There were identified issues, however, with the program that requires improvement. In regards to project scope, it was found that many high school students had difficulty relating to the size and scope of the environmental and open-ended design tasks presented to them. It is recommended that activities are restructured to be more product focused to allow better hands-on understanding of problem contexts by the high school students. Additionally, problem scopes need to be better prescribed initially, allowing the project teams to focus on 'how they are going to solve the problem' and less time on 'figuring out what to do.' It is believed this will lead to more robust project outcomes.

Part way through the program, it became apparent there was a missed opportunity with the structure of the program - a lack of focus on parents of the high school students. The parents were very supportive of the OutReach program and were more eager to be involved than the organizers had foreseen. At the conclusion of the program, many parents expressed that they too wanted to learn more about industrial design as a profession. This is a very important audience for industrial design to engage, as parents play a major role in their children's career direction and choice of academic institution. In the future, program planning will include special focused sessions for parents. These sessions will take place during the launch of the two-week program with presentations describing industrial design and the role of designers and will allow parents to engage the organizers, IDSA officers and professionals directly.

Budget was an issue with the program. The majority of funds, around $1,000 USD, were sourced out of the IDSA-Atlanta chapter's operating funds, accounting for approximately three-quarters of the operating budget for the year. This allocated money went towards acquiring materials for brainstorming tasks and ideation, and for materials for model and product fabrication. It was reported that budgets were tight for what each team wanted to accomplish. For a second staging of the program, it is imperative that additional sponsoring funds be secured. A suggested operating budget, given the same number of teams and similar operating structure, is closer to $2,000 USD. Recruiting a ‘title’ sponsor would also help towards defining the focus and direction of the OutReach program and provide additional material support.

Through this program, several collaboration issues arose, including: time, expectations and responsibilities. Due to alternating class schedule at the high school (classes alternate every other day and every other week), it was not always possible for all academic students to meet with the high school teams during every scheduled class time, due to the fact that academic students have a fixed schedule. Second, there were some cases of mismatched expectations. In these cases, the high school students had an expectation the academic students would serve to advise and guide, rather than supervise. At the same time, the academic students expected the high school students to be more explorative on their own, rather than needing as much direction as they did. Lastly, in terms of responsibilities, there was some confusion on the specific responsibilities of each member in the team. For example, at one point the responsibility of fabricating the design prototypes shifted to the academic students rather than the high school students as was intended by the program coordinators. In a second example, there was a lack of “homework” on high school students’ part. Academic students would expect the high school students to work on projects between meeting periods, but little work was actually done.

Conclusion

This paper discussed an innovative program undertaken and sponsored by the Industrial Designers Society of America (IDSA) to educate high school students about the Industrial Design profession. Professionals, academic (college-level) and high school students were brought together to design urban outdoor devices to impact the city of Atlanta. Through teamwork, time management, brainstorming, sketching, development and fabrication, high school students were exposed to a successful learning experience of the complete design process. Survey questionnaire studies were conducted to assess the efficacy of the program with high school students, and academic and professional designers having a role in the k-12 educational system. Results indicate a successful performance of the program model to be refined and replicated across high schools. The program not only helps high school students to gain a meaningful understanding of Industrial Design, but also mainly gives an opportunity for design professionals to give something back to the design community. The goal of this IDSA-sponsored OutReach initiative is to inform high school students about the profession of industrial design, and for academic and professional designers to have a role in the k-12 educational system.

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Learning by watching: what we can learn from the Inuit's design learning

Janne Beate REITAN*
Oslo and Akershus University College

Abstract: *In this paper, I explore a single case of vernacular clothing design—the learning and practice of design for contemporary Iñupiaq-Inuit clothing made by the women of Kaktovik, North Alaska—and I hope to contribute to a better understanding of design practice and learning in general. Design research has many unexplored areas and one of these omissions is vernacular design—or 'folk' design. In my opinion, professional and academic design may well have something to learn from vernacular design, although this research is about vernacular learning, didactics about what, why and how to learn within the 'making discipline' of clothing design. The study was based on observations, interviews with seamstresses and authorial participation in designing and sewing in conformity with Iñupiaq tradition, and everything was recorded on digital video film. This investigation of Inuit clothing design indicates that learning-by-watching is the most common way of learning. Learning-by-watching is important within learning-by-doing. This concept of learning-by-watching can be seen as a development of both Schön and Wenger's theories of learning, a concept that will probably be of great importance in further research on the learning process of design, from kindergarten to PhD.*

Keywords: Vernacular design, clothing design, design thinking, learning-by-watching, learning-by-doing.

* Corresponding author: Faculty of Technology, Art and Design | Oslo and Akershus University College | Norway | e-mail: janne.reitan@hioa.no

Vernacular design – Iñupiaq contemporary clothing

The concept of *vernacular design* —or 'folk' design – allows for the understanding and appreciation of designs created without recourse to institutional qualifications in the field of design (Simon 1982 [1970]: 55). This paper is based upon a study undertaken in the Iñupiaq village of Kaktovik, which is not far from the Canadian border on the North Slope of Alaska—a people also known as the North Alaska Inuit (Eskimo)—and the study investigates how Iñupiaq women practiced and learned design as they made modern-day clothing, namely *annuġaaq*[1] with *qupak* trim (Figure 4) (Reitan 2007).

The study was based on observations, interviews with seamstresses and authorial participation in designing and sewing in conformity with Iñupiaq tradition, and everything was recorded on digital video film. The foundation for the study was a review of design research according to the vernacular aspect, as well as documentation of contemporary Iñupiaq clothing design.

Christopher Alexander (1964) writes about design in unselfconscious cultures, which in this research project is termed vernacular design. Interpretations of the vernacular clothing designers discussed here have been inspired by Schön's (1983; 1987) theory of designers as conscious *reflective practitioners*—even though, in this case, the reflexivity happens to be only partially articulated, and for the most part is expressed as actively functioning tacit knowledge[2]. Moreover, this study also makes use of the social learning theory of Wenger (Lave and Wenger 1991; Wenger 1998), namely his *communities of practice*, and provides a perspective on learning that differs from the conventional one, which is focused on learning in educational institutions. Thus informed, my interpretation of vernacular design and the production of Inupiaq clothes demonstrates how the learning process can be viewed as a 1) *collective* rather than an individual process; 2) how it is *continuous*, with neither a beginning nor an end; 3) how it is *integrated into daily life* and not a separate, discrete activity; 4) how learning is a *result of observation*, in particular *watching*, 5) how it is *not a result of oral or text-based teaching*; 6) how the appraisal of the learning process was *integrated into practice*; 7) how knowledge is *demonstrated through specific practice*, and not theorized, and 8) how knowledge is always *demonstrated in context*.

The designing and design learning of Iñupiaq clothing

It is not difficult to understand why both old and new Inuit skin garments make a deep impression on researchers, as on people in general, because they are often beautiful and elaborately decorated (Figure 3). As a curiosity, I can mention that my sister-in-law Anguyak made a skin *atigi* (outer garment) (Figure 1) of an aesthetic quality that is rarely seen; she even won the World Eskimo Indian Olympics' Native Dress competition on skin clothing when I was in Fairbanks in the summer of 1998. The trims on these skin garments are improvisations on tradition, which implies the constant creation of new and different patterns. Anguyak, inspired by my master's thesis on the traditional knitted Norwegian Selbu mittens (Figure 2) (Reitan 1992) as symbols of Norway, and as the wife of my brother, a Norwegian, she made patterns on the trim of this atigi based on the eight-petal rose common on the Selbu mittens.

[1] The letter written *ġ* as in *annuġaaq* is pronounced as a kind of *r* in the Iñupiaq language. This means that this word is the origin for *anorak.*
[2] Thomas Kuhn (1970), who refers to Michael Polanyi's (1983 [1966]) concept of *tacit knowing.*

However, there are few Iñupiaq women who actually make skin garments anymore. Skin and fur are no longer materials for everyday use; they are even rare for ceremonial occasions. If I had followed the tradition of the researchers on Inuit clothing by focusing on skin clothing, I would not have been able to observe and watch a single design or design learning process during my fieldwork in Kaktovik, because nobody, as far as I know, actually made any skin atigi during the periods I was there—three months in the winter of 1997 and three months in the summer of 1998.

Figure 1. Anguyak in her skin atigi (outer garment) and her fabric atikluk (inner garment). © Photo Galleri Galaaen, Røros and Janne Reitan

Figure 2. Copy of old Selbu mitten and New Selbu mitten.

Figure 3. *A woman's frock "…from the head of Norton sound". National Museum of Natural History (NMNH 176105) and b. a frock, or atigi, from the Iñupiaq district around Point Barrow (NMNH 74041).*

Figure 4. *Female and male Iñupiaq atigis in the village of Kaktovik.*

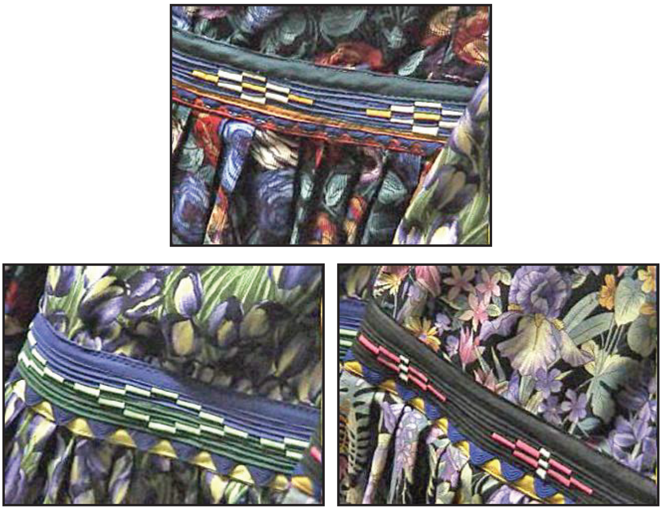


Figure 5. *Three different atigit made by one seamstress of Kaktovik.*

Learning-by-watching

The present investigation of Iñupiaq clothing design indicates that *learning-by-watching* was the most common method of learning. This concept of learning-by-watching can be seen as a development of both Schön and Wenger's theories of learning, a concept that will probably be of great importance in further research on the design learning process in both primary and secondary schools, in addition to academic design schools.

As well as being a design situation, this was a *learning* situation, in particular for the children. They *watched* what the seamstresses did—learning-by-watching—and listened to their comments in the dialogue of the design situation.

Learning-by-watching reflective practitioners

It is difficult to explicitly articulate the rules involved in designing; on the other hand, it is much easier to describe deviations from the norm. Schön also links reflection-in-action to John Dewey's concept of *learning-by-doing*, as an argument for the idea that "…we can think about doing something while doing it" (Schön 1983, 54).

Schön considers the term *practice* to be ambiguous. Practice refers to "performance in a range of professional situations" (Schön 1983, 60)—for example, what a lawyer does—or as "preparation for performance" (Schön 1983, p. 60)—for example, the repetitive or experimental activity of a piano player. A professional practitioner does both, Schön says; "he is able to 'practice' his practice" (Schön 1983, p. 60). Through this, the practitioner develops "a repertoire of expectations, images, and techniques" (Schön 1983, p. 60). From this repertoire, the designer can compose new variations (Schön 1983, p. 140). Schön, a jazz musician himself (Waks 2001), states that improvisation—"varying, combining, and recombining a set of figures within the schema" (Schön 1983, p. 55)—is a typical example of reflection-in-action. The schema is known to all the musicians, and each of them has an individual repertoire to pick from when improvising. To make this even clearer, he also mentions verbal conversation as a kind of collective improvisation (Schön 1987, p. 30).

One key concept that emerges from Schön's theory of design practice is *dialogue*. In his most quoted book, *The Reflective Practitioner,* he talks about "Design as a Reflective Conversation with the Situation" (Schön 1983, p. 76). In his books, both from 1983 and 1987, he uses the term *conversation*, which I perceive to be synonymous with his sense of dialogue. Schön confirms this conversational interpretation in an article, although the term he used was dialogue. "In a designer's dialogue with a situation, types can function both to transform the situation and to be transformed by it" (Schön 1988, p. 183). Dialogue is employed here in a broad sense, referring to the designer's connection to the *materials* of the design situation and the *body of design principles* s/he carries with him/her, principles acquired either from experience or training and that may be either consciously or unconsciously held. The term conversation, if utilised here according to Schön's sense of it, could lead to the misunderstanding that the connection between the designer and the materials of the situation is exclusively *verbal*—that is, oral—as a kind of mystical or supernatural connection. Dialogue, on the other hand, is usually applied in a broader and often more metaphorical context, denoting a meaningful, but not necessarily verbally expressed, exchange between a person and something else—in this instance, the material of the design situation, into which the socially constructed aesthetic values of the local community also impinge.

This corresponds to Schön's interpretation of conversation in a metaphorical sense (1983; 1987).

However, I think Schön fails to see the learning-by-watching in the learning situation between the student 'Petra' and the architect teacher 'Quist'. His emphasis on the auditory sense, which was in play in the coaching activity, perhaps arose from his own experience as a jazz musician, and in the same manner, his inability to see the importance of the visual sense in learning-by-watching might be due to his lack of experience in the visual arts and design. To me, with an inside knowledge of all that is visual in design, the learning-by-watching was obvious. In Kaktovik, where most of the learning and practice of Iñupiaq clothing design was tacit, the visual learning was conspicuous. The practitioners learned by observing the designing, including reflection-in-action or reflection-on-action—reflections that were tacit or articulated verbally. The numerous examples of reflection in and on action in the empirical material indicate that the vernacular designing of Iñupiaq clothing is a conscious process despite the limited degree to which it is articulated in words.

Schön's theory of the reflective practitioner does not seem to have been exposed to extensive critique. Those who do not agree with him have perhaps chosen to neglect rather than critique his ideas. However, parts of his theory have been criticised by some of his adherents, in particular within teacher education. One of them, Newman (1999), has reinterpreted Schön's epistemology of reflective practice through Wittgenstein's later work (Wittgenstein 2001), and in particular the concept of *language games*, in the context of teacher education. Newman states that Schön's theory lacks the essential requirements of a new epistemology, something that Schön ought to take into account because he describes his theory in epistemological terms: "a theory of meaning and an account of language" (Newman 1999, p. 183). Schön claims to build on Wittgenstein's work, but Newman asserts that Schön did not extend Wittgenstein's theory. Newman sees Schön's notion of reflection-in-action as redundant. Rather than supporting Schön's theory, Newman's reinterpretations of Schön's empirical investigations show that these case studies actually support the view of Wittgenstein in his later work, as meaning in language is determined by use and rules depend on the social—that is, the taken-for-granted—practices or customs of society. Newman is perhaps right in suggesting that Schön has fallen short of his ambition to create a new epistemology of practice, but for the present investigation his ideas remain highly interesting, especially with regard to reflection-in-action.

I do not see *learning-by-watching* as contradicting Schön's highlighting of coaching. My contribution is to extend the concepts of practice and learning within the theory of the reflective practitioner. In addition to coaching, learning as watching is important.

In the interpretations inspired by Schön's theory of reflective practitioners (Schön 1983; 1987), I notice that the *social aspect* of the learning and practice of designing Iñupiaq clothing is underestimated. This is something that I regard as crucial for understanding the learning process in Kaktovik. In the next section, which is devoted to interpretation, I extend the social aspect of the design process for Iñupiaq clothing.

Learning-by-watching in a community of practice

In this section,[3] I focus on the context of interpretation, the community of practice (Lave and Wenger 1991; Wenger 1998), which I think is particularly relevant to an

3. An abridged version of this section is published in (Reitan 2006).

enquiry into vernacular design practices and design learning because this social learning theory fits the social practice of vernacular design, although the approach of Lave and Wenger deals with a general theory of learning and not design learning. How do the women of Kaktovik learn and practice the design of contemporary Iñupiaq clothing as a community of practice?

When I asked the informants about who taught them to sew, I often received no answer at first; only after a while did they come up with an answer. One reason could be that they really did not know how they learned to design and sew because nobody explicitly taught them. Some of them remembered who showed them how to sew skin, but more rarely did they remember who showed them how to sew fabric clothing. Because the learning process was so integrated within everyday life, they were not aware of it themselves.

It seems that learning-by-observation, and in particular learning-by-watching, has been a traditional method of learning among the Iñupiat. Before the school teachers and missionaries came to North Alaska, the children learned through continual observation, mixed with regular instruction and tempered by practical experience (Murdoch 1988 [1892]. The first phase of learning-by-watching of modern-day Iñupiaq clothing seemed to take into consideration the young children's lack of motor skills and their inability to technically manage the sewing of the narrow rows of tapes that are necessary if one is to make a good qupak. What characterised a novice seamstress were rows of tape that were too wide, as was the case with my first sample (Figure 7).

However, young girls often did some skin sewing, such as making yoyos or small seal figures. When I expressed my astonishment that they did not practice on parts before they actually made an entire Iñupiaq garment, one of the informants told me that she had received a sewing machine for children when she was about seven years old. She practiced on this, and she also sewed some Western-style clothing, before she made her first Iñupiaq garment at about the age of sixteen. I did not find out whether this was a common experience.

Figure 6. *My sample of qupak #1.*

The first phase of the learning process, before newcomers made their debut as seamstresses of Iñupiaq clothes, was a long one; it stretched from infancy to the teenage years or young adulthood. Throughout these years, the girls and young women would gradually but consistently focus on the different aspects of the processes for between twenty and a hundred different garments, made by various seamstresses. In this phase, they learned only by observation, without practicing or trying to sew fabric Iñupiaq garments. This first phase of learning-by-watching seemed to take into consideration the young children's undeveloped dexterity, as dexterity was needed to sew the narrow rows of tapes to make a good qupak. Although the children did not practice the making of Iñupiaq clothing, the tradition has not died out. In the second phase of learning, after their debut, adult seamstresses constantly develop their knowledge of how to make Iñupiaq clothes as they continue to take part in the community of practice.

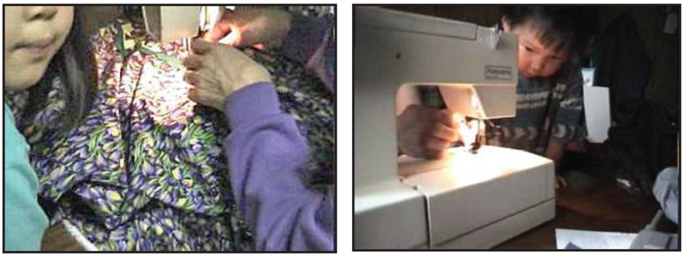


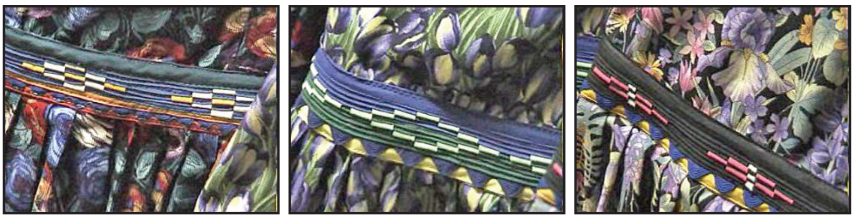
***Figure 7**. Children learning-by-watching.*

Learning-by-watching was also important when they learned to sew skins; that is, in addition to learning-by-doing:

Janne: Did you think sewing was fun when you were a kid?
'Victoria': Yeah, ever since I started learning I helped my mum to thread her needles. Because we had seal lamp, and I could help her to thread her needles. That's why I helped her; to learn. As soon as I know how, that to do, I start helping and sewing.

This has also been confirmed by statements from other elders, such as Rachael Sakeak, whose Iñupiaq name is Nanginaaq: "When we were growing up, we watched our mothers make clothing, and tried to follow their footsteps" (Edwardsen 1983, p. 24). Learning-by-watching is also important within learning-by-doing—to watch what you are doing yourself, experience what you do and reflect on it:

'Lynn': Just from experience, when I got started my work wasn't as even or measured like, I maybe like some work like this. I did start out a little uneven here and there. And also with the gathering that happens when you begin to sew at first. But with time you'll learn that…you'll discipline yourself in *watching* (my emphasis) how much time you spend and trying to making everything more even. After you have sewn awhile you'll get better at piecing things together.



Figur 8. Three different atigis made by 'Joanna'.

'Joanna', who was a skilled seamstress, also learned by watching. The sample or pattern for her work was a sample made by one of her very skilled sisters (Figure 9). She did not copy the pattern, but used it as an example of good composition for the trim work. She changed the composition and shape of the trim very little. She actually made two different atigis simultaneously, using the same sample as her inspiration (Figure 8). The different garments show variations in the shape, though they do not vary greatly. However, the colours of the compositions are very different because they are adapted to the colours of the fabric for each atigi, according to the traditional rules of contrasting and matching. 'Joanna' followed the rules of composition by not deviating much from her sister's sample. By making a composition of colours by adjusting them according to the fabric, she improvised within the traditional framework.

The fabric of the atigi cover 'Joanna' was making was of a floral pattern in green, blue and some yellow hues (Figure 9). I watched 'Joanna' picking up a *dark green* bias tape and putting it on the fabric to see how it looked, and then putting it back again, talking to herself. Then she picked up another *lighter green*, looking at it on the fabric and putting this one back, too. After a while 'Joanna' found a third bias tape, maybe the same colour as the last one, but narrower, putting it together with the *yellow* bias tape she already has sewn on, and finally putting that one back, too. It seemed as though she was looking for something special, maybe a colour she could not find. Her visiting baby grandson was screaming in the background. All the family was present, talking and laughing. She found some dark blue rickrack. "Let me see, which…?" 'Joanna' said, picking a darker yellow bias tape. Then she picked a dark blue bias tape and tested it relation to the fabric, and the yellow bias tape she had already chosen, and a dark green bias tape again, like the first one. Finally, 'Joanna' chose the dark blue rickrack and the dark green bias tape.

This shows that the learning process is, to a considerable extent, a result of close observation; in other words, a result of learning-by-watching and not of teaching.

I see learning-by-watching as a broadening of Wenger's learning theory about communities of practice. Wenger has not mentioned how the members of a community-of-practice actually learn. I regard learning-by-watching as a crucial method of learning within a community of practice, in particular within the visual field of design. In a more auditory field such as music, I would regard learning-by-listening as the most crucial. Both watching and listening can be gathered within a generic term I will call observation—learning-by-observation.

I have tried to extend the community-of-practice theory by investigating the social process of learning; this is learning-by-watching, a highly visual process in the design of Iñupiaq clothing. In a broader sense, I see learning-by-watching as the visual aspect of learning-by-observation within a community of practice. However, I do not see learning-by-observation as the only 'mechanism' of learning (Lave 1997), but rather as an important but underestimated part.

Because the learning process was integrated within the community of Iñupiaq seamstresses, it was continuous and had no beginning or end. The first phase took place before the newcomers made their debuts as seamstresses of Iñupiaq clothes. The first phase of learning started in infancy, when for the first time the prospective seamstresses were able to recognise what was going on around them, by watching and listening. This was true for each individual who grew up in the community. They had access to the community of practice as legitimate peripheral participants just by being at home and absorbing the everyday life of their families. This first phase ended when, as young women, they made their debut as participating seamstresses, usually in their late teenage years or as young adults starting their own families. The older seamstresses often made Iñupiaq clothing for many of their extended family, and even for friends, but usually the young wives and mothers made Iñupiaq clothing for their own husbands and children. This first phase was a long learning period of about twenty years, where the girls gradually but consistently focused on the different aspects of the processes involved in designing and making many different garments, observing how they were done by various seamstresses. However, in this phase, they learned only through observation, without attempting to sew fabric Iñupiaq garments.

Figure 9 Reflection-in-action when designing qupak

This first phase of learning-by-watching seemed to take into consideration the young children's lack of motor skills and their inability to technically manage the sewing of the narrow rows of tapes that are important components of a good qupak. Although the children did not practice making Iñupiaq clothing, the seamstresses did not think the tradition was dying out.

The knowledge was demonstrated through practice—and not out of context. Usually, the designing and making of Iñupiaq clothing was, to a large extent, the result of tacit knowledge expressed through practice rather than through words. This was particularly true with regard to design, as it was different from technical matters, which seemed easier to verbalise. However, the theory about matching and contrasting was expressed verbally by several of the informants, independent of each other. This indicates that the designers are, at least partly, verbally conscious of the conditions in play when they are composing the design of, for instance, a qupak. Often, the same person, the Iñupiaq seamstress, is both the designer and the maker, and sometimes even the user, of the garment in question, and so she seldom needs to explicitly verbalise questions about the annuġaaq's design. Since the learning happens non-verbally—in particular through learning-by-watching—the community of practice for the design of Iñupiaq clothing recognised no great need to verbalise this knowledge.

Schön and Wenger versus Dewey

Schön and Wenger's joint focus on learning-in-practice was explicitly inspired by Dewey's concept of learning-by-doing. Both of them refer to Dewey (Schön 1983, 1997; Lave and Wenger 1991; Wenger 1998). The present investigation of Iñupiaq clothing design indicates that learning-by-watching, rather than doing, was the most common way of learning. I see this concept of learning-by-watching as a development of both Schön and Wenger's theories of learning. I think that Schön's theory of how to educate reflective practitioners misses the crucial aspect of visual learning, which is particularly important in the field of visual design, such as for architecture and industrial design. Nor does Wenger mention the visual aspect of learning. He stresses that learning is conducted in the community of practice, but does not indicate how the learning actually takes place. The focus here is on how the learner learns—and not how the teacher teaches. The latter is often the major focus in learning theories.

Learning-by-watching is actually a new term related to an old phenomenon, a parallel to Wenger and Lave's (1991) communities of practice: "Although the term may be new, the experience is not" (Wenger 1998, p. 7). As explorers and missionaries reported, watching their elders was a common Iñupiaq way of learning, as observed in the late 1800s. This indicates that watching was a common learning method in their traditional society before Euro-American teachers came to North Alaska. My intention is to extend the meaning of learning-by-doing to include learning-by-watching, not to deny the importance of doing. As a matter of fact, Dewey himself criticised the misuse of the concept of learning-by-doing whenever he saw it being reduced merely to activity (Dewey 1979 [1915], p. 255). He includes reading in doing, although he does not mention watching processes and products as part of the learning-by-doing concept, as far as I know. I regard learning-by-watching as a crucial way of learning within a community of reflective practitioners, in particular within the visual field of design. In the more auditory field of music, I would regard learning-by-listening as the most crucial feature. Both watching and listening can be highly important aspects of learning-by-doing. I would encompass them both within the generic term observation—learning-by-observation.

Learning-by-watching at schools, from Kindergarten to PhD programs

What traditionally has been regarded as learning (Kvale 2003, p. 9) is a student or students listening to a teacher who is verbally explaining a phenomenon (speaking to the whole class or to a single student), supplemented perhaps by the teacher writing on a board or drawing a sketch or map. These activities are all intended to have a pedagogical purpose; they are not considered as activities for their own sake. From my experiences, these activities were rare for teachers in arts and crafts education in Forming, Norway, from 1960 to 1997; this education included drawing, textiles and woodwork (Nielsen 2000). In Forming, learning-by-doing was often the ideal, and the misunderstanding of the concept went even further, in my opinion, often just meaning *doing,* with the *learning* left behind. In the lessons in Forming, the students should have been encouraged to express their inner feelings, not learn anything. There was nothing to learn, even by doing; the students just needed opportunities to express themselves. One result of this doctrine has been that the teachers never demonstrated or instructed, and the students rarely watched any samples, models, or patterns, nor any artefacts or processes. The importance of learning-by-watching—in this mainly visual subject—has indeed been overlooked.

Perhaps further research will show that learning-by-watching is a more important part of professional design learning than the design educators are aware of today. If it transpired that such an idea were shown to be valid, this would probably lead to pressure for change in the way design is taught in design schools. One suggestion might be to introduce the students to actual design work, in the real world of design practice at professional design firms, as a way to participate in the community of design practice. Perhaps this should become a regular part of the curriculum. The main purpose would not be the students' contribution to the work of the design firm, but rather how the students would benefit from observing—with their eyes and their minds—the more experienced designers in the firm. Gradually, the students could also learn by doing, of course, but learning would be the main purpose of this practice. To make this possible, the professional design firms should be paid to accept students for learning, as this is the common practice in teacher training, at least in Norway. This kind of practice would also contribute to solving the kind of problems that Lawson indicates arise in design education that is focused entirely in studios at the college or university, where they lack the challenge of "clients with real problems, doubts, budgets and time constraints" (Lawson 2006, p. 7).

Another suggestion would be to make a virtual paradigm for learning-by-watching, using video films of real design processes, conducted by professional designers, to help teach the design students. This would make it possible to watch a process, or particular parts of a process, over and over again, providing an instant version of the long-learning process of the children of Kaktovik, like when I was learning for research-by-design in this project.

A few of the better-educated design students in compulsory schools would certainly become better novice students in design schools, which would probably improve their quality as up-and-coming professional designers. Consequently, to improve design education in both compulsory and academic design education, the use of learning-by-watching in communities of practice would help create reflective practitioners and better designs in the long run.

I regard learning-by-watching as one aspect of learning-by-doing, which can be understood as learning in practice. Another important research theme would be to more deeply explore Dewey's theory of learning-by-doing —a concept that is interpreted in different ways in different contexts—with an emphasis on design learning. I regard the concept of *tacit knowledge* as being important to this connection. Since the 1980s, there has been a great development of theory connected to this concept—or 'knowledge in action' (Molander 1993)—not least in the Scandinavian countries (e.g. Johannessen, Danbolt and Nordenstam 1979; Johannessen and Rolf 1989; Göranzon and Florin 1991; Molander 1993). The concept has been contradictorily interpreted and discussed in different research studies within different professions, not least in nursing (Josefson 1991). There is also an interesting discussion going on about tacit knowledge and visualisation (Gamble 2004; Daly 2009). To explore these research projects and discuss the consequences in regard to design learning would be of great value in developing the field, both in terms of research and practice.

My ambition in the present research project has never been to build a grand theory. Rather, I hope these interpretations of vernacular Iñupiaq clothing design, inspired by Schön's theory of the reflective practitioner and Wenger's theory on communities of practice, can contribute to an adaptive theory about the practice and learning of vernacular design—with the focus on learning-by-watching in a reflective community of practice—in order to develop a better understanding of how design is learned and practiced in general – *Design thinking* (Cross 2011). To fill the present, and rather vast, holes in this patchwork of design research, I have here suggested some research 'patches', some stitch work, that I regard as particularly important for strengthening and developing the fabric of design learning in the future.

The neglect of learning-by-watching, as engaged in by the participants of communities of practice in art and design education, constitutes a shortcoming in both design and art education, which therefore, over time, represents a shortcoming for art and design practice. When the learners do not build on the experience and knowledge of master craftspeople, the result will often be poorer quality. This could be improved if the learners go to a community of design practice and learn-by-watching. I believe this is comparable to the research custom of building on previous research. Here, art and design education has something to learn from research. It is difficult to imagine interesting research results if the researcher does not build on previous experiences and theories. If the researcher does not create new knowledge in the field, the research is merely an uninteresting exercise on the reinvention of the wheel. In the same manner, focusing on previous experiences and a collective repertoire through learning-by-watching (both processes and products) and learning-by-observation is of vital importance for the improvement of both design education and design practice. With better design education, future designers will improve design quality. Such an improvement in design education in compulsory schools would probably also help train better receivers and users of the designs made by the improved designers. There is room for schooling to educate clients and customers, qualifying them to communicate with the designers and demand better designs. A better design education in compulsory school would also make it easier for ordinary people to compose their own designs—as vernacular designers—and allow them to make things, providing an avenue for creative expression. This kind of design is located between the tradition of copying—for example, in folk costumes, which allow for little, if any, creativity in the form of improvisation—and the ideal of so-called 'free-expression', with improvisation within tradition.

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Introducing high school students to design and creative thinking in a teaching lab environment

Gretchen Caldwell RINNERT* and Jillian COOREY

Kent State University

Abstract: *Many students in the United States have limited exposure to design thinking, formal techniques or creative experimentation. For many, a design education begins in college, as one selects their major. Unfortunately, many high school art programs have been eliminated or dramatically reduced, resulting in students receiving less creative exposure and limiting their design preparation before college. Creative problem solving skills are in demand. Sir Ken Robinson, a recognized leader in the development of creativity and innovation, believes our schools are educating students out of their creativity. He argues that we train students to become good workers instead of creative problem solvers. The status quo stifles our profession, with students ill-prepared to face the daily challenges as they begin their academic journey and professional career.We developed Inspire, a creative camp that educates teenagers about design, creativity and critical thinking. Our goal is to prepare students to enter higher education by building insightful portfolio projects, gaining knowledge about the profession while working with mentors. The camp serves as a teaching laboratory for faculty and graduate students interested in design pedagogy. Graduate students participate in curriculum development, lead projects, write lectures and test teaching techniques in a low-stakes arena.*

Keywords: design education, k-12 curriculum, creativity

* Corresponding author: School of Visual Communication Design | Kent State University | USA | grinnert@kent.edu

Introduction

In today's society, there is an increasing exposure to design artifacts, from magazines, posters, iPods to ebooks. However, one problem remains, most of society doesn't know what design means. Design has become a "catch-all," frequently repeated in the mainstream media and used in a variety of disciplines from architecture, to art and even business.

As design educators, we have found this unclear definition of design extends to students. Often, a high school student's knowledge of design revolves around experiences in art classes focused on formal thinking. As a result, they have limited exposure to process, prototyping, typography and basic design principles. The student definition tends to be based around artifacts and statements that describe what they will make. Their value is focused on the "making," not the thinking, understanding or the conceptual process. Additionally, as those high school students begin selecting colleges and majors, their parents and guardians do not grasp what it means to be a "designer." Their collective and limited knowledge of the field can hinder students from entering design.

As a result, many of our introductory courses are filled with students underprepared to declare a design major, let alone hit the ground running. Additionally, a number of students transfer into our program from other majors and universities. Their lack of knowledge about design led them to find our major after already completing a year or two of school. In response, we developed Inspire, a creative camp to educate high school students about design, photography and illustration.

Inspire is a week-long creative camp that helps teenagers learn about design, creativity, critical thinking, fast prototyping and experimentation. Our goal is to prepare students to enter higher education by building insightful portfolio projects, gaining knowledge about the profession while working with both academic and professional mentors. Inspire serves as a platform to cultivate creativity and demonstrates designs relationship to communication, information, commerce and the global economy. Inspire places a strong emphasis on process and a playful exploration of materials, strategy and media. As Inspire is a camp, it is the ideal setting to try skills, experiment with new materials and leave behind the structure, expectations and rigid constraints of the traditional classroom.

Creative Thinking: A 21st Century Skill

As design plays an ever-increasing role in our society, creative problem solving skills are in demand. Sir Ken Robinson, a recognized leader in the development of creativity and innovation, believes our schools are educating students out of their creativity. He argues that we no longer maximize a person's creative potential and abilities. Rather, we train students to become good workers instead of creative problem solvers. The status quo stifles our profession, with students ill-prepared to face the daily challenges required as they begin their academic journey and professional career in design.

A 2011 article by Fast Company, titled "Why Education Without Creativity Isn't Enough", emphasizes the need for creative thinking in our education system while comparing and contrasting work environments of countries around the world. "To compete long term, we (the United States) need more brainstorming, not memorization; more individuality, not standardization" (Fast Company 2011). In 2010, IBM published Capitalizing on Complexity, a study that included the top agendas of global business and public sector leaders. The report concluded there are three widely shared perspectives, one of which stated, "the single most important leadership competency for organizations to deal with this growing complexity is creativity" (Robinson 2011, p. 7).

Creativity is critical to all fields. Students in all disciplines can benefit from educational experiences involving creative thinking, brainstorming, communication and teamwork. The design process lends not only to visually creative fields but also to health, sciences, product development and engineering. Our process includes research, audience and user investigation, ideation and brainstorming, prototyping, testing and refinement. We consider context of use and functionality along with formal thinking. Even a limited design education informs a person about problem solving techniques and influences them to consider the mass amount of messaging and visual communication they come in contact with daily. The design process and exploration is one that offers students from all disciplines a chance to find inventive answers while also becoming critical consumers of information and visual culture.

As design educators, we emphasize and reward creativity, process and innovation. We have incorporated more projects in our curriculum focused on expanding ones creativity and have extended this effort to Inspire. Our mission is to enrich students' lives through the disciplines of design. Each day is a new experience allowing students to explore, grow and expand their abilities. Our custom-designed curriculum covers the following disciplines: print design, three-dimensional design, motion and animation, photography and illustration. Students engage in projects that combine basic research tactics, brainstorming and creative thinking while they envision, innovate and experiment.

Increasing student retention and success

In addition to exposing students to creative thinking and design, our goal with Inspire is to increase a student's success rate as they enter college. Recent statistics of first- to second-year retention rates at four-year public universities in the United States are at a national average of 73.3% (ACT Institutional Data File 2011). Specifically, at our university the percentage of first-time students who returned to continue their studies in the Fall of 2011 was 75% (National Center for Education Statistics, 2012). Meaning nearly 1 out of 4 students didn't return for their second year of college.

The transition from high school to college brings many changes, challenges and hurdles for students. Inspire gives students the opportunity to engage with faculty, current graduate and undergraduate students, easing their transition as they become familiar with our program and university. Throughout the week there are daily higher education topics, which help prepare students for entering college. For instance, during Inspire 2012, students had the opportunity to meet and interact with the Dean of our college. They toured The Tannery and Glyphix, two student-run design firms within our college, where they learned what possibilities await them. They heard from undergraduate leaders of student organizations informing them on how to become an involved student. Attendees were introduced to the school facilities, toured campus, worked in college classrooms and ate in the dining halls, experiencing the life of a college student first hand.

A Primer in Visual Literacy

Visual literacy among teens is a vital skill that is often not addressed in high schools. According to Rick Williams and Julianne Newton, authors of Visual Communication: Integrating Media, Art & Science, visual intelligence is “the ability to observe, understand and respond to images, light, symbols, patterns, colors, contrast, composition, and balance.” (Williams 2007, p. 7) If we are not educating students to be visually intelligent how can they develop literacy for engaging and creating ethical visual artifacts. Furthermore, Williams and Newton explain, “Literacy continues to be misunderstood and applied. True literacy includes the ability to both understand and create in the communication forms of one’s culture and society.”(413) Many of our students read and consume these messages without a serious consideration of their impact on their personal beliefs and the global community. Yet, many students are engaged in design activities by creating YouTube videos, posters for school projects, or a simple website for a friend’s band.

Our culture is inundated with visual messages on a daily basis through news media and popular culture. Research shows that high school students are beginning to research visually, meaning they perform image and video searches online prior to text searches. (Helft, 1; Ito, Horst, Bittani, Boyd, Herr-Stephenson, Lange, Pascoe, Robinson, 22; personal survey) High school students are less cognitively developed than adults and lack life experiences that assist them in understanding visual language. While students visually consume media and visual artifacts this doesn’t mean that they understand the levels of carefully constructed, manipulated and curated information they come in contact with on a weekly, daily and hourly basis. Inspire provides attendees with an understanding of what it means to be visually literate by encouraging creative exploration, critical understanding, image research and the development of a visual language to help prepare them for the digital and visual world. We discuss the basic design principles that cover composition, form, typography, message, color, lighting, motion and contrast. We focus on defining and discussing these key visual components giving Inspire attendees the basic vocabulary needed to be visually critical.

Inspire as a teaching laboratory

At Inspire, projects last one day compared to the several weeks of a typical undergraduate project. It is a low-stakes opportunity to test new theories, projects and curricula. Vital areas of exploration and study have included:

- New collaboration models and curriculum
- The arrangement of effective studio space for collaboration
- How students can best utilize peer-to-peer learning in a studio
- How technology can be used more broadly and enhance the creative process
- How creative communities begin, thrive and continue after an experience like Inspire
- How to strengthen design foundations and better prepare entering freshman

Inspire serves as a platform to develop future design educators. Graduate students work as camp instructors, involved in curriculum planning and development working with full-time faculty. Camp provides them with opportunities to test pedagogical ideas and theories while preparing them for a career in design education. Many graduate students wish to explore designs impact on K-12 education, Inspire provides a venue for their research ideas and studies. This past year involved Penina Acayo, a graduate student from our program. Reflecting upon Inspire 2012, she states,

> My thesis involves creating a design education curriculum for Ugandan high schools, it was imperative that I got some hands on experience in dealing with a similar target audience such as the Inspire group of students. Inspire gave me the opportunity to observe students while they worked on projects, how they interacted with each other and how they used the information provided during the lectures for their own work. (Acayo 2013)

In summary, she was able to gain key insights on teaching this generation of high school-level students, which included: how to introduce basic design principles and terminology, dealing with a short attention span, what materials work best, constant feedback was key, critique sessions should be dynamic and engaging, and lastly, one must take advantage of how tech savvy the students are to keep them engaged.

Additionally, undergraduate students gained leadership skills while promoting community involvement serving as mentors and advocates of design. During Inspire 2012, two of our current undergraduate students gave a presentation on their decision to major in design. They spoke on transitioning from high school into the design program, their struggles and successes and future goals. This talk allowed them to vocalize their understanding and knowledge of design to camp attendees, enabling them to externalize, voice and reflect on their own educational experience.

Results

The 2012 Inspire camp included 23 high school students ranging in ages from 14–18. The students were local to the Northeast Ohio area, including one student from western Pennsylvania. The campers consisted of 5 male students and 18 female students. Inspire brought together students from different economic backgrounds and means, varying educational experiences and contrasting interests. Among these differences, one common interest of the group was visual creativity. Our goal was to unite these students and cultivate a creative community.

The students began each morning with a daily information session. Lectures given by camp instructors provided the students with an introduction to a daily project centered around a design topic (two- and three-dimensional design, photography, illustration and motion design). Students were given several goals and learning objectives for each project, yet the projects were open-ended to encourage creativity and allow for individual interpretations.

The first day was quiet, with the students appearing shy and reserved. Small group critiques were implemented on the first day. The next day, students were paired together as they went on a campus walk. Additionally, challenging them to know everyone’s name by the conclusion of day two greatly encouraged student communications. These small interactions proved to be a critical step in the process of creating a space where students felt comfortable, began to collaborate and form relationships.

Within two days the energy shifted as students were social, bubbly and excited. They made friends and formed social groups for lunch and activities. Laughter and joking was heard as friendships started over sharing a glue gun and tools. Older students mentored and embraced younger students. As instructors, we were impressed to observe the formation of an active and engaged group.

We learned that certain strategies worked best with this creative group of high school students. Similar to our college students, they wanted examples and needed to make an immediate connection between concepts and demonstrations.

> When introducing basic design principles, it's important to keep it simple or use examples that they can relate to while explaining the value of some of the principles that are not self explanatory. Following the lecture with an exercise that reinforces the principles from the lecture is key to getting them to start using thinking about those principles and how they can apply them to their own work. They will not get it right away, so always encourage students to ask questions or seek out their peers. (Acayo 2013)

Unlike college students they lacked fear of failure. Without grading and assessment they felt free to explore and engage. They tried out techniques and embraced ideas quickly. Our activities allowed them to get their hands dirty (literally) in paint, glue, wood and dirt. They made large-scale objects and small delicate artifacts. Each day they were presented with a new format and medium, but the ideas and exploration never ceased. With each project they were given ample time to test, make and create which allowed for downtime and moments of discussion and critique.

Work Produced

Our theme for the week centered around typographic letterforms. We approached each day with a different medium, encompassing the five focus areas within our School:

- Monday – 2D Design
- Tuesday – 3D Design
- Wednesday – Photography
- Thursday – Motion
- Friday – Illustration

TWO-DIMENSIONAL DESIGN

The first project focused on composition, formal aesthetics and single typographic forms. After a lecture on the history of typography and printing, students carved letters into potatoes and made prints using acrylic paint. The potatoes substituted for woodcuts as students emulated the printing process. Letters were created using provided stencils or by developing their own typographic forms, ranging from simple to complex. Students layered colors, textures, shapes, numbers and letters to create their designs. We encouraged them to produce several variations, with careful attention paid to the composition, negative space and color palette. As this was our first project, our expectation of craft and precision was loose allowing students to be free to test the material and explore its possibilities.

The second project involved using type as a basic design element, comprised of shape and form. Students were to use letterforms abstractly, rather than as a vehicle for conveying written information. After a lecture on the basic design principles (including hierarchy, contrast, repetition, use of space) students were randomly assigned a letterform. Working with their given letter, they developed a series of compositions investigating: form/counterform relationships, figure/ground studies and scale contrast. They developed an eye for the subtlety of typographic form and the creative potential of these forms through the compositions created.

Through this project, students were made consciously aware of the design process. Emphasis was placed on design as a creative process, involving a system of analyzing and editing to come up with a solution. Additionally, we stressed peer collaboration as a key to success in their designs. Students were encouraged to walk around the classroom and interact with their peers to gain new insight on their projects. Halfway through the project we implemented small group critiques lead by instructors. Critiquing is a vital step of the design process. The small group critiques helped students see the strengths and weaknesses of their work, while stimulating peer interaction.

THREE-DIMENSIONAL DESIGN

The second day of Inspire began with a lecture on environmental graphic design and wayfinding systems. Students were given basic information including: keys to successful wayfinding, signage vocabulary and how narratives applied to three-dimensional forms. Armed with a camera and notepad, students were paired into groups for a wayfinding walk around campus. Their goal was to identify the various types of signage across our campus. The rest of the day was spent building three-dimensional letterforms. Students creatively tackled this problem using materials ranging from foam core, wood, wire and rubber bands to unconventional items including marshmallows, flowers and paper-towel rolls.

PHOTOGRAPHY

Our third day focused on photography. This allowed us to build off of the activities from the previous day as the students documented their 3D type projects. Their creations became the subject matter for environmental photography studies both outside and inside campus buildings. Additionally, students learned about the basics of photography while working with a professional photographer in the studio. They experimented with lights, depth of field and focus to create dynamic imagery.

MOTION

Thursday allowed for a change of pace as students used point and shoot cameras and cellphones to create basic stop motion animations. Students built letters through motion and transition. The motion was used to represent an action that started with their chosen letter and revealed or removed the letter using stop motion. They were given one example using the letter P, which showed an orange peeled and forming the letter using the remnants of the fruit. Students worked together to record and document their animations. Some became inventive, creating tripods with existing materials in the building. One student created a narrative in her sequence, going above and beyond the project requirements.

ILLUSTRATION

On our final day we focused on illustration and narrative compositions. Students worked with an illustration professor to create illustrations that represented their letterform as part of a simple story. Students worked with collage, watercolor, ink and pencils.

Figure 1. *Students working on projects in the classroom and photography studio. Source: Inspire*

Figure 2. Stills from a student's stop motion animation. Source: Inspire.

Figure 3. Examples of finished projects. Source: Inspire

Knowledge Gained

Inspire camp provided a wealth of information about younger audiences and how they approach, interpret and create design.

COMMUNITY BUILDING IN YOUNGER DESIGN COMMUNITIES

We were able to observe first-hand the development of a young design community. Creative teens built friendships and explored academic activities together. For some students, community building became their primary objective and learning was second. They enjoyed meeting other attendees, however as friendships emerged, at times they became distracted from the projects. In contrast, other students were very engaged in learning. For them, socializing was only for lunch time and group work. A select few became so immersed in their work, they worked through lunch and took projects home to complete.

The building of a design community was especially noted during the last group critique of the week. Compared to the first small group critiques where students were reserved, on the final day they spoke about their classmates work without reservation. The confidence and peer groups they gained throughout the week was apparent. They were quick to point out the successes and strengths of their peers, while also giving constructive criticism.

VISUAL PROJECT EXAMPLES AND AUTONOMY NECESSARY FOR ENGAGEMENT

Students had very different priorities and favored activities that let them be autonomous within loose objectives. With this independence, they often needed one on one discussion, either with instructors or classmates to spark ideas and facilitate ideation. Examples helped open up possibilities and gave students the jump from abstract concept to materialized artifact. Without examples most of the students would have lost time in confusion. One simple example could do more than an hour of oral explanation as it made the expectations concrete.

TIME IS RELATIVE FOR INSTRUCTORS AND STUDENTS

As our week wore on the instructors felt as though they day had been too long, lasting from 8 AM to 5:30 PM. We also worried that too much time may have been allotted for some projects. Following several discussions with parents and students we found that the students did not share our experience. They preferred the long day and felt that the extra time was beneficial in developing the projects. They also enjoyed working with other students and wanted more time in groups. Many parents praised the long day as being exactly what the students needed to experience the college campus and atmosphere.

4. TECHNOLOGY AND DIGITAL NATIVES

This generation of students are technology-savvy digital natives. The concept of digital natives was introduced by Marc Prensky and describes students who “have spent their entire lives surrounded by and using computers, video games, digital music players, video cams, cell phones and other toys and tools of the digital age” (Prensky 2001, p. 1). Throughout the week, most of the assignments were created by hand. However, when technology was involved, they embraced the opportunity. As noted by our graduate instructor, “the use of technology devices seemed to create an ease among the students. This allowed for more peer interaction as it was a commonality they all shared.” Using camera phones and digital cameras, students were able to document their projects during the photography and stop motion day. When students worked in the photo studio they approached technology with comfort and little apprehension, experimenting with lighting and shadows while working with an SLR camera and a tripod. Students with knowledge of software programs such as iPhoto and Adobe Photoshop used the programs to edit their work. Technology also fostered peer-to-peer learning, as those who were familiar with the software educated others.

Conclusion

High school students are rarely exposed to the opportunities a design education offers. With little knowledge of the design profession and career possibilities, creative students tend to gravitate towards traditional fine arts programs or abandon their creative interests. Exposing students to design at a young age is crucial for continued growth of the design discipline. In the summer of 2012, a group of high school students participated in Inspire, a summer design camp. The camp educated students about design by providing an appropriate space for experimentation and an introduction to the design practice, the profession and creative problem solving.

Inspire reached and surpassed many of the goals we established in the planning phase. One of our primary goals was to prepare students to enter higher education by building insightful portfolio projects. At Inspire, students created between 5 and 8 projects that can be included in a collegiate application from a range of design mediums. The work showcased their creative aptitude, effort, focus on craft and detail elements.

Another goal was improving student knowledge and exposure to design through mentorship. By including graduate student instructors, undergraduate student mentors and professional speakers we gave students ample opportunity to learn and engage with strong design role models. The learning lab structure allowed campers to be at the center of our community, while graduate instructors learned about teaching, curriculum development and working with young students. Inspire proved to be a positive experience and has led to new insights in educating high school students about design. The camp also served as a teaching laboratory, giving faculty a space to try new curriculum. Our graduate instructor was able to gain valuable knowledge for her thesis through Inspire, gathering research and testing ideas first-hand. Additionally, the camp made a positive impact on the student participants.

After the camp, many students indicated they planned to pursue a degree in design. Following camp anonymous surveys were conducted with the attendees. Consisting of rating scales and several short answer questions the following responses were noted: When asked about their favorite part of Inspire one student responded: "being able to learn about all the different career paths in Visual Communication Design. I also liked how we were able to have different people come in and speak to us about their careers in design." Others indicated they enjoyed the creative freedom and hearing from our current undergraduates made them want to be a designer. One student indicated that they had been focused on an out of state university for their college career. After an exceptional experience at Inspire, they were rethinking their plans and seriously considering our school. Additionally, we received word from parents of the impact Inspire made on their children. Following camp one parent writes,

I wanted to tell you again what an impact the Inspire Camp had on Peter. He loved it and really enjoyed all of the experiences with various media across the week and the interaction with the other participants. Most importantly, we feel he was actually "Inspired." He wants to pursue graphic design and it helped him see the light at the end of the tunnel with regard to his high school coursework.

Inspire is an annual event and future plans include adding an overnight option with evening design activities to the camp schedule. We plan to increase marketing throughout the region to reach a broader audience. We hope to reach more students next year and offer scholarships to those who have the financial need and creative aptitude.

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Rock Paper Scissors: Reflective Practices for design process in the landscape architecture novice

Jennifer SEEVINCK* and Thomas LENIGAS
Queensland University of Technology

Abstract: *We describe a pedagogical approach that addresses challenges in design education for novices. These include an inability to frame new problems and limited-to-no design capability or domain knowledge. Such challenges can reduce student engagement with design practice, cause derivative design solutions as well as the inappropriate simplification of design assignments and assessment criteria by educators. We argue that a curriculum that develops the student's design process will enable them to deal with the uncertain and dynamic situations that characterise design. We describe how this may be achieved and explain our pedagogical approach in terms of methods from Reflective Practice and theories of abstraction and creativity. We present a landscape architecture unit, recently taught, as an example. It constitutes design exercises that require little domain or design expertise to support the development of conceptual thinking and a design rationale. We show how this approach (a) leveraged the novice's existing spatial and thinking skills while (b) retaining contextually-rich design situations. Examples of the design exercises taught are described along with samples of student work. The assessment rationale is also presented and explained. Finally, we conclude by reflecting on how this approach relates to innovation, sustainability and other disciplines.*

Keywords: Reflective Practice, problem framing, landscape architecture, conceptual thinking, creativity, abstraction, teaching design, assessment, sustainability.

*Corresponding authors: School of Design | Queensland University of Technology | Australia | e-mail: Jennifer.Seevinck@qut.edu.au

Introduction

Student designers have inadequate skills and lack the ability to deal with the open-ended problems and unpredictable situations that characterise professional practice. This stems from the novice's lack of experience. It is however also attributable to shortcomings in education – often resulting from economic pressures on those institutions. We believe that an educational program that develops the student's design process and leverages their existing skillset and experiences can address these challenges. We propose teaching design as a 'Reflective Conversation'. We show how this approach can firstly, develop the student's design processes or rationale for creative decisions and secondly, expand on initial visual thinking capabilities to develop design experience. The approach taken is consistent with Donald Schön's seminal work identifying 'reflective' professional practice behaviours (Schön 1983).

In this paper we describe this approach through example. The example is *Look See Create*, a design process that underlies a series of design exercises in an introductory (first year) course in Landscape Architecture design. The course curriculum, design process and assessment criteria were developed by author Lenigas. In this paper we describe Lenigas' process of *Look See Create* by framing it in terms of (1) Schön's work on Reflective Practice and (2) theories of abstraction and creativity.

The discussion of *Look See Create* includes sample design exercises, student work and the assessment structure used. The need for – and significance of – a design education that embodies Reflective Practice is explained next.

Design Education

Problems in design education can be attributed to the prevalence of 'Technical Rationalism': "…the application of scientific theory and technique to the instrumental problems of practice" (Schön 1983, p.30). As stated this may be caused by increasing economic pressure and the limited resources and high student to educator ratios that accompany it. However, the Technical Rationality model of knowledge does not equip professionals with the adaptive skills for responding to and managing unique situations. Furthermore, this model tends to manifest design problems where the answer is clearly apparent or sometimes even provided. Inherently reductive, it has the dubious benefit of supporting modular, repetitive education and, by extension, faster marking. Thus it often passes for an economically sound approach. However, we argue that it is not, in fact, a quality education product. This is because it does not equip students with the skills necessary for addressing real-world design situations; such as the ability to extrapolate problem variables or generate an independent 'frame' for understanding.

The long-term skills of the student are also lacking within this educational process, and for similar reasons. In design, professional practice is characterised by situations that are open-ended and that change. Hence, flexibility and adaptation are key to long-term survival. This is reinforced by architectural design researcher William Mitchell's description of 'ill-defined' problems. For example, designing "…a house for a poet on a rocky bluff" (Mitchell 1990, p.27) is an 'ill-defined' problem. It does not have a fixed set of design variables but is instead open to interpretation and the creation of new vocabularies. Furthermore, the design process is not routine and there is no single approach to solving it, nor is there a single answer (Mitchell 1990). Instead, as per our example, there are a myriad of architectural structures that could suit the poet. This range of possible solutions is characteristic of the 'ill-defined' problem and further illustrates the uncertain terrain a designer must navigate to bring both meaning and spatial resolution to their work. The situation is further compounded by the lack of explicit definition and understanding of the design process that practitioners actually use. The Technical Rationalist approach inadequately addresses these challenges. However, the alternative approach of Reflective Practice (Schön 1983) can facilitate effective design education.

Reflection-in-action for design

Reflective Practice (Schön 1983) emerged from case studies of professional practitioners across a range of domains – from psychology through to architecture. In the *Reflective Design Conversation* an account and protocol analysis, Schön identified a range of common behaviours in the professional practitioner. These include exercising ‘knowing-in-action’ and ‘repertoire’, ‘problem framing’, ‘listening to situation talk-back’, making ‘moves’ and working iteratively.

These behaviours have subsequently been employed as practice-based research *methods* to guide the process of making creative works and to generate knowledge and design insights. For example in author Seevinck’s practice-based research (2011) the approach involves both the iterative quality of the Reflective Practice methods to evolve design thinking and prototypes; and it facilitates Reflection-in-action through self-critique and qualitative evaluations. Other research that also employs Reflective Practice methods for creative practice is the work at the Creativity and Cognition Studios, University of Technology, Sydney (Candy and Edmonds 2010; Candy and Edmonds 2011).

The foundation of this first year landscape design course, the *Look See Create* process which is shown in Figure 1, also engages with these methods of Reflective Practice:

Firstly, the *framing* behaviour describes how a practitioner constructs their view or understanding of a problem or situation. It is a way of setting the problem that enables a non-standard response to unique, unstable and uncertain situations. Framing therefore distinguishes Reflection-in-action from the Technical Rationality model because the latter relies on standard responses to problems. Framing is achieved by looking at the situation and trying to understand its characteristics. For an experienced designer, the framing process is assisted by their past experience because they know “…what to look for and how to respond to” it (Schön 1983, p.60). For the novice, this process of re-framing requires them to supplement their limited repertoire — the practitioner’s accumulated history of their professional work—through research, experience and guidance.

Secondly, as described by Schön, *knowing-in-action* draws on the practitioner’s *repertoire* and tacit knowledge in the field. Knowing-in-action stems from the common sense concept of ‘know how’. It is the tacit knowledge embodied in an action, where this action can’t be accurately or completely described (Schön 1983, p.50). A process of ‘reflection’ facilitates describing this knowledge and making it explicit: for example the professional designer can ask him/herself ‘what procedures am I enacting when I perform this skill?’ In so doing they move towards a deeper understanding of their process and the ability to apply it more flexibly and with greater control, rather than remaining reliant on intuition. However, the novice designer has very little knowledge of design, as yet. Our approach leverages their small skill to incrementally develop more sophisticated knowledge, design processes and eventually domain-specific skills.

Thirdly, framing a situation or problem and creating a response or solution to it both necessitates analysing or 'listening to' that situation. This framing process changes the understood meaning: that is, when a situation has been reframed it can be interpreted in a new way—or as a different hierarchy of relationships. Comprehending these changes in the situation is described as 'listening' to *situation talk-back* as the situation can be understood as 'talking back' to the practitioner. Situation talk-back is an active review that implies a degree of evaluation and in turn feedback on the part of the designer. Schön describes this as a process that "…spirals through appreciation and re-appreciation" (Schön 1983, p.131-2).

For both the novice and the practitioner, the newly-framed understanding needs to be tested by comparing the new frame against the situation and evaluating what possibilities and constraints it offers. Sketches or prototypes can be created to explore this framing. The result would be reviewed by listening to situation talk-back. The process repeats until the practitioner assesses the new frame as being satisfactory. These processes can be through self-reflection, self-critique, or external evaluation, such as through studio critique. The insights gained from situation talk-back or critiques affect the subsequent framing of the situation and subsequent design responses (or implementations of knowing-in-action).

Reflection-in-action for novice design education

We have articulated two problems with design education: supporting skills for dealing with open-ended or 'ill-defined' problems and the novice's lack of experience. The lack of experience means that their design repertoire is limited. Finding the means to support problem framing given this lack of design expertise is therefore a key issue. However, this requires a problem space or situation that is open-ended enough to sustain exploration and a range of interpretations; namely an 'ill-defined' problem.

Our solution to this is twofold: firstly, we believe that through abstracting and interpretation, sophisticated design thinking can be supported through technically simple problems. Secondly, it is possible to stagger skills development to gradually move the novice from simple to more technically involved tasks that are more deeply in the domain. This then occurs while simultaneously working on complex and unpredictable problems. It can be achieved by drawing on the theories and methods described above. The *Look See Create* process exemplifies this approach to facilitate novice student engagement with complex and uncertain issues. It is now described.

***Look See Create*: a design process for novices**

The *Look See Create* process underlies the design exercises taught in this unit. It has come out of Lenigas's professional design experiences. Lenigas is the lead educator in this design unit and a professional practitioner with an extensive design repertoire that informs his course design.

The first stage of the Look See Create process involves listening and experiencing the project 'site'. The second stage focused on interpretation – where the student must pay attention to what and how s/he 'sees'. This is where an understanding is formed of the place or design situation. It is essentially a point of framing that results in a new way of understanding the place but also in a design problem, "…to create a springboard for design inquiry" (Schön 1985, p.6). The third, 'create' step is where this problem addressed. This may be done by 'amplifying' the newly framed understanding of the

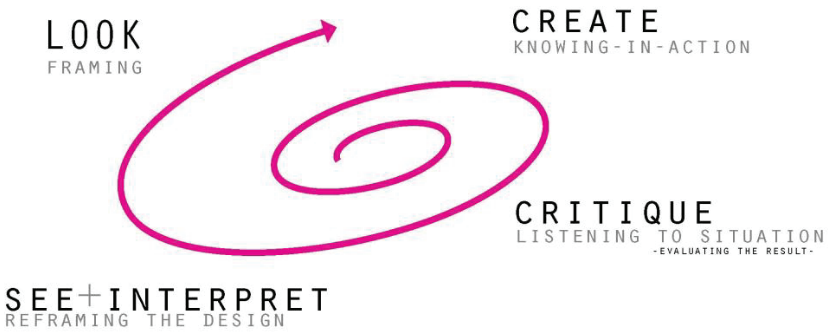

Figure 74 Methods from Reflective Practice are co-located with the Look See Create design process.

situation to create either a concept or a spatial form. As with Seevinck's process and as denoted by the spiral in Figure 1, this is an iterative process.

Critique is a fourth element in the design process that is a common and implicit part of much design and art practice and hence not explicitly stated. It is however key to the process since it provides opportunities for student reflection (Isgreen and Stewart 2009), for example it enables the student to surface and evaluate tacit understandings of a situation in order to "make new sense of the situations of uncertainty or uniqueness" (Schön 1983, p.61). It is useful to understand critique as a means of facilitating situation talk-back and as a consequence, informing problem 'reframing'.

Abstraction, interpretation, creativity

Implicit in Lenigas' *Look See Create* process is an abstraction of the design problem that is neither a dumbing down nor inappropriate to the situation, yet still simple enough for the novice to engage with. The key point here is that a simple task is not necessarily a 'dumb' task. We clarify this distinction by employing abstraction in the service of simplicity. It is therefore useful to clarify how 'abstraction' is understood here.

Abstraction is often understood as meaning "a reduced, often symbolic description of something" (Edmonds 2006). It can also be understood as a core idea behind something. For example, in the visual arts, abstraction allows the artist to focus on the "hidden relations between things" and not just their appearance (Gooding 2001, p.6-7). Abstract artists from early to mid-20th century were moving away from representing the world through "the imitation of natural appearance" (Gooding 2001, p.10), seeking instead to find new ways of seeing the world: "new possibilities of vision, changing the way in which things are seen and known" (Gooding 2001, p.10).

This shift in art also liberated the audience to interpret the various possible meanings of the work. Thus the abstract work gave rise to multiplicity of interpretations or, or as described by art theorist Gooding, "an unprecedented freedom of imaginative response" (2001).

The creative and interpretive role that the viewer of an abstract artwork can take is exemplified in Mondrian's *Composition with Yellow Lines* (1933). In this work the lines never intersect on the diagonally placed canvas, yet it is possible to interpret a symbolic star. This is an 'open-ended' work; namely one with multiple interpretations or understandings. Moreover, here a viewer is needed to realise or complete the work –

the star does not exist without someone there to perceive it. The ambiguity and open-ended nature of Mondrian's canvas is similar to the character of Mitchell's 'ill-defined' problem in that both require creative acts of interpretation. For the designer, the process of interpreting the problem space is a process of assigning meanings to evolve design intentions: "Intentions may be very vague at the outset, then may evolve and sharpen as the design process unfolds" (Mitchell 1990, p.39). Interpretation is key to the design process. For the student it is a core capability that facilitates them in identifying new forms, shapes, connections and meaning in that situation.

The identification of new possibilities is integral to the creative design process, but not identical to it. While creativity is commonly understood as a "novel combination of old ideas" creativity theorist Boden argues that the novel outcome must be considered interesting or valuable in order to qualify as creative (1996). In addition to value and novelty, she also articulates creativity in terms of the 'conceptual space' of a discipline. She describes the conceptual space as a 'grammar' which can be explored to find novelty (Boden 1996, p.82) and states that this exploration of conceptual space is often considered creative. In addition to exploration of their bounds, conceptual spaces can also be *transformed*. She describes 'negating a constraint' as a common method for transforming the conceptual space of a discipline. One of the design exercises that the students reviewed requires them to resolve a 'transformation of the discipline through engaging with a 'negated' constraint. This is the 'inverted landscape,' a design exercise that is discussed later.

Orienting the students towards abstract thinking may also be argued as expanding their ability to think in terms of uncertainty – since as described the abstract is open to interpretation. This increases their versatility to deal with uncertainty in the real world. Furthermore, as argued above, abstraction may also facilitate novelty and creativity, leading to innovative responses to the uncertain situations that characterise professional practice.

We argue that Reflective Practice methods and abstraction theory can facilitate design skill development in the novice. We have shown how both the Reflective Practice method of framing and skills in abstraction necessitate interpretation; and believe that this can leverage students' existing spatial and thinking skills while retaining contextually-rich design situations. In the next section we describe how this was achieved by detailing some of the design exercises within the first year landscape architecture curriculum and its design approach to *Look See Create*.

Rock Paper and Scissors: setting a design problem that develops process in the novice

The combination of theory and methods employed in the *Look See Create* process facilitates sophisticated conceptual thinking through site response and technically simple design exercises. Lenigas creates situations – or design programs – of controlled uncertainty. These, in turn, provide the students with opportunities for experimentation and exploration. These design programs or 'ill-defined' problems are now discussed with accompanying examples of student work.

Design exercises

These design exercises require little domain or design expertise to support the development of conceptual thinking and a design rationale. Furthermore, although they are separate design problems all the exercises are considered as a single managed experience to introduce reflective design practice.

The overarching intent of the design briefs is to manage the increase in the number of variables students must engage with in order to resolve their design outcome. Thus both their skills at abstracting, interpreting, etc. *and* their design process were incrementally expanded. For example, onsite exercises and lectures were created to ensure students both responded to the site and, simultaneously, understood that they were intervening in it; namely reframing their understanding of the situation and changing the situation (for example by the use of site surfaces for presentation of ideas).

Framing in the design process as well as during initial problem formulation was also evident in the dual nature of the design exercises, as these operated on both a conceptual and on a material level. The conceptual levels were supported by the theory of abstraction and by a range of exercises in interpreting and working creatively.

WHITE ON WHITE (DESIGN EXERCISE 1)

This is the first design exercise that first year landscape architecture design students engage with. The problem was developed to be a conceptually rich landscape architecture question that could be explored through a single variable: white paper. Thus the brief was to create a paper collage with white paper.

This 'white on white' design exercise requires 'looking and seeing' landscapes in the city to identify a meaning in that place and distil it into words. It is a process of interpretation and abstraction as well as an exercise in problem framing. The students are then required to create paper collages in white paper, on a white background, to give their chosen words visual form. The overall design exercise leads the student through two cycles of abstraction: (1) from place to word and (2) from word to form. It also leads them through two iterations of Reflective Practice and two problem re-framings. These combined elements develop the students' creative, design thinking and Reflective Practice skills. Moreover, the exercise does not require any domain expertise (such as plant species knowledge) to engage yet it promotes deep exploration of a single variable through the constraint of a single colour and material.

Importantly, the initial studio session was in the field to facilitate live discussion and on-site analysis. This served to engage students with the site on both a spatial and experiential level to broadened their opportunities for interpretation. It also served to challenge student's preconceptions and assumed 'ways of seeing' or interpreting the site. The tutors were then able to guide and critique the students' 'look and see' abstractions as well as showing them different methods to develop outcomes.

The accompanying lecture material focused on core principles but without direct examples. This provided a supporting framework but not a predetermined answer, leaving the student open to generate their own solution using their own framework (and needing to justify this). As is described later, such a pedagogical approach evaluates student performance in terms of exploration and understanding. It serves to encourage iteration, reframing/reinterpreting as well as self-evaluation of design solutions.

Figure 75 Details and student compositions from the White on White exercise. Student designers clockwise from top left: Lisa Parnell, Megan Lipsys, Kathya Salazar, Lisa Parnell, Olivia McBeth, Thomas Kinsella, Olivia McBeth. Compositions © the student designers.

INVERTED LANDSCAPE (DESIGN EXERCISE 2)

The second design exercise that novices undertook was a one-day charette. They were required to design a planting system for an upside down tree. While they were given a domain specific reading in advance (soil requirements), they were otherwise unprepared. To facilitate the limiting of variables, the task used the familiar structure of the pot plant as a starting point. This familiarity also challenged them to see the effects of changing a single variable (the direction a tree grows) and in turn, register the impact of their design decisions.

This exercise focussed design thinking into a short time period. Tutors modelled the iterative and reflective design processes, including methods of problem reframing and interpretation, by providing examples. In addition to evoking the mentor relationship, student interactions in a charette structure also facilitates the development of camaraderie and studio culture.

The process for design relied on a strong integration of sketching and modelling. This reinforces the notion that (a novice's) existing skill set can, through rapid experimentation, generate complex understandings. Overall, this exercise embodies the core concepts of abstraction and interpretation almost literally: by challenging student thinking about what a landscape is and should be. It provides them with additional practice at generating new interpretations and exploring design spaces in their future work rather than assuming the first solution is the best, much less the only, solution.

Figure 76 Student design responses to the laneway exercise and student working in a laneway site. Student designers left: Scott Cameron, Middle top: Madeleine Carlisle, Middle bottom: Megan Lipsys, Left: Debbie Turner. Compositions © the student designers.

Figure 77 Students working in a laneway site. Images by Carla Ramsland and Lenigas, 2012.

OFF-GRID LANE WAY (DESIGN EXERCISE 3)

This was the first formal, or 'real' landscape architecture project. It was intended to transition students into a design practice where they impact on a site without resorting to derivative or uncritical responses. To enable this, the exercise was structured around both an unusual scenario and a theoretical framework that would re-cast a site that initially seemed familiar to them as unfamiliar.

This recasting necessitated students to research the site and theory to allow them to find their own understanding of the situation. As a means of scaffolding students during this investigation, the project was operated as an immersive experience whereby studios were repeatedly held on site as well as requiring analysis that encouraged returning to site outside studio times.

The theory used was Foucault's theory on 'heterotopias' (Foucault 1967). This was a 'core driver' for the project that set the foundation for intellectual discussions and research. It challenged student preconceptions about appropriate types of space, prompting new interpretations and, as argued, innovative solutions. Thus the theory informed the design problem, generating Schön's 'springboard' from which the students would generate their own interpretation and expand their knowledge of the discipline and design practice.

Assessment of this task explicitly addressed the difference between the abstraction for the design framework and crafting a spatial outcome from that 'lens'. For their assessment the students were required to present two major studio critiques. During the first, 20 minute critique (per student) they had to test and support their conceptual frameworks. Communicating at this level necessitated the collation of an extensive body of work in order to evidence their reading of spatial experience, heterotopia theory and the physical site. The process of generating and communicating ideas serves to engage students in the development and testing of hypotheses. It also helps them meet the requirement to support each hypothesis with evidence, research analysis and, ultimately, a rationale or design 'concept'.

In the subsequent design phase, forms that addressed the concepts critiqued were submitted. This final presentation was of a single proposal that they had selected, and therefore a much reduced scale.

SHADOW STUDY FOR A SUBTROPICAL ROOM (DESIGN EXERCISE 4)

This last submission for the semester was the students' introduction to using landscape spatial quality as the primary vehicle to carry the design intent. Their site was the major urban square in the subtropical capital city of Brisbane, Australia. Students were required to design an environment and experience within this site.

The majority of design effort focused on students identifying an experience for the site and then spatially defining this experience using shadow. Thus many of the landscape variables (vegetation, spatiality, microclimate, and comfort) were compressed onto the single plane of shadow. This abstracted problem space helped to avoid overwhelming the novices with the complexities of species palette, something which has the danger of resulting in derivative compositions. Students also researched the qualities of light and its effects on shadow and related this to spatial and physical comfort in their subtropical climate. Once they had developed a shadow design, students were able to interrogate its qualities to 'expand' it to inform the creation of the final complex landscape assemblage.

Part of this process required them to collect foliage samples and review these in terms of shadow and its components. This experimentation informed a subsequent design exercise: extrapolating the type of form that could create their desired shadow and its experience. Thus this exercise led the students from looking at the leaves and places they encounter daily to seeing these in a more abstract way by considering them in terms of experience and shadow. With this 'lens' students could move towards imagining a three-dimensional form that could cast such a shadow and engender this experience in their project site.

Students then worked with design tutors to extrapolate plant forms that could meet these requirements. In this way the students were able to develop sophisticated designs that revolve around the experience of landscape architecture and its subtleties of shade and temperature, while being novices in the use of a landscape palette.

The emphasis on shadow experience necessitated abstract thinking, interpretation and the interrogation of the processes of landscape architecture open to the designer. This scaffolded student immersion and engagement with complex, real-world, landscape design problems. Thus while they developed some specialised knowledge of landscape architecture, their primary vehicle for creating complex landscape outcomes was critical and interpretive thinking skills and iterative Reflective Practice methods.

Figure 78 Students interpret shadows to inform their design. Top Row from left to right: Lisa Parnell, Michael Jenkins, Jason Simms. Bottom Row: Madeline Carlisle. Compositions © the student designers.

Figure 79 Students interpret shadows to inform their design. Source: Seevinck 2012.

Assessment

A single assessment structure was used for all the design exercises and presented at the start of the teaching semester. The repeated use of one assessment model based on the fundamental Reflective Practice of design, rather than several task orientated assessment models for each design exercise, is a deliberate choice. It reflects the focus on developing design processes rather than design objects; since in both our experiences, we have found that a specific, object oriented assessment model has the danger of being reductive and prescriptive, implying design object outcomes. It can reduce student and educator efforts to 'ticking boxes' and limit student efforts at interpretation that, as discussed above, is a key part of creativity. It also implies a predictable outcome. Instead we believe that an assessment model that refers to the design outcome in general terms and to the design process in explicit terms is better able to evaluate the Reflective Practice processes and the skills necessary for engagement with the uncertain real world design problems.

This particular assessment model was developed by Lenigas. It evaluates each criterion in terms of both exploration and understanding (Figure 7). Degrees of exploration and understanding are ranked along the Queensland University of

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STUDENT:

		GRADE	1	2	3	4	5	6	7
		Standard of criteria demonstrated	None or little	Limited	Ineffective and uncritical understanding with no experimentation	Demonstrates a basic understanding with minor experimentation	Demonstrates breadth but limited depth of understanding with some experimentation	Well developed with good understanding and some experimentation	Highly developed with good experimentation
Critical thinking UNIT OUTCOME 3.	10%	**BRIEF ANALYSIS AND INTERPRETATION** Critical analysis and resolution of problem definition							
Design framework UNIT OUTCOME 2.	20%	**THEORY AND DESIGN PRINCIPLES** Creation and resolution of							
		CONCEPTUAL / ANALYTICAL FRAMEWORK Development/testing and resolution of:							
Design resolution UNIT OUTCOME 4.	45%	**UNIFICATION** Of critical thinking and design framework elements to a design resolution							
		RESOLUTION Of design detail							
		DESIGN OUTCOME Well structured, engaging place/forms, and graphically interesting							
Communication UNIT OUTCOME 1.	15%	**GRAPHICS** Overall quality.							
		COMMUNICATION Clarity of design intent conveyed							
Design culture and practice UNIT OUTCOME 5.	10%	**WORK PRACTICES** Iterative development of design. Quality of critique presentation/s							
Assessment Criteria (Linked to unit outcomes)	Weighting	Performance indictors							

GRADE:

- Good understanding of site ☐
- Design resolution is well considered ☐
- Interesting speculation on your ideas ☐
- Well constructed design ☐
- Interesting idea, but lacks resolution or development ☐
- Work would have benefited from a deeper analysis ☐
- Graphics did not communicate your interesting ideas ☐
- Your work needs more focus on core ideas – this will assist in producing stronger outcomes ☐
- Too little work to make a meaningful presentation ☐
- There is a lack of engagement with the brief/site ☐
- Your design proposition lacks continuity to your initial ideas ☐
- More continuous work through out the project would have improved you proposal ☐

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Figure 80 Assessment Criteria developed by author Lenigas focuses on the design process rather than design object.

Technology's grading scale of '1' (low fail) through to '7' (high distinction) while the grade of '4' is a pass. Exploration reflects the course's emphasis on interpretation and iterative development and understanding reflects student engagement with and comprehension of content.

Five criteria that draw from the learning outcomes for this design unit were measured along this scale. Firstly, Critical thinking measures the extent of understanding and exploration of the design brief. Secondly, Design framework evaluates the rationale that the students developed for the problem at hand; something that would have been informed by some theoretical concerns such as the theory of Heterotopias or how the sun moves; or research, such as studying the site and people's use of it. The third criterion Design resolution, looks at how critical thinking and design framework outcomes are synthesised into a unified whole and resolved and then finally interpreted to a design outcome. This is the weightiest part of the assessment model constituting almost half of the total marks at 45%. The fourth criterion is Communication. It evaluates how well the students have conveyed their design intention as well as how interesting their material is graphically. Finally, the last criterion evaluates Work practices, including student engagement with iterative design processes, studio culture (e.g. critiquing) and site visits.

The resulting effect of this assessment structure is an overall picture of where a student's design strengths lie and what areas need improving. For example, when a student submits a derivative design solution, their score for design resolution would be low but their work practices would likely also be low because they did not iterate their work enough. This assessment model allows the student to infer this as a correlation and consider that by increasing their work practices they may also increase their design resolution.

CRITIQUES AND SUSTAINABILITY

Critiques played a key part in both the design process and in assessment. For our Reflective Practice design process, critiquing is a form of reflection and evaluation and served to maximise inter-student learning by making the exploration additive across the studio group rather than isolated in individual ‘silos’: students advance their understanding of the creative possibilities by evaluating and comparing their own decisions and work against the range of ideas being explored in the studio as a whole. Furthermore, the Reflective Practice approach to critique, focusing on problem reframing and situation talk-back, enables deeper student engagement with their and peers’ work. For example, it enables them to read beyond the graphical components of the work (such as a striking shape or appealing illustration), which may be founded on uncritically applied pre-existing skills, to consider it in terms of the situation’s complexities (such as how it relates to the brief, to the theory, to the site and how it unifies these).

Formal assessment presentations were structured as intensive, group critiques. These studio activities involved all students, tutors, and also external practitioners. Prior to the critique’s commencement, we encouraged students to identify interesting works from their cohort by placing dot stickers next to their preferred designs. This allowed for student evaluative learning. It quickly becomes apparent that some works are implicitly understood as stronger than others. The tutors and subsequent critique provide a means of explaining why this is so.

Making this design knowledge explicit builds all the students’ design knowledge and capacity for self-evaluation and reflection. The process and learning also enhances student trust and ‘buy-in’ into iterative design. Ultimately this enhances the students’ passion for learning. As the students’ own desire for design knowledge and ability for critique grows, the course structure has the potential to shift from an ‘educator push’ to a ‘student pull’ or ‘student driven’ learning. This is complemented by studio cultures where students can gain from each other through mentoring, competition and shared interests and discussion rather than solely relying on the lecturers for their learning. As described studio culture is both directly facilitated in design exercises such as the charette and it is assessed through the work practices criteria. These factors have the potential to reduce the pressure on the educators, further increasing the economic sustainability of this approach.

Reflections

The design exercises and assessment structure shown here have been focussed on developing the creative design processes and skills in novice landscape architecture design students. In particular Reflective Practice methods such as problem framing and skills in abstraction such as interpretation were taught, in order to facilitate student capabilities for engaging with unpredictable, real-world or ‘ill-defined’ design problems. A significant point here is that these can be applied to a range of situations and not just landscape architecture. Thus we believe that our students are gaining a highly sustainable education because the skills they acquire are applicable to a range of design and professional domains.

The course described is grounded in an approach and methods from Reflective Practice and theories of Abstraction. These serve to scaffold the novice’s learning and challenge their preconceptions; moving them towards creative and innovative processes as well as solutions. Learning has been both constant and tapered: complexity and sophisticated thinking have been required from the start; while the level of domain specific knowledge has gone from very little, as is consistent with the novice, to slowly increase. While the focus of the course has been on process rather than technical skills, it is also worth noting that the level of technical accomplishment of this course's cohort appears to have surpassed that attained by students in prior years where the course was explicitly focused on those technical skills.

While the work presented here is based only on the first initial offering of the design syllabus, it is our intention to continue reviewing its impact overall several years of student cohorts. However, as has been shown, there have been positive outcomes. Thus we propose that the design process learned by our students has expanded their repertoire in qualitative rather than simply quantitative ways. For example their increased skills in reframing and interpretation allow them to take similar experiences and, using analogy, apply them to current problems. This also contributes to their versatility in dealing with uncertain and ill-defined design problems. Furthermore, as has been argued, abstraction can facilitate novelty and creativity, leading to innovative responses to the uncertain situations that characterise professional practice. In this way we are able to engage the novice at a sophisticated level and equip them with expert level skills. In developing the student's capability to deal with the uncertain situations that characterise professional practice, these processes implicitly increase both the relevance of their education to the 'real' world and its sustainability.

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Building the Narrative Cloud: Reflection and Distributed Cognition in a Design Studio Classroom

Omar SOSA TZEC, Jordan E. BECK and Martin A. SIEGEL*
Indiana University

Abstract: *Education in Human-Computer Interaction Design (HCI/d) aims to instill a human-centered perspective among its students, encouraging a designerly way of thinking that allows them to develop creative solutions that consider the implications and consequences of people interacting with technology. It has been known that a practicum (Schön, 1987) environment contributes to developing this way of thinking by means of reflection (Schön, 1987). We present in this paper a pedagogical approach based on narratives to be employed in studio-based courses for HCI/d. We discuss how oral and multimedia narratives support in conveying content-independent concepts that affect the learning experience. We propose a set of components to help the elaboration of these stories. Additionally, we introduce a conceptual space called the narrative cloud, which helps us to elaborate on the ideas regarding this approach and closely ties to the concept of distributed cognition (Hutchins, 2000). Therefore, the goal of this paper is establish a base for discussing a further development of this approach, or any framework or methods where narratives constitute a fundamental element that supports reflection in HCI/d education.*

Keywords: Human-Computer Interaction, Design Pedagogy, Design Studio, Narrative Cloud, HCI, Reflection, Distributed Cognition, Storytelling, Narrative.

* Corresponding author: School of Informatics and Computing | Indiana University | USA | e-mail: msiegel@indiana.edu

Introduction

Human-Computer Interaction Design (HCI/d) focuses on interaction flows and the interfaces of a system so as to enable its users to accomplish certain tasks and have an aesthetic experience at the same time. The nature of this discipline results in a challenge for its pedagogy: HCI/d students adopt as their primary goal the generation of solutions that are not only human-centered but also creative and feasible. HCI/d pedagogy, therefore, must cultivate competent, confident students capable of achieving such solutions. This is no simple task.

For this type of student, a creative and feasible solution implies the understanding of technology that benefits humans. This suggests the importance of the development of a *computer imagination*, which focuses on the "exploiting of the medium for some purpose that couldn't be done easily in any other medium, and it speaks to needs of users that they didn't even realize they had, but once they 'see' it, they want it all" (Siegel & Stolterman, 2008).

HCI/d involves *designing experiences* (Buxton, 2007). These experiences equate to *stories* about how people integrate technology into their everyday lives. In other words, *talking about interactions is akin to telling people's stories.* Stories also constitute part of the designer's *repertoire* (Schön, 1990), which can be disseminated during the learning process. Thus, stories have the potential of being considered as *cognitive units* (Hutchins, 2000) that would be distributed during the learning process.

With these ideas in mind, we introduce in this paper a narrative-based approach for HCI/d pedagogy. In particular, this approach is considered for a *practicum* (Schön, 1987) or *design-based course* –hereafter referred to as the *studio*. We inquire into the use of stories during the lecture stage in a studio whose intention is to initiate the *metamorphosis* (Siegel & Stolterman, 2008) of non-designer into designer.

In this approach, the teacher selects one concept as an intellectual foundation for a story. The aim is to engage students into *reflection* (Schön, 1987) upon themselves as learners, team members, and ultimately, as agents of positive change through and by HCI/d. We call these foundational concepts *Content Independent Concepts* (CIC). For conveying these concepts we suggest oral and multimedia stories (e.g. video clips or musical pieces). We introduce in this paper a set of components for composing or selecting stories to convey CICs.

Additionally, we look to sensitize students to stories, such that they develop designerly thinking (Siegel & Stolterman, 2008) and a consciousness that focuses on people's stories rather than designing digital artifacts *per se*. As a result of this sensitizing process, the students start building their own stories. These stories and all the other elements of the studio –people, infrastructure, and materials– function as units for distributing cognition and conform to a bigger story, a conceptual space we call *The Narrative Cloud*.

Some considerations for HCI/d pedagogy

Nelson & Stolterman (2012) present a theory where the result of any design process is an *ultimate particular*. These particulars are always contextualized. They depend on certain variables, including the judgments from the designer, the *desiderata* from the client, among other factors (Nelson & Stolterman, 2012). They also emphasize the responsibility of the designer at the moment of introducing the *artificial* (Simon, 1996) into the world. Taken together, these ideas illustrate that HCI/d pedagogy should seek to creating consciousness among the students about the *why* and *how* of introducing *ultimate particulars* in certain contexts.

Hence, design pedagogy has the responsibility of providing an environment that supports the development of what Nelson & Stolterman (2012) call the sets of design competency: *mindset, knowledge set, skill set*, and *tool set*. By developing these competencies the students may create, enhance, increase or refine their *artistry* (Schön, 1987) as part of their design education before they engage with the *real world* and its *ill-structured problems* (Rittel, 1972). We take the *studio* as the environment *par excellence* for *learning by doing*; the ideal pedagogical space for the approach presented in this paper.

When referring to the design of interactive systems, a pedagogical approach based on a (design) studio retains the same characteristics as in any other design discipline, which implies: the inclusion a design problem, lectures related with the design problem or foundations, independent work, and the crucial factor of elaborating and giving critiques of the design proposal (Cennamo, Douglas *et al.,* 2011). The studio can help students understand that design is not about programming, website creation, or graphics, but rather it is an iterative process that requires understanding design challenges, generating multiple ideas, and finding ways of communicating solutions that encourage feedback for future iterations (Reimer, Cennamo & Douglas*,* 2012).

The studio and the act of reflection are inseparable (Schön, 1987). Well-developed reflective thinking results in efficient shaping of a creative design ability (Löwgren & Stolterman, 2004). According to Tracy & Baaki (in press), "when a designer is presented with a complex problem situation, the designer shows a series of questioning, making a decision, reflecting on the consequences of the decision then making another move." And also as Löwgren & Stolterman (2004) point out, "a practitioner has to reflect in her actions by separating herself from the actions and judging the outcomes of the actions." In fact, reflection is an activity that occurs in design due to the nature of the *design problems* or *situations* (Tracy & Baaki, in press), which share certain characteristics that define them as *"wicked," or ill-structured problems* (Rittel, 1972).

Two types of reflection stand out in this context. The first type takes place *during the action* and is known as *reflection-in-action* (Schön, 1987). The second type, *reflection-on-action* (Schön, 1987), is formulated in a more conscious fashion once the activity has been completed, providing the opportunity for recording and archiving. "Reflection-in-action helps designers deal well with situations of uncertainty, instability, uniqueness and conflicted values, which are inherent in ill-structured problems" (Schön, cited in Tracy & Baaki, in press) while reflection-on-action allows designers to "focus reflectively on the process of [their] design behavior in general" (Nelson & Stolterman, 2012). Due to the relevance of reflection for design, reflective frameworks are familiar in studio-based courses for design disciplines (Koschmann, Myers *et al.*, 1994; Ellmers, 2006; Ellmers, Brown & Bennett, 2009). Thus, the approach presented in this paper exposes students to stories with the intention of engaging them into reflection as a primary outcome in a studio.

When a student experience a studio, a *transformation process* occurs, whose consummation is the achievement of designerly thinking (Siegel & Stolterman, 2008). This transformation is expected to be *transactional,* implying that the learning experience results from "unfolding interaction and co-creation over time of all participants and environment" (Parrish, Wilson, & Dunlap, 2011). In addition, the theory of distributed cognition "extends the reach of what is considered cognitive beyond the individual to encompass interactions between people and with resources and materials in the environment" (Hollan, Hutchins & Kirsh, 2000). According to Hollan et al. (2000), three kinds of distribution of cognitive processes may be observed in human activity:

- "Cognitive processes may be distributed across the members of a social group."
- "Cognitive processes may involve coordination between internal and external (material or environmental) structure."
- "Processes may be distributed through time in such a way that the products of earlier events can transform the nature of later events."

Distributed cognition takes into account what is inside humans' minds and considers people as active participants of the cognitive process. The theory also includes the use of external material artifacts to support these types of processes (Hutchins, 2000). All of this allows for establishing a relation between students (as agents) and those elements that constitute a studio. Thus, in our approach we consider that everyone and everything are distributed cognitive units: people (instructor, students, guest speakers), infrastructure (the room, tables, chairs, projectors, screens, boards), materials (sketchbooks, markers, pen and pencils, cameras, mobile devices), deliverables (presentations, printed documents, photographs), communication objects (email, drawings, social networks and blog posts), among others.

A narrative-based approach for hci/d pedagogy

We start from the idea that HCI/d pedagogy entails guiding students in their development as creators of *ultimate particulars* (Nelson & Stolterman, 2012). The studio allows HCI/d students to develop and/or refine their *sets of design competency* (Nelson & Stolterman, 2012), in order to assemble a *repertoire* (Schön, 1987) to face HCI/d challenges. As we discussed, the act of reflecting is a crucial activity that occurs in a studio (Schön, 1987; Löwgren & Stolterman, 2004; Tracey & Baaki, in press), and all of its elements constitute units for distributing cognition (Hutchins, 2000).

Stories are elements of distributed cognition. Some of those stories will come directly from the instructor, and other stories will come from the students. Experiences from the studio will become stories themselves. These stories may be exchanged among students, or recalled in future design challenges. The latter implies that stories are attached to the learning experience and the *repertoire*, which is useful for sharing knowledge among designers (Schön, 1990). Ultimately, experiencing the studio as a whole becomes a story as well. For this reason, the studio should be *experience-centered* (Parrish, Wilson, & Dunlap, 2011).

Our approach considers stories as *tools* for HCI/d pedagogy to be taken into account in the studio. The reason for using this tool is to immerse students into constant reflection during the design process and also to develop human-centered designerly thinking, sensitive to people who live stories everyday. With our narrative-based approach, founded on aims for reflection and distributed cognition, we support the maturation of *design judgments* (Nelson & Stolterman, 2012) among our students.

Content-Independent Concepts

This narrative-based approach makes use of what we called *Content Independent Concept* (CIC). A CIC gives design students in a studio a sense of agency (as a designer). A CIC encourages students to reflect and to generate answers to the question, "How do you see yourself (as a designer)?" A real-world example will prove illustrative.

During our semester-long observation in an HCI/d graduate-level studio, the instructor screened a segment from the documentary *Maya Lin: A Strong Clear Vision*. The segment told the story of the start of what would become Lin's illustrious design career: her winning entry into the national design competition for the Vietnam Veteran's War Memorial in Washington, D.C., U.S.A. The video segment provides glimpses of Lin, a then undergraduate design student at Yale, sketching, visiting the proposed site for the memorial, and sitting at press conferences as her entry was subjected to scrutiny from the design community and vicious attacks by war veterans themselves. Furthermore, the video compares and contrasts her entry with the other entries in the competition and paints her narrative as a David vs. Goliath(s) tale, of sorts. Lin was up against the most prestigious design firms, and her design was simple; almost too simple by comparison. In spite of the scrutiny and attacks, the young designer held true to her vision, not in spite of, but because of its purity; its simplicity.

Immediately after this class session, the instructor engaged in a casual conversation with one of the students and asked for his thoughts on the video. The student responded, "You know, I couldn't help but think that, she was so young and early in her career, inexperienced, really. A student still. And yet she still had the *courage* to believe in her design. It was so simple! You have to be *courageous* to believe in such a simple design. I wonder if I could do that." This example illustrates both reflection on action and a student orbiting around the content-independent concept. In this example, the CIC would be the answer to the question, *"How courageous are you?"* This student may not have had the answer yet and that is acceptable. The point is not that the student has the answer immediately, although some students may have the answers immediately. The point is that students think about *their own courage*. They try to ascertain a sense of it. They grapple not with explicit issues of design but with issues of identity as a designer; issues of agency as a designer, which are independent of any concept we might teach them about design. Understanding of a CIC manifests itself in moments of self-realization; moments when the design student asserts, *"I am courageous," "I am confident," "I can transform the world,"* and other statements of a similar ilk. Students achieve this understanding through two types of reflection: reflection-in-action or reflection-on-action.

The aforementioned student was thinking to himself during the Maya Lin video. The object(s) of his thoughts at this stage, we cannot know with certainty. Nevertheless, if even some of his thoughts related to the video segment or any of its concomitant content, then this student was engaged in reflection-in-action, or, what we call *reflection-in-narrative*. Reflection-in-narrative describes the thoughts a student has about a story during its telling. These thoughts about the story need not pertain to design or design concepts under investigation in the studio. It is more desirable and appropriate if these thoughts pertain to the student's own self (as designer). Figure 1 illustrates how reflection-in-narrative might look during an instructor's delivery of an oral narrative.

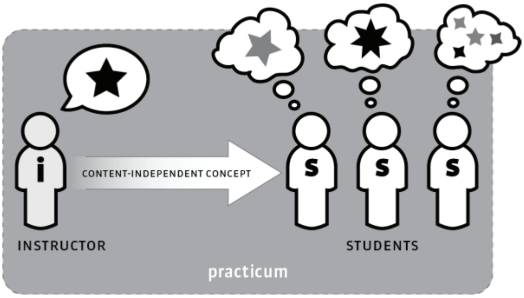

Figure 1. Reflection-in-narrative.

Even though each of the students in this illustration are thinking along similar lines, there are idiosyncrasies to their thought processes. This is to be expected and perhaps even acknowledged explicitly by the instructor. Each student is unique and, hence, brings unique personal experiences to bear on any narrative. Two students may arrive at two distinct CICs in a given narrative. For example, another student may have thought of the Maya Lin video, "I'm not as imaginative as she is," a reflection on creativity as opposed to courage. As we will discuss in a subsequent section, such differences emphasize the responsibility of the instructor to select appropriate narratives in order to communicate particular CIC's. But we must acknowledge that even the instructor's careful selection process cannot protect against different interpretations, and so we look elsewhere for a solution: *reflection-on-narrative*.

Returning once again to the Maya Lin example, when the instructor asked the student for his thoughts on the video after class, he was prompting the student to *reflect-on-narrative*: to reflect on the story *after* its telling. Like its precursor, reflections at this stage need not pertain to design or a particular design concept. It is more desirable for these reflections to yield insights about the self (as designer). Figure 2 illustrates how reflection-on-narrative might look after an instructor's delivery of an oral narrative.

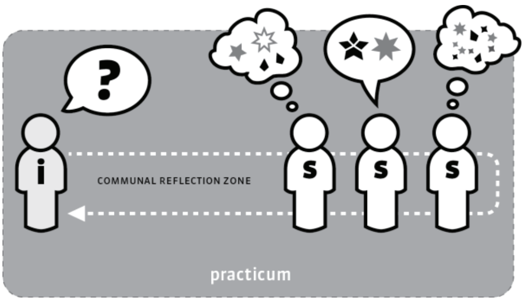

Figure 2. Reflection-on-narrative.

One major difference between reflection-in-narrative and reflection-on-narrative is the point at which they occur. Reflection-in-narrative occurs *during* the story. Reflection-on-narrative occurs *after* the story. Another key difference, illustrated in figure 2, is the nature of the reflection. Reflection-in-narrative is akin to an internal monologue whereas reflection-on-narrative is a dialogue or discourse with instructors, peers, or both. It is at this stage that different perspectives and, thus, potentially different insights regarding the CIC come to the fore. As students give voice to these different perspectives, we observe a third key difference between reflection-in-narrative and reflection-on-narrative: reflection-on-narrative encompasses new instances of reflection-in-narrative.

For example, if the instructor/student interaction we described in the Maya Lin case had taken place *in* class instead of after class, then all the students in class would have been listening as the first student talked-aloud his reactions to the video. This talk-aloud is, in essence, a personal narrative -- a mini-journey of self-discovery; a narrative that would naturally cause all those students listening to reflect-in-narrative on a deeper level. If this reflection happens in a formal environment (e.g., in the classroom) then the instructor must engage students with guided questions to (1) reaffirm the CIC for those students who may have understood it in the first place, and (2) guide those students who may have had different interpretations toward the intended interpretation. If this reflection happens in a less formal environment (e.g., casual social gatherings) then the instructor may not have the opportunity to proffer guidance. Hence, it is imperative that she or he selects a meaningful, impactful story. We discuss three types of stories and the components for creating or selecting them.

Stories: type and composition

There are at least three types of stories an instructor might bring into the studio in order to teach content-independent concepts: oral narratives, video narratives, and musical narratives.

Oral narratives are spoken-word stories. In a studio setting, the instructor is usually responsible for telling oral stories unless he or she provides students with an opportunity to participate in formal storytelling. Oral narratives are especially effective when they are personal. The telling of personal stories often puts the instructor in a vulnerable position because they reveal aspects of life to which few gain access. For example, during our semester-long observation of a graduate-level studio, the instructor told the students a story about the days he spent at his dying mother's bedside, struck at the contrast between her countenance and the bustling shoppers at the mall across the street from her care facility. The death of a friend or loved one –let alone a parent– is a deeply personal matter, and, as such, these stories can be difficult to tell in front of a student audience. However, to tell such a story with sincerity, fully acknowledging the concomitant vulnerability has the potential to put students in touch with their own humanity.

Video narratives are video-based stories. Video narratives are cheap, efficient ways to build meaningful stories capable of communicating CICs. Unlike oral narratives, video narratives can break from the limitations of reality. Video narratives can transport a student-audience through space. They can slow down or speed up time. They can force students to confront death or new life. But video narratives have limitations, too. Chief among those limitations is novelty. Video has been a relatively common tool in the instructor's toolbox for quite some time, and so the instructor bears the responsibility of carefully selecting a meaningful, impactful video in order to counteract the potential lukewarm reception to "showing a video in class."

Musical narratives present a unique set of challenges in that their meaning can be more ambiguous than their oral and video counterparts. Musical narratives rely on the instructor to guide students thinking with a thoughtful observation or rhetorical question posed immediately after the piece. During our observation, we noted that students articulated visceral reactions to music more so than video or oral stories. That is, they spoke of how the music made them "feel" rather than what it made them think about. Only when the instructor pointed to a particular line or musical technique did their intellects kindle.

Although there's no general formula to compose a story in order to convey a CIC, this approach considers the following components for accomplishing that task:

- Characters
- Setting
- Actions
- Time Pins
- Objects
- Emotions
- Intentions
- Values

This set of components is non-exhaustive and it can be modified depending on the needs and abilities of the storyteller and/or the type of story. Even when these components are suitable for oral stories, they can also work for selecting stories on other formats (e.g. video clips).

CHARACTERS

In this approach, HCI/d is understanding people's stories around interactions with other people and technology. To sensitize students to this idea, we exploit the use of stories that are people-centered. The characters' experiences will establish the medium through which the CIC will be transmitted.

It's advisable to keep the number of characters to a minimum. Every character represents a *voice* inside the story. Consequently, it is important for those voices not to conflict with each other. Consider having only one main character. Keep the main character's voice *strong* and *active*. When participation of other characters is required, keep the rhythm of the story by providing the appropriate timing for this participation.

In HCI/d, Personas (Cooper, Reimann, and Cronin, 2007) are an effective tool for developing and refining a particular design. A story conveys a CIC that is not particular to design or design processes. However, it might be beneficial to think about characters as Personas in the sense that the storyteller must have intimate knowledge of the character(s) for her narrative. Rich, well-developed characters reach students just as rich, well-developed personas reach design teams and stakeholders.

SETTING

The story takes place in an imaginary world. An effective story should detach the audience from reality and transport them into the *diegesis*. To achieve this, it is necessary to find what constitutes the set of descriptions that will create an appropriate *atmosphere* for the story. The students should be engaged in such a manner that they can *sense* or *imagine* the weather, landscape, odors, texture, spatial distributions, and other details. The storyteller's mastery rests on creating the setting without overloading the audience cognitively.

ACTIONS

Action refers to any relationship of *cause and effect* between one, two or more characters. With this in mind, we identify three types of action:

- Interaction with the self.

- Two or more characters interacting.
- Characters interacting with objects.

We invoke the first type of action when we want to externalize a character's thoughts or reflections. The consequences of this type of action reveal insights about the CIC. It is important to point to the *why* and the *what* in a character's reflection. If a story has multiple characters, their interactions *thread* the story. Similarly to the first type of action, there might be consequences of these interactions that may direct the transmission of the CIC. The latter doesn't necessarily happen when one or more character interact with objects. Interaction with objects serves the purpose of clarifying or enriching the context of the story. The actions allow the students to understand part of the current state of the story –the *where* and the *what*. The form in which it is said these interactions occurred –the *how*– will affect the students' ability for *threading* the story in their minds.

TIME PINS

Time pins exist in order to bolster this narrative threading. Time pins occur naturally in any narrative. At a high-level, we can think about time pins as signifiers of transitions between ideas. In other words, time pins are transition points. They mark the transition from one scene to another. They mark the transition from one idea to another. In multimedia narratives, which we will discuss shortly, they may even mark the transition from one shot to another. Time pins contribute to students' ability to engage with stories by breaking them into manageable chunks.

OBJECTS

Descriptions of objects in the narrative should be as concise as possible. Props are objects that contribute to the story's atmosphere and they might also be things with which the characters interact. Although it has been remarked that the story should be people-centered, there may be exceptions to this rule. This is not a suggestion for anthropomorphizing an object, but using an object and its characteristics as a medium to convey a CIC.

EMOTIONS

In order to complement the story's atmosphere, any emotion in an oral narrative must be transmitted through verbal or nonverbal communication during the telling. For example, the storyteller can describe explicitly a character's internal emotional state: "He was overwhelmed with melancholy." "Happiness washed over her like a steam bath." "They looked at the horizon, feeling young at the prospect of adventure." Alternatively, the narrator can exhibit the emotions him or herself through body language, facial expressions, gestures, or tone of voice. The inclusion of emotions in the story nuances the various participating voices thus making the story that much more real.

INTENTIONS

Any interaction among characters or between character(s) and object(s) will be triggered by some *motive* or *intention:* the *why*. Students might distinguish the intentions that come from a character's reflections. The storyteller should revise the intentions contribute positively in conveying the CIC.

VALUES

Values are those additional layers of meaning extrapolated across the story lending it a normative stance. For the storyteller it is important to keep in mind when and how to embed value-laden elements in a story. Values are expected to motivate students to adopt a stance throughout a story.

The expansion or modification of these components will depend on the *expertise* (Nelson & Stolterman, 2012) and *repertoire* (Schön, 1987) of the storyteller. In the studio, this role is initially played by the instructor. But later, it's expected that students start to employ stories as a form of communication.

Stories: social and emotional development

Beyond our belief in the stories as powerful tools to engage students into reflection during the lecturing stage of a studio-based course, we hold that stories augment students' social and emotional development (Pedersen, 1995). Students listen to stories in the studio *as a group*. Consequently, they become sensitized to the same CIC. Following the act of listening, the students reflect on and grapple with issues raised in the narrative. And this reflection is emotionally driven. The narratives themselves manifest emotion. The storyteller brings emotions to life through the performative act of telling. And the students' reactions to the narrative are emotionally charged.

We define emotionally-charged stories as those that resonate with an audience even when the audience does not know why. In a studio, emotionally-charged stories motivate students to create their own stories as part of the learning process. Students share these stories in the studio and through other outlets, such as a sanctioned blog. Sharing is the primary means by which students attain their understanding of the CIC. It is also the means by which students shape stories out of their learning experiences. We have observed that students' sharing of stories extends beyond the end of a studio. Emotion is one reason for this extension; it tends to transcend time. However, there is a practical reason, too. As a storyteller, the instructor models the structure and elements of storytelling.

The instructor models how and when to think about and apply stories during the design process. Stories are tools, after all. The instructor uses them to convey CICs, and students use them to attain mastery of CICs. Knowing when to inject a narrative into a studio and when to prompt students to reflect on a narrative is for the instructor to decide; it is context-dependent. The same principle is true for students, however the decision of when to discuss a story and, consequently, to create their own narrative is less strict.

It is less important for students to pick an *opportune* time to discuss and create stories. In a studio, the act of discussing and creating narratives is fruitful in and of itself because as students create narratives of their learning experience, at least two things happen: (1) They approach understanding of CICs, and (2) they create internal separations of thoughts or experiences (Murch, 2001). Regarding the latter, the act of story-creation divides the larger narrative of students' learning experience into manageable chunks. In other words, the students' own stories serve as *time pins* in the larger narrative of their learning experience.

The narrative cloud

As students externalize and exchange stories during the design process, they contribute to a conceptual space we call the *narrative cloud.* We envision the *narrative cloud* as the highest level on which we can model the learning experience as a narrative (see Figure 3). In the narrative cloud, the instructor abdicates sole authorship. In the narrative cloud, stories act on, are acted upon, and complement each other. The instructor, students, additional active agents, and other objects construct the *narrative cloud* together; storytelling and meaning-making are thus “socially distributed across members of a group” (Hollan et al, 2000).

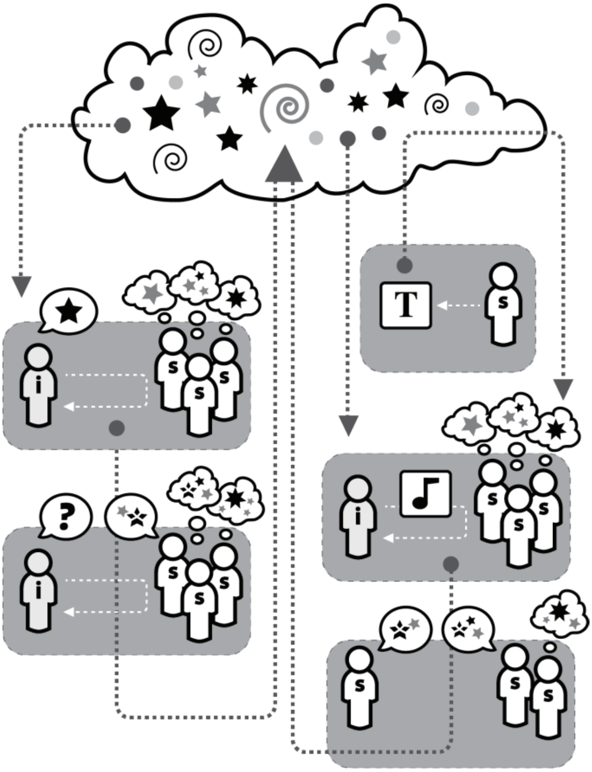

Figure 3. Schematic representation of some scenarios about the construction and retrieval of stories from the narrative cloud.

As illustrated in figure 3, multifarious stories within the cloud coexist, overlap, and intersect. The points of overlap and intersection have the potential to yield insights about aspects of pedagogy, such as: applicability and efficacy. Narratives must be applicable to students. Inapplicable narratives are unlikely to yield meaningful student engagement. If a narrative overlaps or intersects with others infrequently (or not at all) then the instructor might consider whether that narrative is applicable to his or her students. Narratives must also be effective. That is, they must be told such that they encourage students to engage with the narrative. An ineffective story is likely to overlap and intersect infrequently with other narratives. Seemingly inapplicable and/or ineffective narratives must be evaluated for revision or exclusion from the studio. We do not expect that this evaluation can be conducted from memory. Instead, we advocate for the preservation of these stories and (at least part) of the student responses to them.

Preservation is a means to several ends. First and foremost, it provides rich qualitative data for the instructor to analyze and interpret regarding stories used in a studio. In addition, depending on the mode of preservation, it provides a platform for student engagement and interaction. Finally, again, depending on the mode of preservation, stories may be transmitted across time between student cohorts thus enriching the narrative cloud for a different group of students.

Effective preservation requires finding the appropriate means to lend materiality to these narratives. Whether the means of preservation is analog or digital does not matter. However, there are at least three qualities which any means preservation should possess: accessibility, durability, and ease of communication. These qualities skew in favor of digital preservation, however there is a particular analog method that we have observed to be useful: an iterative exercise of *drawing the whole game* (Perkins, 2010) whereby students draw and re-draw their conception of the "whole game" of HCI/d. At the end of the semester-long studio, students were left with a tangible record of their evolution as design thinkers. They can trace the transformation of their understanding of design. The *game* is sketched and, as such, is accessible to all students. In the digital realm, we have observed that blogs can be particularly successful methods of preservation. Blogs are familiar and intuitive (and therefore accessible) to most students. Blogs are durable. Unless someone deactivates a blog or cleans out all of its posts, its content will remain intact for a long time. Finally, blogs allow for multiple modes of communication (text, image, video, audio, etc.). In sum, blogs can be ubiquitously accessed and extended.

Armed with these materialized reflections, an instructor can use them as tools for analysis and reflection-on-action. What worked well? What failed? Which stories were effective? Which weren't? Which CICs were understood quickly? Which ones took more time to understand? Which ones are still processing? The students' materialized reflections are units of distributed cognition at the pedagogical level; they are an essential component of an instructor's thinking about his or her course. Taken over time, these reflections are fodder for the instructor's own learning: has the storytelling improved such that more students are engaging, grappling with, and attaining CIC understanding? Through this lens, the narrative cloud is so much more than just a repository of stories. It is an evolving component of distributed cognition across space and time. It is an integral nexus of foundational aspects of design, including: reflection (Schön, 1987), experience (Wong & Pugh, 2001) and distributed cognition (Hutchins, 2000).

Conclusions and future work

We introduced an HCI/d pedagogical approach to be applied in a *practicum* or studio-based course (Schön, 1987). This approach employs stories as a means to convey *content-independent concepts*. These stories gather in a conceptual space we call the narrative cloud, and they serve to engage students into self-reflection. This self-reflection motivates achievement of two student goals: (1) empowerment of the individual as designer, and (2) cultivation of consciousness about the nature of being a designer: a transformative agent of the (natural) world through the introduction of ultimate particulars based on design competences and judgements (Nelson & Stolterman, 2012).

We now discuss some of the limitations of our approach. Students may have difficulty comprehending a narrative-based approach in a studio. It defamiliarizes more traditional means of lecture-based instruction in which the lecture content links directly to course content. We see this space as an opportunity. The naturally exploratory studio context favors extending the learning process beyond the communication of theory, principles, or technical skills. It represents a space where learning as an *aesthetic experience* (Parrish, Wilson & Dunlap, 2011) is feasible.

Instructors may perceive a limitation of this approach in that it does not instruct design principles *per se*. We are not advocating the narrative-based approach as a replacement to the instruction of design principles. Rather, we are advocating it as an augmentation to teaching design principles. According to Nelson and Stolterman (2012), "facts and skills are only valuable in the context of the confidence to take action or do things." Our approach aims to instill a sense of agency in design students; it aims to bolster their confidence. And so there may not be a place for this approach in every HCI/d studio.

Just as the approach does not fit with every curriculum, neither does it fit every instructor. Instructors interested in adopting a narrative-based approach to HCI/d pedagogy must be committed and sincere. Students at this level have a keen sense for insincerity and superficiality. If the instructor does not buy into the method, then the approach will fail. If the instructor does buy in, then he or she must acknowledge that telling stories is not the same as lecturing. An instructor who expects success using this technique interchangeably with traditional lecture will inevitably fail. Unless the instructor is a seasoned storyteller, it will require committed practice in order to hone the storytelling craft. The components we outlined in this paper constitute a good starting point. They can be used as criteria to evaluate stories for use in a narrative-based approach.

Future work

As we move forward with our research, we aim to develop a framework for practical use. When should an instructor think about using the narrative cloud approach to HCI/d pedagogy? What are the implications of use? How should an instructor prepare to integrate the narrative cloud into his or her curriculum? How might it change the way we think about instructor/student interaction? How might it change the in-class dynamic between student and instructor, or between student and student? What happens when the narrative cloud exists in a non-HCI/d studio (e.g., architecture or industrial design)? What implications does the narrative cloud have for pedagogy in general?

The narrative cloud is about people. The instructor and students create it through the telling of stories. But its reach extends beyond the boundaries of the academic institution. The purpose of HCI/d pedagogy, after all, is to train the next generation of designers. The narrative cloud aims to grow a workforce of designers who prioritize their users above themselves. We believe that one effective way to do that is to imbue designers with a strong sense of agency; to enable them with the courage to go out into the world and act and to build for them a socially-minded collegial community of designers who think about people first, not technology.

Through the process of exchanging stories and inquiring into the meaning of those stories, a natural shift occurs whereby students no longer speak of the stories themselves. The students begin to speak of themselves in relation to the stories. They begin speaking about stories in terms of their personal experiences. They seek meaning in themselves. They strengthen and refine their sense of agency by composing their own life narratives. In the end, the students are the story.

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Educating Process of Design to Learn Urban Park Design for Non-Landscape Architecture Students

Rahman TAFAHOMI*, Seyed Moslem Seyed ALHOSSEINI, Farshad NOORIAN
Hasanuddin LAMIT and Haidar HABIBIE
Tehran University

Abstract: *The aim of this paper is to apply urban design disciplines as method of teaching in urban planning bachelor program especially for urban park design course. Contemporary situation of urban planning students identify that there are less design courses, so they normally less introduced with design principles also design bases in the department, and so this condition creates problems in the process of urban park designing. So methodology of this research based on the questionnaire technique with a comparative approach to ask opinions of students before and after the course. Finding of research identified that students were less introduced with application of basic geometrical design such as point, line, plane, and volume before of this subject. Additionally, students identified that imaging process of landform and landscape has had weakness particularly in topography, site analysis, and environmental qualities in education syllabus of urban planning department. Results of research identify that mix model principles can explain and detail those design disciplines for students also introduced them with design concepts particularly in those missing parts. Furthermore, mix method learning system is effective regarding opinions of students as sufficiency in conceptualizing and imagination process after studio.*

Keywords: Urban Design Principles, Park Design, Non-Design Students.

* Corresponding author: Department of Urban Planning and Design | Tehran University | Kish International Campus | Iran | e-mail:tafahomi@gmail.com

Introduction

Higher educational institutes have broad types of students in different levels, programs, and courses with multi-level of tendency and interesting to the design courses in Iran. For instance, some courses like urban park design normally present in architectural, urban planning and built environment faculties also department with different syllabus and details additionally less explicit design curriculums.

It seems generally, designing of parks and green spaces are accomplished by landscape architectures, environment and green space designer as anticipatable course who passed the essential and fundamental subjects in designing curriculums. Nevertheless, for those non-designers that have deficiencies in design courses such as urban planning students in the diploma program is not easy to find out design matters in this program. In this case, teaching technique limit to introducing and presenting overall information about park to enhance students with the concept of park design. Therefore, according to subject, students attend in a theoretical and verbal class to listen and look some experiences about park design projects although in studies motioned about various methods, techniques, and tools to increase as mix method education process such as graphical, mathematical and analytical (Demirbas and Demirkan, 2003).

Additionally, park design is a specific studio in landscape architecture program and students have proper opportunities to introduce with landscape design in studio that it is included particular subjective parks such as river, mountain, shoreline, forest, and so on also in scale such as national, local, small and other scales, additionally themes parks as well. Nevertheless, it seems there are gaps between course and purposes of urban design park in urban planning department that it creates ambiguous conditions for both students and lecturers to encounter with this subject. So, each of them interpret and apply this course regarding their idea and findings. For example, some of students believed this course is optional subject that have not basic roles in the curriculum, while some of lecturer, interprets this subject as a theoretical subject that has only a introducing role to give them some general information and so for some of them including students and lecturers find this subject as opportunities to complete design course particularly those shortage of landscape architecture syllabuses that normally kept out of urban planning programs.

Problem Statement

Urban park design subject as part of diploma in urban planning has deficiencies in the syllabus, manual booklet and description page that it creates differences among lecturers to encounter with this subject as theoretical or practical subject however, in the text of manual mentioned that this subject is theoretical base with some simple design exercise to introduce students with design matters. Nevertheless, it seems that this course could be effective to promote designing knowledge of the students also application micro scale plan that it is normally missing in the syllabus of this course.

Additionally, another problem is different ability of students in this program to design regarding background of educations in high school and the local education system. For example, it has been observed that some high school and technical schools have had priority to mathematical or geometric subject, or in opposite, some of them attention more to the studio and practical courses. As another point in differentiation level of students, could mention to those technical schools students that normally have variety in the field of studies including construction, mechanical, agriculture, electronic and architecture. Therefore, levels of introducing with the design course and interesting to the design area have been totally different. It seems the curriculum of Urban Park Design course has paid less attention to these differentiation among of students that this deficiencies need to study.

In other words, students have common courses in large scale base without extra subjects in small scale courses in the B.A program and diploma of urban planning in those educational institutes. So students have had less design courses in practical subjects particularly in the essential and basic design techniques. Therefore, these deficiencies have created problems in the physical and metaphysical design parts for students. For instance, in studies of Varkkai (1997) in urban design education in the US universities was identified that normally students have deficiencies in the design courses. Moreover, Kreditor (1990) pointed to those neglected subjects in urban design educational institutes in US. Therefore, it seems that there are some deficiencies in the urban planning courses regarding design criteria such as design studio particularly urban park design. Hence, should consider the level of introducing those students with the design bases and process from specific methods and techniques to assess imagining, innovating, and creating of them regarding basic design forms, shapes and urban design disciplines and orders as regards urban design principles.

Methodology

Methodology of this paper has designed on the qualitative method particularly comparative questionnaire with qualitative approach. Therefore, the questionnaire designed with comparative approach in two parts to measure level of influences the syllabus of design course on the qualities of the design processes. In this case, the questionnaire designed in two columns with both comparative questions including first column, the data before of presentation the course in the class, and second column, the data after it. Structure of questionnaire designed on the half open-ended questions to use of extra opinions and information of students like to present. To check up the validity and reliability of the questionnaire, the structure of questionnaire checked with three lectures in department of architecture as explanatory stage and so those recommends were applied to correct the questionnaire. In pilot survey stage, the questionnaire was passed among a small group of educated students to check the understanding, answering, and responsibility of them in regard of questionnaire. Answers of those pilots identified that some questions have had ambiguous in opinion of students, some of them were needed to restructure or replace, and integration that this results influences on the structure of final edited questionnaire. To analyze the data were used the qualitative approach regarding absence of Stevens Measurement Scales standard (Stevens, 1947, 1954) for quantitative analysis including nominal, ordinal, interval, and ratio scales. Therefore, qualitative analysis chose as valid technique as non-quantitative to analyze data questionnaire technique(Neuman, 2006; Tafahomi, 2012).

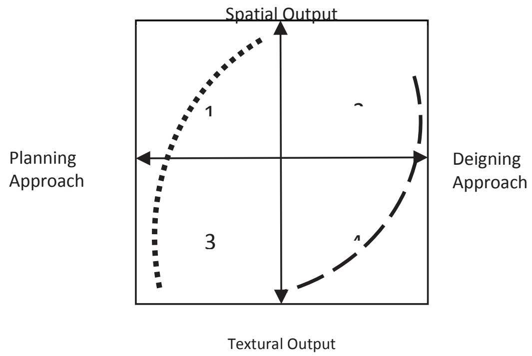
According to method, the structure of questionnaire combined from five parts including introduction, introducing questions, general questions, design questions, and other opinions about the course. In the introduction part was explained objectives of the questionnaire. Then, in the introducing part, were asked some questions about ages, gender, educational backgrounds, and professions. In general questions were asked about area of interesting, knowledge about parks and green spaces, level of introducing with green space regarding those space references and literatures. In the design parts asked questions about introducing with the fundamental design components and compounds such as point, line, plane, and volume, additionally, analytical disciplines of design such as spatial, textural, visual, morphology and so on. Finally, in the last part were required from students to write other opinions about course. For data collection, the corrected questionnaire was distributed among students who have been passed this course to complete. The statistic group combined from 40th students as total number of class, however, some of them had been returned to their cities and was not jointed to this research. In the first announcement were jointed 11 students and in second and third were added 9. For covering all students were asked to those joined students, to deliver questionnaires to other friends that were not informed about the research process and announcement. Since distribution time of questionnaire returned 22 questionnaires and with following process for those no returned persons got extra 9. So the statistic society of research based on the 30 completed, 1 non completed, and 9 no returned questionnaires. As an example in this case, Miller and Salkind (2002) mentioned from Heberlein and Baumgartner (1978) that with continued requests by researcher from respondents will increase the level of answering around 30%, although in this case, research following process could not obtain to this result.

Theoretical Framework

Design and designing process have were been one of sophisticated and complicated areas in recent literatures of architecture, urban planning and urban design field studies (Zeilsel, 1986; Lang, 1987; Lawson, 1997). So this specification has attracted authors and experts to explain this process in diagrams and figures or texts to document this scientific process (Lang, 1987; Zeilsel, 1986; Moughtin et al, 2003). This broad area of the design normally classified into two parts including meta-physical part of design in including thinking, imagining, and innovating, and physical part of design such as sketching drawing , and designing.

Those two parts additionally have been strongly connected with each other, in whole large scale to small scale plans and projects in both planning and designing approaches. Indeed, in the large scale plans in planning and designing areas there are diagrams and conceptual maps that were called as designing such as regional strategic plans and maps, also in the micro and small scales, there are other kinds of maps that were called them as design such as detail and specific plans. Therefore, studies have showed that large scale plans had have tendency to the spatial output with planning approaches while the micro scale plans have tendency to the textural output with designing approaches (Tafahomi, 2012).

Figure number 1: Textural and Spatial Area of Design (Source: Tafahomi, 2012)



As another important factors in the designing and planning should pointed to structure of the design problems definition that it is specific and explicit in the designing process. For instance, studies have showed that each design problem has own specific structure and relation that good design practices have been normally depended to methodology and process definition the problem by designers (Chermayeff and Alexander, 1963). Therefore, different design structures needs to different designing problem solving such as scales, methods, process and approaches. For example, scale of the problem solving in urban design is more larger than architecture also scale of problem solving in the urban planning is more larger than urban design, hence this hierarchy exist in different scales of plans and projects (Lawson, 1997).

Additionally, studies have showed that architecture areas have had tendency to integrate other area of knowledge to develop methods and products such as mathematic (Verner and Maor, 2003), with fascination so fantastic forms (Pizarro, 2009), sensitive relation with environment (Pallasmaa, 2005; Zardini, 2006), and environmental pollution and risk (Clarke and Stansfeld, 2007). Therefore, in this broad area of knowledge, they use from different style of techniques and methods. First of all, architecture use of the own methods in research and design, then they apply from relevant field of studies like urban planning and designing also landscaping, and after that, it extends to other area of knowledge like psychology, sociology, and behaviour studies courses although they normally prefer to use a own mix method and approach to increase validity of method. Therefore, application of urban design dimensions, aspects and principles (Tafahomi, 2012) could provide sufficient condition to convert those gaps and shortages particularly in urban park design for non-designers students.

Data Analysis

According to the questionnaire structure designed in two comparative parts and approximately with the same target but different purpose, in the first part, was asked respondent's opinions before of this course and in second part was asked they opinions after passing this course that all data mention in below. The general information and data of the respondents identified that respondents were included 14 males and 16 females. Answers of respondents showed that they educated more in mathematics and technical branches in high school courses with overall 85 percent than other fields of studies that it was included 75 percent females and 95 percent males. In the profession question they answered majority as student with 80 percent.

The collected data including the questions belong to Before of Course and After of Course that they mention in below parts:

5-1 Questions in relation to Before of Course: in the first part, there were 5 questions with level of education. These questions measured the level of introducing and interesting respondents with the park design areas. Summary of the answers of the respondents to Yes/No question is mentioned in below table:

Table numer1: Answers of the respondents to questions before of course

Questions	**Positive approach**		**Negative approach**	
Level of responsibility	High level	Good level	Average level	Low level
1-Interesting to Design	23	7	0	0
2-Introducing with design	12	6	5	7
3-Previous related course with design	5	3	7	15
4- Evaluating the level of depth introducing	4	8	12	6
5- Paying attention to structure of parks	2	4	4	20
6-Application topography in design	0	0	3	27

Those students in answer to questions about introducing with the basic components and compounds in design including point, line, plane, and volume mentioned only the name of the figures. Additionally, in the question about application basic shapes in design process such as quadrangle, cycle, and triangle sited answer No for all those shapes. Furthermore, the respondents in answer to question about design principles as a systemic approach in design process such as spatial, textural, environmental, cultural orders mentioned that they no introduced with those kinds of orders.

5-2 Questions in relation to After the Course: questions in second column of the questionnaire designed to evaluate influencing of the course on the opinions and abilities of students. So, questions of this part were designed with approach to evaluate effects of course on the opinion and mind of the students. This part similar with previous, have had ordinal and interpretative questions. Summary of the answers of the respondents to questions is mentioned in below table:

Table number 2: Answers of the respondents to questions after of course

Questions	Positive approach		Negative approach	
	High level	Good level	Average level	Low level
1-Effects of course on the interesting to design	18	10	1	1
2- Evaluating the level of introducing	22	8	0	0
3- Paying attention to structure of parks	29	1	0	0
4-Application topography in design	28	2	0	0
Questions	Chosen options by respondents			
5- Interesting to the syllabus of course	Design (24)	Analysis (5)	Documentation (1)	
6-Effictive technique in the course	Sketch (18)	Correction (8)	Lecturer(2)	Discussion (2)

Those students in answer to questions about introducing with the basic components and compounds in design including point, line, plane, and volume mentioned new imaginational and conceptual words including for point: sign, landmark, focus, and center, additionally, for line idealized movement, direction, path, and terrain feature lines, and for plane described layer, map, ground, and earth, and finally for volume they pointed to space, pace, and texture. Furthermore, the respondents in answer to question about design principles mentioned as a systemic approach in design process such as spatial, textural, environmental, cultural, social, functional, activities, accessibility, movement, and city furniture orders.

Findings

Findings of research identified those males interested more than females into research in spite of high number female students in this field study particularly who were fresh students without any profession background as well.

Those ordinal questions in the *Before of course* part identified that they have been interested into design subjects however they have less been introduced with the particular curriculums or courses in design matter. Additionally, students' evaluation process of their educations in relation with the design courses explained that they were believed which; they have passed some effective courses in relation with the design however their assessments of qualities of those courses were not sufficient regarding level of introducing with the design courses. In the last question, respondents identified that they have less been introduced with the topography concepts and subjects while in urban planning topography and slope are important aspect in planning and designing stages.

Additionally, in the analytical parts of the questionnaire, respondents could not imagine any interpretive words or conceptualize application of those asked figures and shapes into spaces and places. This gap addressed to shortages into basic courses in early times of education particularly in the fresh times in the university. Furthermore, for those geometric shapes such as quadrangle, cycle, and triangle the condition were the same. Moreover, finally, in this part, respondents mentioned that they have been less introduced with the design principles as analytical approach. Therefore, as a result could conclude that subjects before of Urban Park Design could less provide effective condition to present this subject.

In the second part of questionnaire, questions in related to *After of course*, students identified that the course could strongly effect on their interesting into design subjects which, it could be observed from frequencies of answering to the question with positive approach for the design part, as more interesting section of the course. Additionally, the data identified that students in evaluation of the level of introducing to the design subjects chose more high and high options, so the course has been effective on the design knowledge of respondents. Furthermore, respondents mentioned that their paying attention process in to park structure increased in the course and they got systematical and analytical approach regarding structure, topography and geomorphology.

In addition, students identified some detail and fundamental aspects of course to show effectiveness of educational plan on their conceptualization and imagination and interpretation abilities. They mentioned some words in questionnaire that implied on increasing level of imagination and innovation regarding those basic shapes. Finally respondents identified their knowledge about the design principles according to urban design analytical approach as new achievements. In this results could conclude that process of the class with those structures and duties trained abilities of students in the innovation and creation stages that these factors were mentioned by them. Hence, the syllabus of urban park design was adapted more with practical studio than theoretical class although in this process respondents were not conscious about this experiment.

Conclusion

Diploma program in urban planning department as part of B.A of urban planning has deficiencies in basic subjects regarding design field studies. These shortages have impacted on the qualities of analysis and design in the course particularly in the urban park design subject. Findings of research identify that respondents assumed that their introducing have been adequate for designing however results of the questionnaire addressed to those absences and deficiencies. Indeed, those basic subjects in design in this program could not provide sufficient condition for students to design urban park although they have been more interesting about this course. Therefore, it is suggested to reedit the syllabus of this course.

Diploma of urban planning has deficiencies in the systemic approach for analysis and design process that it appears in the localizing stage of design such as urban park designing. It is notable that more syllabus of this course has been adapted by macro scale approaches like analysis, design, and general outlook. Therefore, this insufficiency could address to absence of architectural and basic design subjects in the curriculums of this course, even less consideration of educators to add those essential design materials to the program.

Results of research show applying and integrating other methods into urban planning such as urban design principles could provide richer condition as a systematical approach to appear analytical structure for analyzing and designing places that could nominate as mix model. Those urban design principles that were applied in this research include five analytical approaches such as spatial and textural, visual and perceptual, functional and activities, accessibility and movements, green spaces and urban furniture. Additionally, procedural and contextual layers include in the subject that could point to social, cultural, economic and management parameters in analysis and design stages which, these mix methods converted and changed the class into a design studio as an interdisciplinary approach.

Therefore, the mix model in presentation of the course in the studio could be provided sufficient condition to expand ability of students to imagine, innovate, and create new concepts in the design area particularly green spaces. Hence, mix model of education encountered students with new sphere of design that it has been missing in the course which, could be mentioned those important items such as topography, geomorphology, terrain, site design, urban design qualities, and plants.

Urban park design is a macro scale and detail design projects that those students were less introduced with these kinds of designing so results of research identify that all built environment field studies need to multi scales design courses to introduce students with related courses in the same area of knowledge and profession. Indeed, architecture, landscape architecture, urban planning, urban design, tourism planning, and other courses in this field have relation and connection in plans, projects also in scales and patterns. So, these departments should support particular subjects which they are more relevant with courses and profession. Therefore, it is suggested to establish a share committee for those relevant courses with all participated members as steering or strategic committee to check and control qualities of syllabus and presentation by lecturer in the class. Additionally, this committee should be have responsibilities to recognize and determine the limitation and differentiation duties and tasks of courses in all departments to monitoring process, materials, results, outputs and qualities of courses.

Finally, it is suggested that lecturers and teachers in the design class with non-designer students should be ready to use of own creation and experiences to change and complete syllabuses regarding class levels and essential qualities. Indeed, those lecturers who are encounter with design education to non-design base students have responsibility not only to own subject but also to those previous subjects that presented by someone else that maybe have less been sufficient. It is notable that this kind of streams changing have root in the realistic part of the world particularly in the developing countries.

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K-12 Design Education, Creativity, and The Corporate World

Robin VANDE ZANDE*
Kent State University

Abstract: *Creativity has been described by a number of researchers as a 21st Century Skill and a way for students to succeed as learners, workers, and citizens. The corporate sector has had tremendous impact on what happens in American education for years and continues to do so. Teachers should understand that it is often beneficial to speak the language of business and cite corporate authors to offer validation for what they teach as being essential for creative skills. An effective way for teachers to teach creativity in the context of business is through design education, a natural integrator of various subject areas.*

Keywords: K-12 Design Education, Creativity

* Corresponding author: Kent State University | USA | e-mail: rvandeza@kent.edu

In effect, because technology has made simple tasks easier, more emphasis is being placed on a workforce that is proficient in higher order skills, which have been identified as The 21st Century Skills. A great deal of research has been conducted to define the skills that the American workforce will need as learners, workers, and citizens. Many top corporate leaders support the 21st century skills, as being the skills for today's students to be successful in a world that is quickly changing (Khadaroo and Clabaugh 2009). Many countries use have national, state, and district standardized tests to access learning. However, quality learning measured by the standardized test system is only one aspect for measuring academic outcomes (Wagner 2008). Education accountability should exceed the boundaries of what is possible to test through standardized tests and should consider the skills listed for the 21st century workforce as being equally important. This is a position paper that views the skills of innovation and creativity and what those mean to people in American business as a predictor of future success. Content knowledge is important but the application of skills in real-world examples is the ultimate goal. Design education has an essential role to play in this arena. The ideas stated here could very likely be applied to design education in many countries.

Three sources that identified the 21st century skills were selected for this writing. The sources include: *Tough Choices or Tough Times: The report by the new Commission on the Skills for the American Workplace* (National Center on Education and the Economy (U.S.) 2007), created by 19 individuals who did two years of research in the United States and 13 other countries; *The Framework for 21st Century Learning*, a compilation of research conducted by The Partnership for 21st Century Skills from education, business, and industry publications in the last two decades (Partnership for 21st Century Skills 2008); and *The Global Achievement Gap* (Wagner 2008), written by Tony Wagner, co-director of the Change Leadership Group at Harvard and senior advisor to the education program of the Bill & Melinda Gates Foundation. These sources approached the topic from different perspectives. However, a basic skill that all three sources listed as essential was the ability to be innovative and creative.

Reviewing the backgrounds of these three sources reveals that their missions stem from the belief that improving the performance of the K-12 education system in the United States is necessary to be competitive in our rapidly changing world. *The New Commission on the Skills for the American Workplace* is a national coalition of business leaders, education leaders, and political leaders. The committee was initiated as a result of their belief that the quality of the American workforce has declined in the past 40 years, which has put the US economy in a "perilous position", said Marc Tucker, president of the National Center for Education and the Economy (Brodie 2009). Their report details recommendations for education reforms.

The Partnership for 21st Century Skills was formed in 2002 through the efforts of the U.S. Department of Education, AOL Time Warner Foundation, Apple Computer, Inc., Cable in the Classroom, Cisco Systems, Inc., Dell Computer Corporation, Microsoft Corporation, and the National Education Association. Their mission is to "serve as a catalyst to position 21st century skills at the center of the U.S. K-12 education by building collaborative partnerships among education, business, community and government leaders" (http://www.21stcenturyskills.org).

Tony Wagner interviewed business leaders from high-tech, retail businesses, and basic manufacturing operations about the skills they want new employees to possess. The interviews were followed by conversations with nonprofit, philanthropic, and education leaders. Wagner explains that business leaders have been the primary advocates for education reform. He continues to say that educators and business representatives seldom talk and have little common ground, if any at all. It is time that educators more fully understand the impact that the corporate world has on American education, what is being proposed by the corporate world as being advantageous skills for employment, and how to develop ways to work together. Design education is positioned to meaningfully contribute in this endeavor. An area to start is in the training of students in the 21st century skills, particularly in innovation and creativity.

Design Education

Researchers of K-12 design education in the United States discuss design education as falling into four broad categories: *objects, communication, environments,* and *experience* (Vande Zande 2010). The design of *objects* may be referred to as industrial or product design. It includes the design of tools, furnishings, transportation, and fashion, among others. The design of *environments* is comprised of building and landscape architecture, community planning, interior design, and recreational spaces. *Communication* design encompasses graphic design and information architecture that would consist of publications, packaging, computer graphics, video, film, and advertising. *Experience* design may be referred to as interactive or event design. It includes designing occasions in which the user interacts in a situation or plans an event, such as festivals, theme parks, parties, computer and video games, strategic plans, and interactive websites (Margolin and Buchanan 1995).

The definition of creativity includes the concept of uniqueness as a result of a use of new materials, a new use of old materials, new ideas, new combinations of common ideas, and/or new style or revision of a past style. However, in the most innovative designs there is a unique solution that creatively satisfies a problem. Design combines two ways of thinking: a mix of creativity and analytical reasoning (Dorst and Cross 2001). The creative part of designing is not just the introduction of something new, but how that leads to a result that is unexpected and valuable (Gero 1996). A designers' primary strategy involves looking for solutions. Designers typically take a great deal of time before coming to a solution because they must explore what already exists, look at hidden topics and possibilities, then work through many concepts that go beyond the first idea. They try out different perspectives to get an idea of the challenges and limitations.

On one level design is a profession with particular skill sets and theories that are taught, but on another, basic designing is an innate ability. We make decisions about what to wear, how to personalize our living spaces, or fashion our appearance through the style of our clothing. These basic design decisions identify who we are to ourselves and to others. This suggests that design may be defined as the human capacity to shape our environment in ways that serve our needs and give meaning to our lives (Heskett 2003). The capacity to shape our world has gotten to the point that few aspects of our planet are left pristine. Life is nearly entirely conditioned by designed outcomes (Heskett 2003). Consider our landscape, for example. In most residential and commercial places, the lawns are mowed, weeds are pulled, bushes and plants are selected for color and texture then are pruned and shaped, and sidewalks are edged, all to create a particular effect. This example demonstrates that even nature is designed to serve our needs, reflect cultural values, and give meaning to our lives. In most American communities it has become a cultural expectation that lawns are cut. In some places laws are enacted that restrict the height of grasses and collection of weeds. Why? It may be that by mowing the grass and pulling weeds reduces habitation for insects and animals, protecting us from their unwanted intrusion into our environments. However, lawn mowers are noisy, may be dangerous, and give off emissions. Insects and animals are destroyed and the lawns are rarely used for anything. Whether you agree with this practice or not, it illustrates that personal choice in designing permeates our lives, through shaping our lawns, to the selection of our clothing and accessories, and to arranging our living and work spaces.

To go beyond our innate proclivity to design requires that we teach students a basic conceptual understanding and skill sets. The optimal approach is to teach design in K-12 education as an interdisciplinary endeavor. The characteristics of design have a multidisciplinary nature and are to be found somewhere at the intersection of technology, art, and science (Findeli 1997). As Richard Kimbell writes about the teaching of design and STEM (science, technology, engineering, and math) subjects, "(Design) really is the integrator, the sense-maker, the interest-provider that transforms arid and failed models of learning and brings them to life" (Kimbell 2011, 7-8). Most often subject content in schools is taught in segmented and separate classes, which does not replicate many life experiences. Every day we need to apply knowledge from a variety of sources to resolve problems, manage relationships, and establish a quality life. Integrated design lessons help students connect their learning experiences, to produce a more holistic approach to learning. The aesthetic aspects or stylistic concerns should be taught in the art program with the functional aspects taught by the STEM teachers. History, economics, psychology, kinesthetics, music, writing and reading are areas that may be covered when researching aspects of a design problem. The interdisciplinary model of making connections between or among fields of study creates relevance and context, and assists students in understanding relationships among concepts (Jensen 1998).

K-12 students in a design study first learn the design process of problem solving and design thinking. They then work with the compositional tools that designers and artists commonly use, the elements of art and principles of design, as a way to create the style or aesthetic qualities of a product (Shadrin 1992). They become proficient at creating drawings or models used to communicate ideas to others and for translating ideas into dimensional objects (Todd, Todd, and McCrory David L. 1996). They study the basic skills and concepts used in technologies, materials, and differing philosophies that have impact on the approach a designer uses to create a result.

The Design Process and Design Thinking

Many designers and engineers use a tool called the design process. The process follows a planned sequence of analytical, synthetic, and evaluative steps, until the final solution is found (Lawson 1997). Creativity is infused throughout the process, which starts with defining the goals and objectives of the challenge and designing a plan to structure and direct problem solving. Problems that allow for creative solutions tend to be ambiguous and include conflicting assumptions and information that may lead to different solutions (Reiter-Palmon et al. 1997). Problem formation and reformation are an integral part of creative design. Once the problem is defined it is necessary to build a knowledge base by researching its various components. Researching takes the form of reading resources, observing participants, and/or role-playing. Designers then draw on their personal experiential base, applying abstract thinking and imagination through brainstorming to generate a variety of possible solutions. The design process offers a viable structure for students to use in problem solving.

Tim Brown, CEO of IDEO, one of the top design firms in the world, is a promoter of the concept of 'design thinking'. Creativity is thought of at IDEO as a methodology that is human-centered, powered by a drive to understand what people want and need through observation, interviewing, and soliciting feedback throughout the design process. The shift from the emphasis only on the output to design thinking, where the emphasis is also on the act or the process, has been the catalyst for change at IDEO (Brown 2009). The designers involve community participants in generating possible solutions. They have anthropologists, psychologists, sociologists and designers out in the field, because IDEO (and most design firms) believe that the collaborative practice with more people looking at a problem, and more people thinking creatively, means that a better idea is more likely to happen. It is essential for the designers to understand the cultural context to include multiple perspectives through the use of teamwork.

A year-long ethnographic study was conducted by Sutton and Hargadon (Sutton and Hargadon 1996) of the design firm IDEO. The purpose of the study was to understand how the firm could consistently maintain high levels of creativity for so many years. They concluded that the use of brainstorming created a culture that inspired innovative design concepts. Design thinking is used to stimulate creative thinking in order to produce a solution using empathy, visual thinking, storytelling, and multifunctional teaming. These processes start with ‘empathy’, which incorporates caring for the customer (Patnaik and Mortensen 2009). Visual thinking, or comprehending through images, is an alternative method to verbal thinking, comprehending through words. Storytelling provides a vision for a solution through a factual or fictional narrative. The use of multifunctional collaborative teams is critical because of the complexity of design problems.

Transferred to the classroom, the design process and design thinking in a supportive climate is essential. Students are given a structure to work through a problem, are encouraged to be playful and think of wild thoughts without having to have THE right answer, and use empathy to consider varying perspectives. The students should work on their design projects while remaining open to unexpected ideas and new possibilities, working with a team where everyone contributes and builds on each other’s thinking. As students become more capable of these skills, they are preparing for 21st century society and workforce.

21st Century Skill: Innovation and Creativity

The *Commission on the Skills for the American Workplace* predicts that the kind of leadership needed for this century requires “a deep vein of creativity…people who can imagine how to use things that have never been available before, create ingenious marketing, write books, build furniture, make movies, imagine new kinds of software” (National Center on Education and the Economy (U.S.) 2007). Generating fresh solutions to problems is part of the intellectual capital that gives a company its competitive edge. *The Partnership for 21st Century Skills* (Partnership for 21st Century Skills 2008) includes within this category, thinking creatively, working creatively with others, and implementing innovations. Thinking creatively starts with idea generation techniques, trying radical and incremental concepts, and evaluating and refining ideas. In working with others, it is important to learn how to communicate effectively and to be open and responsive to diverse perspectives. It is advised that students learn how to understand limitations to adopting new ideas but to view failure as a learning opportunity and understand to act on innovative ideas as a possible contribution.

Tony Wagner (Wagner 2008) explains that the heavy emphasis on standardized tests in a narrow band of subject areas has caused American public schools to cut back significantly on contributing to this country's capacity for creativity, imagination, and innovation. However, business leaders nearly always mention creativity and innovation as one of the skills that matter most. The neurobiologist, Robert Sternberg (Sternberg, 1996) identified creativity as an attitude toward life. Creativity is about coming up with an unusual idea, persuading other people that the idea is good and there is a willingness to take a risk. Corporate creativity is characterized as the ability to perceive the world with a different vantage point, to find patterns, to connect seemingly unrelated phenomena, and to recognize solutions (Naiman 2009). People should think in disciplined ways but also have a lively imagination. Curious people look at root components and do not accept things at face value.

It is beneficial to speak the language of business and to cite corporate authors as a way to offer validation for what we teach as being essential for 21st century skills. An important skill to teach is creativity and an effective tool is the design process, which follows a planned sequence of analytical, synthetic, and evaluative steps, until the optimum solution is finalized (Lawson 1997). A study of the design process teaches students to clearly define the design problem through questioning, followed by building a knowledge base through researching the various components of the problem. Researching takes the form of reading resources, observing participants, and/or role-playing. In the next phase students use experience, apply abstraction and imagination through brainstorming. The final steps involve a synthesis of a possible solution(s), creation of a prototype, presenting their idea to an audience who provides feedback, and modifying to produce the final chosen result.

'Ready to Innovate' Report

In 2007, the Conference Board, Americans for the Arts, and American Association of School Administrators surveyed American business executives and school superintendents to define and compare their views on the notion of creativity. The report that was published in 2008 is entitled *Ready to Innovate: Are Educators and Executives Aligned on the Creative Readiness of the U.S. Workforce?* (Lichtenberg, Woock, and Wright 2008). The report stated that American employers rate creativity and innovation among the top five skills as needed for new entrants to the 21st century workforce. The report continues to explain that superintendents who are charged with the education of the future workforce overwhelmingly agree that creativity is increasingly important. Both rate arts training as being crucial to developing creativity. However, what the report found was that there are discrepancies between the business employers and school superintendents on what define the important characteristics of creativity. The findings also indicate that most high schools that provide the courses of study where creativity is most encouraged, such as art and design, are taught only on an elective basis. Yet, 85% of employers who want to hire creative people say that they are unable to find the applicants they are looking for.

There are two issues that should be addressed: 1) Administrators need to be convinced that training students to use creative thinking is an important skill for the future and 2) educators need to understand what characteristics best demonstrate creativity to people who are hiring and defining creativity for their workforce. The first issue may require a shift in the high-stakes standardized testing culture to one that recognizes that students need to demonstrate skills and application of knowledge in other ways. The second issue is that creativity should not only take place in the art or science classrooms, it should be used in learning in all subject areas, by generating original ideas, looking from a new perspective at things we may take for granted, realizing that there may be many ways to solve a problem, and arranging known components in new ways. The design process may be used with each of the top five observable behaviors rated to be important for creativity.

Business Leaders Define Characteristics of Creativity

Problem-Identification or Articulation

When the 89 employers of the "*Ready to Innovate"* report were asked to rank eleven skills of observable behaviors related to creativity, they put "problem-identification or articulation" at the top. This was different than "problem-solving", which they rated as 8^{th}. The difference between these two is that the first allows students to look at a situation and specify what is needed. The second very likely starts with a problem given to the students by the teacher and students are told to solve it. As Einstein said, "The formulation of the problem is often more important than the solution" (Wagner 2008). Employers want their employees to be able to trouble-shoot, see the problems and identify solutions. Teachers should teach some lessons that are open-ended for students to define the problem.

In the first of three main stages of the design process of problem solving, the *problem stage*, the designer identifies the parameters of the situation, including analyzing the problems and objectives, then researches information related to the problem. For students to mirror this ability, the teacher would give a scenario and ask the students to answer the when, what, why, where, how, and who questions so that they define the problem. Following this format, students learn problem identification.

Ability to Identify New Patterns

The second highest rated characteristic that the business sector named was the "ability to identify new patterns of behavior or new combinations of actions". This was expounded on when the employers were asked about what they evaluated in an interview. Employers said that they wanted prospective employees to be able to look spontaneously beyond the details of a question. In other words, people who can think creatively can see new ways of approaching a topic. The *creative stage* of the design problem solving process involves brainstorming and visualizing numerous possible solutions, without jumping to the first, most obvious conclusion. Brainstorming exercises assist people in seeing new patterns in a question or new combinations of actions. Brainstorming sessions need "springboards" to encourage creative thinking. One brainstorming technique used in a marketing strategies workshop for generating innovative business, product, or service ideas, involved all of the senses. Colorful gift bags were filled with small items of different textures, tastes, appearances, ingredients, sounds, and smells. In the brainstorming session, groups of three or four people sorted through one of the bags, imagining how the sensory aspects could be incorporated into a new product. After 20 minutes, each group presented their ideas for further brainstorming from other groups (Kyle). There are many resources that provide good brainstorming exercises, such as *Thinkpak: A Brainstorming Card Deck* by Michael Mickalko (Mickalko 2006) or *Brainstorming Reinvented: A Corporate Communications Guide to Ideation* by Linda Conway Correl (Correll 2004).

Integration of Knowledge Across Different Disciplines

The characteristic of creativity rated third highest by employers was "the integration of knowledge across different disciplines". Teaching design lends itself very naturally to interdisciplinary teaching. The interdisciplinary model of making connections between or among fields of study creates relevance and context, and assists students in understanding relationships among concepts (Jensen 1998). Such a model is about making meaningful patterns so students are then able to see the relationship of parts to whole or how concepts from various disciplines are interconnected. When information is interconnected and students understand that what is learned in one subject can be applied to other areas, they become more adept at identifying, organizing, and utilizing information (Caine and Caine 1997; D'Arcangelo 1998; Resnick 1987; 2003). Design education provides the context for these goals through teaching about many historical, social, and psychological aspects of life.

Teaching about designed objects relates to the values, beliefs, time, and place for which those objects were intended in a real life situation that may have familiarity to all. Frans Johansson wrote *The Medici Effect,* a book about creative thinking (Johansson 2004). He suggests that we must have a depth and breadth of knowledge in order to maximize creative potential. In order to improve depth, he advocates for grouping students into teams with different knowledge areas. Within the team, it is beneficial to assign specific areas for each to research and be the "expert".

Ability to Originate New Ideas and No Right Answer

Employers who were surveyed rated the "ability to originate new ideas" as the fourth characteristic and "comfort with the notion of 'no right answer'" as fifth. In job interviews, these employers were impressed with people who could respond to hypothetical scenarios. The ability to generate new ideas by combining seemingly disparate elements is called synergistic thinking (Adams 2005). Design teachers encourage their students to create original ideas, to themselves and from other students. There are a number of good resources with synergistic exercises, which stretch students' thinking beyond the usual. Two such resources are *Design Synectics: Stimulating Creativity in Design* (Roukes 1988) and *Synectics: The Development of Creative Capacity* (Gordon 1961).

Establishing an Environment for Creativity

Within the educational atmosphere of standardized testing and the measures used for educational accountability may stifle creative thought. There needs to be a balance. Certain things need to be learned through rote learning but for the most part, students should be given tasks that maintain their intrinsic motivation without the feeling that they are doing a task simply because they are told to do it but do not understand the relevance to their lives (Amabile 1989). Teaching to the test reduces intrinsic motivation and creativity. When giving grades, focus on "what you learned" rather than on "how you performed". If possible, allow students a chance for revision (Amabile 1989).

The final stage of the design process is a credible approach for students to culminate a project. It includes presentation then revision steps. Students present their design solution to the other students, a group of parents, faculty, administrators, and/or a group of people who are in some way connected to the topic area. The audience would be the "focus group" who will give feedback on the effectiveness of the solution. There are various approaches to presentation, which may involve a planned lecture, a digital program (such as PowerPoint or Prezi), graphics, presentation boards, video and audio documents, among others. In developing a presentation, here are some points to follow: 1) clearly state the design problem, give a brief background of the research, quickly explain the considered solutions, and show the final model stating why it was the best solution. 2) keep the presentation short and simple. 3) be accurate and relevant to your audience. Once the feedback is given, students have a chance to revise their final product. It is about the process of using other people's expertise and experiences to inform the students on new perspectives and to think beyond their own possibly limited creative ideas. It is also about the product in allowing students to take the information and implement it in a way they think that best fits their ideas.

Conclusion

For students to acquire one of the key 21st Century Skills, that of innovation and creativity, design educators should take the lead. Creative thinking and behavior may take place in any subject area that is taught in school or in any sector of business. But I believe that design educators know best how to motivate students to exercise this skill, which is often demonstrated effectively in their classrooms. I also believe that design teachers should be giving training to administrators and other faculty members in how to approach teaching and learning creatively. *The* third point is for design educators to understand that one of the most effective ways to get support is to educate business leaders that creativity and innovation are important aspects of design education and it is giving them what they ask for in our society and future workforce.

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Human-Centered Design in Primary Schools: a Method to Develop Empathy with and Knowledge of the Needs of Elderly

Fenne VAN DOORN* and Remke KLAPWIJK
TU Delft

Abstract: *Human-Centered Design is of growing importance for professional designers and in the past two decades a series of techniques for designers to develop understanding of and empathy with a diversity of users has been developed within this field. In the second half of the 20th century, intended users were involved late in the design process, i.e. during the testing of products or prototypes. More recently, the user is involved in the early phases, when the direction is set. Users have rich local contextual knowledge and can work together with professional designers. Although these techniques are now entering mainstream design education at the university level, they have not yet reached Design and Technology Education in primary and secondary schools. Teachers do not yet provide opportunities for pupils to conduct research to uncover the needs, wishes, and experiences of specific user groups. However, this understanding of users belongs in D&T education, because artifacts have a dual nature: a physical and an intentional nature. In this paper we describe a Contextmapping method for pupils (aged 9-12 years) and illustrate this with a design project. The assignment for the pupils was to "design a playground in which children and elderly people are active together" in which the pupils developed an understanding of elderly people through Contextmapping.*

Keywords: Human Centered Design, Primary school, Contextual User Research

* Corresponding author: Studiolab | TU Delft | The Netherlands | e-mail: f.a.p.vandoorn@tudelft.nl

Introduction

Human-Centered Design

Considering the needs of users is becoming common sense in professional design projects. Designers take into account the needs and wishes of users and more and more are aware of the fact that they design for a diversity of users. In this way, they acknowledge the dual nature of technical products. Products have a physical and an intentional nature (Kroes 2002; Kroes and Meijers 2006). On the one hand, a product is defined by its physical characteristics; on the other hand an object derives its social meaning from its users. In order to call an activity 'technological', there must be the users' role (Kimbell 1994: 250). The following example illustrates this: a rock is not a technological object when it is just lying in a river. However, when some one recognizes it as a hammering instrument to put up a tent, the stone becomes technology. The stone gets its social meaning through its purpose and function for the user.

It is these latter meanings which justify our developing of products, and for which understanding the user is crucial. Designers need knowledge about and have to develop empathy with the people they are going to design for. Traditionally, users were only involved in the later stages of the design process during the testing and evaluation of products. However, in the early stages of a design project, where the context is explored, requirements are defined, and ideas for solutions are developed, everything is still open and hardly any choices have been made yet. It is at this stage that user input can have the greatest impact in ensuring that successful products are developed. But asking users about their wishes and needs is not as straightforward as showing them a product and asking what they do or do not like about it. In **Human-Centered Design** joint design and research activities of professional designers and laymen take place from the start of the project, throughout various cycles (Maguire 2001).

Users are acknowledged as important experts amongst other experts in Human-Centered Design. They are the ones with rich contextual knowledge. Quite often, users have knowledge that designers and other experts lack. This is especially true when the target group, e.g. the ageing population or low-income groups, leads a different life than the professional designers. Although they are laymen in design, they can contribute tremendously to the design process. When sharing their experiences in ways that designers can use, users share insight in their local context, their wishes, needs and dreams for the future.

Contextmapping

To develop empathy with and get inspiration from users at the beginning of a design project, designers can perform Contextual User Research. This is an empathic, qualitative and design-driven form of research, which gives insight in the daily life and experiences of potential users. At the TU Delft a procedure called Contextmapping, has been developed to conduct contextual research with users (Sleeswijk Visser e.a. 2005).

The basic principle of Contextmapping is that 'users are the experts of their own experiences' (Sleeswijk Visser e.a. 2005), but this expertise lies in deeper levels of knowledge, which we are not immediately aware of, structured, or expressed in words. Therefore, generative techniques are used to guide participants in small steps through the process of accessing and expressing these deeper levels of knowledge. In Contextmapping participants first get a number of small assignments in which they observe and reflect on a certain topic in their lives during a couple of days. Next, a few participants come together for a generative session and are given some creative assignments, in which they make something and then talk about it. Where other tools focus on the meaning, utility and usability of existing products or prototypes, Contextmapping is a much more open approach to collect stories to get insight in the experiences, dreams and needs of people.

Concluding, in order to address the intentional nature of technology, professional designers can include the user perspective in the early stages of the design process. They seek for understanding and empathy by including unique personal stories and experiences of layman through joint design projects or contextual user research. In the next section we will see how this important principle of Human-Centered Design has been adopted within the context of design and technology education.

Human-centered design in primary and secondary education

Among professional designers, attention for the user has been growing in the past decennia. Is the same happening in Design and Technology Education? Do teachers and curriculum developers recognize the inclusion of the user-perspective in the D&T curriculum as important? Is it possible to include the user-perspective in classrooms? As we will show, this differs from country to country.

The Netherlands

In the Netherlands, Science and Technology is a relatively new area in primary education and has been introduced in the curriculum in 2002. Since then policymakers have focused on implementation of science, technology and design in schools. First, only by supporting early adopters by establishing networks and providing financial means for curriculum experiments and diffusion of the results. In 2004 the Ministry of Education, Culture and Science and two other Ministries decided that one third of the schools had to implement the new subject (OCW 2004). Many schools took up the challenge and were supported by a network of expert organizations. In 2008 policy makers realized the need for further professionalization and approximately 5,000 teachers received a free training.

A key idea in the Netherlands is that pupils' activities should mirror the activities of professional designers and scientists. Schools should provide their pupils opportunities to develop a research and problem-solving attitude starting at age four (Boeijen e.a. 2011). Inquiry based learning in authentic situations is advocated. Context-concept based approaches are implemented in the Dutch primary schools and also in the secondary schools (Eijkelhof and Kruger 2009).

The official goals of the D&T education have been formulated in a number of policy documents. The two core objectives that are related to D&T are (MECS 2006):

> 44 Concerning products from their own environment, the pupils learn to find connections between form, material use, and the way things work.
> 45 The pupils learn to design, realize and evaluate solutions for technical problems.

In 2011, a more detailed description of the goals and content of D&T education has been made (Boeijen e.a. 2011). Boeijen e.a. advocate the use of a design cycle with stages to structure the learning and design processes of pupils and mention four stages.:

- Signaling, analyzing and describing a problem,
- Developing a Design Proposal and adapting it,
- Making a Product/Prototype,

- Evaluating, Testing and Improving the design/product.

For each design stage the main activities, competences and knowledge areas have been described but ‘user’, ‘needs’ or related terms are not mentioned. Only two minor references to the social aspects of design are made. From this, it is clear that Dutch policy makers focus the learning mainly on the physical aspects of the design process, as they do not clearly state the necessity of considering users in design processes.

However, the Dutch educational system does provide opportunities for human-centered design. First of all, the design cycle and a concept-context approach are advocated in primary and secondary education. In concept-context learning, real life problems are used to gain insight in abstract concepts (Koski e.a. 2011). This facilitates the inclusion of the user-perspective. Secondly, the integration of design and technology with other subjects such as geography, history, math and languages are advocated in primary education (Platform Béta Techniek 2012). Although this is partly stimulated to make room in an over-crowded curriculum, it makes it possible to include the human factor in design projects.

ENGLAND

In England, the intended curriculum does include the user-perspective. For Key Stage 1 (pupils aged 5-7 year): "*Pupils should be taught to generate ideas drawing on their own and other people's experiences"* (www.eudcation.gov.uk)." For Key Stage 2 (pupils aged 7-11 years) the goal related to the user-perspective is "*Pupils should be taught to generate ideas for products after thinking about who will use them and what they will be used for, using information from a number of sources, including ICT-based sources*".

The intended curriculum for Key Stage 3 (pupils aged 11-14 years), acknowledges the importance of the user and the social function of products; see Nicholl e.a. (2012) for a more extensive review of the policy documents. "*In Design and Technology pupils combine practical and technological skills with creative thinking to design and make products and systems that meet human needs*" (QCA 2007: 51). As part of the design process *"pupils have to develop an understanding of user's need and the problems arising from them"* (QCA 55). The critical evaluation is also related to the user: "*Evaluating the needs of users and the context in which products are used to inform designing and making*" (QCA 53).

In all Key Stages, pupils have to include the user-perspective. This should start in the early stages of the design process and continue during designing, making and testing. However, the learning goals and way the user is included differs. For the pupils aged 5 to 7 years, the policymakers consider the pupils own experiences as a starting point. This is in line with the developmental stage of these pupils. Teachers should provide pupils with opportunities to develop their own hands-on experiences with products so that they can understand and communicate their own wishes and needs. A next step is to become aware of experiences of other people. For these young pupils it is important that teachers select design projects closely related to their own local contexts with research on users the pupils are closely related to, e.g. their grandparents, house pets or the butcher next door.

Using a storytelling approach with figures they can easily relate to can be a fruitful way to establish empathy and the motivation to solve problems for other people. Stories are a great way to learn in schools because stories improve comprehension due to the many details and evoke prior knowledge (Haven 2007). Researchers who apply

Context mapping are also “storytellers”, e.g. results are often presented in the form of storyboards.

Starting from Key-Stage 2, policymakers expect pupils to design products and solutions for people with other needs, capabilities and experiences, for example the ageing population. The policymakers restrict the research on users to thinking and the use of secondary, internet sources. This is not necessary. Looking at their developmental stage, we assume that pupils at this age are motivated to discover human-centered design and able to apply the same kind of research strategies as applied by professional designers, e.g. contextmapping. As Nicholl (2012) argues, we can only speak of authentic learning in Design and Technology when pupils develop local and specific knowledge of the people they design for.

The case study of Hill (1998) is one of the very few examples of design processes in education, in which the user is included (Nicholl e.a. 2012). In the study, a secondary student designs a table for people at a retirement home. The student visits the retirement home several times, has discussions and decides to make a table from concrete and steel. After numerous sketches and drawings and the production of a small-scale model out of wood, she visits the residents again. At that point she finds out that the people at the retirement home did not want her design because it would tear and hurt the residents skin. This was frustrating for the student: "*And then I found out that they didn't want that at all. I can't remember what the reason was for not wanting the design. It was kind of disappointing because I had at least 20 drawings for them. And they did not want the design*." (Hill 1998, p. 213).

As part of the D&T curriculum, teachers should stimulate the direct interaction of pupils and users. However, as the case study with the retirement home shows, it is not easy to collect information on the user needs and dreams in an early stage of the design process. Students may easily start to design solutions before they understand the situation from the user-perspective. Although the information on including the user perspective in primary design and technology education is limited, we assume that pupils in key-stage 2 can apply the same kind of tools as professional researchers use. However, experience with these tools in educational settings is lacking.

In the next section, we describe the development of an educational tool based on Contextmapping.

Case study

In this section, we report on a case study where pupils, aged 7-12, are asked to design a “movement-garden” in which elderly people and children move together. They take on the role of researcher and apply a Contextmapping related tool to gain knowledge of, and empathy with, the way elderly people move.

Assignment

For the pupils, the goal of this project was to come up with innovations to place in a new playground, in which children and elderly can be active together. Towards the pupils we used the term “movement-garden”, to make sure that they would come up with new inventions, instead of traditional playground equipment. This assignment was related to the ProFit project, which is funded by the European Union, under the

Interreg IVB North West Europe program. Within this project the “playground” will be realized in the form of a field-lab (profitproject.org). The relation to this real-life project made the assignment very concrete. For example: the pupils visited the actual location of the future playground, which is positioned next to an elderly home and in close reach of multiple schools and family houses.

Collaborators

In this case study we investigate opportunities to put pupils in the role of researcher. Figure 1 shows a designer or researcher who trains a pupil to conduct contextual research with someone in his direct environment, in this case his grandmother. The pupil can be seen as a collaborator who performs research with somebody from the intended target group: a source. This approach is related to Contextmapping, as it uses some of the same principles: seeing the user as the expert of their experiences and making use of generative techniques.

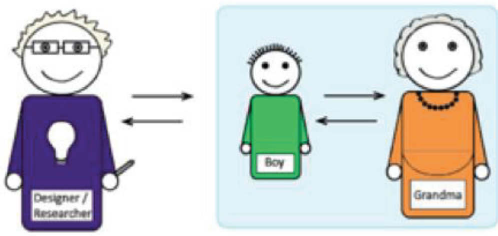

Figure 1. *Using Collaborators to conduct Research*

Design benefits – Professional designer

The original goal of this case study was design driven; to find out if pupils are able to do interviews and extract valuable insights as research collaborators in order to contribute to the design process (van Doorn 2013). Therefore the pupils took on the role of collaborator; researching their peers and their grandparents. Expectations were that the pupils would be able to collect rich contextual insights, since they are closer to other interesting research participants, both geographically and socially, and since within the same target group, people speak the same language and share a contextual world (blue border in Figure 1). In general, people have different interactions with their peers than with a researcher. A returning issue within qualitative research is the development of rapport, or mutual understanding and fellowship. By using people who are close to each other to conduct a research, rapport is already there. The collaborators might even become a “super sources”, delivering other insights than “normal” participants, possibly because these pupils feel more connected to the project.

PARTICIPATORY DESIGN WITH CHILDREN.

In Participatory Design, users are working actively together with designers. Participatory Design has been conducted with children (Read et al 2002) and several methods are developed to enhance the process for a younger target group. Druin developed “Cooperative Inquiry” (Druin 2002), a design approach building on participatory design and contextual inquiry, to let children participate in the development of technology. Within Cooperative Inquiry, children and adults participate together in intergenerational teams. They visit other participants in their own environment, conducting interviews and leading discussions.

Educational Benefits

Although this collaborative research method was developed for design purposes, we foresee strong educational benefits as well. The pupils are stimulated to develop knowledge of and gain empathy with a different target group, e.g. the ageing population. They will experience the diversity of this group when pupils share their interview-results with other pupils. As they compare the experiences and needs of elderly people with their own situation, they will discover similarities and differences and get a deeper insight in their own situation. During the process, they learn to ask questions and become better listeners. The goals that we want to achieve are the following. Pupils:

- gain empathy with a target group that is different from them.
- discover similarities and differences with others.
- learn to ask questions to people from outside their peer group and become better listeners.
- learn to share and synthesize their findings from the interviews.
- generate ideas drawing on their own and other people's experiences.

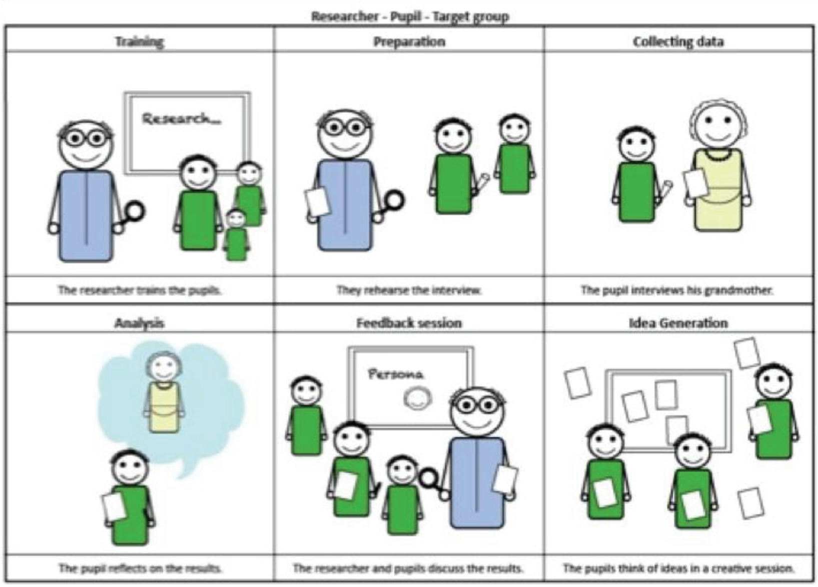

Figure 2. *Scenario*

Case study scenario

The scenario shown in Figure 2 served as the basis for this case study. This scenario includes a training of the pupils, a practice round, the collection of data by the pupils, a moment of reflection and a feedback session in which the pupils share their insights and draw conclusions. The final step was a creative session in which the pupils translated their research findings into ideas.

Limitations

As seen in Figure 2, this project ended with a creative session to think of new ideas. In a next research project, it would be interesting to take the method further into the design process; to send the pupils back to their participants with the ideas they came up with in order to get their opinion.

Procedure

Twenty pupils, aged 9 to 12, from a primary school in the city of Delft participated in this project. For them, the goal of this project was to come up with ideas for a new playground in which children and elderly can be active together. The entire project consisted of four sessions with the pupils and the individual conduction of the interviews; the content of each session will be explained in this section. The group sessions and the interviews the pupils conducted were audio-recorded and transcribed in order to gather insights about the used method. The project was directed and supervised by one researcher.

Session 1 – Research questions

In the first session, after the project was introduced, the pupils sketched ideas for new playground equipment; to be used by pupils and elderly together. They found out that it is hard to think of ideas that are not just for you, but also for other people. The next step was to find out what the needs and wishes of the intended target groups are. The pupils were divided into small groups, either focusing on peers or on elderly. Within these small groups they thought of questions to ask their target group and gave input for the development of a research booklet (Figure 3).

Figure 3. *Children thinking of research questions*

It turned out to be hard for the pupils to come up with questions individually. By making it into a group process and challenging the group to come up with a certain amount of questions, they let loose of their boundaries, inspired each other and came up with a lot more questions.

With the input from the pupils, the researcher developed two different research booklets (one for interviewing pupils, one for interviewing grandparents). These booklets are a mix of creative assignments and interview-questions the pupils came up with. The booklets are meant as a conversation starter and a way to structure the interviews pupils are going to perform with either friends or grandparents.

SESSION 2 - TRAINING

In the second session the pupils came together in small groups again, to give their feedback on the research booklets. They were mostly concerned about the appearance of the booklets. One content adjustment the pupils suggested was the addition of a blank space for a question of their own choice, which they could come up with during the interview. Although not all pupils used this question during their interview, it added to the feeling of ownership and occasionally gave an interesting insight. Overall the pupils were exited to start working with the booklets:

> Boy: “This booklet looks really cool…. I’m already looking forward to doing the interviews!”
> Boy: “I don’t really have adjustments, we are just going to do it, just give it to them!”

After the discussion of the booklet, the pupils received a short training to prepare them for the conduction of the interviews. During this training the pupils got some interview tips and they rehearsed the interview on group members (Figure 4). This last part was the most useful; they learned by experience and only when practicing did the pupils show if they really understood what to do.

> Boy: “This booklet has enough in it to discover a lot. Some people need a lot of questions to get to know one thing. With this booklet… after two, three questions you know something already.”
> Girl: “I think sometimes you can spend an hour on only this first question.”

Figure 4. *Rehearsing the interview*

One of the interview tips during the training was to ask the participants to think aloud. The pupils picked this skill up very quickly and used it during the training as well as during the actual interview. Another tip was to use a pause every now and then to challenge participants to share even more. This tip was recognizable for several pupils. *“Sometimes when somebody asks me a question, I don’t know the answer. But then a* *few moments later I remember again!"* It is valuable to relate the interview skills to the pupils' own experience and then practice them on each other.

Half of the groups interviewed friends from their own age and the other half interviewed their grandparents. The interview with friends was easier to practice, because the pupils answered the questions as themselves. When rehearsing the interview with grandparents, the pupils pretended to be elderly. At first there was a lot of giggling and funny acting but along the way it was striking to see that they realized how little they actually knew about their grandparents and started to become curious about what their real answers would be.

The training sessions were performed in small groups of 4 or 5 pupils. These groups worked very well; during the training they gave each other tips on how to improve their interviewing skills. The groups worked very seriously and when one of the pupils misbehaved, the rest of the group reprimanded him. There was a lot of discussion within the groups about the research subject. Some of the pupils knew each other well, which gave another dimension to the practicing of the interviews; they could add to each other's answers and dive deeper into some of the subjects.

- Question from booklet: With whom do you play with and what do you do?
- Girl answers the question
- Boy to girl: "I thought you also play most with Bobby right? Isn't that true?"
- Girl: "Yes that is right, I play a lot with Bobby, my sister, I didn't think about that, I thought you meant friends not family."

CONDUCTING RESEARCH INDIVIDUALLY

Over a period of two weeks, the pupils went to interview their peers or their grandparents individually. Only one pair of boys chose to do the interviews together. Some examples of pages from the research booklets can be found in Figure 5.

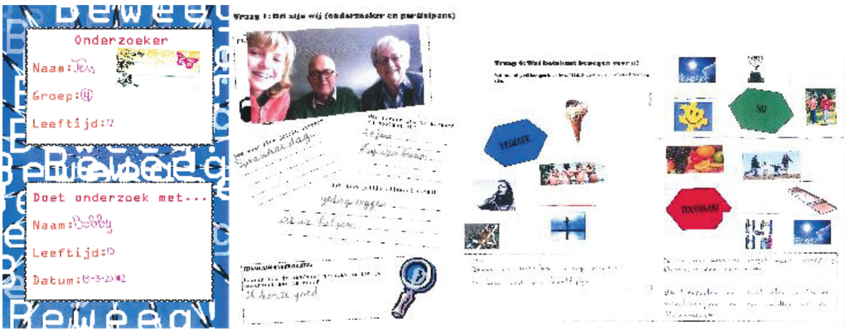

***Figure 5**. Pages from research booklet*

SESSION 3 – ANALYSIS/PERSONAS

Subsequently to conducting the interviews, the small groups came together for a feedback session in which they discussed their results. After sharing their experiences, the groups filled in templates of personas as a kind of summary of different kinds of participants they encountered (Figure 6).

By making the personas, the pupils integrated information from the different interviews into one story. The process of filling in the persona was done within the small groups and every group was lead by the researcher. Together they started with an empty template and the first step was to come up with a name and age for this new fictive character. By asking the pupils for the ages of their participants and choosing one in the middle, the children got the idea of combining real data into one coherent story. After giving this persona a basic identity (where he lives, what he looks like, etc.), they started thinking about his activities, wishes, thoughts and stories. Somewhere during this process, the pupils thought of a title to give to this persona, summarizing the most important characteristics, for example 'somebody who is active and loves nature' or 'a make-up lover'.

The personas worked well, the pupils thought the templates were inviting and wanted to start right away. When making the personas and combining several participants into one character, some pupils were more comfortable to share their experiences. When using personas they didn't have to talk about a specific participant so they didn't feel like betraying this person and the insights were more anonymous. For example when the pupils were making a persona about an old grandfather one boy added:

"He moves in order to meet people, he is kind of lonely."

It is easier to say something like that about a fictive character than about your own grandfather.

By making the personas within small groups, everyone could add to the discussion in their own time, this gave an energetic and positive atmosphere. It turned out that the pupils were capable of comparing persons very well; they are able to see the differences and similarities between people and to make a short description of a certain character. In the end, the descriptions of the personas were much more elaborate than the description of the individual participants.

Finishing the personas marked the end of the research phase. At the end, one girl wanted to fill in a persona about her own grandparents to keep at home. Like a memorabilia from the research, feeling proud of what she had achieved.

***Figure 6**. Example of filled-in Persona Template*

Session 4 – Creative idea generation

In a final creative session, the pupils thought again of ideas to place in the new playground, but now with the use of their personas and their gained knowledge about the target group. The whole class participated in this session at the same time and new groups were formed to generate ideas together, each group combining pupils with knowledge from the two different target groups. We feel that the ideas from this generative session were more empathic towards elderly than the ideas from the first session. One signal for that is that the drawings from the first session often didn't include any persons. In the final generative session almost all groups draw persons and they explained more about the roles and wishes of these different persons (Figure 7).

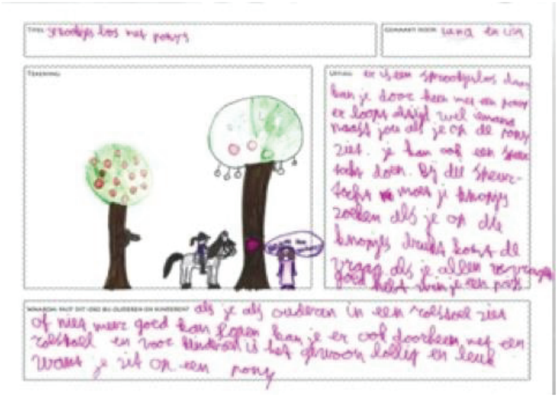

Figure 7. *Example of a generated idea*

Figure 8. *Idea Presentation*

Some first adjustments to the method are tested in another project with 27 twelve-year-olds at a Dutch high school. In this project the pupils had more influence on their research. Their target group was elderly, but the exact research topic was their own choice. Some groups investigated loneliness, others medicine use, communication, etc. Their final goal was to design something meaningful that fits the older population. This enables pupils to signal and select a design challenge that develops from the interaction with users. The process becomes more dynamic and iterative compared to a pre-defined challenge.

Conclusions/Discussion

The case study made by Hill (1998), which was described in the introduction, shows how difficult it is for pupils to understand the user in an early stage of the design process. When formal methods are absent, pupils tend to communicate about designs and do not investigate experiences, wishes and needs. As a result, pupils have limited information about the problem situation and are not able to develop solutions relevant to the user.

Our case study shows that it is possible to develop methods for human centered design that can be applied in primary schools. Pupils aged 9 to 12 are able to use interviews and personas to collect, analyze and synthesize information on the lives, needs and wishes of users. The method enables pupils to communicate with the user in a more open manner; the focus is not on products, but on experiences. We assume that this enhances the quality and the creativity of the design process and it's results. When pupils explore the experiences of the users first hand, they may notice other things. A number of research findings from the pupils differed from average ideas about the elderly. For example, one of the personas, Jan, aged 74, dreamt about learning to climb again.

Developing empathy

At the start of this project we foresaw a number of educational benefits for the participating pupils. During the project we found that these benefits were realized. Through well-prepared contact they gained empathy with a target group that is different from them. By asking questions and listening carefully to the answers, the pupils discovered similarities and differences between and with the elderly people, but also between them and other pupils. Other educational benefits were:

- While conducting interviews, the children gained new knowledge and activated old knowledge about people close to them.
- They accessed and shared their own experiences
- They were able to synthesize the collected information and developed mental images that respect the diverse target group.
- They generated ideas, keeping the needs and wishes of users in mind
- They used their own personal network to arrange participants and in some cases strengthened their family bound.

Boy: "My grandfather told me that he used to play soccer a lot, and all kind of things he did when he was a child, building huts for example! Usually he doesn't share these kind of things."

Research skills

The pupils showed, during this project, that they can be skillful researchers. They were good at asking questions and follow-up questions: Some children were very determined to get to the bottom of things. They took their role of researcher very serious and that reflected on their participants, especially the elderly, who answered most of the times very serious and elaborated. The use of voice-recorders strengthened this role and added to the feeling of professionalism.

During this project they practiced a great number of social and analytical skills. An example of this is that they came up with appropriate questions to get to the knowledge they needed. Next to that, they were good at summarizing and derived conclusions and actions from these summaries.

The level of skills as well as the thinking abilities of the children varied. The difference was partly due to age. One example of the difference in thinking level can be seen in the following answers from two different children:

Researcher: "Ok, what would this person write, dear diary, I think moving is…".
Boy (9): "Super cool! Supersonically cool!"
Girl (12): "A lot of fun because you can see everything around you. When you sit alone and still in your room you don't experience much."

In our case study, the differences in thinking level and the ability to put yourself in someone else's shoes were partly overcome by mixing the ages within the groups, so younger children learned from the older ones. The project shows that pupils aged nine are already able to use formal methods such as interviews and personas to gain knowledge on their peers and elderly people.

Success Factors

A number of aspects are especially responsible for the successfulness of the method:

- Becoming Curious: By starting the project with thinking of ideas for the "movement-garden" and subsequently asking the pupils what elderly would think of their ideas, they find out that they are missing knowledge and become curious. By practicing the interviews they also become curious about the real answers elderly would give.
- Early in the Design Process: Placing the encounter with the target group at the beginning of the project forces pupils them to gather insights before developing elaborated design ideas.
- Guidance and Security: The formal method gives the pupils structure. It is scary to do the interviews, by giving them the step-by-step guidance they felt more secure. Practicing the interviews improved the pupils' interview skills and they got familiar with the procedure.
- Ownership: Letting the pupils think of questions themselves and incorporating their contribution into the research booklet gave them ownership. The research booklet appealed and gave motivation.
- Authentic task: Letting the pupils arrange their own participants was valuable; finding them, setting a date and taking action was good to practice. When the pupils finished their interviews they were proud and really liked it.
- Cooperation: The team-members had a joint commitment. They shared knowledge, were focused on the task and supported each other to come up with a good design for the neighbourhood.
- Synthesizing information in Personas: The personas were an easy way to get the most valuable insights together into a story the children could work with. The personas were build-up with all group-members together. Everybody contributed to them, instead of making individual ones, which made the personas much richer. By making the persona together they all felt connected to the persona they were going to work with.

Improvements

In our case study, a researcher with a background in industrial design guided the process. However, the developed method can be used by teachers as well to help children to research people in their direct environment under supervision of a designer or teacher. In order to implement this method in a school environment without outside supervision, some aspects need to be further developed.

The method could be applicable to different (more open) themes in which pupils can specify the subject themselves, following their own interest and curiosity.

Reporting in the booklets, in written form, was hard for some of the pupils. Other ways of reporting can be explored or the interviews could be conducted in pairs; with one pupil focusing on asking questions and the other on reporting and observing.

Most of the time, the questions the children asked were related to activities. It would be nice to elicit more storytelling during the interviews by follow-up questions instead of sums of activities.

We hope that all policymakers turn away from the object-centered D&T education and explicitly state the necessity of human centered design. Our Contextmapping tool demonstrates the feasibility of human centered design in primary schools. Including the user will increase relevance and originality of the pupils design ideas as they develop new knowledge of users.

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A methodological approach to modelling design led innovation across secondary education: An Australian case study

Natalie WRIGHT*, Cara WRIGLEY and Sam BUCOLO
Queensland University of Technology, Brisbane, Australia

Abstract: *Incorporating design thinking as a generic capability at a school level is needed to ensure future generations are empowered for business innovation and active citizenship. This paper describes the methodology of an investigation into modelling design led innovation approaches from the business sector to secondary education, as part of a larger study. It builds on a previously discussed research agenda by outlining the scope, significance and limitations of currently available research in this area, examining an action research methodology utilising an Australian design immersion program case study, and discussing implications and future work. It employs a triangulated approach encompassing thematic analysis of qualitative data collection from student focus groups, semi-structured convergent interviews with teachers and facilitators, and student journals. Eventual outcomes will be reviewed and analysed within the framework of a proposed innovation matrix model for educational growth, synthesising principles responding to 21st century student outcomes. It is anticipated this research will inform a successful design led secondary education innovation model, facilitating new engagement frameworks between tertiary and secondary education sectors, as well as providing new insight into the suitability of action research in prototyping social innovation in Australia.*

Keywords: Design led innovation, design thinking, secondary and tertiary education, action research.

* Corresponding Author: School of Design | Queensland University of Technology | Australia |
e-mail: n.wright@qut.edu.au

Introduction

The publication of Landry's *The Creative City* (2000), Howkin's *The Creative Economy* (2001) and Florida's *The Rise of the Creative Class* (1999) has stimulated a liberal discourse on the value and importance of creativity and innovation to the global economy, and to understanding the complex challenges facing us in the twenty-first century. However, "in the last eight years, Australia has slipped from fifth to eighteenth in the World Economic Forum's Global Competitiveness Index". (Carr 2009, p.2). With an understanding of design as the link between creativity and innovation (Cox 2005, p.2), Australia needs to consider design thinking as central to its innovation drive (Livingstone, 2012) for future productivity. As The Centre for Educational Research and Innovation (2008, p.3) acknowledges, this is dependent on building capacities in life-learning skills, creativity, and innovation, ensuring alignment of education with the knowledge economy and society of the 21st Century. New modes of education that prepare the "missing middle" or K-16 education pipeline (Carnevale and Desrochers 2002, pp.18-22) to effectively drive the creative economic engine, need to be explored, ensuring that future business leaders are equipped with the necessary skills and habits to sustain economic, social and environmental resilience.

The United Kingdom Design Commission recommends an urgent re-examination of design education at all levels to preserve design industry competitiveness and to contribute to social and economic revival (Design Commission 2011; Design Council 2011, p.14). An international analysis of design education policy highlights that Finland's significant investment in interdisciplinary design research, education and promotion in 2005, dramatically impacted the country's global competitiveness (Design Commission 2011, p.39), and rated Finland as the top performing education system in 2006 (Ministry of Education and Culture of Finland 2007) and in the top three performing countries in the OECD 2009 PISA tests (OECD 2010). Australia's Asia Pacific neighbours including Singapore, Korea, Hong Kong and China are also actively realigning design education to ensure the effective delivery of an innovative workforce to support industry. These countries also rated amongst the top-performing school systems in the 2009 PISA tests (OECD 2010).

Australia also statistically rated significantly above the OECD average in the 2009 PISA assessments and is placed in the McKinsey School Systems Report "Good Performance" band (Finland is the only country placed in the Excellent Band) (Mourshed et al. 2010). However, due to the absence of a National Design Policy, and a National Education Policy that fails to recognise the cultural, economic and environmental contribution of design, Australia's activities did not rate a mention in this report. However, if indeed, "using creativity and design-based thinking to solve complex problems is a distinctive Australian strength that can help meet the emerging challenges of this century" in the Asian region, as stated in the *Australia in the Asian Century White Paper* (Commonwealth of Australia 2012, p.8), then there is a need to cultivate this strength by establishing a design led culture similar to the Nordic countries. In the context of this paper, "design led" is defined by Bucolo and Matthews (2011, p.2) as "the tools & approaches which enable design thinking to be embedded as a cultural transformation". Design thinking can be defined as the translation of "observations into insights and insights into products and services that will improve lives"(Brown 2009, p. 49). This transformation requires the introduction of design awareness at a school level, and the provision of incentives for students and teachers to work across disciplines and build open collaborative learning networks servicing

Australia's vast geography. However, to date, delivering design led innovation in an educational context has been confined to an industrial design/product design discipline (Wrigley and Bucolo 2011; Fixson 2009) and from a design thinking perspective in business education in limited international universities (Matthews, Bucolo and Wrigley 2011). Furthermore, there are no clearly defined frameworks for the application of design led innovation in the education sector, and empirical data surrounding design education integration in secondary school contexts, and its impact on national innovation and education systems, is extremely limited.

This paper, as part of a larger study, builds on a previously discussed research agenda (Wright, Wrigley and Bucolo 2012) by outlining an action research methodology designed to assist in the development of a prototype "innovation matrix" for modelling design led innovation in the secondary education sector. A focus on the action research cycle, which essentially mirrors the innovation process, highlights the intrinsic importance of the methodology design to the success of this research. To date, the role of action research as a resource for large-scale innovation has been limited, so it is therefore important that meta-methodology research in this area is discussed and reported to the research community. The paper reviews literature and highlights the current gaps in knowledge surrounding design led innovation in secondary education, and then describes an action research methodology utilising an Australian regional secondary school design immersion program case study entitled "*goDesign* Travelling workshop program for regional secondary school students" (Wright et al 2010). A triangulated approach to thematic analysis of qualitative data collected from student focus groups, semi-structured convergent interviews with teachers and facilitators, and visual protocol analysis of student journals, is discussed. A design led innovation framework for business growth is overlaid with 21st century student outcomes (The Partnership for 21st Century Skills 2009), and will be used to capture the results of the action research study and provide future recommendations for curriculum advancement of design in secondary education. It is anticipated that the findings of this research will allow further prototype testing through action research, potentially encouraging policy makers to see the value of design led innovation in the education sectors, and also contributing to knowledge about the viability of action research to successfully attain a scale required to achieve social innovation.

Modelling design led innovation across the secondary education sector

To ensure Australia remains globally competitive in the knowledge economy, there is an urgent need to investigate the impact of a design led culture on national innovation, in particular the introduction of design thinking as a generic capability at a school level. This research problem will be investigated through questioning:

How can design led innovation be modelled across the secondary education sector in Australia as part of a design led culture, to facilitate 21st century student outcomes and empower future generations for business innovation and active citizenship in the knowledge economy?

The study will address the lack of evidence-based theory-practice research on modelling design led innovation across the secondary education sector in Australia and the following sub-research questions:

- How can design led innovation capabilities be facilitated through an Australian immersion program?
- What is the perceived value of design led innovation capabilities held by students, secondary school educators, tertiary educators and design professionals?
- What is the perceived value of design in secondary education and its role in the future knowledge economy?

It is the proposition of this research, that a comprehensive analysis of current research in the five areas of international design and education policy, design led innovation in business, design led innovation in the education sector, secondary education curriculum and innovation/engagement in the secondary/tertiary education spheres is required (refer Figure 1), in order to assist in prototyping a model for design led innovation in the Australian secondary education sector, in the form of design immersion. Informed by this model, the "*goDesign*" (Wright et al 2010) regional case study pedagogy/curriculum and associated research agenda will be revised in preparation for a second phase to be conducted in Queensland, adding to the body of knowledge surrounding the value of design immersion programs in Australia, and potentially encouraging other states to broaden the case study and research findings.

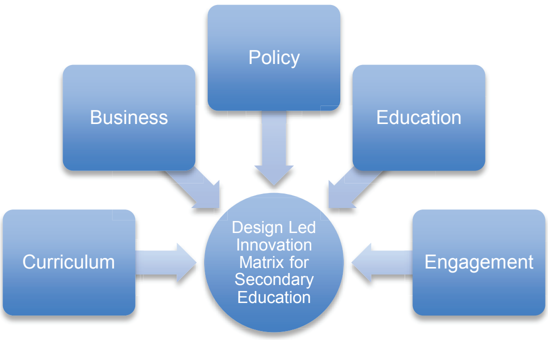

Figure 1. Key Components of the Proposed Research

Design Education in the Knowledge Economy: An Emerging Field

More recently, design thinking has been acknowledged by increasingly diverse professions and industry leaders as a wider strategy to enable innovation across all sectors, including education. This is evidenced in program changes at Harvard, Stanford, MIT and other top 50 ranked universities, and executive training in leading business organisations. However, reviews by McGimpsey (2011) and Miller (2011) of design education in the United Kingdom National Curriculum since its establishment in 1988, highlight a surprising lack of evidence-based research assessing the impact of design in the secondary education sector on national innovation and education systems. To ensure that future business and community leaders are equipped with the necessary skills and habits for the future, there is a need to address this gap with further research in design led innovation in the secondary education sector.

Consideration of a design led innovation model for secondary education in the knowledge economy, requires an understanding of the evolved cultural shift from the traditional "teacher-based approach" towards a "learning based approach" (Thomas and Brown 2011). John Seely Brown (2010, p.xi), former Chief Scientist of Xerox Corporation and Director Emeritus, Xerox PARC, notes that learning in the 21st century is no longer '"learning about" nor "learning to be". Instead, he proposes that there is a "need to embrace a theory of *learning to become",* where learning is an evolving practice of becoming, dealing with more than systems and identity, and transmission of knowledge. To do this, he says that we need to consider new emerging modes of learning which consider "social, distributed and networked dimensions" and the "broader economic and technological landscape" in which the learning occurs (Brown 2010, p. xii).

In this "New Culture" the students of generation "P" for "participatory" (Jenkins 2006) learn from the building of their own networked communities or collectives (Thomas and Brown 2011, p.52) based on shared interests and perspective, and assisted by digital technologies (2011, p.89). Cope and Kalantzis (2010, p. 597) argue that this shift from authoritative instruction to peer-to-peer learning through agency, requires that education needs to cater for the "growing numbers of people who are designers by persuasion but not profession". Design in education must be conceived of as interdisciplinary and even metadisciplinary.

Beckman and Barry (2007) claim that the embedding of design thinking incorporates all four phases of an ideal learning cycle – experiencing, reflecting, thinking and acting. They advocate for the value of innovation as an experiential learning process of "problem finding/problem selecting, solution finding/solution selecting, or story-telling" (2007, p.47). As opposed to the main focus of education today on problem solving, the innovation process places equal importance on identifying, framing and reframing the problem to be solved. It is also a learning cycle that draws upon the four learning styles of (i) diverging, (ii) assimilating, (iii) converging and (iv) accommodating. It allows the learner to experience their learning style preferences, and gain an understanding and empathy for the different personalities required to achieve innovation. Design led innovation in education provides a logical structure and framework for critical and creative thinking and a curatorial approach to nurture and empower non-traditional forms of collective learning. It also has the potential to provide an extra visual language for communication, unlock practical competence in non-academic students and develop resourceful optimism, motivation and a sense of agency (Design Commission 2011, p.28), thus addressing the pressing educational challenges of promoting active citizenship, developing employability, and tackling underachievement and social exclusion (Bentley 1998).

If "creative people are indeed the chief currency of the emerging economic age" (Florida 1999, p.28), the Australian National Curriculum needs to optimise vocational creative capacity building, elevating creativity, from its value-neutral position in art education and as a higher order thinking skill in Bloom's Taxonomy, to an interdisciplinary and metadisciplinary practice for innovation. This will require a comprehensive design led framework to be developed to allow prototyping and infrastructuring for social innovation across the education sector. It must engage on a political level and respond to economic growth imperatives, as well as educational objectives. It will also require educators to shift their attention from "content delivery to capacity building, from supplying curriculum to co-creating curriculum, from supplying education to navigating learning networks" and to shift student attention from "their own individual performance to their capacity to learn through their own networks – to connect, access information and forge relationships in and through dynamic and productive teams" (McWilliam and Haukka 2008, p.23).

It is understood that Finland's high educational outcomes have not been achieved by performance measures, standard templates, teacher accountability, or by prioritising test performance above all other aspects of learning. As Bentley (2008, p.228) notes, this success has been achieved through the development of a set of institutional foundations that promote a "culture of open, network-based interaction, symbolised by Nokia". On this basis, Bentley (2008) advocates for open innovation, involving new practices and models for schooling generated at a local level, and continuously reshaped and tested via open collaborative learning networks with clear protocols and coordination systems (2008, p.206). This research proposes such a model for design led innovation that has the capability to be tested through action research in schools, with a view to larger scale reform.

Design Led Innovation in the Classroom

This research utilises Baghai, Coley & White's (1999) "horizons of growth" framework in order to better understand a model for design led innovation that can potentially be translated across educational contexts. Baghai et al (1999) describe a company's growth potential to be a function of three distinct phases or "horizons" of product and revenue creation, each managed simultaneously for effective innovation. Horizon One in this framework is defined as the core business of the current corporation, usually accounting for the majority of annual revenue, profit and cash flow. Horizon Two includes the ventures in the entrepreneurial phase or just entering the market (with a long way to go before market maturation). Finally, Horizon Three contains the investments or seeds for tomorrow's growth.

Similarly, a "growth staircase" of manageable actions can be drawn to establish three horizons required for effective innovation in the classroom and the growth of the 21st century student. Carroll et al's (2010) research conducted within an urban middle school in the United Kingdom education system, highlights the efficacy of design thinking under three major themes of (i) Design as Exploring: Understanding Design, (ii) Design as Connecting: Affect & Design, and (iii) Design as Intersecting: Design Thinking & Content Learning. In this context, overlayed with the 21st Century skill outcomes outlined in the P21 Framework Definitions (The Partnership for 21st Century Skills 2009), the "Design as Exploring" theme can be categorized as the "Horizon One" phase described by Baghai et al. (1999). This is where students explore and understand the design process while also mastering core subjects and 21st century themes such as global awareness and entrepreneurial, civic, heath and environmental literacy (The Partnership for 21st Century Skills 2009, pp. 2-3). The "Design as Connecting" theme relates well with the "Horizon Two" phase (Baghai et al, 1999). This involves preparing students for more complex life and work environments with creativity and innovation skills, critical thinking and problem solving skills, communication and collaboration skills, information, media and technology literacy (The Partnership for 21st Century Skills 2009, pp. 3-6), as well as metacognitive skills. Lastly, the "Design as Intersecting" theme correlates with the Baghai et al's (1999) "Horizon Three" objective. This consists of planting the seeds for tomorrow's growth by developing adequate life and career skills to empower utilisation of design thinking in life and work environments, including flexibility and adaptability, initiative and self-direction, social and cross-cultural skills, productivity and accountability, and leadership and responsibility (The Partnership for 21st Century Skills 2009, pp.6-7).

Mapping the efficacy of design thinking with the 21st century student outcomes provides a framework for the evaluation and continuous improvement of design thinking pedagogy in the classroom. However, in order for this framework to resist a linear approach to creative capacity building, and allow for more longitudinal data collection, it must incorporate the complexity of changing learning environments, intermediary social structures and stakeholders, and new pedagogical approaches.

The Innovation Matrix

In business, Kyffin and Gardien (2009, p.57) propose “the scope of innovation has increased in complexity, where products, services, user needs and technologies need to be integrated while bringing many different stakeholders together”. They indicate that this therefore requires an alternative non-linear process of innovation as a network of options seen within a trajectory of three horizons of growth and utilised on a case-by-case basis. Their “Innovation Matrix” emphasises that different competencies, capabilities and personal profiles are required for each phase and propose that the mechanisms of “identifying value”, “developing value” and “communicating value” are superimposed on the three horizons model to effectively capitalise on opportunities in Horizon Three.

In the quest for a design led innovation approach for the secondary education context, where Horizon Three represents the development of individual life skills beyond the classroom and the navigation of complex environments in the globally competitive information age, it can be argued that a similar landscape of complexity exists. McWilliam and Haukka (2008, p.21) note that creative capacity building requires a fundamental shift towards a more experimental pedagogical setting, drawing on a fluid network of people and ideas. As design becomes located more centrally in society’s immediate agendas by the discourses of the knowledge economy, it is also relevant to note Cope and Kalantzis’ (2011, p.45) notion of a “shift in the balance of agency”, which they argue “affects the roles and relationships of designers and users and which increasingly demands design interdisciplinarity” and a transformation of the repertoire of designers’ practices.

This has implications for teachers, professional designers and tertiary educators in modelling design led innovation in the secondary education sector. As schools “transform themselves to become the hubs of learning networks …. brokering learning opportunities with people and organisations in the communities around them” (Bentley 1998, p.183), teachers will gain opportunities to embrace new flexible learning opportunities beyond the classroom, motivated by the power of community-based collaborative learning. Therefore, a similar “Innovation Matrix”, to allow innovation-generating possibilities in an open learning model, and to leverage future development in this sector, warrants construction. It needs to capture the potential variables of community, parents, design and industry professionals, business professionals, university educators, tertiary design, business and education students, online tools and out-of-classroom activity.

Literature Summary

A review of current literature surrounding the five aforementioned study areas, highlights a number of knowledge gaps as summarised below:

- Design led innovation frameworks in the business sector have not been mapped across the education sector, and therefore literature on how to successfully implement design thinking across (and into) education is limited.
- There is a lack of systematic academic research surrounding the role of design thinking in educational contexts. The research to date has largely been driven by policy or conducted in small isolated contexts.
- There is limited current research that addresses how design led innovation correlates to the development of the 21st century skills.
- There is no substantial current research on design led innovation in the secondary education sector. Academic research on design led innovation education in the tertiary sector is limited to business, science and technology and design. As a result, the value of implementing design led innovation in secondary schools and tertiary education sectors for future business success is, as yet, unknown.
- Creativity has become increasingly important within the wider secondary education discourse and now occupies a central position in definitions of curriculum design. However, the definitions of design, design thinking, design-led innovation and creativity in the education sectors are currently ambiguous and misunderstood.
- Research surrounding educational innovation has neglected to comprehensively explore design led innovation as a strategy for aligning education with the knowledge economy and society of the 21st century.

The summary of literature, indicates that in order for design led innovation to be successfully modelled in the secondary education context to build generic capability for future 21st century citizens, design led innovation in the business sector must be translated across to the education sector. From this, a framework for future action research can be developed.

Methodology

From the identification of the research gap, the methodology of action research was selected, with the aim to explore design led innovation in an immersion program in the classroom, and conducted through a multiple embedded case study. Cope and Kalantzis's (2011) notion of a "shift in the balance of agency" demands a research methodology which is "as an agent of change" (Gray 2009, p.313). Appropriately for this study, action research is widely used both in business and education spheres as an emancipatory tool to approach real-world problems and bring about social change, requiring collaboration between researchers and practitioners - a marriage between "Theory" and "Praxis" (Hammersley 2004). In a quest to utilise this methodology within a framework for future open innovation at local levels across the state, Bjorn Gustavsen's experiences from action research programmes for business innovation in Scandinavia, must be noted. To date, action research has so far played a limited role as a resource in democratic innovation, with the core challenge to encourage participants/researchers "to reach a level of scale, or mass, that makes innovation possible" (Gustavsen 2005, p.267). This study also becomes meta-methodology research to this end, adding significance to the contribution of this study in a global context.

Research Approach

Crotty (1998, pp.2-9) suggests that there is an interrelationship between the researcher's epistemological stance and the theoretical perspectives adopted, which in turn influences the research methodology, and then the choice of methods for data gathering. Figure 2 illustrates the proposed research relationships in this research design. An inductive approach will be utilised, with data gathering and data analysis methods designed to be qualitative (favoured by participation).

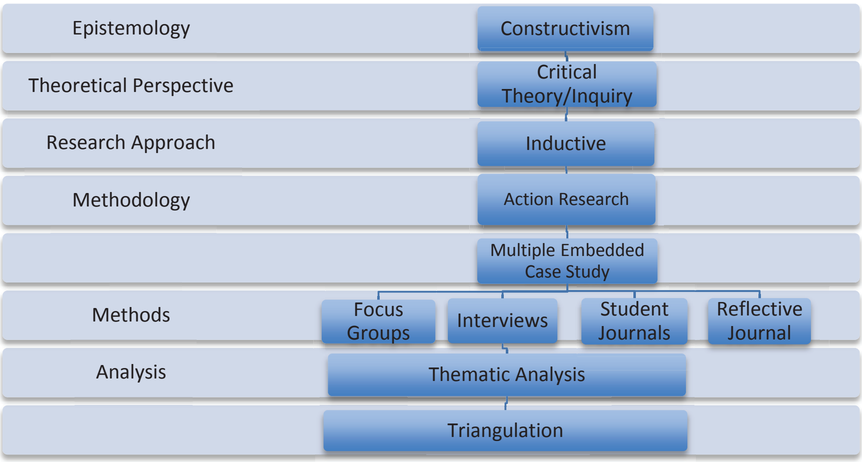

***Figure 2**. Structure of the Proposed Research Process. Source: Adapted from Crotty 1998.*

In actively seeking to showcase to policy makers, the value of design process to prepare students with the skills for the 21st century knowledge economy, this research takes a constructivist epistemological position, emphasising "instrumental & practical function of theory construction" (Crotty 1998, p. 57). In the mode of "bricoleur", constructivist research requires that the problem be approached in "a radical spirit of openness" to the potential of reinterpreting conventional meanings (1998, p. 51).

It follows then, that the primary constructivist approach is critical inquiry for the development of critical theory. This is a meta-process of investigation that invites both researchers and participants to question currently held values and assumptions, and challenge conventional social structures, as a guide to effective action (Gray 2009, p.25). By preparing students with the tools to utilise the design process as a different way of looking at the world, the research aims to empower them with life learning skills to create social change, for the cultivation of a more progressive, creative and democratic society. Boog argues that the action research methodology has these emancipatory intentions and is:

> designed to improve the researched subjects' capacities to solve problems, develop skills (including professional skills), increase their chances of self-determination, and to have more influence on the functioning and decision making of organisations and institutions from the context in which they act. (Boog 2003, p.426)

His review shows that design thinking is to some extent implicit in the historical roots of action research. It is a methodology developed out of critical theory, but goes beyond just understanding the situation, to asking "How can it be changed?" (McNiff and Whitehead 2011, p.47), with an emphasis on its participatory nature to combat relations of power.

The research seeks to address global competiveness by establishing a design led culture, involving the introduction of design thinking as a generic capability at a school level. Bucolo and Matthews (2011, p.2) define "design led" as having a vision for growth based on deep customer insights; expanding this vision through co-design with stakeholders; and mapping these insights to all aspects of the business. This correlates to the aims of action research, which Carr and Kemmis (1986) describe as a practice-based practice: the improvement of practice; the improvement of the understanding of practice; the improvement of the situation in which the practice takes place. Review of the design thinking or innovation process as adapted by Beckman and Barry (2007, p.47) from Kolb's experiential learning cycle, against the "spiral process" (Hammersley 2004) of an action research cycle (Zuber-Skerritt 2001, p. 15), presents some distinct similarities. The "Plan", "Act", "Observe" and "Reflect" cycle of action research corresponds to the "Imperatives", "Solutions", "Artifacts" and "Insight" of the design thinking/innovation process, thus the generic capabilities of design thinking are mirrored in the research process. In much the same way design is an iterative process, Zuber-Skerritt (1996a) notes that reaching the fourth step in the action research cycle initiates a new cycle and so on. Additionally, action research, like the innovation process, is "problem-sensing and problem-focusing" - a problem indicates a need to effect change and bring about improvement (Hart and Bond 1995, p.52), requiring an organised involvement of a researcher or a consultant in the environment where the problem exists (Gill and Johnson 2002, pp. 65-95).

As this study requires the influence of the researcher/facilitator as an outside design "expert", who will have a major role in the research endeavours and the development of the efficacy of educational practices and professional development, the methodology is distinguished by Zuber-Skerritt (1996b) as technical action research. Hart and Bond (1995, pp. 37-38) observe seven criteria of action research that differentiate it from other methodologies:

- is educative;
- deals with individuals as members of social groups;
- is problem-focused, content-specific and future-orientated;
- involves a change intervention;
- aims at improvement and involvement;
- involves a cyclic process in which research, action and evaluation are interlinked;
- is founded on a research relationship in which those involved are participants in the change process.

In addition to this, educational action researchers transform their practice into living theories, informing new practices for themselves and others in the direction of their educational and social values (McNiff and Whitehead 2011). This study will take a living theory perspective that will place the researcher as the practitioner at the heart of the educational inquiry, with a view to generating a personal living educational theory. The researcher will explain how they are accountable for their own learning and their influence in the learning of others. (McNiff and Whitehead 2011, p.47)

Research Objectives

With an understanding of Carr and Kemmis's (1986) previously mentioned definition of action research as "the improvement of practice; the improvement of the understanding of practice; and the improvement of the situation in which the practice takes place", a collaborative, participatory, whole school community approach aims to achieve the following primary objectives:

- Speculation on the alignment of design led innovation in education with 21st century student outcomes and preparation for business innovation and active citizenship in the Knowledge Economy.
- Facilitation of meta-research, allowing for the researcher's improved understanding of the methodology and its value to their design education practice in the creation of a personal 'living educational theory' about innovation and cultural transformation.
- Proposal of guidelines and development of a framework or innovation matrix for modelling design led innovation in the secondary education sector in Australia, to allow for prototype testing through action research, with a view to larger scale reform.

To achieve such objectives the study is informed by a comprehensive literature review comprised of the five aforementioned relevant areas of study, within Flick's (2006) three categories of theoretical, empirical and methodological literature. Given the state of Queensland's unique reliance on industry clusters in regional and remote centres for economic growth, and its sheer geographical scale and diversity, which typifies the greatest challenge to modelling design led innovation in schools in Australia, a case study utilising participants in a wide, random sampling of regional public secondary schools was devised. The integration and contrast of differing perspectives will allow construction of a rich and detailed understanding of context to inform a design led education innovation model in the form of the proposed "innovation matrix".

Case Study

The case study (or multiple case studies) is the prevailing medium for action research (Gray 2009, p.30). However, as action research deals with a specific situation, generalisation can be a concern (Gill and Johnson 2002). The multiple embedded Australian case study undertaken, was a design immersion program entitled "goDesign Travelling design workshop program for regional secondary school students" (Wright et al 2010) conducted throughout 2010. It was a three-day supportive and interactive experience simulating a design studio environment for up to 20 self-selected year 8-12 students and teachers from six selected regional Queensland high schools. Each workshop linked regional communities with two tertiary design educators, a visiting design practitioner, and in some locations, a local industry professional. The workshop program introduced the different disciplines of Graphic Design, Fashion Design, Product Design, Interior Design/Architecture and Landscape Architecture. Locations and participants in each of the six workshops are summarised in Table 1. During the program, students and teachers explore, analyse and re-imagine their local town through a series of scaffolded problem solving activities around the theme of 'place'.

Underpinning the program is the integration of Burnette's IDESiGN (1993) teaching model and a place-based approach that "draws upon local cultural, environmental, economic and political concerns"(Smith 2007, p.18).

Methods

The validity of action research is based on many factors: the use of different methods; interpretation of findings is shared with the participants to give "consensual validity" and the applicability of results in real life achieves "action validity" (Heller 2004). Furthermore, McTaggart (1997, p.37) notes that validity is maintained by '"triangulation of observations and interpretations, participant confirmation, and testing the coherence of arguments being presented". Carpenter and Suto (2008) define methodological triangulation as that meaning that multiple methods are used in the data collection process. If similar findings emerge from these different methods, it "serves to enhance the validity of research results" (Hesse-Biber and Leavy 2005, p.65). To ensure validity of the research methods is maintained, a data triangulation approach, consisting of research outcomes from each workshop in the case study, was employed to collect multiple forms of visual and verbal data, illustrated in Table 1 including:

- visual design outputs and student reflective journals used during the three-day workshop and collected at the completion of the workshop program;
- qualitative semi-structured convergent interviews (Dick 1990) creating a dialectic with the participating school principals and teachers, and facilitators (captured by video recordings) at the completion of the workshop program; and
- qualitative semi-structured focus groups conducted with the students (captured by video recordings) at the completion of the workshop program.

Additionally, the researcher's reflective journal captured evidence of research/practice insights and reflection on student/teacher learning.

***Table** 1. Schedule of goDesign Case Study Data Collection Methods*

Case Study	Data Collection				Date
	Semi-structured Interviews	Focus Groups	Student Journals	Reflective Journal	
1	Principal IDT Teacher IDT Teacher Design Professional Facilitator Tertiary Student Facilitators (2)	Grade 10-12 IDT/Visual Arts/ Graphics Students (20)	Grade 10-12 IDT/Visual Arts/ Graphics Students (20)	Researcher + Facilitator Validation Group	Feb 2010
2	Dance Teacher Visual Art Teacher Design Professional Facilitator	Grade 12 Visual Arts students (6)	Grade 12 Visual Arts students (6)	Researcher + Facilitator Validation Group	March 2010
3	Principal Manual Arts Teacher Visual Art Teacher Design Professional Facilitator	Grade 8-12 Secondary Students (8) (incl. (2) intellectually impaired)	Grade 8-12 Secondary Students (8) (incl. (2) intellectually impaired)	Researcher + Facilitator Validation Group	May 2010
4	Graphics Teacher Visual Art Teacher	Grade 10-12 Visual Arts/	Grade 10-12 Visual Arts/	Researcher + Facilitator	July 2010

	Design Professional Facilitator	Graphics Students (20)	Graphics Students (20)	Validation Group	
5	Graphics Teacher Visual Art Teacher Design Professional Facilitator	Grade 10-12 Visual Arts/ Graphics Students (20)	Grade 10-12 Visual Arts/ Graphics Students (20)	Researcher + Facilitator Validation Group	August 2010
6	Principal IDT Teacher Teacher's Aide Design Professional Design Professional Facilitator	Grade 10 -12 IDT/Visual Arts Students (20)	Grade 10 -12 IDT/Visual Arts Students (20)	Researcher + Facilitator Validation Group	Sept 2010

Analysis

Somekh (1995) states that action research reporting should address academics' and practitioners' interests alike. This research draws on a comparative analysis of the emergent themes from the triangulated collection of multiple information sources of qualitative data. Thematic analysis is "a method for identifying, analysing and reporting patterns (themes) within the data" (Braun and Clarke 2006, p.79) and is perceived "as a foundational method for qualitative analysis" (2006, p.78). Thematic outcomes from the triangulation will then be utilised within the framework of the proposed aforementioned "innovation matrix" model for educational growth, to inform a design led education innovation model. The analysis methods for each data set will be as follows:

Semi-structured convergent interviews and focus groups

Raw interview and focus group case data will be collated, transcribed and analysed for each case. Each will undergo a case-by-case emergent thematic analysis using grounded theory processes of coding, memoing and sorting (Glaser 1992). This is essentially a detailed examination of the data for identifying, naming, categorising and describing patterns in the text. From the emergence of themes, a coding framework will be generated in order to identify the significant themes, categories and sub-categories.

Student Reflective journal and visual design outputs

Student reflective journals and visual design outputs will be analysed using visual protocol analysis to identify similar emergent themes, as discovered through the other analysis protocols. Instead of identifying themes from a verbal data set, now this will be done from a visual data set format. Loizos (2000) argued that visual data collection is also needed to corroborate testimonials of verbal data as a means to uncover ambiguous interpretations. His conclusions are in accordance with those studies in which sketches were used along with verbal protocols in order to access greater detail of the design process as a whole. (Loizos 2000, p.96)

Researcher's Reflective journal

The researcher's reflective journal will be analysed to find evidence of exercising influence to improve learning for improving practice, contributing to meta-research in improving the research practice, and the development of a researcher/practitioner Living Educational Theory (Whitehead 2003; McNiff and Whitehead 2005). In accordance with the suggestions of McNiff (1988), the five facilitators who accompanied the researcher to conduct the case studies in each location, along with the design professionals (where available), will form a validation group, which will meet at crucial stages of the project to scrutinise the outcomes of the study.

Implications and Future Work

This paper presents the methodological approach of an ongoing research project aimed at modelling design led innovation strategies from the business sector across secondary education, to provide a clearly defined social innovation prototype model. Using a triangulated approach to thematic research outcomes from an action research methodology in a multiple embedded case study, it is expected that this research will provide a new framework for curriculum involving design led innovation in the secondary education sector, to assist in preparing students with the skills required to operate in the 21st century knowledge society. This framework or "innovation matrix" will accommodate a network infrastructure, engaging the tertiary education sector, community, industry and design professionals, to provide opportunities for growth beyond the traditional classroom scenario. It is also expected that this research and the resulting conclusions for the finished project will provide a deeper understanding of the value of the action research methodology in modelling design led innovation in the education sector, in particular its ability to scale to achieve social innovation. Furthermore, it will improve personal learning for improving practice, contributing to meta-research in improving the research practice, and the development of a Living Educational Theory. It is perceived that there will be a multi-faceted contribution to new knowledge in the broader research community, with findings from this study impacting the professional design sector and business sector, as well as the secondary and tertiary education sectors. It is anticipated that the findings of this research will encourage policy makers to see the value of design led innovation in the education sectors, and encourage ongoing action research investigations in this area, with the long term aim to address the lack of evidence-based theory-practice research on modelling design led innovation across education sectors in Australia.

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The creative citizen: Understanding the value of design education programs in the knowledge economy

Natalie WRIGHT[a*], Rebekah DAVIS[b,a] and Sam BUCOLO[a]
[a]Queensland University of Technology; [b]Griffith University

Abstract: *The knowledge economy relies on the diffusion and use of knowledge as well as its creation (Houghton and Sheenan, 2000). The future success of economic activity will depend on the capacity of organisations to transform by increasing their flexibility. In particular, this transformation is dependant on a decentralised, networked and multi-skilled workforce. To help organisations transition, new strategies and structures for education are required. Education systems need to concentrate less on specialist skills and more on the development of people with broad-based problem solving skills that are adaptable, with social and inter-personal communication skills necessary for networking and communication. This paper presents the findings of a 'Knowledge Economy Market Development Mapping Study' conducted to identify the value of design education programs from primary through to tertiary level in Queensland, Australia. The relationship of these programs to the development of the capacities mentioned above is explored. The study includes the collection of qualitative and quantitative data consisting of a literature review, focus groups and survey. Recommendations for the future development of design education programs in Queensland, Australia are proposed, and future research opportunities are presented and discussed.*

Keywords: Knowledge economy, creative economy, design education

Education in the Knowledge Economy

Over the last twenty years societies have transitioned away from labour intensive 'smoke-stack' industries towards a knowledge intensive and creative organisational focus. A consequence of this transition has been the transformation of the workforce, from labour intensive into flexible, decentralised, networked and multi- skilled. This

* Corresponding author: School of Design | Queensland University of Technology | Australia | e-mail: n.wright@qut.edu.au

transition requires new cross-public-sector strategies, systems and policies for educational innovation. It has become imperative for individuals and organisations to continuously evolve, learn, create and apply knowledge – to participate in "lifelong learning" (Bentley, 1998, p.81). To this end, Bentley argues that education systems should strive for three things (1) autonomy, (2) responsibility and (3) creativity (1998, pp.356-357).

The generation of a "networked economy" (Seltzer and Bentley, 1999) dictates that education needs to focus on the connections between schools and society, relating learning to the challenges of adulthood, and giving young people exposure to a wide range of contexts, role models and experiences of genuine responsibility (Bentley, 1998). A new "landscape of learning" that understands the business climate and extends beyond teacher responsibility in the classroom, to address the pressing challenges of promoting active citizenship, developing employability and tackling underachievement and social exclusion, is required (Bentley, 1998). Landry's *The Creative City* (2008) and Florida's *The Rise of the Creative Class* (2004) have stimulated rich discourse on the socio-cultural and economic implications of developing formal and informal intellectual infrastructures in cities to attract a new 'creative class' population. As universities are seen as the central actors in this networked knowledge economy, it is critical that their role and contribution as a key stakeholder is understood and clarified to ensure future policy is directed to generating conditions in which they best perform (Dodgson, 2012).

New education policy and modes of education that go beyond the current "back-to-basics" core secondary curriculum organised around the discrete disciplines of mathematics, science, English, and languages, need to be explored to allow the 'missing middle' of the K-16 education pipeline (Carnevale and Desrochers, 2002) to effectively drive the future economic engine. In a new "participatory" (Jenkins 2006) culture, a transition from the traditional "teacher-based approach" towards a "learning based approach"(Thomas and Brown 2011) will see students learning from the building of their own networked communities or 'collectives' based on shared interests and perspective, and assisted by digital technologies as a source of rich information and play. Future learning environments will centre on students proving that they can embrace the unknown - and through inquiry, embark on a process of re-creation (Thomas and Brown, 2011). These new models of education are demand-led, do-it-yourself, individualised modes of learning.

As the 21st century knowledge economy relies on the diffusion and use of knowledge, as well as its creation (Houghton and Sheenan, 2000), education systems must concentrate less on specialist skills and more on the development of adaptable people with broad-based problem solving skills, diversity of perspective, and social and inter-personal communication skills necessary for networking and communication. According to the Partnership for 21st Century Skills, preparing students, workers and citizens to thrive in the global skills race to ensure economic competitiveness involves a focus on innovation, creativity, critical thinking, problem solving, communication and collaboration (The Partnership for 21st Century Skills, 2009). Further, Burnette (1993) indicates, these graduate attributes "are all directly addressed through the different ways of thinking during design". Design is often viewed as the most appropriate tool in which we can better understand the processes of change and becoming capable of change-making (Kimbell and Perry, 2001). Design is now being flagged as a form of knowledge-based capital that can be used to drive innovation and growth (OECD, 2012a). Design as a discipline has become a significant domain of activity which demands the full attention of policy and decision makers (Chapman 2002).

This paper presents the findings of a Knowledge Economy Market Development Mapping Study (Wright, Davis and Bucolo, 2013) commissioned by Queensland Government Arts Queensland in response to a state government design policy focus to "build design knowledge and learning" (Queensland Government Arts Queensland, 2009). This study was conducted to identify the scope and value of the design education and research program activity from primary schools through to the professional design sector in Queensland, Australia. The relationship of these programs to the development of the creative citizen in the 21st century knowledge economy is explored. Recommendations for the future development of design education programs in Queensland are proposed and future research opportunities are presented and discussed.

It is anticipated that the findings of this research will contribute to the development of a comprehensive national resource pool of academic support literature demonstrating the need for education policy to acknowledge the critical role of design thinking and practice in education, in fostering future productivity and community.

International and National Design Initiatives

The inaugural UK Design Commission's report, *Restarting Britain – Design Education and Growth*, recognises that design skillsets provide an extra visual language and a logical structure and framework for critical and creative thinking. Design also encourages behaviours which unlock practical competence in non-academic students to help them develop resourceful optimism, motivation and a sense of agency (Design Commission 2011). The report acknowledges that the UK has a rich history in design education, however reviews by McGimpsey (2011) and Miller (2011), of its inclusion in the National Curriculum since 1988, highlight a surprising lack of evidence-based research assessing the impact of design on national innovation and education systems. This lack of evidence-based research has prompted a call for an urgent re-evaluation of design education at all levels (Design Commission, 2011; Design Council 2011).

Increasingly, design is being valued by governments and international organisations as a tool to promote innovation and development (Patrcinio and Bolton, 2011). The European Design Leadership Board (European Union, 2012) highlights six different areas for strategic design action towards growth and prosperity, including the education system, indicating a clear trend toward design integration across, and between, disciplines and stakeholders. An international analysis of design education policy (Design Commission, 2011) highlights, that due to the high cultural value placed on design and creativity across all levels of education, industry and practice, Finland is ranked as one of the top-performing countries in terms of the quality of its educational system (OECD, 2012b), and has dramatically improved its global competitiveness. The establishment of the first interdisciplinary university - Aalto University, Helsinki - demonstrates Finland's commitment to fostering interdisciplinary practice at all levels towards national innovation.

The United States is also viewed as a world leader in interdisciplinary design education initiatives, particularly at the primary and secondary level. Project H Design is one example of a new era of design education and non-profit sector level engagement. The goal of Project H is to use design to activate communities and build creative capital within public education. In the Asia Pacific region, Singapore, South Korea and more recently Hong Kong are re-examining design education at all levels to ensure delivery of a workforce for future industry innovation. In Singapore, children are exposed to design education programs in both primary and secondary schools, and 'Design and Technology' is a compulsory subject in lower secondary schools. In New Zealand, the Growth and Innovation Framework (GIF) has been used to develop a knowledge-based economy by providing new ways for government to link cultural and economic values (Bill, 2011).

Comparatively, Australia's activities in this area are limited. While it is well regarded as a high performing country economically, much of this has been attributed to an unsustainable mining sector boom. Viewing 2011 data in the World Bank Knowledge Economy Index (KEI), Australia is ranked second (KEI 9.71) for education (based on three variables of adult literacy rate, secondary enrolment and tertiary enrolment) and 19 for innovation (KEI 8.92), behind some of its Asia Pacific neighbours (The World Bank, 2012). This highlights the urgent need for Australian institutions (and specifically Queensland) to engage in deeper collaboration in order to generate, disseminate and apply knowledge generated by design, to build a reputation in manufacturing innovation (Prime Minister's Manufacturing Taskforce, 2012).

The Creative Industries Task Force 2001 report (2001) highlights design as a growing sector, emphasising four key areas that design will need to address in the future – (i) Aging population; (ii) Social responsibility; (iii) Competitive advantage; and (iv) New technology. However, the current National Design Policy, and National Cultural Policy fail to recognise the contribution of design-led thinking in the cultural and economic sectors. Furthermore, these policies also fail to acknowledge the importance of design-led thinking in education for future sustainment. The Australian National Curriculum has seen a nation-wide reconfiguration of learning to create efficiencies across states and also to recognise 'higher order thinking' and complex problem solving abilities. However, design is not yet recognised in the education context as a vehicle for achieving these aims. This is primarily due to a lack of local (Australian) evidence-based research, and the lack of understanding surrounding the critical role design-led thinking can play in fostering these student (learner) capabilities.

The Queensland State Government has a very successful, internationally applauded Design Strategy (See Project, 2009) that positions Queensland as a leading centre for design in Australia and the Asia-Pacific region. The *Queensland Design Strategy 2020* (Queensland Government, 2009) is a whole-of-Government framework, to be implemented over three four-year periods, to lead industry, community and the public sector in adopting and valuing design, with four key objectives:

1. Strengthen the Queensland economy
2. Foster a design culture
3. Build design knowledge and learning
4. Support public sector innovation

The Queensland Design Council (QDC), a high level strategic advisory body whose role is to inform the Queensland Government's design agenda and the direction and priorities of the Queensland Design Strategy 2020, believes that design-led thinking and practice is central to Queensland's development, productivity, culture and quality of life. It also believes that the role of design thinking and practice in education is critical.

Background to the Study

For Queensland to position itself as a knowledge economy, and as part of the Asia Pacific design community, it must demonstrate leadership in valuing, prioritising and measuring the success of design and creative education across all levels. Moreover, if Australia's world position for education is to change, then the current social and professional status of teachers must change (Hattie, 2010). With this agenda, *The Knowledge Economy Market Development Mapping Study* (Wright, Davis and Bucolo, 2013) was commissioned by the Queensland Government, Arts Queensland to garner a direction for future prioritisation and funding of design education and research activities and to drive market development in Queensland. Moreover, the study responds to the *Queensland Design Strategy 2020* objective to "build design knowledge and learning" (Queensland Government 2009).

This study aimed to contribute to design sector development by establishing a platform to assist the Queensland Design Council to visualise current activity, assess existing programs and funding, and advocate for the development of new programs, projects or strategies (with appropriate funding). This is necessary in order to address deficiencies responding to future knowledge economy demands in design education and research in Queensland. By examining activity in design education/research across primary school, secondary school, tertiary, continuing professional development and postgraduate research, this study demonstrates the breadth of public engagement in design.

Building on the National Cultural Policy Discussion Paper (2011) and Australia's omission from the *Restarting Britain: Design Education and Growth* Report (Design Commission, 2011), this study was designed as an initial phase with the aim of building momentum for future academic research. Moreover, it is anticipated that this study will encourage other state government departments to contribute to the development of a national resource pool of academic support literature. In doing so, this knowledge pool would demonstrate the need for policy to acknowledge the critical role of design thinking in fostering future productivity in education and industry.

Survey

The study began in July 2012 with a review of national and international design education programs, and a scan of literature and relevant government and resource sector information. To complement this information, key targeted stakeholders representing design professionals, government, academia (tertiary) and teachers (primary and secondary) were encouraged to participate in an online survey. The survey was designed to gather information about design education and research programs, and gauge participant perceptions of these programs in Queensland. Given Queensland's geographical scale and unique reliance on industry clusters in regional centres for economic growth (Queensland Government, n.d.), the survey was distributed across Queensland including both urban and regional areas that spanned Mt Isa, Cairns, Emerald, Chinchilla and Quilpie, South East Queensland and Brisbane city.

A quantitative 5-point Likert scale was used to gauge perceptions of design education and research programs across five areas (i) self-reflection of program success, (ii) students/participant engagements, (iii) participant and facilitator engagements, (iv) resources, and (v) the host organisation/school. A total of N=40 respondents completed the survey, including participants from primary, secondary, tertiary, post-graduate and research level engagement, as well as continuing professional development, yielding a response rate of 28% (13% regional responses).

PARTICIPANT DEMOGRAPHIC

Of those surveyed 40% are involved in Tertiary level programs, 25% in Secondary level, 15% Primary, 12.5% CPD and 7.5% Post-graduate/research. Participants were aged 22–61 or over, with 27.5% 41-50; 25% aged 51-60; 20% 22-30; 15% 31-40; and 12.5% 61 or over years of age. 60% of respondents were Male and 40% Female. In terms of job identification, 28% of participants identify as a professional working in the private industry as a designer, manager or creative director, etc. Academics made up28% of the participant cohort, teachers 18%, facilitators 13% and Government representatives 13%. Half of the participants (50%) have been involved with design education programs for 10 or more years and just under half (46%) have been in their current position for 10 or more years. 82% indicated that they facilitate, run and or teach distance learning/online learning initiatives.

FOCUS GROUPS AND IN-DEPTH INTERVIEWS

Following on from the survey, two focus groups and an in-depth interview with self-selected key stakeholders who participated in the survey, were conducted. Participants included representatives from primary, secondary, tertiary and professional design education programs, as well as recent tertiary graduates. This provided an opportunity to discuss more pointed issues surrounding design education and research in Queensland, and this included regional participants. Each focus group was audio recorded and a thematic analysis was conducted to identify key themes and categories emerging from the data. The questions sought to identify participants' thoughts on:

- The role and value of design education and research
- The current and future challenges for design education and research programs facing related sectors
- Who is responsible for driving design education program development?
- Ways of establishing and maintaining design education and research initiatives in Queensland
- The impact design education programs have on the broader economy
- The role of design thinking and practice in education and the relationship between this and future productivity
- Future opportunities for design education and research programs

Findings

The Education Landscape

Servicing a current population of 4 585 776 (Queensland Government Treasury and Trade, 2012), collectively there are 1,239 State Schools (including prep, primary, secondary and special schools) in Queensland, the majority of which are located within the Metropolitan and South West regions. As highlighted in the Action Plan for Rural and Remote Education 2011-2015 (Queensland Government, 2010), approximately half of the state schools cater for almost a quarter of the state school students in rural and remote areas. This equates to approximately 616 rural and remote schools. In 2011, 18% of Australian primary schools (1708) were in Queensland (ABS, 2011). Most notably, Queensland has a higher proportion of small regional primary schools than other States in Australia (McCollow 2012). This provides unique challenges and opportunities for Queensland, different to other states of Australia, to develop programs that can be easily transferred, shared and disseminated across schools and regions. The Queensland Government *Smart Classrooms* initiative (2012) provides a comprehensive student-centric strategy for digital education in Queensland state schools. Other initiatives such as *Design Minds* (State Library of Queensland, 2012) also provide opportunities for schools to network, connect, share and collaborate, utilising resources and information freely available through digital technologies.

In 2011 there were 494 Secondary schools registered in Queensland (ABS, 2011). Of all state schools in Queensland, 15% are secondary schools, 4% special schools, 7% combined primary and secondary, and 74% primary schools. This is a concern, given the need to increase secondary and tertiary enrolment figures to drive innovation in the knowledge economy. Currently, design is not delivered as an Overall Performance (OP) Ranking subject for immediate university entrance in schools as part of the National Curriculum. Queensland primary and secondary teachers operate within strict pre-existing teaching frameworks and benchmarks including NAPLAN (National Assessment Program for Literacy and Numeracy), Australian National Curriculum, C2C (resources assisting teachers in implementing the National Curriculum in the classroom), and Queensland Professional Standards for Teachers. The Queensland Studies Authority (QSA), a statutory body of the Queensland Government, provides Kindergarten to Year 12 syllabuses, guidelines, assessment, reporting, testing, accreditation and certification services for Queensland schools. Currently, limited aspects of design exist within the syllabuses of Graphics, Visual Arts and in limited schools, Industrial Technology and Design (formerly Manual Arts). Teachers delivering design education programs are taking their own initiative to integrate 'design' within existing subject areas and learning benchmarks.

There are nine universities across Queensland, each offering different educational objectives, but all offering programs related to design education across a variety of levels including: Graduate Certificate, Bachelor, Graduate Diploma, Honours, Masters (Coursework and research), as well as Doctor of Philosophy (research). Two universities offer mostly distance education programs, one of these offering 8 campuses across Queensland including 6 regional campuses. Overall, the tertiary sector offers 32 university campuses across the State, 37.5% (n=12) have campuses in regional locations. All, except one university, offer HDR programs with design as a potential research theme. A number of college institutions offer opportunities for skill development related to the design industry. In Brisbane, international higher education is the largest export industry. Estimates indicate that $2.27 billion in course fees was acquired in 2010, plus a further $4.11 billion in non-course related spending (Study Brisbane, 2012).

Compiled from survey and literature scoping data, the study highlighted the design education/research programs (Refer Table 1 in Appendix) that have been conducted across Queensland since the inception of the *Queensland Design Strategy 2020* (2009). It is evident that Queensland has cultivated a strong culture around design education for the secondary education sector, engaging with industry, tertiary sector, and state funded programs in conjunction with the State Library of Queensland. Queensland also has proactive professional design institutes providing continuing professional development programs for designers. More work, however, is required to develop and capture activity in the primary education sector.

Design Education and Research Activity

Participant responses emphasised the passion that exists for those who participate in design education (DE) and research programs. The majority of participants (76%) enjoy participating in these programs and indicate that they strongly agree that DE programs have been worthwhile. Most participants (82%) understand the value of such programs and 92% strongly agree or somewhat agree that they would like to participate in more programs. The value of these programs for students was also emphasised, with 97% of the respondents strongly or somewhat agreeing that students/participants enjoyed the DE program/s, and 60.5% strongly agreeing students/participant's benefit greatly from them. Despite this, over half (55%) of respondents somewhat agree that students/participants are capable of understanding the value of the program/s. Finally, 84% strongly and somewhat agree that students/ participants would like to participate in more DE program/s.

Of the respondents, 73% strongly agree that staff/facilitators who have assisted or co-organised the DE program/s have enjoyed participating and almost all (92%) indicated that they strongly or somewhat agree that staff/facilitators benefit greatly from DE program/s. Well over half (71%) strongly agree that staff/facilitators are capable of understanding the value of DE program/s. However, 13.5% indicated that they rarely have other staff/facilitators from their school/organisation enquiring about design education program/s.

A clear challenge facing most programs is the provision of ongoing funding. Underlying, systemic support from the State Government was highlighted as important by many, with one participant indicating, "Government support is critical to ensure that design is taken seriously as a method to improve business success and not a cosmetic treatment" (Survey respondent P17), another respondent noted:

> The viability of programs over the long term depends on mutual interest, ongoing systemic support and funding by appropriate funding groups. The outcomes are usually of great educational benefit to individuals, help build social capital and are of great potential benefit to the economic and strategic futures of the wider community. Investment in innovative teaching and learning at secondary level will be critical in the development of a skilled, flexible and critically aware community. (Survey Respondent P20)

Over a quarter (32%) of participants strongly disagree that DE programs require minimal resources. 63% strongly or somewhat disagree that DE programs require minimal external support. Well over half of participants (65%) strongly disagree or somewhat disagree that DE programs require minimal internal support.

For regional respondents, additional concern centred on "a general misunderstanding of the importance of the impact of design in education and its role in rural areas" (Survey respondent P31). In addition to continuity of funding, participants also cited other factors such as resources, workload, teaching ratios and National Curriculum as points of concern. Most respondents (84%) strongly or somewhat believe their school/organisation understands the value of design education programs and almost half (45%) strongly agree that their school/organisation supports DE programs. However, in terms of program expansion, 22% indicated they strongly or somewhat disagree that their school/organisation is working hard to increase the number of DE programs. 60% strongly or somewhat disagreed that DE programs are easy to organise.

Participants also indicated the broad social, economic and community impact from positive experiences with design programs (94% strongly or somewhat agreed), however, the key challenges to ensuring program success are the over reliance on individual (often volunteer) commitment, greater involvement of the wider design community, and teacher uptake.

Mapping the programs across the State, it is clear that the majority of these programs centre on cross-sector and cross-disciplinary engagements. For the most part, survey participants indicated participation in somewhat generic design education activities that focus on bringing awareness of the role of design in fostering creativity and the 'process' of designing as a tool to empower and problem solve.

Perceptions about Design in the Knowledge Economy

In response to the motivation for this research study, one respondent voiced their concern for the priority of design education to feed the economy, but to urgently address systemic environmental challenges.

> The usual 'economic' factors as narrowly defined by standard definitions of 'the economy' is the key variable. The compelling need to fundamentally change our thinking on a local and global scale has to be addressed as a matter of urgency. Continual 'growth' economies are not possible: the Earth is finite yet we continue to plunder and trash it at an increasing rate (…..) and meanwhile talk about how we use design to grow the 'knowledge economy'. There won't be a recognisable economy of any description unless we drastically rethink our whole social, political and industrial approach. Design thinking is key to changing our worldview and to providing ways to mitigate the worst of the ecological changes humans are precipitating — but not the sort of clichéd puerile 'designer' approach that has been widely promulgated as a means to sell more stuff. (Survey Respondent P15)

In this regard, it was evident that the perceived value of design education is that it provides an opportunity to challenge current educational models because education "is the best way to have broader change across society" (Participant 06). Current education systems are perceived as inefficient and centred on "wrote learning" which does not foster discovery and exploration or provide "enough encouragement to think more broadly" (Participant 04). As this is viewed as a systemic challenge, discussion centred on how to make "design thinking" intrinsic and cross-disciplinary.

Participants generally agreed that design education is less about "turning out designers" and more about skilling "people who are empowered to think" and "engage with problems in an optimistic and enterprising way" (Participant 08), and producing "people who are good leaders" (Participant 10). "Design Leadership" (Participant 01) was flagged as a new emerging discipline, one that isn't design discipline specific, but which focuses instead on leadership of the design process.

> Design offers a different paradigm and design education seems to encourage that different paradigm of thinking (…..) its about questioning, constantly questioning and understanding that you don't have the answers and understanding that even if you do have the answer it might not be the only one. Discovery, exploration these are all… they're things that are more engrained in the culture of design. (Participant 05)

Demonstrating the economic value of the "intangible asset" of design was viewed as a key challenge to design engagement and registering with government representatives. "Nothing related to design is recognised by treasury" (Participant 01). Central to this challenge is the fact that the "people at the top, in charge, don't have a design awareness. Therefore it is really hard to build a business case for it because they don't see the value" (Participant 4). 'Design' as a word and the use of language to describe design was also discussed as a future challenge - as expressed by one participant:

> I think the word design is one of the first challenges (..).The perception is that design is elitist and it's for others and that this is the normal paradigm and then there is creative thinking or design thinking. I think demystifying design, democratising design, whether it's using language that is accessible… (Participant 06)

Planning for the Future

It is apparent, given the interest in this study and the extent and quality of design education programs developed since the implementation of the Queensland Design Strategy 2020 in 2009, that participants are reliant on the government to have the foresight to implement and retain long term design and education policy. However, it is perceived that the departmental government structure and political terms limit the capacities of stakeholders to work towards integrated holistic solutions for design and education. The "conflict between the political paradigm, political terms of three years, and design thinking as a longer-term device" (Participant 06) was discussed, and highlights the need to draft co-aligned policy that takes into consideration the long-term planning required for effective design education program development alongside the often short-term focus of government agencies. To enact a cultural change involving the integration of design in generic education at all levels, evidence-based research communicating the value of design in preparing the next generation to be multi-skilled, is urgently required. However, there were concerns about the fact that firms tend to look to the government for support in the first instance, and problems associated with this (reliant) approach were discussed.

> I think for me, in my head the biggest challenge would have to be the red tape in terms of the bureaucracy around change, fundamentally changing something going forward […] I'd love to say that's possible, but I'm thinking how is that ever possible because the people at the top that are in charge of these decisions don't have a […] design awareness. (Participant 04)

It was acknowledged that opportunity for design practitioners to engage with local educational institutions are limited, but improving; "But if industry is to drive education, how does industry do that?" (Participant 09). Discussions centred on the development of economically sustainable and engaging design programs and initiatives independent of Government as a primary source of funding, resource and promotion support. Participants also discussed the need for development of new growth industries for the future generation, and the importance of ensuring that education and technology are viewed as central to this growth.

> On the world stage Australia needs to pick up its act. […] I believe in schools and universities and even in our own manufacturing industries, if we don't train people to be savvy, we're not going to compete with China/Asia. Where we need to really pick up is in design. (Participant 14)

Education and Curriculum Development

Curriculum was seen to be a key driver or enabler for change in thinking, particularly in regional areas. It was deemed a responsibility for academics to evolve and develop their curriculum accordingly, in conjunction with industry and community. Participants discussed the challenges in primary and secondary school education surrounding the limited capacity of educators to develop and innovate curriculum. Comments about the new National Curriculum highlight concerns for the future of design related programs within primary and secondary education in Queensland. As illustrated in the quotes below, discourse centred on the conflict surrounding education structures and the challenges of engaging holistically with design education programs and potential mechanisms for professional (design industry) and educational (teacher training and community education programs) change.

> … for all the boys and girls we have in high school in the regional areas we've got to show them what the big world is out there and start making them step up to the plate ... (Participant 14)

"Both the current and future challenge for design education in secondary schools is the national curriculum" (P11). This concern stems from the fact that there is a push (transition) to a uniform education system. A consequence of this process has meant the authority developing the curriculum are not designers, nor are they obtaining consultation from experts or industry, and as a consequence participants believe they are "watering down the design elements of those subjects" (Participant 11).

Tertiary Sector Development

The key challenge facing the tertiary sector is defining the contribution of design education in the higher education sector, and to acknowledge and account for the graduates from these programs. Specifically, the distinction between design thinking and design research was highlighted as a challenge. This is because these programs seek "to harmonise the real value of research and bring that to practitioners" (Participant 10). The translation of tertiary sector work (research) into a tangible output for industry (practitioners) can be improved. Moreover, the issue of graduates and jobs was also discussed with one participant highlighting, "From a tertiary point of view we are aware we graduate more than what industry will employ" (Participant 13). This participant expanded this point to highlight the need for the tertiary sector to better communicate to students/graduates that design is more than 'seeking employment' in one specific discipline. It was implied that design can cross disciplines and boundaries, and that this is accepted within the academic community, however, it was acknowledged that this isn't always so well communicated to students and industry alike.

Akin to this, was the discussion by participants, surrounding the challenge of graduates who are "job ready" and the "tension between being job specific and theoretical design thinking". Academics and professionals alike argued, "we need to educate professionals" to better understand the concept of design thinking, and that when embarking on course design, academics need to understand the challenges of industry and "keep coming back to the touchstone of what practitioners do" (Participant 10). However, the goal of educating for future practice and future global challenges was also briefly discussed. Participants debated the merits of 'training' for an industry that is rapidly changing. One participant highlighted this complexity by simply stating, "how do you prepare students for practice but also for a non practice?"

(Participant 10). Industry too, was worried about the over-abundance of graduates and the lack of available opportunities, with one industry professional emphasising that "I don't think we need more designers, we need better designers" (Participant 09).

More broadly, it is evident that all sectors - primary, secondary, and industry – rely on the tertiary sector as a point of intersection and congruence for design program development, implementation and facilitation, and it therefore has an important role to play in fostering the future development of collaborative and engaging design education and research programs. One participant stated, "Everyone is concerned for the future, however, it is the role of academia to suggest alternatives. Not just one or two but a number of ways." (Participant 12)

Recommendations

Recommendations emerging from this study were tabled under the five main areas of (i) The Value of Design Education and Research in the New Economy; (ii) Up-skilling and training educators; (ii) Learning Beyond the Classroom and Challenging Curriculum; (iv) Responsibility and Accountability; and (v) Measuring Impact and Disseminating Knowledge.

The Value of Design Education and Research in the New Economy

For future global competitiveness, Queensland needs to re-examine design education at all levels as part of a democratised design-led culture, to actively nurture creativity and design–based thinking skills. This is because there is a lack of knowledge and awareness of the potential for the application of strategic design to governmental challenges. A key priority of Queensland's *Design Strategy 2020* is to 'Build design knowledge and learning' (2008) to, in turn, deliver outcomes for the other three strategy objectives. There is a need for design thinking to infuse all sectors of government and for the Queensland Design Council to seek out opportunities to more strategically align design to address emerging local challenges. It is an economic imperative that universities, government departments and business and community partners build on the traditional triple helix mode of innovation, utilising interdisciplinary, multi-dimensional, collaborative design thinking models to form creative alliances which can mobilise knowledge, talent and investment in order to address societal problems through coordinated action.

Moreover, government investment in design education programs involving all education sectors are valuable in communicating the importance of design education and research in the new economy, and connecting and mobilising community in this mission through valuable ongoing independent cross-sector partnerships.

Ongoing development and support for regional programs, including hands-on workshops connecting students and teachers with design professionals and tertiary educators is required. To do this, design thinking must be embedded across all disciplines in education, and design must be conceived of as interdisciplinary and even meta-disciplinary, to cater for the growing numbers of people who will be designers by persuasion and not by profession (Cope and Kalantzis, 2010).

Up-skilling and training educators

Preparing creative citizens for a participatory culture will require educators to shift their attention from "content delivery to capacity building, from supplying curriculum to co-creating curriculum, from supplying education to navigating learning networks" and to shift student attention from "their own individual performance to their capacity to learn through their own networks" (McWilliam and Haukka 2008, p.23).

The omission of design from the Australian National Curriculum and existing teacher benchmarks dissuade teachers to engage with design pedagogy or develop and innovate curriculum, unless they can see benefits for student engagement. There is a need for professional development for teachers in design pedagogies, especially in regional areas where they are not exposed to design professionals or tertiary design educators. Hands-on professional development programs need to demonstrate that design-based learning does not add to workload.

Furthermore, changes to tertiary pedagogies for primary and secondary teacher training will ultimately be required to include design. Therefore, new models of engagement between education sectors in potential disciplines of business, education and design/creative industries need to be investigated and led by the tertiary sector.

Learning beyond the Classroom and Challenging Curriculum

Educators need to consider new emerging modes of learning that consider "social, distributed and networked dimensions" and the "broader economic and technological landscape" in which the learning occurs (Brown, 2010, p.xii). An open learning model needs to be constructed to allow innovation-generating possibilities and to leverage future development in this sector through ongoing action research.

Ongoing support for design immersion education programs and design education competitions is needed from industry, government and education sectors to ensure they continue to fill a gap in education, not prescribed by the National Curriculum. This will help to address issues in relation to the 'missing middle' education pipeline. Capturing ongoing research data and publishing on these programs will encourage further interest in design-based learning. This requires greater collaboration between the Queensland Studies Authority and professional designers/design educators to update curriculum to integrate design thinking and design processes.

Engagement with the tertiary design sector to develop a cohesive future evidence-based research data collection strategy for design education is needed, and funding for research programs in Queensland needs to be investigated.

Responsibility and Accountability

There is a required 'shift in the balance of agency' with design practices and professional acquiring greater social significance and reconsidering the scope of everyday professional practices. (Cope and Kalantzis, 2011) This brings with it a required rethink about design education at all levels, and who is responsible and accountable to enact this cultural change. New funding models need to be investigated as a revenue source for further activity, therefore mobilising local involvement, collaboration and promotion in all design education sectors.

Investment in creative capacity building in regional hubs must tackle social exclusion arising from socioeconomic divide and regional diversity. The establishment of a Creative Education Trust utilising financial legacy from the finite mining boom could prioritise design education and research activity across the state.

A Foundation established to engage schools, universities, government and the business and design sectors to actively explore partnerships and the educational value of design to solve issues related to the Asia Pacific, would provide further momentum for design education and research programs. Furthermore, the tertiary sector is a key player in driving design education and research. Universities must embrace interdisciplinary learning on both the undergraduate and graduate levels, spanning business, design and education. University design schools need to consider new programs that anticipate industry needs, including degrees in cross-disciplinary design, design management and design leadership, which teach design thinking as an approach to solving complex problems. Finally, capitalising on the interest shown in this study, the development of a Design Education and Research Taskforce, reporting to government, and responsible for the coordination of education sectors and industry, may be a useful next step in engagement, agenda setting and funding development for key programs and research.

Measuring Impact and Disseminating Knowledge

There is a need for funding and infrastructure to be developed locally to allow ongoing prototyping and associated research measuring the impact of design in the education sector, toward innovative national policy reform. Ongoing funding support for the continued development of programs, and associated research and dissemination of knowledge, will provide internationally significant findings. Future research on the impact of design education on regional Queensland needs to be conducted and prioritised to provide evidence of its value in building innovative, adaptive and resilient communities, and on future requirements for design education and research centres in regional Queensland.

This study was designed as an initial phase to build momentum for future academic research supporting the need for design thinking and creative practice to be embedded in education at all levels. Future opportunities for funding to support ongoing design education research should be considered and a strategic plan for future research in this area developed. An ongoing dialogue between Government and the tertiary education sector must be maintained for future progress.

Summary

Overall, the findings of this research draw attention to the need to better integrate design across all levels of education in order to build creative capacity. To do this, a greater understanding of the role of designers in the new economy is needed. This requires the up-skilling and ongoing professional development and training of current and future educators and teachers about the processes of design; and encouragement, wherever possible, to engage in learning beyond the classroom. This is necessary to ensure future graduates (of any discipline) are appropriately skilled, but also have the capacity to think and engage in critically reflective discourse. It is evident that the tertiary sector will continue to play an increasingly important role in nurturing a creative, innovative and adaptive culture fostering design education and research across all levels of education and training.

Finally, there is an urgent need to continue gathering state-centric, empirically derived evidence surrounding the impact of design and its role within the knowledge economy. Relatively little is known about the value of design and the role it can play in building innovative, adaptive and resilient communities. The report provides the first critical step in this process, however, further work is needed to help inform, transform and shape the future of Queensland through design. If indeed, "using creativity and design-based thinking to solve complex problems is a distinctive Australian strength that can help meet the emerging challenges of this century"(Commonwealth ofAustralia

2012, p.8), as stated in the *Australia in the Asian Century White Paper*, then Queensland's efforts to date in cultivating this strength must be supported through open innovation and ongoing reform and investment in design skills, education and research.

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Appendix 1

Table 1. Mapping Design-related Research and Education Activities in Queensland.

PROGRAM	Primary	Secondary	Tertiary	Post-grad / research	Industry/ CPD
AGDA Annual CPD Program					⊙
AIA Annual CPD Program					⊙
AILA Annual CPD program					⊙
Asia Pacific Design Library	⊙	⊙	⊙	⊙	⊙
APDL[1] Lecture Series					⊙
Australian Space Design Challenge		⊙			
Cardboard Chair Pressure Test		⊙			
Centre for Subtropical Design				⊙	
Creative[3]					⊙
Creative Business Benchmarker				⊙	
CCI ARC Centre of Excellence for Creative Industries and Innovation				⊙	
Design Futures Program	⊙	⊙			
Design Futures Hothouse Conference			⊙	⊙	⊙
Design Integration Workshop					⊙
Design Integration Workshop Program					⊙
Design Minds	⊙	⊙	⊙	⊙	⊙
DIA Accredited Designer™					⊙
DIA Annual CPD Program					⊙
Design Thinking in School	⊙				
Experience 2012 National Architecture Conference					⊙
Explore University Day and/or Camp - goDesign Express Program	⊙	⊙			
F1 in Schools program	⊙	⊙			
Flood of ideas – School of Ideas Competition	⊙	⊙			
Giddy Widdle	⊙				
goDesign Travelling Workshop Program for Regional Secondary Students		⊙		⊙=	
Gold Coast Digital Marine Challenge	⊙	⊙			
Grey Street 2020 Workshop Program – goDesign Express Program		⊙	⊙		
Homegrown 2011: 'life in the slow lane' Exhibition and Workshop Program		⊙	⊙		⊙
Design Awareness Talks	⊙				
KGSC Art + Design School of Excellence		⊙		⊙	
KGSC Engineering Technology School of Excellence		⊙		⊙	
Living City		⊙			
Optimism					⊙
Origami	⊙	⊙			

[1] ADPL - Asia Pacific Design Library, State Library Queensland

PROGRAM	Primary	Secondary	Tertiary	Post-grad / research	Industry/ CPD
Out of the Box Festival (OOTB)	⊙				
QLD Academy of Creative Industries		⊙	⊙		
QAGOMA Children’s Art Centre Program	⊙	⊙	⊙	⊙	⊙
QLD Art Teachers Association (QATA) In-service Day Conference		⊙			⊙
QLD-Smithsonian (Cooper-Hewitt) Design Museum Fellowship Program	⊙	⊙			⊙
RACQ Technology Challenge, Maryborough	⊙	⊙		⊙	
Second Skin	⊙	⊙		⊙=	
Sit-Art 60 Chair Design Challenge		⊙	⊙		⊙
TEDx Brisbane					⊙
The Edge, State Library of Queensland		⊙	⊙	⊙	⊙
The Window Project			⊙		
Ulysses: Transforming Business Through Design					⊙
Unlimited: Designing for the Asia Pacific	⊙	⊙			⊙
Urban Design Alliance Forums					⊙
Vibrant City		⊙			
Widening Participation - goDesign Express Program	⊙	⊙			
Year of Creativity	⊙	⊙			

⊙ = ‘Second Skin’ and ‘goDesign’ are linked to research programs and/or projects. Dissemination of work surrounding these activities is currently in development and/or press.

E-learning

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From Long-distance to No Distance: Performance-based long-distance education in art and design

Bo GAO*
Tongji University

Abstract: *This paper is to introduce an enhanced teaching and learning experience, which brings people in different location to act in the same spectacle, a real-time building together rather than only verbal communications in front of the screen. The "e(ating) meeting – Project of the VISIT 2012" is a teaching project undertaken in the year 2010~2013, and is a cross-cultural long-distance learning and collaboration experiments between two international universities. The objectives of this collaborative project are to develop and experiment new teaching approaches and tools through an intercultural and interactive platform in art and design. This paper unfolds the process and outcomes of the project "the Intercultural and education dialogue" with the aim of developing a practicable model of long-distance education in art and design through innovative teaching methods. This paper also analyses how those methods of teaching can improve the quality of learning practice, especially in online distance art and design education practice.*

Keywords*: Performance, Atmosphere, Long-distance education.*

* Corresponding author:Tongji University | China | e-mail: gaobotj@163.com

Introduction

It's discussed in this paper about a real-life teaching project "e(ating) meeting – Project of the VISIT 2012" which is initiated, designed and practiced by D&I (the College of Design and Innovation of Tongji University) and BUA (Bern University of the Arts), and is among many co-operations between Chinese and European Art & Design Universities in the past decade. This Project was supported and sponsored by the Sino-Swiss Science and Technology Cooperation program SSSTC. The objectives of this collaborative project are to develop and experiment new teaching approaches and tools through an intercultural and interactive platform in art and design. As the project name indicates, virtual or physical students and teachers group have been planned in the project to carry out the courses and workshops in either university where appropriate.

The rapid development of the internet has not only changed the way how people understand the world, but also provides new opportunities inherent in the existing art and design teaching mode. However, the current state of art and design teaching is not changed as Norman stated, contemporary design higher education is still focused on developing students' traditional design skills such as sketching and model-making (Norman, 2010). Art and design education needs to conform to this trend and react to adjust the current teaching model and approach. With the increasing maturity and diversification of internet and multimedia technology, especially technology availability and achievability, the cross region long-distance art and design education model with multi-stakeholder involvement and interaction become a trend of exploration by many top international art institutions.

The paper leads to the discussion about the form of long-distance education approach in art and design courses based on the preliminary findings of intercultural performance learning, which will unfold a creative multi-site education model which allows the interactive learning and developing by students and teachers in different culture background and different time zone.

The paper also constitutes one of the research products of the Project VISIT, including workshops and courses in D&I and BUA in the past 3 semesters. The exciting project outcomes provide the teachers and students in both universities an unparalleled platform to imagine and realize much broader cultural interactions in the subject area, to plant the new approaches in the day-to-day education courses and to create the new design environment by using the technology.

Challenges of learning online

Education through online platform is not new to the life. It usually refers to the virtual classroom built on the Internet technology, which can release the learner from physical on-site presence and allow the participation by using the computers or watch the telecommunication media. The existing education through online platform provide traditionally unidirectional teaching mode mainly in reading and explaining, so it is a substantial challenge to embed the cultural interactions and design communications in the online platform and use the multimedia technologies to present the design works and enable the people in different sites to collaborate in the same task. This is also turning on a new horizon to design and deliver the art and design courses with different participants from different culture background, language capabilities and religious or belief originations.

Diversified visual cultures

With the increasingly connected global community of design and environmental sustainability, art and design education require diversified visual cultural elements to reflect the cultural communications and penetration. The primary target of the expected new education model is to break down the hurdles over time zone and geography to build up a conveniently obtainable learning platform, which can bring the possibilities to have all the attendance teach, learn, work, communicate and archive the data. This presents "home students with [an opportunity to develop] a portfolio of globally relevant skills and knowledge without them leaving their home country" (Harrison & Peacock, 2010, p.878). It has to be an open space with capacity to support most kinds of media format we use in the digital world. More and more international art schools are investing in the similar program to cope with this art and design education requirements as well as the cooperation needs from other part of the world.

Language barriers

The notion of "Foreign Talk" was defined by Ferguson (1975) when practiced speakers of a particular language attempt to communicate with other individuals for whom the speaker's language is not the mother tongue. Research tells the both sides of communicators are spending more energy to ensure the information accuracy than the context and culture that the language implies. The level to which a native speaker feels he needs to adjust his speech in order to address a non-native speaker varies but it has been suggested that in extreme examples the use of Foreigner Talk results in the native speaker producing "ungrammatical sentences" (Snow et al., 1981, p.81). Longer conversations with non-native speakers have been suggested to necessitate more use of Foreign Talk by native speakers (Snow et al., 1981). As well as this, it has been suggested that foreigners who tend to make more mistakes with regard their non-native language receive more Foreign Talk in conversation with native speakers (Snow et al., 1981). The use of "foreigner talk represents an attempt to improve communicative efficiency by mimicking the speech of the foreigner" (Snow et al., 1981, p.90).

As such, a performance based communication approach for art and design education has been designed and practiced in the project to avoid the language misunderstanding and improve the dialogue efficiency. The borderless performance language will be unified to help the participants put more focus on the design works and it is proved the increase of productivity.

Time zone and geography separation

Miller described the long-distance learning as "a process to create and provide access to learning when the source of information and the learners are separated by time and distance, or both." (Honeyman, M; Miller, G; 1993) The distance and separation are just the impacting factors but the actual challenge is to deliver the timely message in the synchronized platform and drive the productive outcomes over the difficulty of different location gaps.

In addition to the performance language, scenario course environment has been applied in the online platform as well to establish a story-line oriented design learning progression which provides the students in the different locations a concrete and extensible information channel. The scenario course environment was developed by all the participating parties to ensure a common understanding, and by the aid of multimedia technology the design ideas can be implemented collaboratively one after another (day and night in different time zone) to make seamless communication and creation process.

The conception of Project “e(ating) meeting”

Based on the considerations mentioned above, with the title of “e(ating) meeting” Project of VISIT 2012 is designed to be an intercultural research related to the topic of “eating together through online platform”. “Eating together” is created to give more tasks requiring simultaneous interactions of using cooking tools, setting table, grabbing food and etc., which will expect to perform beyond traditional “talk and demo” mode of e-learning.

The student and teacher group in each university need to build up the scenario of an eating environment for the design project around the topics how the table is set, what the table is served and how are the feeling and emotion when the eating is happening and continuing. In China and Switzerland where the background of eating environment is different, the groups will work out how can the common cultural elements meet to produce the unanimous design language, in terms of taste, smell, mood or experience that can be captured and expressed.

The technical tools used frequently are distance communication tool Skype and similar ones to keep the dialogue between D&I and BUA, but more importantly is the virtual digital space designed for the groups in Shanghai and Bern to share and comment on the material, skeleton, sound, colour and pieces of video/audio as the idea knocking and integrating. From student’s mind, everything may be related or linked are uploaded or marked, and categorized for the usage going forward. This in fact broadens the thinking options comparing to the traditional teaching model where teachers and students are sitting in the room and looking at the same board.

Students and teachers experienced the idea contributions resulted from the culture and living style diversity in different regions, used body languages to perform for clarifying, understanding and arguing, and developed the design works collaboratively which completely overstepped the time zone and geographic gaps.

Project Methodology

To test different types of design skills, the project was designed to set up 3 small teams of students from one university to co-work with their designated small team from another university to complete the different design tasks. Altogether, this bilateral collaborative project involved more than 30 students and 10 academic staff. Since there is no technology specialist involved, the project challenges include both technical issues in the communication enablement and operational issues to balance the quality and time consumption of different academic tasks.

The overall project is composed of 2 introductive sessions and 1 main task.

<u>Introductive session 1: Tools</u>

Students are required to select a cooking utensil for the food making and physically present to the other side. The kitchenware selected shall be very typical in Chinese and Suisse kitchen with specific form, function and appearance. Students can choose the kitchenware and explain and perform visually through Skype on the purpose of choose.

The project requirements on the “cooking utensil” are 2 sides pack for both China and Switzerland, with connection in 4 experimental levels:

- The shape and appearance
- The use and functions
- Perform and demonstrate how the tool is in use
- Invent/imagine the new use or functions of the tool

<u>Introductive session 2: Performance</u>

Students and teachers are required to perform through the online environment, with the setting projection in the paper background and the laptop screen.

<u>Main task – create/invent something new, together</u>

The students choose their setting. It can be similar to Session 1 and 2 but can also be a new/different combination or media.

Topic is predefined as a family dinner that is an event to be prepared, realized and performed by groups in both sides. The event shall contain elements that both sides can (CN and CH) have access to. Elements can be “real” or “digital”, but need to bring a “real” environment that people from both sides are able to experience a dinner together.

The critical successful factor for the long-distance education, particularly in art and design, is how to make the long distance to no distance, how to bridge through the gaps in diversified visual cultures, foreign talk, time zones and geographical distance. In the task development stage, we learned the findings resulted from the previous projects that the key focus areas would be on the stimulation of learning with scenario environment, inspiration of performance-based involvement and driving interactive learning experiences. The pre-designed winning formula can be interpreted as:

Performance-based education = Σ(Experience-based learning, student’s creativity)

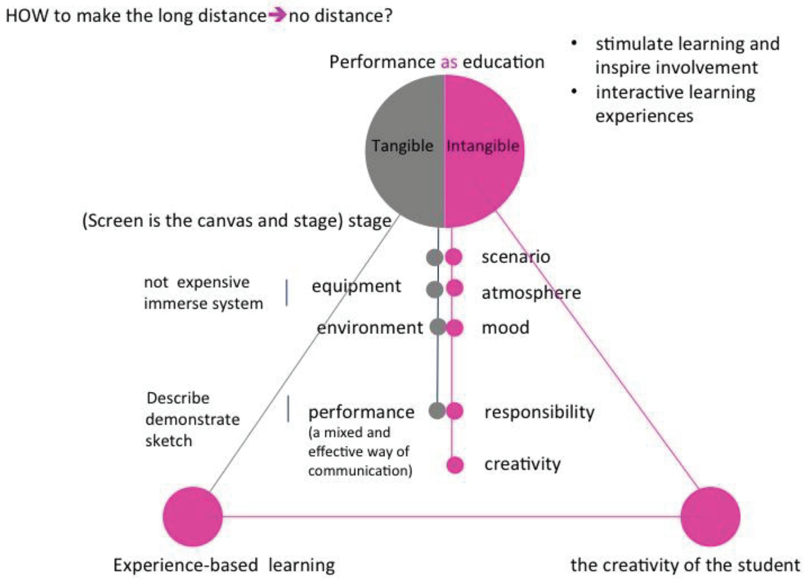


Figure 1: The structure of formula: Performance-based education = Σ(Experience-based learning, student's creativity)

The performance-based education is not in the way of performance for performance, but in human's life existed in the performance and the relation to the education. How does the performance assist the long-distance education and improve the learning experience in overstep the gaps caused by cultures, foreign talk, time zones and geographical distance?

Firstly, the performance-based education requires certain level of the communication skill and teaching skill. Since performance is the certain communicative approach and teaching method, the teaching process will be a journey to shape students' communication skills in the different cultural and geographic environments.

Secondly, the performance-based education reflects certain level of symbolism. Language, gesture and motion of the performance are considered as the symbols of the expression and delivery. Symbol itself doesn't have meaning, however, its meaning lies in the user who uses the symbol and the thing that symbol indicates, to remove the language barriers. Performance on this level belongs to technology and instrumentalism.

Thirdly, the performance-based education becomes certain level of methodology. Performance and the study of performance are regarded as the basis of education (especially pedagogy).

Fourthly, the performance-based education is originated from certain level of environment. The environment of performance with instant reactions and responds makes no distance in the remote level of communication.

From the view of performance-based education methodology and the practice in the projects, the aims of performance (why performs) are consistent with educational aims, and the locations of performance (where performs) are separated in different sites, and the performer and the observer (who performs and who observes) are students from both sides collaborate together (partner), and the context of performance will be transformed as the context of education.

Building live 3rd space through Multimedia

Our teaching should take into consideration about the students' experience and activate emotional world of students, so that they become proactive in discovering the learning, scenario creation and process achievement. “distance between everyday actions of individuals and the historically new form of societal activity that can be collectively generated as a solution to the double bind potentially embedded in ... everyday actions” (Jean Lave and Etienne Wenger (1991) Situated Learning. Legitimate peripheral participation, Cambridge: University of Cambridge Press) It needs to create a virtual “situation” of their specificity, particularity with unconventional, thus infect, irritate and shock the audience in learning. Teaching must be carried out in a specific context. The technologies are used “to transcend national boundaries and the constraints of distance educational opportunities” (Harrison & Peacock, 2010, p. 878).The teaching in situational settings makes teachers and students trapped interesting.

Multimedia teaching is a modern teaching methods, in a broad sense refers to a combination of the application of a single instructional media in a variety of functions such as computer, TV, video, projector; while in a narrow sense refers to teaching application of multimedia technology, namely the use of multimedia computer processing and control symbols, language, text, sound, graphics, images, animation and other media information, organic combination of various multimedia elements according to teaching requirements to complete a series of human-machine interactive operations. It has two prominent characteristics: firstly it’s one single combination of educational media applications which distinguishes from the traditional teaching media; secondly it’s viable interactive operation processing information which brings people "immersive" live experience significantly different from those of other educational media. The major difference between multimedia teaching methods and multimedia teaching is that the core of multimedia teaching methods is not just using audio-visual computer-controlled education equipment in the on-site teaching, but to be able to realize the interactive teaching and teacher-student interaction and "experience", and based on the "experience" to design multimedia teaching core courses.

Benefited from information technology, the traditional physical field boundaries has been broken through and reformed to co-existing status of physical space and digital space, substance and virtual objects. The physical and virtual composite space becomes future practice field of distance education. Mobile or portable information terminal (PIT) will play a more important role in these areas. Massachusetts Institute of Technology (MIT) Media Lab has been committed to a seamless connection to the digital world and the real world. The "sixth sense device" by an Indian-American student, Prarnav Mistry, foreshadowed the learning facilities available anytime and anywhere. “'SixthSense' is a wearable gestural interface that augments the physical world around us with digital information and lets us use natural hand gestures to interact with that information. SixthSense bridges this gap, bringing intangible, digital information out into the tangible world, and allowing us to interact with this information via natural hand gestures. ‘SixthSense’ frees information from its confines by seamlessly integrating it with reality, and thus making the entire world your computer." (Prarnav Mistry, http://www.pranavmistry.com/projects/sixthsense/)

When building the live "3rd space"(real +virtual scenario/situation) of "e(ating) meeting", teachers demonstrated to the students on the space structure and functions, encouraged students to set up their own "common classroom" in order to involve and engage each other to discuss. In the workshop students set up scene projector, camera, and the curtain wall to form a "no distance shared space", to connect the design and painting in one site with another working site thousands of miles away. In this space, the distance was shortened on the screen and the students established their own virtual "common classroom" in the e-platform to reach the synchronized learning environment and shared in this real and virtual combination of live 3rd space as the same physical classroom.

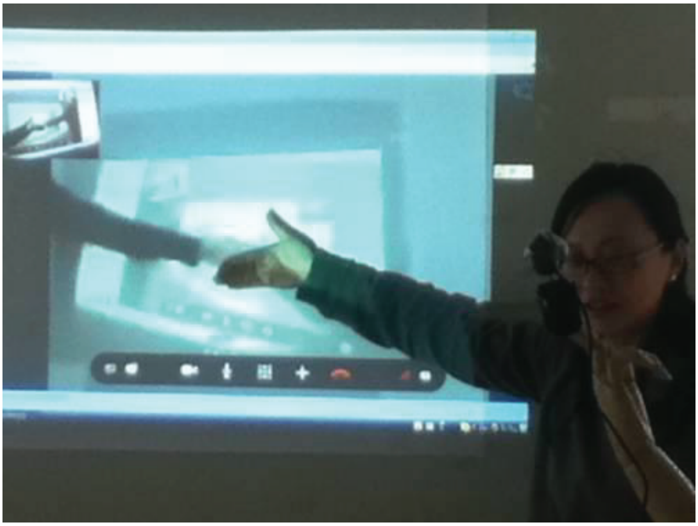


Figure 2: Teachers demonstrated to the students the virtual "hand-shaking" experience through e-platform by using video conferencing software and projector.

Immerse in the"3rd space"

The 3rd space is set to lay the foundation for the next step of experience teaching. Experience (learn from one's personal experience), refers to the understanding of things in practice. By experience, individuals feel and understand things to their own "self" (the existing experience and psychological structure), find association between things and self to generate emotional reactions, and develop wealth of imaginations and profound insights. When the experience as a pedagogic concept, it refers to the emotion and meaningful activities resulted from the real feelings and deep understanding on the things. In other words, the germinal and main unique experience of "self" is closely related to the unique insight or sense of

emotional response. Concerned about the emotional experience of student teaching, is about to stress the unique experience of the individual student. Teaching is dramatic demonstration, teaching reproduction is demo on how you demonstrate. (Fredric Jameson Brecht and Method. London & New York: Verso. 1998. Reissued: 2011 Verso) Drama is creating meaning and visible mental models of our understanding together, in imaginative contexts and situations. It is not about performance, but exploration. And the teacher in drama becomes a learner among learners, a participant, and a guide, who lends expertise to the students. (Jeffrey D Wilhelm and Brian Edmiston, 1998, Imagining to learn, Portsmouth, NH: Heinemann)

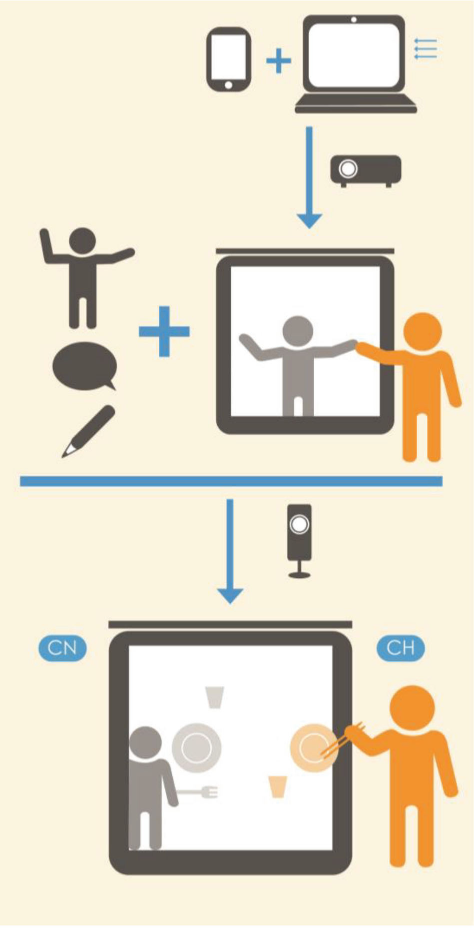


Figure 3: illustration of Immersion in the"3rd space" by a shared performance through multimedia technologies

Students in D&I and BUA jointly design, discuss and create an atmosphere to understand each other's culture, and actively participate in the way of performance to create more realistic "3rd space".

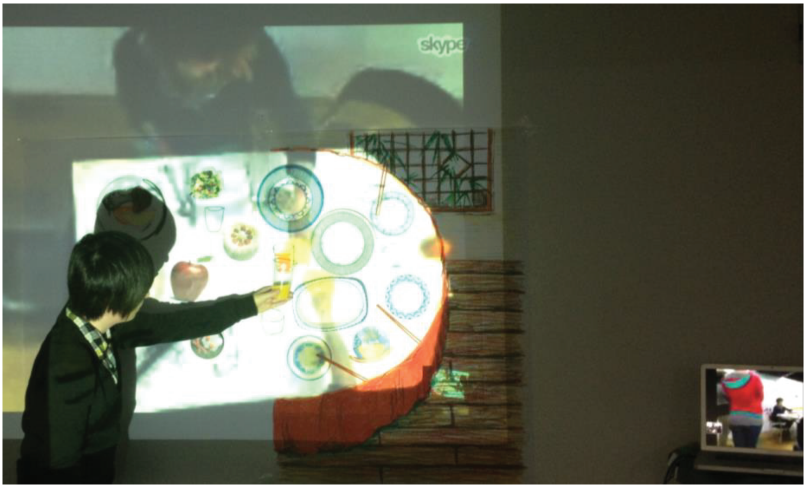


Figure 4: The student's final presentation is delivered in the combined e-platform "common classroom" to demonstrate their interactive contribution to the "e(ating) meeting" environment which goes beyond the traditional PowerPoint presentation method.

The presentation of "sharing a meal" in project "e(ating) meeting" was quite special. The common 3rd Chinese students paint food on paper, which was vertically projected on the wall, and designed patterns on the paper plates, instead of using real ceramic ones. So that the different types of food and tableware, and the changes from plan to elevation all existed on one platform at the same time. The Chinese student is toasting with the Swiss who were thousands of miles away from them.

"ACTION" mode (The rhythm)

"ACTION" mode refers to the connection mode selected based on the responding time due to different time zones / geographical distance in the long-distance education. It's not a workable approach for the long time meeting by using the computers only, even worse than long time connection by the computer and occasional connection by the people to keep the rhythm. The biggest difference between long distance and face-to-face education is with or lack of eye contacting, so as to disperse the attention. "Action!" is the order by the director to start the performance when all the preparations are completed in the film studio. "ACTION" mode then implies the atmosphere building in the long-distance education when teachers use the word of command to activate students' more efficient and positive study mode.

Figure 5: As showed in the Figure 5 the students show fatigue after a long video call.

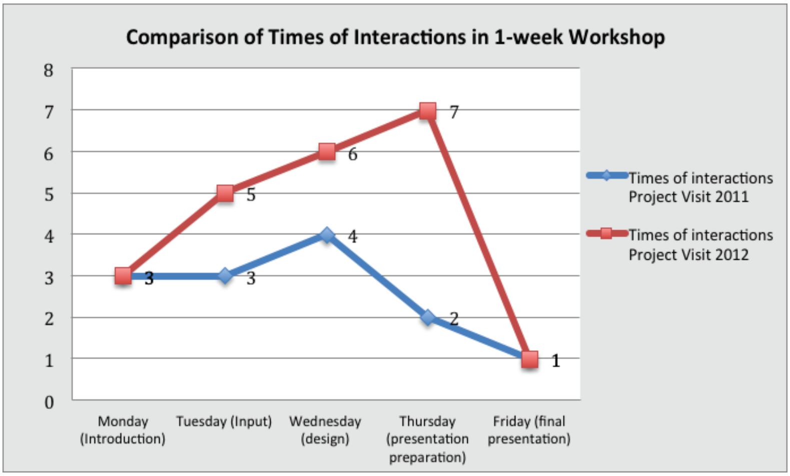
Figure 6: teachers are activating the students, Action!

The changing role of teachers and students

The role of teachers' in the multimedia teaching experience needs to transform into the role as documentary director. The role of the teacher is changing from focusing on being a teacher to a designer of learning experiences (Spence 2001). Documentary director is viewer, educational drama scriptwriter and performance scientists and artists, so this role is more related to the functions of companionship and real-time guidance, to keep the real-time record of learners but not to act instead of learners, to provide positive encouragement and pay attention to the real-time feedback. I believe that the teachers in the teaching process shall make study against the students as service counterparty and conduct comprehensive analysis against the learning stuff, to meet and even exceed the students' learning aspirations and meanwhile retain certain flexible space with them, as well as timely and positively respond to their feedback. In art and design education, teachers shall make full use of the network edge to guide and encourage the active participation of all students in the innovation and creation to display students' consciousness of ownership and independence. The changing role of the students here is close to actor. The actor's creation is a screenplay based on, and faithful to the character created by the playwright's pen. The so-called "faithful" are not mechanically reproduced, but contains vibrant "re-creation".

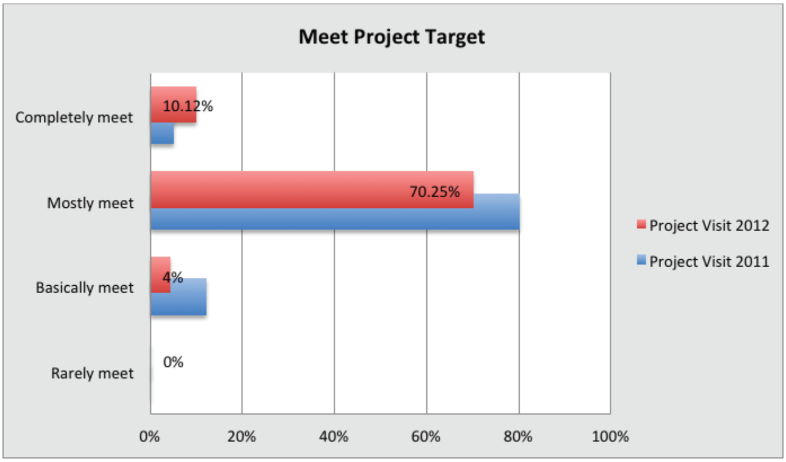
Conclusion

As stated at the beginning, the project between two universities aims to unfold an experience in art and design education, to jump off from the traditional "read + explain" and "talk and demo" mode to a more creative and interactive "build and immerse" mode. Here below is a comparison chart to show the increasing times of interactions in one-week workshop.

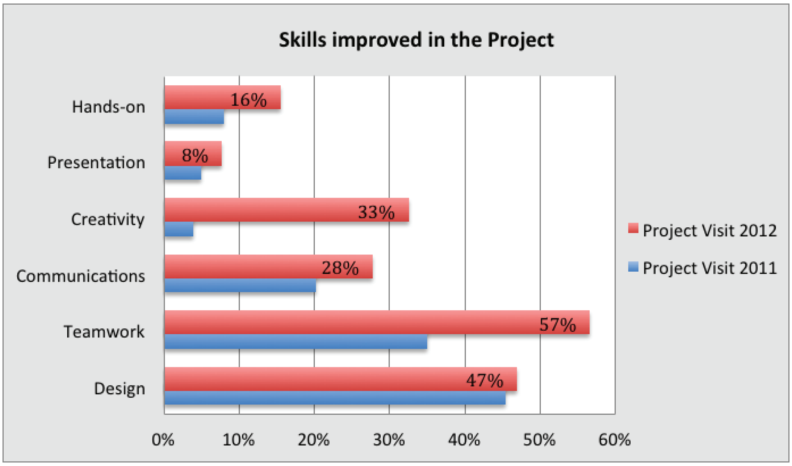


At the beginning of the project, students were given a questionnaire including the feedback about design ability learning, international collaboration, and comments/expectations of the workshop. 5 month later, the students were asked to attend the interview about the feedback that reflects the skills and ability they had learned through the workshop.

The results presented in this paper are from the questionnaire and interviews and the students' comments. The number of students participating in the questionnaire is 25, and the outcomes can be considered as the general result only.



Students indicated that working in “e(ating) meeting”, Project of VISIT 2012, was a brand-new experience. Students commented that they were inspired by other students or by seeing how differently they approach their work: “I've never had this kind of experiment and I find it very interesting. Actually there are far more possibilities of what could be done in this way. This is just a beginning. Additionally, this project enabled us to have a mutual understanding of Chinese and Swiss culture.” (Wang Siyi, visual communication student 4th year)



Performance-based long-distance education emphasizes the full mobilization of the people’s facial experience. The specific ways can be categorized as: multimedia teaching software, remote interactive curriculum, multimedia space / environment, performing presentation, simulation, and expert presentation in appropriate way.

We have the findings by the completed project phase summarized as:

First, in long-distance education in arts and design education, creating situations will develop "face to face" physical space. The extension of the screen, projector set in parallel and situation creation (tangible and intangible) can eliminate the distance as much as possible to form a "no distance ", face-to-face educational space.

Second, the real world and the virtual world constitute the link in the 3rd World, "performance" has become the core concepts of the understanding of the Third World. The students perform in the educational life with their own behaviours, we can say that they are involved in the formation of outside world and the world of their own understanding, with the gesture of the body, the movement of self-expression, the expression of a role, so that students immersed in the context. It is the teaching mode for long distance education to communicate effectively.

Third, the "experience" includes all sensation, perception, consciousness and other related things. When performance shows a way to enter into long-distance education, it will form a force to make the education become more expressive, and make people become more expressive and full of life energy. At the same time, the people (both teachers and students) in the education are in self-expression, encouraging and inspiring others by watching each other's performance, and eventually get the education goal achieved.

Finally, we know that the virtual environment will never become a reality, because the byte will not turn into atoms. The long-distance art and design education inspired mankind's curiosity to find out the truth from the real world. It can be an effective complement to the physical art and design education practice; however, it will be on no account to completely replace the value of physical education. The physical education experience provides real life experience of people and fun of lively communications of human beings. The limitation of internet technology in real world will also restrict the quality of long distance education, as one of the participating students mentioned: "The result may be constrained by certain conditions. In any case, design and innovation are the progress of struggling and compromising with technique and ourselves. However, it was fantastic to get such a result. Idea is important but barely itself without knowing how to fulfil it. My comment is the improvement of network speed if there is a next time." (Cheng Guangxi, media design 3rd year)

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Supporting Art and Design student transition into Higher Education

Julie HASLAM* and W. Rod CULLEN
The Manchester Metropolitan University, United Kingdom

Abstract: *In 2007 the UK National Audit Office reported retention levels as an important factor in measuring university success. It also reported institutional variations in withdrawal themes concluding that some differences were likely to relate to how well individual institutions were helping students to deal with the challenges of study in HE. As a great deal of research has found retention to be related to student satisfaction, and this in turn to be primarily dependent upon student preparedness and their expectations many institutions have focused on enhancing this area of the student experience. This paper raises awareness of the predominant role of emotions and social interactions in art and design pedagogy and describes the development and implementation of an online portal designed to support a cohort of students about to undertake a BA (Hons) Fashion Design and Technology programme. Support was designed to promote early induction and engagement and to assist in student's preparation, six weeks before arriving at university. The project followed the ADDIE development model and adopted a multi-phase sequential mixed methods research strategy. Evaluation of this project inter-mixed focus groups and semi-structured questionnaires over five key research phases targeted at appropriate stages of the ADDIE development model.*

Keywords: Transition, Pre-entry, Retention, Withdrawal, Art and Design.

* Corresponding author: Manchester Metropolitan University | UK | e-mail: j.haslam@mmu.ac.uk

Introduction and background

Retention levels are an important factor in measuring success of UK Higher Education (HE) institutions. However, with one in five full time students reported as failing to complete their studies (National Audit Office 2007) improving retention is high on many institutional agendas.

Studies have found retention to be related to student satisfaction, and this in turn to be primarily dependent upon student preparedness and expectations of HE study (e.g. Charlton et al. 2006 Lowe and Cook 2003). A recurring theme in studies of student performance is that experiences in the first few weeks are vital in students' decisions to withdraw (e.g. Fitzgibbon and Prior 2003 Tinto 1988). However, it is generally recognised that the whole first year experience is crucial in determining persistence decisions (e.g. Yorke 2000 Fitzgibbon and Prior 2003 Johnson 1994). Consequently, universities have been encouraged to review their induction procedures to better support student transition to HE.

Research exploring student induction generally agrees that academic, social and personal adjustments are the most important factors determining successful progression through tertiary education (The Higher Education Academy 2006). Furthermore, it is widely recognised that induction should be thought of as an on-going process beginning when students first establish contact with an institution and continuing up until the end of the first year (e.g. Hamshire and Cullen 2010 Shock Absorber Project 2007).

At Manchester Metropolitan University (MMU) a Student Induction and Transition framework (SIT 2009) has been developed splitting the first year into three periods: Pre-entry and early transition; Welcome weeks / early induction period; Ongoing induction. This framework provides a structure for the development of induction processes.

During the 2008/09 academic year the BA (Hons) Fashion Design and Technology (FDT) programme in the Faculty of Art and Design identified several issues of concern including:

57% of 1st year students with attendance levels below 70%.

Overall programme retention rate of 79% (below the institutional requisite of 85%).

The biggest contribution to retention figures being level 4 students (first year undergraduate).

Typically the programme recruits students based on A-level or equivalent qualifications. The perception of the programme team was that students struggled with the transition from more formal teacher centred learning they are familiar with, at A-level, to teaching approaches that demand high levels of self-direction and personal motivation. Consequently, the decision was taken to develop new induction procedures for the programme, based on the SIT (2009) framework.

This paper describes and evaluates the implementation and development of an online portal for the FDT programme targeting the core issues identified above, during the pre-entry and early transitional period of induction.

Development approach and research methodology

The project followed the ADDIE development model, a five-stage instructional design process for courses and educational programmes (Peterson 2003). A multi-phase sequential mixed methods research strategy was used to undertake evaluative research through the development process.

The approach combined multiple data collection methods with different weaknesses but complementary strengths, providing convergent and divergent evidence relating to the study (Johnson and Turner 2003). A focus group (video recorded semi-structured group interviews) and semi-structured questionnaires (intra-mixing both open and closed question types) were inter-mixed in five key phases at appropriate stages of the ADDIE model. Where appropriate, purposeful samples of users and none users of the portal were used. An overview of activities is provided in Table 1.

Ethical approval was received from the Faculty research ethics committee. Students' participation in all aspects of the study was voluntary and those participating in the focus group signed consent forms.

Analysis of data

The focus group (Phase 1) was transcribed into text and subjected to thematic analysis. A nomothetic approach was used to identify 'key areas' or 'themes' in the participants' transition experience. A constructivist viewpoint was adopted in order to "step beyond the known and enter into the world of participants to see the world from their perspective" (Corbin and Strauss 2008, 16).

Open questions in the online surveys (phase 2-5) were collated; basic descriptive statistics were calculated and then used to generate appropriate tables and histograms.

Closed questions in the online surveys (phase 2-5) were subject to thematic analysis following the same approach as for the focus group transcripts.

Table 2. *Overview of the development process and related research activities*

Dates	ADDIE stage activities	Research activities
6th May 2009	Analysis Gathering of information and requirements to inform development of the online portal	Two separate phases were involved in analysis stage. Phase 1. Qualitative research. Exploration of transitional experiences. Use of small focus group with five 2008/2009 level 5 FDT students.
6th July 2009		Phase 2. Quantitative and qualitative research. Use of an online questionnaire to investigate pre-entry concerns and individual needs (based on outcomes from Phase 1). Completed by 75% of incoming (2009/10) FDT students.
May-July 2009	Design Portal design based and informed by requirements identified through analysis of Phase 1 and Phase 2.	Formative evaluation of phase 1 & 2 undertaken.
July-August 2009	Development Portal built using Adobe GoLive.	
24th August 2009	Implementation Portal accessible to students four weeks before the start of term. Invitation to portal sent via letter and students home email.	Use of the portal (including forum) was monitored throughout. First use of the portal took place 26th August 2009.
6th October (2 weeks into study)		Phase 3. Quantitative and qualitative research. Use of an online questionnaire to explore student's early experiences of the course and portal. 67% of the new (2009/10) FDT students responded.
6th November (6 weeks in)		Phase 4. Quantitative and qualitative research. Use of an online questionnaire to explore student's on-going experiences of the course and portal. 84% of the new (2009/10) FDT students responded.
15th December 2009 (final week of the 1st academic term)	Evaluation Full summative evaluation draws on results of all of research phases (1-5).	Phase 5. Quantitative and qualitative questionnaire. Use of an online questionnaire to determine student's overall induction experience of users and non-users of the portal. 51% of the new (2009/10) FDT students responded.

Phase 1 and 2: results and design implications

Analysis of the phase 1 focus group and phase 2 questionnaires identified seven key issues with design implications for the proposed FDT portal. These are outlined and discussed below.

Issue 1

Participants in the focus groups (level 5 students) suggested that students often felt isolated at the start of their Higher Education experience:

> The first year is really hard I think to deal with like being away from home and with these people you don't know and stuff. I found it really lonely. Student 5

Such feelings of isolation have been associated with the emotional complexity of the transition to HE (Shock Absorber 2007). Interestingly, the experience of the level 5 students is slightly at odds with incoming (level 4) students who provided mainly positive emotional responses (e.g. excited and raring to go) and low levels of anxiety and stress (Figure 81). This suggests the incoming students have some difficulty in envisaging the emotionally transformative experience (Austerlitz 2008) they are about to undertake.

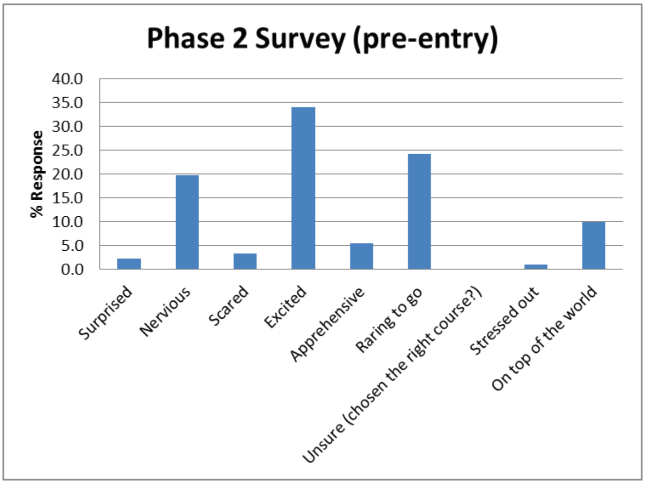

Figure 81. *Phase 2 Survey Q1: Incoming (level 4) student's feelings about coming to university*

DESIGN IMPLICATIONS. THE PORTAL SHOULD:

- Provide provision of support in order to buffer the emotional experience of transition to HE study.
- Provide support for social transition into HE.

Issue 2

The focus group participants suggested providing prospective students with the opportunity to meet and get to know peers and current students before starting the course:

> It would help to know that other people have got the same worries as you. You're not the only one freaking out that you're going to be the only one living in Halls

> and stuff like that. It would help you to know that there are other people who are going through the same. Student 4

In addition, 79 % of prospective students who responded to the phase 2 questionnaire acknowledged they would value the opportunity to meet and make friends with others in their cohort before starting on the course.

DESIGN IMPLICATIONS. THE PORTAL SHOULD:

- Enable the development of peer support networks before the start of the course.
- Deploy a third year student to act as mentor within an online forum in the portal.
- Provide an opportunity to meet with other new students before arriving at university.

Issue 3

The focus group discussions on preparing for university centred on practicalities of living away from home (e.g. accommodation and buying pots and pans) rather than any anticipated differences in the teaching, learning and assessment:

> I just bought saucepans…and bed sheets I didn't do anything else. Student 5
> I just came. You had your break and you had to find somewhere to live so that was the main thing. Student 2

80% of the incoming students reported concerns that can be categorized into **Finance/lack of money**, Living away from home/homesickness, **Study load**, Anxiety, Low self esteem and **Making friends**. Interestingly, similar issues (in bold above) were found by Yorke (2000) and the NAO report (2007).

The focus group also felt that a portal environment could enable prospective students to find answers to basic questions and address concerns by talking to other new students:

> I think it's a really good idea [the proposed portal]. I would've liked to have had someone to talk to first beforehand. I'd want to see where they were staying and like what they thought. Student 1

DESIGN IMPLICATIONS. THE PORTAL SHOULD:

- Provide easily accessible advice on practicalities of living and working away from home.
- Deploy a third year student to act as mentor within an online forum in the portal.
- Provide an opportunity to meet with other new students before arriving at university.

Issue 4

Some focus group participants seemed to lack confidence and expressed surprise that they have been given a place on the course. This appears to originate from misinformation provided by advisers during application:

> They [our teachers] said you can't get in [to MMU] it's too hard and only people from Manchester and really good students get on the course. They just said there's no point [in applying] basically. Student 2

The incoming students surveyed did not appear to be lacking in confidence with 94% reporting being excited and 65% that they were raring to go. Although about half also reported feeling nervous the majority were clearly enthusiastic at the prospect of coming to university.

DESIGN IMPLICATIONS. THE PORTAL SHOULD:

- Provide a welcoming and encouraging environment and seek to build upon student's confidence and self-worth.
- Utilise and capitalise on the high levels of enthusiasm that students feel on first arriving at university.

Issue 5

The focus group also revealed some confusion with the pedagogic nature of art and design study where "many 'right' answers may exist" (Austerlitz et al. 2008, 127):

> Tutors must communicate with each other much more so you're not telling us [the students] two different things and be more clear don't presume we [the students] understand anything - break-it-down. Student 5

This highlights, to some extent, a mismatch between student's expectations and the realities of studying in HE. Unlike other subjects with more inherent solidity and certainty, the ambiguous nature of Art and Design, where learning activities are often open to suggestion and interpretation, can bring about feelings of uncertainty and anxiety for students (Ewings 2008). As expectations are known to impact on students' adjustment to university (Jackson et al. 2000) it is important to manage these.

DESIGN IMPLICATIONS. THE PORTAL SHOULD:

- Provide opportunities for students to adjust their expectations of studying Art and Design before coming to university.
- Prepare students for the realities of HE teaching, learning and assessment.

Issue 6

Participants in the focus group were unprepared for the level of autonomy and self-direction expected of them:

> You need to be prepared…not for anything to be spoon fed to you like it was in college or on foundation... they [the tutors] don't just hand out to you. You have to go to the library and look on the Internet for books that they've recommended to you and you have to go and get them books yourself… It's you're an adult now you kind of expected to do everything for yourself. Student 3

Furthermore, focus group participants felt that communication with current students about their academic experience would be useful in providing an insight into the work and level of the course:

> You [portal designer] could definitely put some work on there so you [the student] can kind of see what you're going to be doing. Student 4

DESIGN IMPLICATIONS. THE PORTAL SHOULD:

- Set learning, teaching and assessment expectations and explain how academics skills will be developed during the course.
- Provide real examples of learning activities and work.
- Deploy a third year student to act as mentor within the portal.

Issue 7

Some difficult early experiences had led to low morale in focus group participants and general cohort. This had impacted negatively on some students' engagement with the course and ultimately some withdrew simply because they had become personally unhappy:

> There was a lot of negativity in our course in the first year. I think a lot of people have kind of brought each other down and I think that's why so many people end up quitting or not coming in. Student 4

This could be linked to feelings of isolation identified in *Issue 1* as there is an emotional element to issues of morale.

The focus group subsequently explored the some times mixed emotional aspects of engagement with tutors. The group felt it would ease future students' anxiety if they got to know programme tutors a little before arriving at university via the proposed portal:

> …so that you [the student] recognise people and you kind of know what they're [members of staff] like and kind of feel more relaxed when they walk into the room. Student 3

Austerlitz (2007) showed that tutor/student relations can significantly impact upon students' motivation and feelings of self-worth and it would seem appropriate to facilitate effective tutor/students relationships as early as possible.

DESIGN IMPLICATIONS. THE PORTAL SHOULD:

- Enable peer support networks to develop quickly.
- Enable students to find out about and engage with key members of the programme team before coming to university.
- Provide a quick and easy way for students to communicate directly with the level 4-year tutor.

Design of the portal

The site map (Figure 2) is a schematic representation of the portal design based on the requirements identified in phase 1 & 2. The inner circle represents the portal itself and extending beyond - the provision of all the preparatory and support resources, with URL links and individual Internet addresses. A screen shot of the FDT portal homepage can be seen in Figure 3.

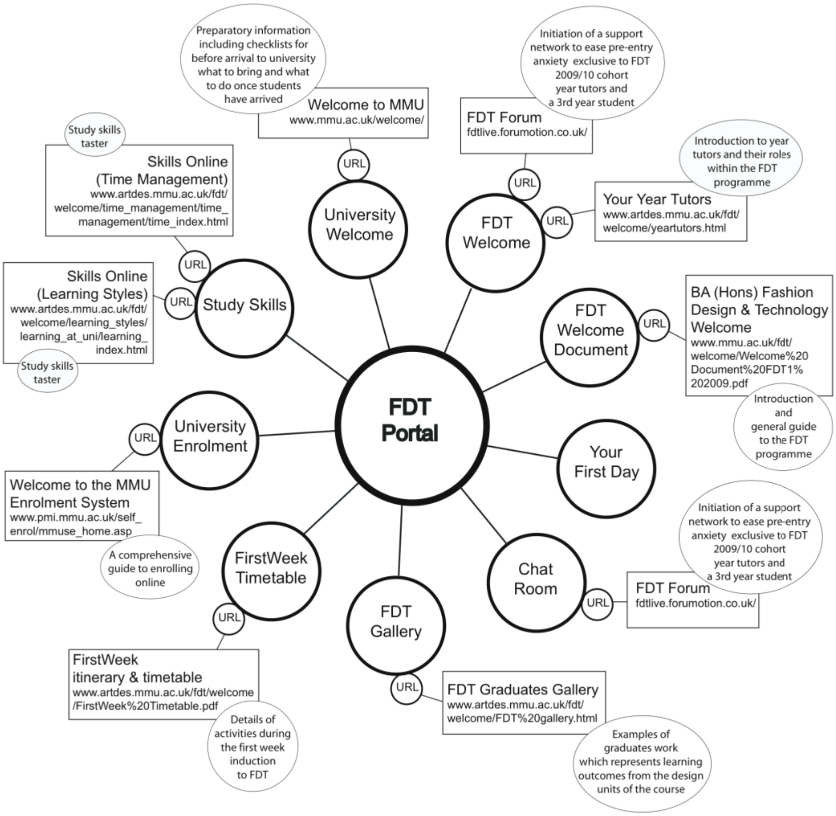

Figure 82 Site map illustrating layout of the FDT portal and URL links directing students to support resources.

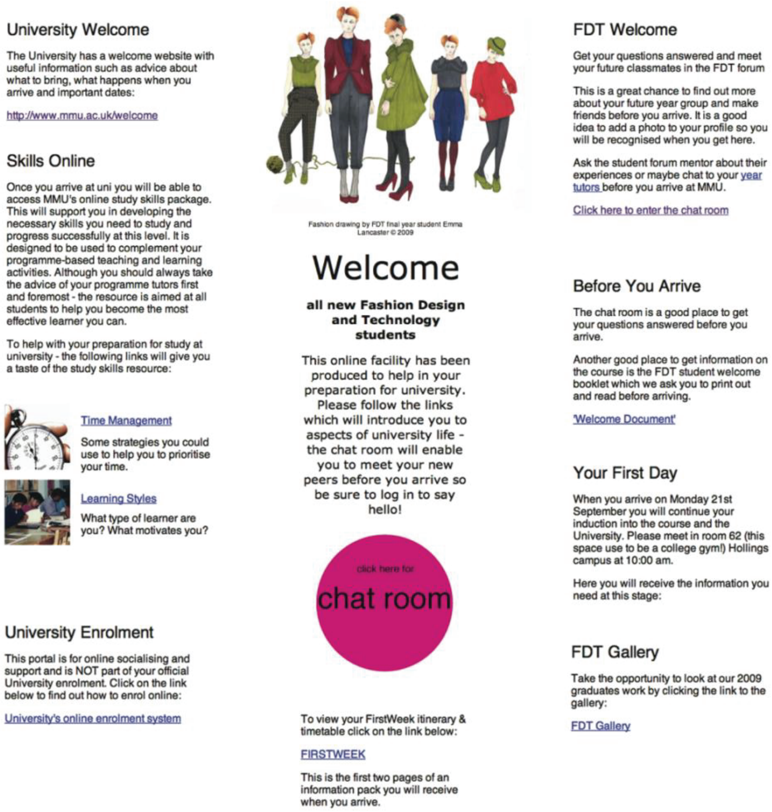

Figure 83 *The FDT portal homepage*

The portal was built using Adobe GoLive, Hyper Text Markup Language (HTML) editor and web site management application from Adobe Systems and hosted on the MMU Art and Design Internet Server, where students could access the support without being formally enrolled on the course.

Phase 3 and 4: formative evaluation of the student transition and FDT portal

Developing peer support networks

Both the phase 3 and 4 surveys indicate that the majority of students had begun to develop academic and social peer support networks. Within the first two weeks of study, the majority (83%) of the students had made friends, which they could talk to about course study problems (Table 2, Phase 3, Q1). While 70% had already made friends that they could talk to about personal problems (Table 2, Phase 3, Q1). After 6 weeks 82% had friends on the course to help them in times of stress (Table 2, Phase 4, Q7). These findings are very positive as it is widely suggested that being part of such networks enhances the first year experience (e.g. York and Longden, 2008).

Table 3. *Phase 3 & 4 survey results*

Phase 3 survey (6th October 2009): Transition to University: how is it for you? N=30 (67%)					
Question	Strongly Agree	Agree	Neither	Disagree	Strongly Disagree
Q1. I now have friends on the course that I can talk to about course study problems	14 (46%)	11 (37%)	5 (17%)	0 (0%)	0 (0%)
Q2. I already have friends on the course that I can talk to about personal problems	10 (33%)	11 (37%)	6 (20%)	3 (10%)	0 (0%)
Q3. Meeting the year tutor within the portal before arriving at university made the first day less daunting.	11 (37%)	12 (40%)	6 (20%)	1 (3%)	0 (0%)
Q4. I feel I can ask tutors questions when I'm stuck	8 (27%)	18 (60%)	3 (10%)	1 (3%)	0 (0%)
Q5. Visiting links on the FDT portal help me to understand the course better	6 (20%)	18 (60%)	5 (17%)	1 (3%)	0 (0%)
Q6. I'm finding the work much harder than expected	1 (3%)	4 (13%)	8 (27%)	13 (43%)	4 (13%)
Q7. I am enjoying new and interesting ways to work	8 (27%)	16 (53%)	5 (17%)	1 (3%)	0 (0%)
Q8. During study tasks I feel happy to work on my own	12 (40%)	16 (53%)	2 (7%)	0 (0%)	0 (0%)
Q9. Starting at university was a very emotional time for me	3 (10%)	4 (13%)	10 (33%)	8 (27%)	5 (17%)
Q10. With hindsight I wish I had used the FDT portal more to prepare for university	2 (7%)	9 (30%)	7 (23%)	11 (37%)	1 (3%)
Phase 4 survey: Adjusting to University: how are you finding it six weeks in? N=38 (84%)					
Question	Strongly Agree	Agree	Neither	Disagree	Strongly Disagree
Q2. Our workload is much more than expected	8 (21%)	19 (50%)	7 (18%)	4 (11%)	0 (0%)
Q3. The course is exactly what I expected	2 (5%)	8 (21%)	24 (63%)	4 (11%)	0 (0%)
Q4. I am concerned about my time management	7 (21%)	18 (47%)	10 (26%)	3 (8 %)	0 (0%)
Q5. I thought we would get more help from tutors	5 (13%)	21 (55%)	6 (16%)	6 (16%)	0 (0%)
Q6. Lack of money is a real problem	20 (53%)	12 (32%)	3 (8 %)	3 (8 %)	0 (0%)
Q7. Course friends help me in times of stress	11 (29%)	20 (53%)	4 (11%)	3 (8 %)	0 (0%)
Q8. I am enjoying the challenge of university study	5 (13%)	22 (58%)	11 (29%)	0 (0%)	0 (0%)

Role of the portal in developing peer support networks

The extent to which the FDT portal facilitated students making friends is unclear. The portal went live on August 24th 2009 and several students had registered and used it as early as August 26th 2009, illustrating early signs of enthusiasm. By the start of term (21st September 2009) 47% of students had registered, but only 28% of members had uploaded posts to the forum. These figures may not give a true indication of the engagement with the forum; a more detailed analysis showed viewings to be more extensive. For example a single topic entitled: What would you like to do during induction week? received a total of 319 views and 53 separate posts. This indicates that more students were reading (and re-reading posts) than were actually posting.

Postings covered a variety of issues, both social and academic, including induction week, accommodation, practicalities of moving to Manchester, timetabling and programme related issues.

Generally, postings used friendly, informal language and were written in text speech (but were still legible) for example:

> So excited bout sat guys!! Woop Woop. Arriving at 3 @ Wilmslow Park. Anyone else??? Cant wait to meet you all guys.

Users clearly felt that the forum provided a safe and friendly environment and were comfortable enough to use informal language in their postings. It was also apparent that, as intended, the portal was enabling some of the students to make friends and begin to interact socially before arriving at university.

Deployment of a third year student mentor to facilitate the forum (Issue 2) initially appeared to be ineffective as their first post received only 3 replies. However, closer analysis revealed that the post was actually viewed 108 times, suggesting that although interested, new students were reluctant to engage in discussion. As the focus groups in phase 1 had suggested that the experience of current students would be of interest to incoming students this was surprising. The reasons for this are unclear but it is notable that the mentor had no previous experience of this role and on at least one occasion took 6 days to reply to a question. With hindsight the mentor may have needed greater support and advice on how to facilitate the forum.

Impact on emotions and expectations

After two weeks study, the students seem generally unaware of any emotional impact of coming to university with just 13% considering it an emotional time (Table 2, Phase 3, Q9). However, the phase 4 survey (6 weeks into the course) shows a rise in reported negative emotions and a general decline in positive emotions compared to the phase 2 survey (cf. Figure 1 with Figure 4). Of particular note is a big rise (1% to 30%) in the number of students reporting feelings of stress. This is not a surprising finding as there is a growing belief that becoming a university student is essentially an emotional process (Christie et al. 2008).

Closer inspection of responses to the phase 3 and 4 surveys indicates a divergence in student's expectations and their experiences between the surveys. After the phase 3 survey the course appears to be in line with student expectations. Only 16% report that workloads are higher than expected (Table 2, Phase 3, Q6), 80% are enjoying new and interesting ways of working (Table 2, Phase 3, Q7) and 93% are happy to work independently (Table 2, Phase 3, Q8). However, six weeks into the course, despite 72% reporting that they are enjoying the challenge of university study (Table 2, Phase 4, Q9), 72% are experiencing higher than expected workloads (Table 2, Phase 4, Q2), 68% have concerns about their time management (Table 2, Phase 4, Q4), 68% anticipated more help from tutors (Table 2, Phase 4, Q6) and only 26% are finding the course to be exactly as expected (Table 2, Phase 4, Q3). Furthermore, 85% of students are experiencing financial pressure at this point (Table 2, Phase 4, Q7). It would appear that the realities of studying on the course (i.e. a developing miss-match between expectation and experience) combined with mounting financial pressure are leading to increased stress for the students and an erosion of positive emotions.

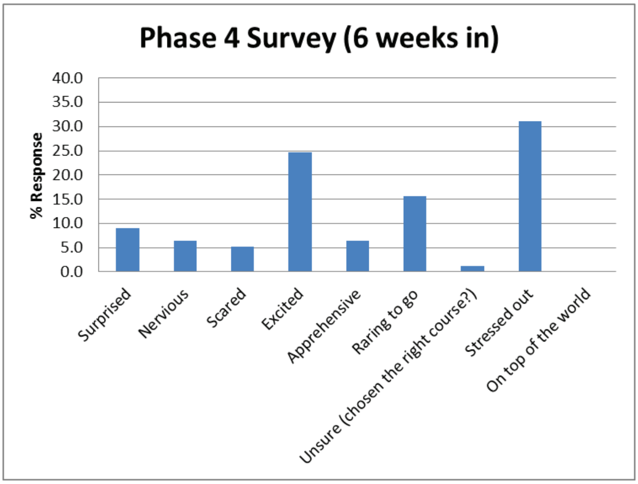

Figure 84. *Phase 4 Survey Q1: Level 4 student's feelings about coming to university after 6 weeks of study*

This observation raises concerns as research findings from Brissette et al. 2002 and Johnson 1994 found that high levels of stress are strongly associated with early departure from higher education. However, the same research suggests that optimism influences improved psychological well being and aids in better adjustment as a result of coping strategies used during times of stress. Despite the high number of students reporting feelings of negativity and high stress levels an equally high level of responders reported still being optimistic about their study (Figure 4).

Role of the portal in managing expectations

It was hoped that the FDT portal would be useful in managing student expectations and help them to understand the requirement of their course. Interestingly, the phase 3 survey elicited mixed responses about the students' use of the portal to prepare for university. 80% said that visiting links on the portal had helped them to understand the course better (Table 2, Phase 3, Q5). However, while 38% of respondents indicated that they wished that they had used the portal more to prepare, 41% disagreed and 21% reported being unsure (Table 2, Phase 3, Q10). According to findings within the Higher Education Academy report (2006), support provision is not always utilized to its full advantage. The students who most need it are not necessarily the ones that will use it. Furthermore, some literature suggests that characteristically, students at this stage of their development tend to overestimate their knowledge, abilities and understanding (Drew 1998). Consequently, students so early into their study may not recognise the value of a support facility such as the FDT portal and are consequently still surprised by the realities of study at HE level.

Engagement with tutors

An important aspect of Art and Design led courses is the fact that students depend upon the guidance of their tutors, which is particularly important given the ambiguous nature of Art and Design pedagogy (Ewings 2008). Developing effective working relationships between students and their tutors is therefore essential. After two weeks 77% of students report that meeting the year tutor via the portal made the first day less daunting (Table 2, Phase 3, Q3) and 77% felt that they could ask tutors questions when they were stuck (Table 2, Phase 3, Q4). However, after 6 weeks 68% expected to receive more help from tutors (Table 2, Phase 4, Q6). Although good tutor/student relationships had been established this provides further evidence that some students were unprepared for the levels of autonomy expected of them at HE level. Further analysis reiterates this thinking; at six weeks into the course attendance was found to be 17% lower than for the previous year's cohort (2008/09). This was evident despite significant additional early support being available on the FDT portal.

Phase 5: summative evaluation of the student transition

51% of the cohort completed the final questionnaire survey. 83% of respondents confirmed receipt of an invitation to visit the FDT portal and 57% reported that they used it in preparation for coming to university. Unfortunately, 17% of students indicated that they either did not receive, or were unsure if they had received, an invitation. Some non-users of the portal reported struggling to gain access and not understanding how to use it and feeling disadvantaged by this. Evidently some work is required on the administration to ensure that all the students receive an invitation and that these include clear instructions on the use of the portal.

Those students who did use the portal reported that it had helped them to get to know other students and to realise that others had the same feelings and concerns about starting at university. Furthermore, being able to see work from current students was reassuring to them:

Viewing current students work and the chat room to at least see some of the other students who would be on my course, even if I didn't actually have the courage to speak to them yet.

The opportunity to interact with the year tutor was also valued by users of the portal:

The portal was very helpful as Julie [level 4 year tutor] was willing to answer all our queries concerning the course.

Analysis of the site activity log showed that use of the portal continued after the initial induction week throughout the first term. Reponses to open questions suggest that this aided the development of students study skills and awareness of course expectations and closed question responses revealed that:

92% agreed they knew what would be expected of them in terms of attendance.

88% agreed they knew how to follow timetables.

76% agreed when asked if they understood the various teaching methods used to deliver the course.

96% agreed in knowing how to make the most out of taught sessions.

Poor attendance was however a feature of the rest of the term down from 83% for the 2008/09 cohort to 66% in 2009/10. Given the link between low attendance (and poor general time management skills) and the likelihood of withdrawal from study

(Johnson 1994 Fitzgibbon and Prior 2003) this was concerning and suggests that the implementation of the FDT portal has not impacted positively upon student engagement or autonomy. However, by the end of the first term retention on the programme was 100%. Based on the evaluation findings it is suggested that the FDT portal has facilitated the development of support networks and valuable coping mechanisms, relatively quickly. In this respect the induction process appears to have worked effectively in buffering the highly stressful and emotional process of transition to university at least during the first term. The final retention rate for the academic year was 77%, slightly up from 75% in 2008/09. Although this is a slight improvement there is still a need to improve retention and further investigation of the withdrawal themes and the student experience during the second term is now required.

Conclusions

A key finding of this project is that student expectations and experiences of university life appear to diverge at some point between two weeks and six weeks into their first term. The causes of this are undoubtedly multi-faceted. A significant emotional shift occurred over this period as feelings of optimism and excitement faded and levels of stress increased and despite best efforts in managing expectations, explaining approaches to teaching, learning and assessment and providing examples of work via the portal, many students were still unprepared for the levels of independence and autonomy expected of them. This seems to have directly impacted upon engagement and attendance.

The key transitional student interest is making new friends. The FDT portal facilitated development of social and academic support networks that have mitigated emotional and expectation issues and appears to have impacted positively on overall retention to the programme.

Future developments to the FDT portal and induction process must aim to build on the emotional wellbeing and optimism that is prevalent in new students. To do this, mechanisms must be put in place providing emotional support for students when they are at their most vulnerable (between 2 weeks and 6 weeks into the course). Furthermore, we must recognise that current approaches do not prepare students for the independent and autonomous learning expected of them. Simply explaining what is expected is not effective and we need to revisit our current approaches to learning skills development.

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Feel the Fear: Learning Graphic Design in Affective Places and Online Spaces

Anitra NOTTINGHAM*
Academy of Art University, U.S.A and The University of Melbourne, Australia

Abstract: *This paper explores the idea of pedagogic affect in both onsite and online graphic design learning spaces, and speculates on the role that this affect plays in the formation of the design student. I argue that embodied design knowledge is built by interactions with design professionals, activities that mimic the daily work of designers,* ***and*** *practices of display such as student work galleries within design schools. Therefore bodies in motion, and the places they move within, take on more importance in the making-up of a graphic design student than we may expect. This idea has implications for online design learning. This paper crosses both Actor-Network Theory (ANT) and Non-Representational Theory (NRT), and works three instances of affect. The analysis presented here is targeted towards exploring the contribution of affect to teaching in onsite and online learning spaces. As the practices described here carry through time and space to other design schools, this paper has implications for a broad suite of practices in design education Thinking through how affect plays out in the onsite design school points the way towards more vibrant online learning spaces.*

Keywords: Graphic Design, Design, Education, Online Learning, Social Media, Actor-Network Theory, Learning Spaces, Non-Representational Theory, Material-Semiotic, Socio-Material.

* Corresponding author: School of Graphic Design | Academy of Art University | San Francisco, U.S.A | e-mail: anottingham@academyart.edu

Introduction

Most design schools are vibrant places, where a myriad of encounters between students, teachers, and professionals can occur. Some of this vibrancy comes from the materiality of the design school itself, which more often than not contains curated displays of exemplar student design work on its walls (see Fig 1). These practices of display contribute to making the design school a learning place, capable of generating emotional attachments that enable (or thwart) learning (Sagan 2008). Overlooking the affective potential of design learning places has consequences for online learning. Many learning management systems are created in the style of "instructivist" spaces (Cheers, Chen and Postle 2011), the equivalent of an online filing cabinet: aesthetically dull, utilitarian. The main problem with this approach is that these sites are configured in ways that actively block opportunities to encounter others—and the exemplar work of others—outside of the sequestered virtual classroom.

It's my contention that the spaces of onsite design schools are more than a backdrop for learning (Holland, Gordon and Lahelma 2007), but instead are affective places that do much unattended to pedagogical work. Further, I argue in this paper that fresh understandings of how affect in onsite design school is assembled, and what it may contribute to the making of novice designers, could provide clues to improving the online design student experience. I will prosecute my case by examining theories of affect, and speculating on the ways affect may be used to "catch students up in learning" (Mulcahy 2011).

Presented as background to on-going research into design learning environments, this paper focuses on graphic design education and draws concepts from two practice-based theories: Actor-Network Theory (ANT) and Non-Representational Theory (NRT). ANT is a material-semiotic theory, which sees the social as emerging from the myriad relations between human and non-human actors. ANT is "a way of doing and writing research" (Arnseth 2011) which allows us to analyse how the materiality of learning environments is implicated in the development of design students. NRT shares an interest in materiality, but, unlike ANT, draws our attention more closely to human expressive qualities. NRT is, in essence, about:

> practices, mundane everyday practices, that shape the conduct of human beings towards others and themselves in particular sites. … It is concerned with practices through which we become 'subjects' decentred, affective, but embodied, relational, expressive and involved with others and objects in a world continually in process. … The emphasis is on practices that cannot adequately be spoken of, that words cannot capture, that texts cannot convey − on forms of experience and movement that are not only or never cognitive (Nash 2000 p55)

I work three empirical instances of affect here: the hallway gallery of the onsite School of Graphic Design at San Francisco's Academy of Art University (AAU) (see figure 1), its retired blog The Digital Wall, and its new Pinterest home @aaugd (see figure 2). The methodology employed here is empirically based, in that it utilizes a narrative strategy drawn from Bruno Latour's exhortation that researchers "just describe" (Latour 2005, 144) all the actors, human and non-human, they observe in the field. The three descriptions used here are generated by: a video walk through of AAU's onsite school, and two written observations of the online spaces, I call these descriptions "data stories". The resulting analysis of these data stories is targeted toward revealing

Figure 1. Images of the hallway gallery of exemplar student work in the School of Graphic Design at the Academy of Art University, San Francisco. Clockwise from left: a close-up of one of the cases, a view looking down the main hallway reveals a student looking at the wall, a panoramic image of the School of Graphic Design office (the large "e" is on the left) displaying the precisely placed "authorized" flyers, and a close up view of one wall of the hallway. Source: Anitra Nottingham (2011). Bottom image of the design office: a panoramic photo by Hunter Wimmer (2011).

something of how affect may be assembled in design learning places, and what pedagogical work such affect may be doing.

Graphic design, embodied knowledge, and hallways

Graphic Design knowledge displays characteristics of embodied knowledge as described by Blackler (1995) in that it is learned by doing and by dialogue, and is (atleast partly) tacit. Graphic design is taught by means of the design studio, where teachers and students collaborate on projects together and conduct both individual and group critiques—thus mimicking the practice of professional designers. In this process, graphic design teachers seek to develop a *design eye* in their students: a mode of analysis that sorts good from weak design. This design eye assists the design student to reflect upon and improve upon his or her own work. But the design eye is not developed by human action alone; places and things are complicit in this process. Most graphic design students move through, and dwell within, the walls of design schools. A key component of this daily experience is the myriad encounters students have with exemplar student work usually displayed on the walls of the design school. These interstitial, often ad-hoc, gallery-style spaces are characteristic of an education in graphic design. The AAU *hallway gallery* (Figure. 1) could be described as one of a "tribe" of hallways that exist in many other design schools. Different members of this tribe wear their individual quirks and preoccupations on their walls. Some members of the tribe may be relatively barren but will still 'speak' of their designer-ly preoccupations through unique architecture, while other hallways are highly designed and carefully curated spaces.

Research has shown that the critique in graphic design education is a form of signature pedagogy, as described by Shulman (Shreeve 2011). Signature pedagogies are "pervasive, routine, and habitual" (Shulman 2005) pedagogic practices within a discipline that create links with professional practice and prepare students for working life in the profession (Shreeve 2011). A characteristic of signature pedagogies is the practice of "benchmarking" which forces students to measure themselves against others (Shulman 2005). Group critique in the graphic design studio is an example of benchmarking, and so is a hallway gallery. Benchmarking encounters are commonly affective encounters (Shulman 2005), capable of producing the excitement of competition as fear or doubt in the design student. The key contention of this paper is that affect, arising from encounters in the classroom, leaks (Massumi, 2002)—by means of exemplar student work—to design school hallway galleries, and is a crucial ingredient that helps the student "catch" (Mulcahy 2011) the *design eye.* Traditional psychological readings would indicate that this transmission of pedagogic affect happens in relations between human bodies. However, post-structuralist notions of affect enable us to re-imagine places and spaces—even if they are non-living or virtual—as bodies, and as such, participants in affective relations. I will show that the AAU hallway is in fact a more stable version of the affective encounters that occur in the classrooms around it every day and is both an affect filled display, and a calculated pedagogical act.

About affect and affective relations

Affect is both the "body's capacity to affect" and to "be affected" and is a slippery concept, often described using terms such as "forces" or "energies", "intensities" and "shimmers" (Gregg and Seigworth 2010, 1), amongst others. Affect when it happens to a human body can turn into feeling(s) or emotion(s); this Massumi describes as "intensity owned and recognized" (Massumi, 2002, p. 221). Affect arises *in-between* relations (Anderson 2006); as such affect is always *becoming* and has a "not-yet" quality (Gregg and Seigworth 2010, 3): contingent, of the moment, and capable of change. The body's capacity to **be** affected means affect seems to come from the outside **in**, and as bodies have, in turn, the capacity **to** affect, affect can be transmitted from the inside, **out** (Gregg and Seigworth 2010). A sports event is a commonly used example to describe a circulation of affect: the "feeling" that "runs" through a crowd and can manifest as cheering or groans depending on what happens on the field (Massumi, 2002). For the purposes of this paper however, we might best think affect as a "shimmer" like that experienced in an art gallery: a hushed feeling of subdued excitement that can render the most rambunctious individuals quiet or introspective. Thinking affect in terms of a visit to a gallery acknowledges the subtle, micro variations of the "shimmer", as opposed to the more energetic idea of "intensities" (Gregg and Seigworth 2010).

Broadly speaking, much contemporary work theorizes affect in one of two ways: either *psychobiological*, or as *bodily capacities of affect* (Gregg and Seigworth 2010). A psychobiological reading emerges from the work of Eve Sedgwick and Adam Frank's re-reading of the work of Silvan Tomkins (1967). Here, "affect becomes an object" that is human centered and "capable of leaping from one body to another"; it is "contagious" and capable of "being caught" (Ahmed 2010, 39). Whereas a post-structuralist notion of *bodily capacities for affect*, as developed by Gilles Deleuze and Félix Guttari (1978) (and based on the ideas of Spinoza from his *Ethics*) conceives affect as *contingent to*, but not necessarily *connected with* emotion within human bodies. This reading of affect makes room for non-human participation in affective relations, because affect is a feeling or sensation that is contingent to the body, but capable of circulating around and through objects, spaces, ideas and people. Thinking affect with Deleuze and Guttari enables non-human objects—such as a hallway or a blog—to be re-thought as a body, as bodies are "defined by their potential to reciprocate or co-participate in the passages of affect" (Gregg and Seigworth 2010, 2) and for affect to become attached to these kinds of non-human entities.

In a place like the AAU hallway gallery, it is the student work pinned on the walls that is a non-human "body" capable of triggering a series of affective relations with human bodies passing by. Deleuze states that a piece of art (or say a piece of design) doesn't have affect embedded within it, but it is capable of *producing* any number of affects, depending on the affects and percepts which are located inside the viewer (Deleuze and Guattari 1996). For instance we can see red, we can experience excitement, so red in a piece of art (or design) may, depending on percepts of the viewer (say they grew up somewhere where red is perceived as lucky, or perhaps dangerous) trigger an affective relation which is capable of becoming something—a feeling or emotion—once inside the mind of that viewer. The potential for affect then exists between the exemplar student design work and the student body. Whatever feeling an individual student experiences in the AAU hallway gallery however, is contingent, specific to the student and their individual bodily capacity to be affected.

Theoretical perspectives and affect

Bruno Latour employs an Actor-Network Theory (ANT) sensibility in his reading of bodies, objects and affects in the 2004 article "*How to talk about a Body?"*. ANT, developed by Latour, Callon and Law in the 1980s, turns our attention to the socio-material practices; the way that objects, people and ideas come together (or not) in webs of relations or *actor-networks*. Bodies, according to Latour, can coexist with objects that have the capability to affect them, and transform the body into something other. Describing the learning experience of making "a nez" (literally "a nose" or perfume expert), Latour draws our attention to the role of material objects in learning, in this case the odour kit, which attunes perfume students to the minute differences between different smells. Here the students are "bodies learning to be affected" (Latour 2004, 209) by "hitherto unregisterable differences" between smells, through the "mediation of an artificially created set-up" (Latour 2004, 225). We could view the AAU hallway as a kind of "odour kit", an object set-up for the pedagogic purpose of attuning the student body to "hitherto undetectable differences" between different kinds of design.

Non-Representational Theories (NRT) provides another useful way of thinking about how bodies can be formed by the places within which they dwell. Non-Representational Theories are a series of diverse ideas which focus on spaces, bodies, objects, activities and practices—what can be described as the “background “hum”” of everyday life (Anderson and Harrison 2010, 7). Non-Representational Theory as described by Nigel Thrift suggests that our embodiment: habits, dispositions, our ways of being in the world emerge from the multiple interactions —including affect— that make up the world we inhabit (Thrift 2007). *The world of the onsite AAU School of Graphic Design* for example, is an unfolding series of interactions between people places and objects, and affects. There are many kinds of affects possible, many kinds of interactions, and many kinds of outcomes, and the material world has affordances that enable some, and prevent (or restricts) others (Thrift 2007). Becoming a designer against another background, in another “world” from that of the AAU Onsite School of Graphic Design, with its hallway and affects, would therefore produce another sort of designer. This idea has obvious implications for online learning, which I will return to later.

Affect and the Formation of Taste

The *design eye* I have described is a kind of informed taste. Bodies and affect have a role in how we form our taste—our likes and dislikes. The ability of affect to pass through bodies is what allows us to be affected by the atmosphere of a place — “what is out there is getting “in”” (Ahmed 2010, 36-37) but affect can both “circulate” and “stick” to bodies and worlds (Gregg and Seigworth 2010, 1), producing attachments to places and things. Sara Ahmed states that “evaluations are expressed in how bodies turn toward things” (Ahmed 2010, 39) in that we move closer to the things we like and further away from the things we don’t like. Getting physically close to (especially touching) an object has an ability to connect us to it, and further that connection is “preserved through habit” (Ahmed 2010, 35) which would suggest that the more we move in a space, the more capable we are of becoming attached to the place or object.

Ahmed additionally states, “to be affected by something is to evaluate that thing” (2010 31), suggesting that the more time we spend in a hallway, the more we interact with it, the more chance there is that affect sticks to it and that we will begin to evaluate and pass judgment on it because “affect is what sticks, or what sustains or preserves the connection between ideas, values and objects” (Ahmed 2010, 29). This idea allows us to connect the AAU hallway gallery and its affects to student bodies and the formation of taste; it’s not just the display of work that matters, but the proximity, habit, and the daily affective relations that allows students to make value judgments about the design in the hallway.

To instill a design eye online may be a matter of engaging online students in a series of affective relations by making digital displays of student exemplar work “sticky”. To think about how we might achieve this let’s examine how affect is assembled onsite by turning our attention towards the AAU hallway gallery.

Onsite Places: the AAU Hallway Gallery

Picture the hallway in an art and design school in downtown San Francisco, where the communities of graphic design practice encounter one another. Officially authorized to be here are students, faculty and staff, visitors, potential students, parents, and (at night) the maintenance and cleaning staff. But they are not the only members of this community present. This community is not just composed of the people; there are a host of things here, what Bruno Latour terms the “missing masses”. Let’s step out of the elevator and meet some of them.

*This hallway is a bright but not overpowering red on one side, giving an energetic feel to the space, and on the other, a sky blue. This color combination shouldn't really work, but somehow does—the people who painted this space know how to use color for effect. On the previous floors, you have seen A4 sized printouts in a mishmash of styles, sizes and typefaces announcing classes and sports games taped haphazardly to the wall near the elevators. Here, they have been cleared away, and instead there are only the state required and AAU policy safety and recycling notices, and two flyers produced by the design school attached to the wall with red construction tape placed at precise angles on each corner. Leaning casually against the window from inside the design office directly ahead is a large sculptural, red, metal, lower-case **e**.*

This hallway is a square donut, walk in either direction and you will end up at the same point, so you wander to the right because this is where the "deep cases" begin. These cases are lit by recessed spotlights and are packed full of 3D student design work: packages, posters, bottles, boxes arranged hierarchically with smaller work at the front, a layering that allows the eye to move up and down and then sideways, prompting movement from group to group, moving the body along the case. At the first right angle turn, a large poster acts as a focal point, drawing you around the corner. Shallow locked glass cases flank the entire length of this section of the hallway, overhead spotlights directed towards them.

On previous floors, student work was mounted in cardboard frames, but here work is printed on heavy matte paper and hung simply, affixed to the drab grey fabric wall by pins that hold and bracket each corner. All the pins are the same. The gaps between the pieces are optically balanced; there are no empty spaces. The visual effect is of a multitude of pieces placed and grouped precisely to fill the space seamlessly. There is no sense that arguments or disagreements happened while this arrangement was decided; it is consistent as if designed by one person. You encounter two students standing in absorbed concentration in front of separate cases, seemingly unaware of each other. As you approach, one of them repositions himself to stand up straighter and moves further away from the case.

Around the next corner a potential student and her family gather at the end of the hallway speaking intently as they cluster close to and gesture towards the case in front of them. Here there is noticeably less natural light, and few people. When you look closer at the student work you notice that it seems less finished—competent, but compared to the work you have viewed so far, not quite as perfect. Rounding the last corner, you find that the cases lining both the walls here house multiple versions of typographic exercises: variations on a theme, subtly different arrangements, demonstrating the by now familiar pre-occupation with small precisely placed type. Nothing on the walls you have seen so far looks like the average everyday design you see in the real world, rather it looks like the idealized version—a designer's idea of what design could be.

The material environment of the AAU hallway is shown as a kind of visual "background hum" in which *unauthorized or sloppy design has been cleared away*. The large **e** (perhaps literally) says "typography is a big thing to us" and is supported by the multitude of type examples on the hallway walls: the "*familiar pre-occupation with small precisely placed type"*. Above all is the careful display of the student work, *the multitude of pieces placed and grouped precisely to fill the space seamlessly* which allows no respite from the constant stream of a certain sort of design, which rains down upon the students moving within the space. Drawing on Latour's ideas of bodies being capable of transformation via a network of relations with objects, this description shows the AAU hallway as a pedagogic object set up to attune the students to look at design the same way that the odour kit attunes the student *nez* to the minute differences between odours. Latour states: “Before the session, odours rained on the pupils without making them act, without making them speak, without rendering them attentive, without arousing them in precise ways” (Latour 2004, 207). In the same way repeated movement of the student body within and through the hallway attunes the student to the particular brand of design it displays, making them attentive, arousing them in certain ways that assist them to judge differently all the design that is “rained down” upon them, both inside *and* outside of the hallway.

This description shows the range of affective responses the AAU hallway is capable of eliciting from those who pass through it: from quiet absorption, to self-conscious re-positioning of the body, through to subdued excitement. The use of student work in this hallway over the work of others is crucial to generating affect. It’s possible for an individual student to experience any number of feelings in this hallway—excitement, pleasure—but the work of their peers primarily enhances the capacity for a student to experience fear of not measuring up to the competition. As students are in “constant relations with their environs”, and because affect is not “a one way street” (Anderson and Harrison 2010, 207), this affective relation may loop back in unpredictable ways depending on whether it encounters challenge, submission, or outright resistance (Thrift 2007). The outcome of this calculated pedagogic act is not certain or pre-ordained (Thrift 2007, 114). The intended pedagogic effect then is precarious and contingent, and never predictable.

Now consider an AAU student, who doesn’t walk this hallway—could they have the same capacity to be affected by seeing the work of their peers? Walking the AAU hallway gallery is 3D immersive experience. By contrast, the students of the AAU Online Graphic Design School inhabit physical spaces that may have nothing in common with the carefully curated design of the AAU hallway gallery. Take as an example the spaces described to me in a letter by AAU online-only student Lisa: “*My AAU campus was in my basement studio 26 miles west of Chicago, Illinois. Most mornings I had a roughly 4 second commute to school, traveling from my futon to my laptop.”* Nevertheless online design students become designers (as Lisa did), just as their onsite counterparts do. Thrift (2007) would suggest that the online student embodiment, their way of being in the world, must be different because they do not inhabit the onsite world of the AAU school of design. Therefore is the “online becoming” of the designer more difficult, more precarious, because online students do not walk a design school hallway and experience its affects in a bodily way? Let’s now consider an online student, thousands of miles away experiencing a hallway built of pixels.

Online Spaces: The Digital Wall

The AAU online graphic design world consists of a private learning management system (LMS), which is primarily white with black type and a heavy black bar across the top, and a similarly designed onsite school blog: 79nm.com. The Digital Wall, an online student work gallery blog, uses a yellow and black Posterous template (see top, figure. 2) and in both design and location, stands outside the two authorized virtual bodies of the AAU School of Graphic Design. The Digital Wall displays work in the order it is uploaded, or can be viewed by tags, negating any attempt to place work in a controlled

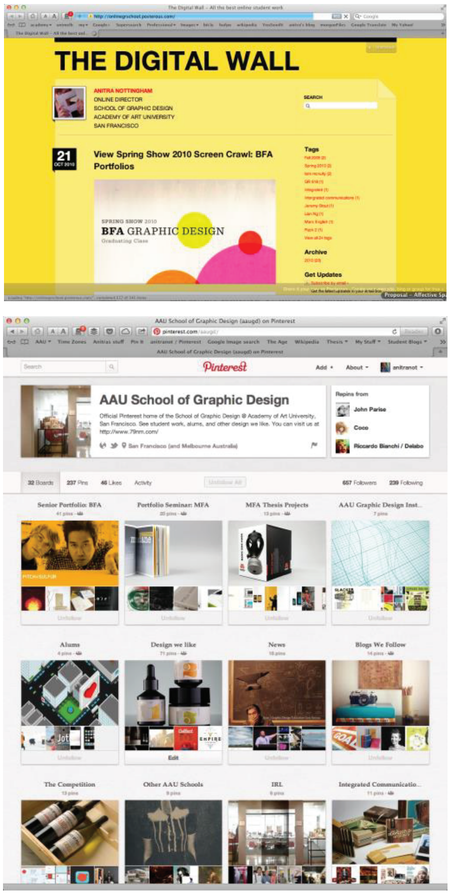

Figure 2*. Top: a screen snapshot of* The Digital Wall*, the retired blog from the Online School of Graphic Design at the Academy of Art University. Bottom: a screen snapshot of* @aaugd*, the new Pinterest home for the School of Graphic Design at AAU. You may view the original video walk through of the AAU hallway gallery, filmed by Hunter Wimmer (2010) here: http://pinterest.com/pin/166914729909629631/*

sequence. It is out of date: the last entry was a year ago. There are no comments, no students have "liked" this blog, yet there have been over 5000 hits. This blog is perhaps doing much unnoticed work; work that is unacknowledged by either students or administrators.

There is something undoubtedly more immersive about a body moving through the hallway than one looking at a screen. The immersive quality combined with the everydayness of the onsite AAU hallway gallery gives it power, something *The Digital Wall* fails to achieve because it has not (yet) inserted itself into the flow of the AAU online students' everyday (digital) life: *There are no comments, no students have "liked" this blog.* Notably *The Digital Wall* does not exist within the virtual body of the school: *does not reference or relate* in the way the AAU hallway does to the physical school. In so doing, the Digital wall does not promote a sense of belonging or connect the blog with the physical, or virtual, AAU "body". There are visitors but sadly any work the blog does is: *unacknowledged by either students or administrators, who cannot see these bodies, or how these bodies may be reacting to the work they see.*

The AAU hallway is a gallery. In a gallery we are watching others look at the art (or design), and being aware of others watching us look. Hennion argues that our taste is “the taste of others” in that “we rely on others in a reflexive way to constitute our tastes” (Hennion 2007, 103). A student can accept the valuation of the work in the hallway as good or not, but whether we accept or reject a valuation, it is done in the presence of others (Hennion 2007). *The Digital Wall*, as currently configured, is not a gallery; it does not allow the visitor to stand alongside others and be seen to be looking; it does not allow for the formation of taste in the presence of others. However there are ways to make a space like *The Digital Wall* a more gallery-like experience. After all one can’t truly know if a fellow gallery visitor likes a piece of art, but if they “thumbs up” or “like” it, this allows us to fix our subjective view alongside the views of others. This one instance demonstrates the possibilities inherent in online spaces; these spaces can enable powerful connective experiences, leading to potentially generative learning. Recent developments in social media have enabled such a space to exist. We will now look to the successor to *The Digital Wall*, AAU’s new Pinterest Home: *@aaugd*.

Online Places: @aaugd

@aaugd, the new Pinterest home for the AAU School of Graphic Design is in a constant state of becoming. Within minutes of its creation, followers flooded in to watch it being built, image by image. At this moment, late on a Tuesday night, @aaugd has 237 images displayed in carefully curated groups or “boards” and is “followed” by 626 others, not all of them students at AAU.

Pinterest, a social media platform, allows users to gather, curate, and arrange visual assets so that they may be accessed and shared with others. When image tiles, or “pins” are selected, they “flip” and enlarge obediently at the user’s command, flipping again and merging with a stream of images when dismissed. There is movement here, a sense of travel, as the interface scrolls up and down, advances and retreats. A user may “get close” to any pin they find interesting, and can scroll quickly past any they don’t. There is much human exchange here, but it is somewhat “silent” compared to chatty spaces like Twitter and Facebook. A “like” allows a user to “collect” an image to view, but not to share with others. A “repin”, more sought after by users and sometimes capable of creating a slight frission of affect, allows the user to collect and add an image to their own collection, and simultaneously share it with others. A repin is validation, and any AAU student work uploaded, or repinned, by @aaugd is effectively branded as exemplar student work by the mere fact it is worthy of being shown to @aaugd’s followers. It’s not obvious to any but the individuals interacting in this virtual space that many teachers and students are encountering each other here, by repinning and liking each other’s pins.

The Pinterest interface mimics the “pinboard” or “moodboard” that marks the beginning of many a design project. An architect designed the Pinterest user interface and its rigorous clean simplicity may be a legacy of his design school training. The grey background in fact bears a remarkable similarity to the grey cloth of the physical pinboards in the AAU hallway, a perfect neutral grey that allows all the content to “pop” from the “wall”. The interface allows the labels of the @aaugd posts to be somewhat obsessively formatted, with carefully placed slashes between the discrete sets of information, not unlike the precisely placed pins of the physical hallway—despite the fact that this formatting may be effaced at will by the next user.

The material affordances of *@aaugd* allow AAU design students to form taste in the presence of others (Hennion 2007)—their teachers, peers, and the broader design community—on a broader scale than the now retired *Digital Wall*. The Pinterest interface is more sympathetic to the AAU design school preoccupations, even its interface *bears a remarkable similarity to the grey cloth of the physical pinboards in the AAU hallway.* Potentially, Pinterest is a more "sticky" way for students to experience exemplar student work by allowing users a sense of movement, and the ability to pause and move "closer" to the student work: *A user may "get close" to any pin they find interesting, and can scroll quickly past any they don't.* In some ways, this hallway—shareable, viewable anywhere on any device that has an internet connection, and unconstrained by physical space limitations—is a more powerful version of the online AAU hallway gallery. Potentially, the affective qualities of the Pinterest interface via its movement, and the ability to "touch", collect and spend time with images, could render this gallery more affective, more "sticky" to the student viewer.

Conclusion

What sort of graphic designers students become is not just the consequence of the teachers, ideas, and tools they encounter and learn to manipulate, it is additionally a consequence of inhabiting a certain kind of "world of Graphic Design School" with its many objects, affects and interactions. Design school hallways, the signature pedagogy of graphic design education, which form part of this "world of design school", work affect on student bodies. Hallways are therefore places of transforming and becoming. These hallway galleries can be seen as objects set up for a pedagogic purpose; they are made to attune students to look at design differently. Encountering the work of peers increases an individual student's bodily capacity to experience fear, a potent emotion that saturates many other design school experiences. The nature of affect to stick, and be preserved through habit, means the proximity and daily travels through a hallway can do work to form taste. As interstitial spaces, hallway galleries afford the kinds of encounters that allow students to form taste, or develop the "design eye", in the presence of others. However, because affective relations can loop in uncertain ways, fail, or encounter resistance, a hallway like the one at AAU is a pedagogic act with uncertain outcomes.

We can take some important clues from the material world of a place like the onsite AAU hallway to build better online spaces. A digital version of an onsite hallway should work to insert itself into a student's life in a way that cannot be easily ignored, and should allow students to experience the virtual gaze of others. *The Digital Wall* shows how such a space may fail; *@aaugd* points the way towards a future where experiencing design school through a flickering screen may become a more truly immersive and transformative experience. *@aaugd* is a signpost towards a more vibrant online learning *place*, one more capable of allowing design students to "catch" a "design eye".

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Developing interactive learning environments to promote scaffolding and reflection: A look at the *Digital Process Book* for design studio education and comparisons to K12 science education applications

Lori BRUNNER STONE*, Abigail LUNDQUIST and Stefan GANCHEV
Iowa State University

Abstract: *The purpose of this paper is to describe the development and rationale for the design of the Digital Process Book (DPB) learning tool for design education at the University level and discuss the similarities with applications to learning tools in K12 science education. The DPB is an interactive learning environment that is intended to promote reflection throughout a student's design process, as well as integrate important scaffolding elements in the system that supplements the traditional in-person contact between a student and an instructor. It is based on tenets of Cognitive Load Theory, which argues that learners are not able to work to their potential if there are too many elements that they need to process in their working memory. The goal of instructional technologists and instructors is to help students decrease their extraneous cognitive load so students have more cognitive resources to focus on the tasks at hand. Design projects are complex design problems that require a way for students to organize, categorize, and sort the many artifacts and ideations that are produced in their design process. These same goals and needs for university design students are similar to learners in K12 science education.*

Keywords: Design process, instructional technology, human computer interaction, scaffolding, reflective learning, cognitive load theory

* Corresponding author: Iowa State University | USA | e-mail: lbrun@iastate.edu

Introduction

Reflection and being a reflective inquirer are important skills for students to master. Students must learn to do more than simply pursue multiple questions in mindless, unclear exploration of sources. This requires new skills to be developed by students; they have to learn the practice of reflective inquiry. Students need to "organize, evaluate, and monitor the progress of an investigation. They need to keep inquiry plans and candidate explanations in mind, systematically interpreting their collected data, periodically reflecting, evaluating their progress, and replanting (Loh, Radinsky, Resier, Edelson & Gomez 1997). They must focus their attention not only the products and results of their work, but also on their inquiry processes. In order to successfully complete an investigation must be reflective inquirers. The purpose of reflective inquiry is to make visible and tangible to others the reasoning and thought processes behind the work being shown. This helps the student and teacher evaluate the processes, improve, and learn from their experiences. Students should reflect on successful outcomes as well as mistakes in order to improve and learn. Having reflective inquiry is parallel to the design rationale in a field such as interior design.

The purpose of this paper is to describe the development and rationale for the design of the *Digital Process Book* (DPB) learning tool for design studio education at the University level and discuss the similarities with applications to learning tools in K12 science education. The DPB is an interactive learning environment that is intended to promote reflection throughout a student's design process, as well as integrate important scaffolding elements in the system that supplements the traditional in-person contact between a student and an instructor. It is based on tenets of Cognitive Load Theory (Pass, Renkl, & Sweller 2003; 2004), which argues that learners are not able to work to their potential if there are too many elements that they need to process in their working memory. The goal of instructional technologists and instructors is to help students decrease their extraneous cognitive load so students have more cognitive resources to focus on the tasks at hand. Design projects are complex design problems that require a way for students to organize, categorize, and sort the many artifacts and ideations that are produced in their design process. These same goals and needs for university design students are similar to learners in K12 science education.

Interactive Learning Environments

Interactive learning environments are an important part of human computer interaction. They allow users to intimately interact with their computer and the computer provides learning opportunities as well guidance to the user. Interactive learning environments have become a necessity as many modern-day classrooms support more numerous students than ever before. While the increased number of students is undoubtedly a positive outcome, having so many students does not allow a teacher time to have a personal and calibrated exchange with every student about learning progress and guidance (Rogoff, 1990). This has led to the advent of computer learning tools in which support for student learners is provided through software that individuals can then interact with. The use of such software tools in learning can be challenging because in order for them to be effective, they need to be dynamic and able to adapt to different learners and learning styles while still maintaining their original purpose and programming.

Interactive learning environments have a wide range of applications in the classroom and need to be accessible to both student learners and teachers for very different reasons. The teacher is responsible for the content of the material to be learned by students. Their role is one of a knowledge facilitator who has the necessary skills and strategies to teach. They should help to motivate student learners with support that can take a variety of forms such as providing hints, showing examples, and emphasizing the most important features of a task in order to help students reflect on the material (Puntambekar, 2003). The role of the student is to be engaging in their investigations and learning applicable skills, but most importantly they need to be reflecting on the material presented. Software tools developed for educational purposes are in key in this because they make tangible the invisible processes of reflection that students should experience.

The learning benefits of interactive learning environments are substantial because of the new opportunities they provide. As a digital tool, they can help the student learner to manage a design investigation by preventing cognitive overload. They can aid students in coordinating data, text, images, and annotations to be used in projects. Additionally, the option to have multiple users accessing a project is a possibility that allows for group projects that have a single repository for all information pertaining to the investigation. Many of the new software programs that have been developed in the last fifteen years provide support for students in a manner similar to a teacher. They can prompt students to reflect being learned and on material being discovered. Furthermore, they can offer hints and clues about what actions to take next and help students to organize material so that it accurately depicts the internal processes being undergone. With the help of these educational software programs, students learn to become reflective inquirers and the importance of documenting the evolution of their design. This is done so that the otherwise intangible procedure can be visible to all.

The accurate and complete depiction of the design process is essential to both teachers and students. For teachers, being able to see the methods used by students is critical in understanding how student's designs came about and the steps taken to achieve the final result. The teacher can then help the student to analyze the methodology and determine its effectiveness in producing the desired design solution. However, the end result should be reviewed as only one component of the design process and the student should still be expected to present their processes in a clear and organized fashion. The teacher and student should collaboratively discuss possible unrealized design solutions and reflections made by the student. Students need to come to the realization that detailed documentation of the design process is the only way in which they can produce better designs. Open discussion of the process between peers and student to teacher will help students to analyze their design methods and become better designers.

Scaffolding

Working by themselves, it is difficult for students to learn detailed design processes and create designs that are innovative and accurate. They rely on teachers to provide direction and instruction in order to accomplish tasks that would normally be beyond their reach. This is called scaffolding and is defined by Wood, Bruner, and Ross (1976) as an adult controlling those elements of the task that are essentially beyond the learner's capacity, thus permitting him to concentrate upon and complete only those elements that are within his range of competence. Vygotsky originally developed the concept of scaffolding (1976), where he advocated that every child has a zone of proximal development in which tasks may be too difficult to complete by themselves, but with the aid of another knowledgeable person with can learn how to successfully complete the task.

The knowledgeable individual, referred to as the expert, uses scaffolding to help the learner understand the task and methodologies for completion by structuring or arranging the task in such a way that a learner can execute it with success (McLeod, 2010). Support for the novice learner is essential and Wood et al. documents six types that an expert for can provide: first, a learner's interest must be obtained, second, the teacher needs to reduce the degrees of freedom by breaking the task down into smaller components, third, the teacher has the responsibility to maintain direction and keep the learner goal-orientated, fourth, critical task features should be highlighted and emphasized for the novice learner, fifth, frustration of the learner needs to be controlled, and sixth, the teacher should be able to identify and demonstrate ideal solution paths for the learner (Wood, Bruner & Ross, 1976).

An essential element of scaffolding is the process of internalization that learners undergo as they master the material and complete the task successfully (Vygotsky, 1978). The process of internalization should result in an understanding not just of the specific task at hand, but should be able to be generalized to other similar tasks. This is an important step for the student as it means that they are moving towards independence and have achieved mastery of the task. At this point, the teacher should begin to offer less support as there is a transfer of responsibility from the expert teacher to the novice learner. This concept is known as fading and is an essential part of successful scaffolding.

The purpose of fading is to help the learners further internalize the material they are learning and to have them take control of their learning processes. This concept is fairly simple for a person to implement, but represents a challenge when it comes to interactive learning environments. Software programs often begin by offering a multitude of hints and prompts to students in order to help them adjust, learn how to reflect, and accomplish tasks successfully. Then, as students begin to master the process of investigation, they can choose to ignore the hints or tell the computer not to offer them anymore. However, if they continually neglect certain aspects of the task the computer program will start to prompt students again. The other potential complication with this method is that students are often unaware what level of support they need in order to be successful at task completion. Other programs allow the teacher to control how many hints and prompts are given to students and support is faded out in this way such that as students' progress and master increasingly difficult tasks, they are weaned off of support offered by the software program. In order to have successful fading of support a calibrated understanding of each student's level of knowledgeable and ability is necessary.

Achieving scaffolding in interactive learning environments represents a challenge because it needs to offer calibrated support for the individual learner, fade the support out at the appropriate time, and maintain its functionality as a workspace for the investigative process. Additionally, a delicate balance needs to be struck between allowing individual learners the freedom to be creative and express their innovativeness while preserving function and guiding the learner through the process of design and reflective inquiry. Most programs begin by allowing the user very little control and offering plenty of support through hints and prompts as learners are still trying to master basic concepts and need help with most aspects of the investigation and are prone to forgetting elements of the design process when not reminded. As the learner progresses and masters more concepts and performs the process correctly support begins to fade out as fewer hints and prompts are offered, provided that the learner does not regress and begin forgetting to reflect or answer questions relevant to the task. When the learner has mastered a task, they are allowed more freedom to adjust and control settings within the program. This represents the transfer of responsibility from the program acting as teacher to the student learner who is no longer a novice. At this point, the student should have internalized the necessary processes and will reflect and critique their own designs and methods.

The *Digital Process Book* Learning Tool

Studio experiences are central to design education, particularly at the higher education level. These experiences are concentrated on teaching students a design process. Through long-term projects lasting between four to sixteen weeks in duration, students are encouraged to explore, to try several ideations, to provide research that substantiates their decision-making, to analyze their design alternatives, and to develop innovative, original solutions to complex problems. These projects culminate in a final design (a product, a solution), and a compilation of their process in the form of a process book. This process book includes representations of all of the activities that occur and the artifacts that are constructed as a student completes a design project. It allows the instructor, external reviewers, and others to see the process a student goes through to complete a project. Schenk (2007) describes this process work in the graphic design context as “job bags,” where this material, for the most part, provides the “drawn record” of the design process.

Unfortunately, a shortcoming of existing paper-based process books (Appendix A) is that they are a linear compilation of the design process that do not offer the structure or framework that beginning design students need (Brunner, 2008). In essence, they are a black box in which the student stores the remnants of the project. These students are required to manage a large amount of information in design projects, which places a heavy burden on a student’s cognitive load. Cognitive load is a construct that represents the cognitive resources that performing a particular task imposes on one’s limited cognitive system (Pass, Renkl, & Sweller, 2003). Students are not able to direct all of their creative abilities towards a design project when they must allocate a substantial portion of their cognitive resources organizing and making meaning of the complex design problem. The process book, however, has the potential to be more than simply a receptacle of students’ artifacts of a given project. This was the impetus for developing the DPB.

Goals of the Digital Process Book (DPB)

The main goal of the DPB is to function as a learning tool that complements studio-based activities, while enhancing the student’s design thinking, including reflective thinking. See Appendix B for a screen shot of the home page. It is envisioned to capture the spontaneous actions of manual sketching and diagramming, while assisting the student in compiling, managing, and encoding information, so the collection of information is translated into a successful solution. It shall facilitate increased communication between student and instructor, as well as providing a venue for student-to-student commenting and feedback. The DPB shall also allow inclusion of computer drawing files from programs such as AutoCAD and Revit, as well as integrate the many diverse forms of data that a design process embodies, such as text documents, tables, matrices, photographs, and audio and video.

The goals and requirements for the prototype included: 1) develop quick and easy ways to add and post images, diagrams, sketches and notes to a project page, 2) devise an easy and intuitive way of adding and reading comments related to a process book page, 3) integrate a file management system, 4) enable private and public access of process books for instructor progress tracking or employer review, 5) develop deadline and important dates tracking, using calendar and task functions, 6) devise a simple, internal drawing function that incorporates a set of common drawing features, 7) incorporate an embedded self-reflection function or journal into the system, 8) integrate an evaluation component for individual drawings and images, 9) enable users to print a report of DPB pages for archival, review, and portfolio purposes, and 10) to integrate an explicit design process paradigm into the system so learners become more aware of the activities that are associated with a particular design phase, as well as to scaffold these expert processes of chunking and sorting relevant information into a meaningful whole.

Two rounds of high fidelity prototypes have been conducted, along with usability testing and surveying of university design students (Brunner Stone et al 2012). The DPB research group has also created an advisory board to provide feedback and suggestions for the system development.

Important Features and Functions of the DPB Prototype

The many important features and functions of the DPB are also common in digital learning tools for K12 science education—namely the *Progress Portfolio*. While developed initially several years ago (Loh et al 1997), the Progress Portfolio posses several commonalities with the DPB for university design students, who are working with the complexities of ill-defined problems and the output and organization of all of the artifacts that are typically produced in a design project. We discuss the similarities with these two digital learning tools by feature and function, and then the connection to reflective thinking and scaffolding. This comparison highlights the universal aspects of the DPB to other learning environments and users, not just to design students and adult learners. We begin by briefly presenting an overview of the *Process Portfolio* highlights.

THE PROGRESS PORTFOLIO

The Progress Portfolio (PP) is a workspace for K12 science students, where they can keep track of a multitude of sources and make notes about sources and the analyses generated. The students can manage these sources and analyses and they can communicate with others about their projects. The PP works in union with and incorporates other useful tools such as data visualization software and digital libraries. These aid the student in generating and analyzing the data. This is a tool that is meant for incorporation into all aspects of the investigative process and helps learners to document all aspects of the investigation including questions, pictures, documents, annotations, various revisions, and presentations of material. The PP is designed to make the intangible aspects of the investigative process into visible objects that are meant to be “worked with, discussed, presented, and revised, allowing students to tell the story of their investigation and reflect on their inquiry process” (Loh et al., 1997).

PAGES

The central feature of the DPB (Appendix C) and the PP are pages. This is where students can place images and objects, as well as receive comments from their peers and instructors about certain contents on these pages. These comments are page specific and are not linked to an individual object, which is discussed next. The page in the DPB is supposed to replicate the form of the paper-based process book, for a more nature way of going about their design process. Many times it is important to place several objects on a page for a more meaningful chunk of information the students are creating, expressing, or researching. This is too limiting if students are only able to view objects individually. The pages act as a series of workspaces or ideas that can easily be reflected and acted upon. The underlying structure of the DPB is a database that links objects to pages (if the student decides to place this object on a given page). An object can be placed on more than one page if a student wishes. Each page is associated with a certain design phase; there is typically five to seven phases in a given design paradigm, and this is set up by the design instructor prior to the start of the project. It is important to provide some scaffolding of these design phases into the DPB system, as this has been a weakness in novice designers processes.

OBJECTS

Objects in the DPB can be a wide range of items including images either downloaded from the Internet or images created by the student. Photos, diagrams, tables, and videos, as well as sketches that are scanned and saved as image files are examples of objects in the DPB system. This is similar to the PP, but would probably have less scanned sketches from the student. Objects are an important connection between the DPB and paper-based process books. Anything that a student could possibly create on a paper can be uploaded into the DPB system as an object and then later placed on a page.

An important feature about an object in the DPB is that students can annotate these images with comments and also assign ratings (Appendix C) to these. This is an important reflection component of this system as it creates an easy way for students to go back to created objects, think about them, and then determine if this object is a 'good', 'neutral', or 'bad' iteration of an idea. This quick visualization self-assessment is important, as students are encouraged to produce several ideas, concepts, and/or sketches as part of their design process. These embedded rating functions are what instructors consistently prompt or ask students in the studio learning environments. Thus, the rating function is another example of scaffolding incorporated into the DPB.

TEMPLATES

Templates are currently incorporated into the DPB during the final phase of the design process, where they are developing layouts of their final presentation boards. Design students in such fields as interior design or architecture may not have the experience or skills of creative effective layouts. Thus, several presentation board templates are available to students so they can just drag and drop completed drawings and images to placeholders in these template pages. There are also text boxes for prompting students to correctly title and label each of these presentation elements. This is another example of a scaffold built into the DPB. Also, as students progress through the different studio levels, they may not need such explicit templates and scaffold so these may be less prominent or even eliminated from the upper level studios as needed. This is an example of scaffold fading in the DPB system.

In the PP system, students, designers of the software, and instructors can create templates that might best accommodate the specific needs of the project. When instructors create templates, they can add prompts to force students to reflect and record observation about objects.

ANNOTATIONS

Annotations in the DPB and PP are very important for reflection. There is an option on each page for students, students' peers, and instructors to input comments about content on the page (Appendix C). On a more intimate level, the student designer and owner of the project can make annotations about an object as well. Prompting students to annotate their work in their paper process books has been a difficult endeavour, so a built-in mechanism for students to easily input some reflective thought is a crucial aspect in the DPB system. It acts as a reflective and scaffold feature in the DPB. The comments feature is intended to be more public or produced externally from another student or the instructor. The annotations are designed to be more internal and reflective for the student designer.

In the PP system, these annotations are visually displayed as "sticky notes" to resemble the physical function of a paper based process. These notes are also designed with a color-coded scheme for easier categorization of different aspects of a project as well.

LIBRARIES

In the DPB, the built-in sketch pad includes libraries of common shapes to quickly select and use to create an object. Lines (free-hand, straight, arrows), rectangles, circles, and textboxes are used extensively to construct diagrams, flow-charts, and schematic drawings in the design process. While there are many external digital software programs that are stand alone sketch pads, the DPB researchers believed that an internal sketch pad was important for seamless process work, helping to reduce the extraneous cognitive load imposed upon a design student. In addition to the library components of the sketch pad, the DPB is planned to incorporate "worked examples" relevant to the specific project scope. These examples (imported into the students' library) is another instance where scaffolding aspects are integrated into the system design. While students could easily access these examples from external Internet searches and course textbooks, it is the direct access to these specific examples in the library that help to reduce a student's extraneous cognitive load while designing. These examples could be more apparent in lower level studios and then decrease as the student becomes more knowledgeable about such examples and concepts.

TEXT FIELDS

The DPB includes a journal type feature in which longer entries may be made concerning the progress through the project and any ideas or concerns that a student has about their work. Journaling is a common way in which instructors can encourage students to reflect on their work, but many times a separate journal becomes secondary or cumbersome for students to actually complete. An area within the DPB system, and even prompts for asking them to record daily journal entries are included in the DPB interface. Mechanisms can also be built into the DPB that would require a student to provide a journal entry each day or on a frequently designated basis.

Prompts

Prompts are an important feature in both the DPB and PP, as they are excellent ways in which to scaffold an instructor's guidance or an expert's process. The DPB is beginning to incorporate several system wide prompts to assist the students in their work. As the DPB is in its second round of prototyping, an increasing amount of prompts will be added to the system over time, as the researchers continue with the usability testing and implementation into the classroom settings for study and refinement. Mouse-over areas of informational test, and areas to include basic definitions for the design student are planned in future prototypes.

The PP software helps to prompt students to reflect about material they are working on or have recently added. In addition, it may offer hints directing students to reflect specifically on a question or counter point. The instructor may add prompts when they design a template so that these prompts are structured to fit the project and emphasize material the instructor finds to be of importance.

Clusters

Clusters may be defined as ways to group individual pages of a student's project. In the DPB, these clusters represent the different design phases of a project. Thus, at any given time of a life of a project, a student can visualize the pages that are associated with a particular design phase. The PP system uses a similar type of cluster, but these clusters are not pre-determined but are more content-driven and project specific.

Presentations

Presentations as defined in the DPB include a series of pages that can be added to a portfolio or PDF file. In design projects, being able to highlight and communicate a student's process is important to the instructor, student, and future employers. The presentation function in the DPB allows students to select certain pages to include in this file, or include all pages created during the project. The process is easily archived for several communication purposes that a student may find useful in their education goals (getting a job, reflecting on past projects, etc). Thus, the DPB acts as a process portfolio for the student after the completion of a project.

The PP offers a presentation tool, which allows a student to quickly create a 'PowerPoint' featuring slides from the various pages and clusters they collected throughout the investigation. Thus, the DPB and PP have similar presentation features embedded within the given systems.

Task Management

The DPB is currently adding task management features to the system, the first priority being a task list generated by a student and associated due dates. A more elaborate calendar feature is planned for the next round of prototypes of the DPB. It is intended that both students and instructors will be able to add critical deadlines to the designated project. Again, there are may external task management software programs readily available now, but an internal, simple task management system will help with the reduction of extraneous cognitive load stressors of the student.

The PP does not offer a calendar or task management system, but instead relies upon the instructor to offer verbal guidance as to what needs to be done. This may be because of the level of the student learner, and the difference in skill levels between K12 and university level students. As adult learners and persons more responsible for making their own priorities and deadlines, the task management system may be more natural for these students at the university level.

Significance

Design studio experiences rely heavily on the one-on-one interaction between faculty and student, but the current students in the 21st century have many digital tools and new ways of communicating with others as well as themselves. These students demand immediate feedback, try to multi-task between several different priorities at once, and have access to a breadth of information from the Internet that was not available to the design student twenty years ago. These changes are both challenges and opportunities in instructional practices and strategies at the university level. One opportunity for design instructors and instructional technologists is to think and devise innovative ways for students to process the abundance of information they are introduced to in a given design project. The DPB is focused on assisting in this purpose. It is also important to note that these functions and goals of this system has many universal qualities, in that most of the DPB goals and features are also important to other educational contexts and levels, such as K12 science education. As the development of the DPB prototypes continue, we find more useful connections between other disciplines and its uses. Thus, the DPB is transformative across discipline and age group borders.

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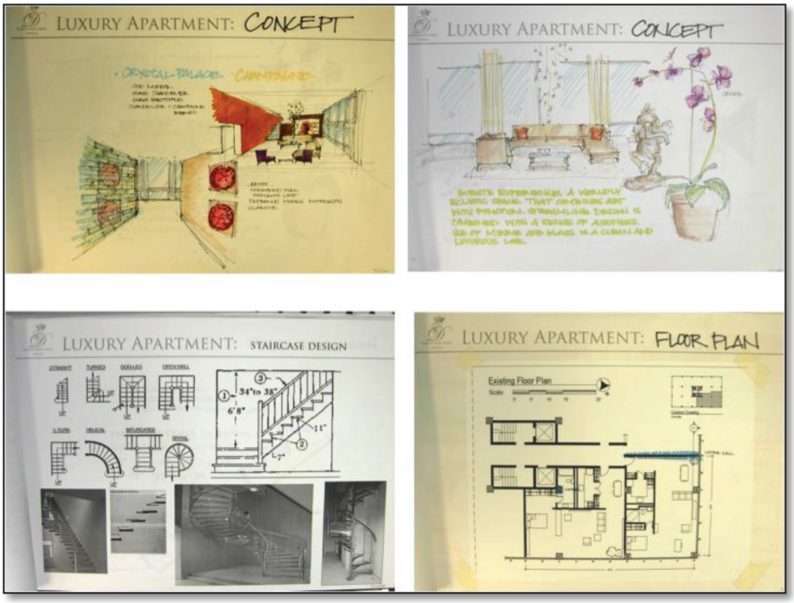
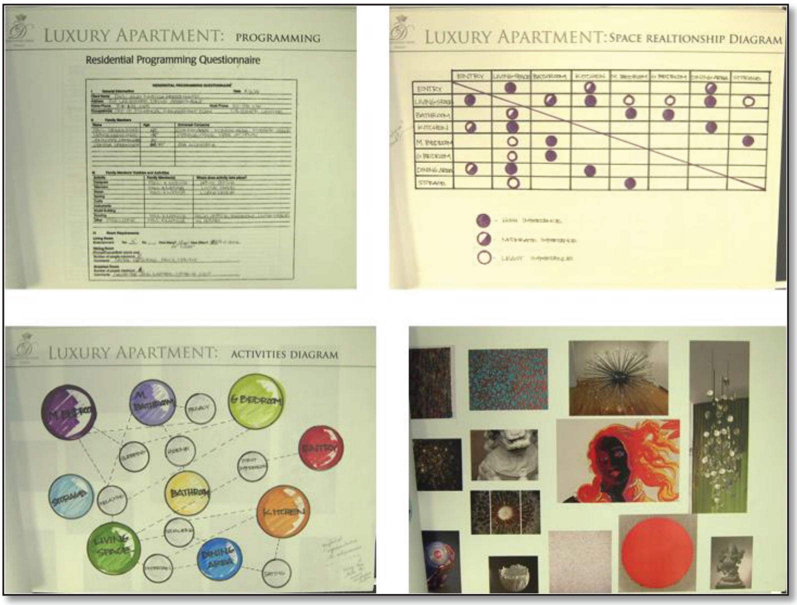
Appendix A

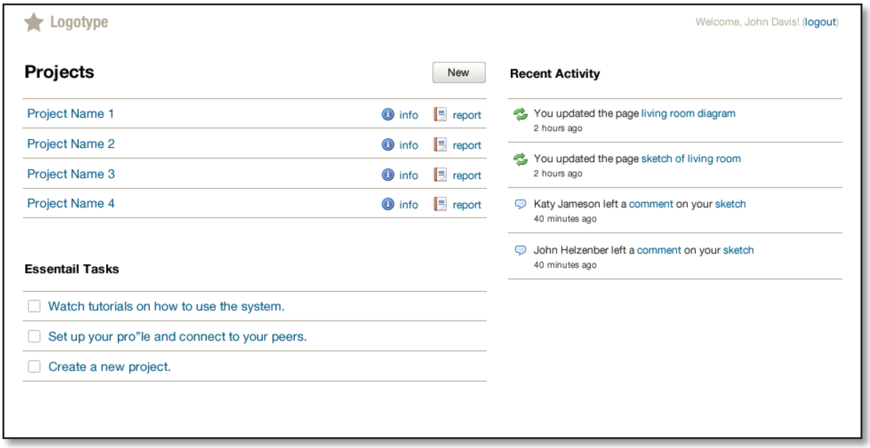
Example of Paper Process Book Pages





Appendix B

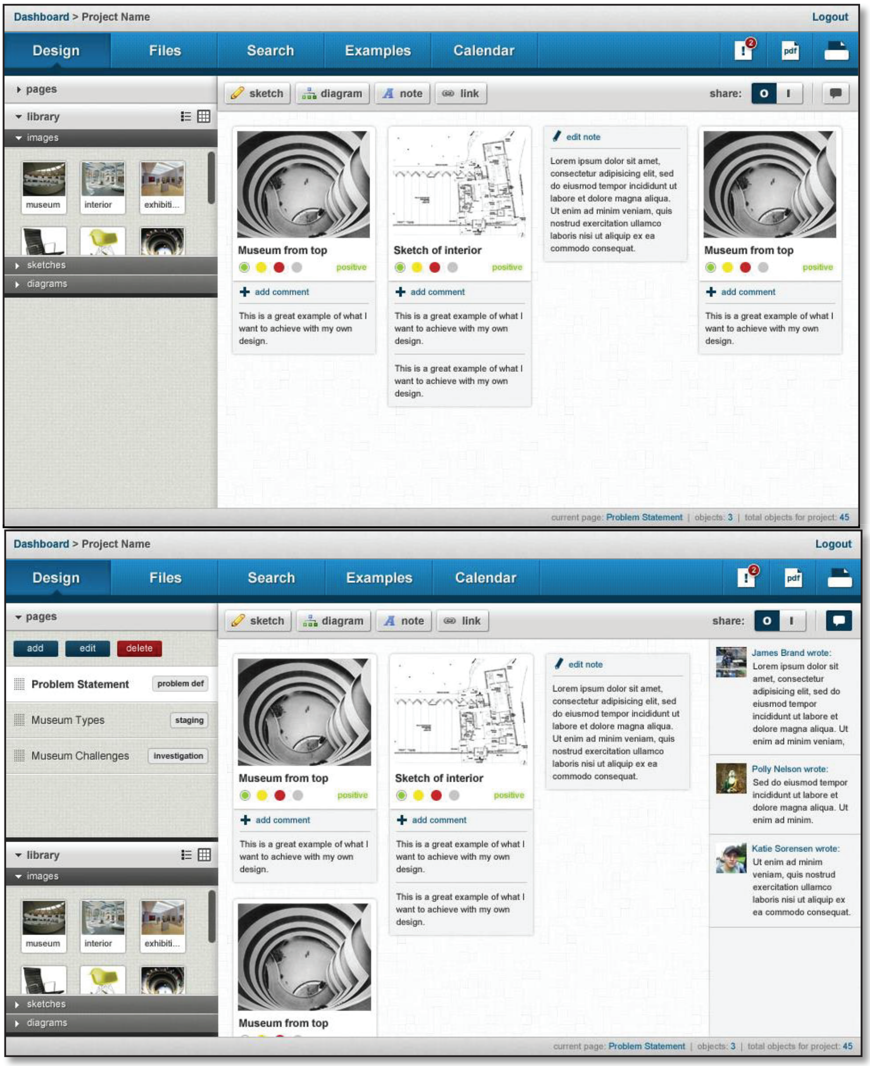
Home Screen of the DPB



Home screen where students can either open a new or existing project in their DPB system, view essential tasks that they have created in the past, or view recent activity that they or others have completed that are associated with the student's DPB project.

Appendix C

Screens of the DPB



These screens show a DPB page, objects, annotations, comments from other students, rating options for objects, an internal library, and main menu features of the system. The objects can be moved around the page window in any fashion the student desires. Each page includes a unique ID created by the system, and a place for the student to add a title for each page.

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E-learning as a balanced way of teaching museums and exhibitions to provide both theoretical and practical education

Dina ZAKI*

Alexandria University, Egypt

Abstract: *One of the challenges of teaching museums and exhibitions courses is that the lecturer has to both teach a theoretical curriculum and organize field trips. The aim is to make the student practice museum education as a model of communication-educational patterns, and recognizes the importance of art exhibitions in developing creativity within the curriculum of a bachelor stage of art education in Egypt. However, the course includes a large amount of knowledge, such as types of museums and the nature of art exhibitions, as well as the importance of museums, in addition to the practical portion, which includes the design and implementation of programs, activities, and workshops in museums; however, it is not allocated in the schedule. On the other hand, two hours per week for the course is not enough to teach the curriculum in a balanced manner. E-learning features a maximum utilization of time, reduces the workload at the university, and increases the students' understanding of the content, allowing them to make more field trips throughout the duration of the course). Consequently, the researcher designed an approach for this course that depends on blended learning through sessions using the Internet. The designed course will rely on specialized teamwork and a group of programs, such as Firefox, Internet Explorer, Flash, RealPlayer, and Excel.*

Keywords*: E-learning, Museums, Exhibitions.*

* Corresponding author: Art Education | Alexandria University | Egypt | e-mail: dina_adel2@yahoo.com

Introduction

Education in Egypt faces several challenges in all aspects of life. Perhaps the most important of these are Egypt's population explosion, an explosion of knowledge, the development of a new philosophy of education, a lack of faculty members, and technological developments. Educators must be mindful of these challenges, and they must pay careful attention to the techniques of modern teaching to address some of the major problems faced by colleges, universities, and other educational institutions. They must increase their effectiveness by increasing the rate of learning, which can provide equal opportunities to anyone, anywhere, taking into account individual differences among learners (Safety 2008, p. 3).

Many studies have shown that electronic courses help increase academic achievement for students and build a good direction toward learning. They also successfully utilize the Internet to build the communications and discussion skills of many students (Safety 2008, p. 3).

E-learning is known as a supplementary pattern; it is a learning style intended to supplement, rather than replace, traditional classroom education. Another learning style is blended learning (BL), which combines e-learning with classroom education; this model combines the advantages of classroom education and e-learning education on the basis of the integration approach.

With the advent of Internet technology, there has been a shift toward education based on the learner-centered environment, based in turn on Constructivist thoughts (which posit that the learner builds knowledge while trying to become familiarized with the experience). What we know depends on the quality of the previous knowledge that we have and on how we organize new experiences within those pre-existing knowledge structures. Under this proposal, there are three principles of e-learning structural design:

- Education should take into account the experiences, convictions, and knowledge structures already accorded to the learner.
- Education must be easily understood and modified by the learner.
- Education should be designed to facilitate viewing and exploration. (El-Kasas 2008, p. 25).

This research, considered an applied model for the e-course production done by the researcher, was produced under the auspices of the National Centre for e-learning Education for the Supreme Council of Egyptian Universities, with funding from the project designed to develop information systems and technology at Egyptian universities. The information and communication technology project (ICTP), through the production of e-courses at the University of Alexandria, published a learning management system and e-content and approved a production decision. A museums and exhibitions e-course is taught to fourth-year students at the Department of Art Education, Faculty of Specific Education of Alexandria University.

One of the challenges of teaching museums and exhibitions courses is that the lecturer has to both teach a theoretical curriculum and organize field trips. The aim is to make the student practice museum education as a model of communication-educational patterns, and recognizes the importance of art exhibitions in developing creativity within the curriculum of a bachelor stage of art education in Egypt.

However, the course includes a large amount of knowledge, such as types of museums and the nature of art exhibitions, as well as the importance of museums, in addition to the practical portion, which includes the design and implementation of programs, activities, and workshops in museums; however, it is not allocated in the schedule. On the other hand, two hours per week for the course is not enough to teach the curriculum in a balanced manner.

E-learning features a maximum utilization of time, reduces the workload at the university, and increases the students' understanding of the content, allowing them to make more field trips throughout the duration of the course (Hawkings 2004, p.80). Consequently, the researcher designed an approach for this course that depends on blended learning through sessions using the Internet. The designed course will rely on specialized teamwork and a group of programs, such as Firefox, Internet Explorer, Flash, RealPlayer, and Excel.

Research topics

There are two main research topics for this paper. The first is the theoretical framework, which includes e-learning, e-courses, and blended learning. The second is the practical framework, which includes the SCORM system and the museum and exhibitions course to show how the students prefer using e-learning as it saves time to practice and easy to use .

Theoretical framework

THE E-LEARNING CONCEPT

E-learning is "expanding the concept of teaching and learning process to go beyond the walls of the traditional classroom and departure for multivendor environment, using interactive teaching techniques redefined the role of both the teacher and the learner" (Obeid 2010, p. 33).

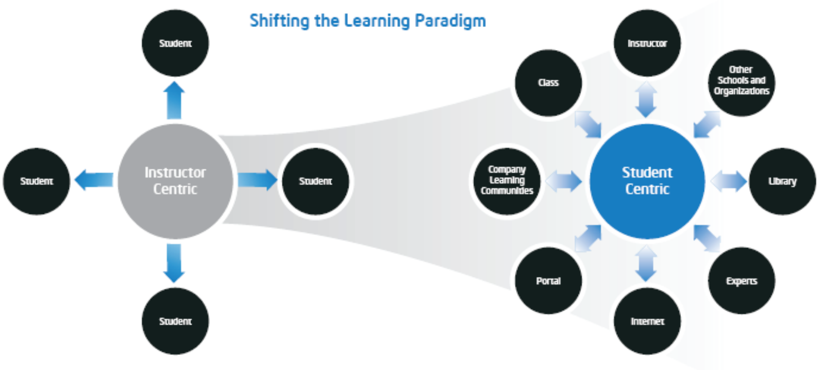

***Figure 1**. Shifting the learning paradigm. Source: Aydin 2008, p. 45.*

"E-learning is education, which aims to create an environment rich interactive applications based on computer technologies and the World Wide Web for information, and enables the student to access learning resources at any time and from any place" (Safety 2008, p. 15).

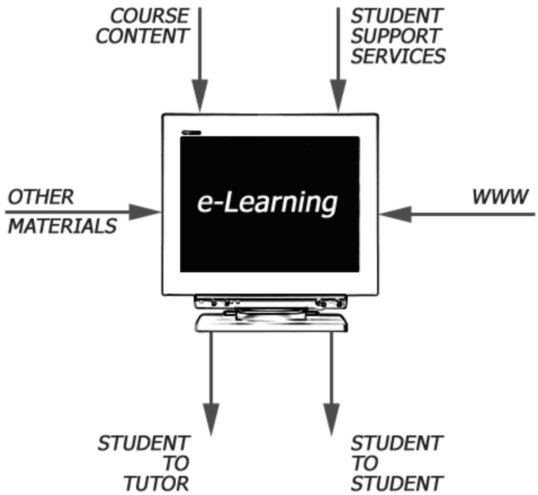

Figure 2*. The e-learning concept. Source: Keegan 2002, p. 34.*

In Figure 2, the computer screen represents the study area—the equivalent of a lecture theatre, classroom, or practical training area of a conventional educational institution, or the student's home in distance education. In the diagram, course content is provided on the computer screen and student support services are electronically provided to the student in the form of electronic communication or feedback on assignments or other issues. Access to the Internet is provided for other resources, suggested readings, and library resources. Other learning materials can be CD-ROMs or other audio- or video-based resources, as well as paper-based resources.

In Figure 2, student-to-student communication is done by email, bulletin boards, or chat rooms, in which students can communicate with other students in their class or institution mainly by typed interactions. Student-to-tutor communication is also mainly done by email, with tutor intervention in listservs a further possibility, as well as tutor reaction to student assignments, quizzes, and other forms of summative or formative evaluation (Keegan 2002, p. 36).

THE STUDENT-CENTERED APPROACH TO E-LEARNING

Using a management system for administrative issues; offering students personal tools for construction, presentation, reflection, collaboration, etc.; facilitating networks between students within the same course; and facilitating networks between students and other people working within the field (Dalsgaard 2005, p.55) are all examples of the student-centered approach to e-learning. Self-organized learning networks provide a base for the establishment of a form of education that goes beyond course- and curriculum-centric models, and envisions a learner-centered and learner-controlled model of lifelong learning (Koper 2012, p. 22).

THE E-COURSE CONCEPT

An e-course is electronic educational activities that represent all or some of each accredited university course; the learner receives this instruction via the Internet. Moreover, an e-course is a set of components based on multimedia and consists of graphics, text, exercises, tests, records (e.g., recorded test scores) and bookmarks. The more complex e-learning programs contain animations, simulations, audios and video multimedia, and Internet links, as well as scientific material. E-courses further consist of a set of tools that enable students to communicate with both their instructors and their fellow students (Mourad 2011, p. 6; Obeid 2010, p. 40).

TYPES OF E-COURSES

According to Mourad (2011, p. 9) and Obeid (2010, p. 48), there are three types of e-courses, each depending on the requisite types of e-learning:

- direct electronic courses that replace traditional classroom learning;
- courses supporting the traditional separation of education, which are used along with the traditional separation; and
- blended learning.

Direct e-courses must be complemented by the upper limit of these standards, which can be education without any physical contact between student and lecturer, with students taught entirely over the network. Some universities can provide conventional meetings, such as examinations in laboratories, but these meetings amount to no more than 25% of a course's lectures.

Blended e-courses depend on the proper proportion of e-learning relative to traditional education. The level of support for blended learning e-courses determines the depth the lecturer needs for such standards, so they must make decisions to help and support the process of traditional education using techniques and tools such as the Internet in the process of providing content and communications capabilities.

THE IMPORTANCE OF E-COURSES IN THE TRADITIONAL EDUCATION PROCESS

THE IMPORTANCE OF E-COURSES FOR THE LEARNER

- Learners can choose what information needs and experiences they require in a time and at a speed that suits him—not associated deadlines or schedules.
- Students can learn in an atmosphere of privacy, in isolation from others, and can repeat learning as much as he needs to without having a sense of fear and embarrassment.
- Learners can overcome some of the issues and stages that they deem inappropriate.
- E-learning provides a huge amount of information without having to go to the library.
- It is possible for a learner to develop computer and Internet skills by dealing with e-courses.

THE IMPORTANCE OF E-COURSES FOR THE LECTURER

- A lecturer does not need to repeat an explanation several times, but offers his time and effort for guidance, counseling, and the preparation of student activities.
- Lecturers can focus on the skills actually needed by learners.
- Lecturers can focus on giving feedback to the learner, to direct them in the correct direction of learning.
- E-courses provide a variety of forms of interaction between lecturers and learners.

THE IMPORTANCE OF E-COURSES FOR THE INSTITUTION

- E-courses save learning institutions the costs of paper, printing and binding, storage, and other publishing costs.
- E-courses allow for the speedy updating of educational material, which is instantly provided to distance learners.
- E-books can be quickly distributed to leaners anywhere as soon as they prepared and programmed.

- To avoid the disadvantages of using traditional books, learning institutions are replacing paper books with e-books (El-Kasas 2008, p. 24).

THE EDUCATIONAL ASPECTS AND EFFECTIVENES OF E-COURSES

E-courses should begin with organizational material that contains a list of information referring to the course objectives and the duties of students, as well as the learning resources required to complete the course. This information provides the student with the idea behind the course and allows them to assign the appropriate time and expectations necessary to complete the scheduled work, as well as assessment methods and the distribution of grades.

CONSISTENCY AND HARMONY

E-course structures must be consistent in terms of function and general format. They must also be designed to achieve consistent, speedy help for both student and lecturer. Maintaining consistency when viewing courses, as well as the length of their content and activities and their distribution in a course, requires proper balance between course units.

CONTENT

Each course must build on others so that it is rich in content and reflects multiple perspectives of ideas and concepts. Courses should contain scientific material in multiple formats, aided by the presence of a large number of educational materials from multiple sources such as audio and video multimedia, standard documents, and external Web sites. It must also take into account the different types of learning through content and audio, video, and kinematics.

INTERACTION

Each course must contain strategies and a variety of learning opportunities for interactions between students and the educational material, as well as between students and lecturers and students and their colleagues. These types of interactions help to build a learning community and develop critical thinking skills. They also help to provide cooperation and opportunities for the understanding and application of educational materials and concepts.

THE STAGES OF E-COURSE PRODUCTION

The production phases (analysis, design, development, implementation, and evaluation) of e-courses can be summed up by the Addie model, given in Figure 3.

***Figure 3**. The stages of e-course production. Source: E-Learning Centre 2012.*

- **Analysis:** Read content, study the receiver, know the potential of the educational environment, and have knowledge of the objectives.
- **Design:** Planning design content includes setting educational goals, collecting resources and determining the means of education, determining the order and flow of content, and determining the method of valuation.
- **Application:** Develop content on a learning management system and train the trainers and trainees to use the system.
- **Evaluate:** Evaluate the effectiveness and quality of the course in two stages: formative assessment and statistical evaluation.

GENERAL SPECIFICATIONS FOR THE COURSE

- The course has a clear title associated with scientific specialization of the course.
- The course contains a clear introduction, taking into account the learner's background and expectations.
- The course's introduction contains the objectives of the course and information showing how closely the scientific content relates to the associated specialization.

ORGANIZATION OF THE CONTENT

- The course contains a schedule for the contents' topics, referring to how the content is organized.
- The course topics are logically and serially organized.
- The content's units are structured in a way that shows consistency between subjects.
- Sources are listed at the end of each unit, in line with the unit's theme.
- Titles and subtitles are used to accurately organize the content.

LANGUAGE

- A clear writing style must be used.
- Instructions should be clear and ambiguous.
- The use of words and sentences should be clear.
- Short paragraphs should be used.
- Course terminology should be derived from the nature of the content.
- Graphics and shapes should be used accurately and should relate to the content's topics (Blended Learning 2012, p. 126).

E-COURSE PRODUCTION PROCEDURES

FIRST STAGE: PROVIDING THE COURSE

The consideration when providing an e-learning course is the terms of the course selection. The National Centre for e-learning in Egypt collaborates with the e-learning center at Alexandria University in the selection of courses that will be produced at the UNU Centre in accordance with the conditions and specifications mentioned in the criteria for the selection of courses.

The second consideration when providing an e-learning course is the documents required. When the terms and conditions are available, documents and contracts are required as a prerequisite for course admission to go on scientific arbitration. The documents required are a disclosure statement and forms for course documentation, the teaching schedule for the course, a biography for the author, the course material in electronic form, such as on a CD or in PowerPoint or Word, and any relevant printed material. In order for arbitration to be successful, it is preferable that the course includes the following:

- educational objectives for each unit of study and each semester whenever possible;
- any activities;
- a variety of question types with a variety of answers;
- video clips whenever possible;
- simulation for practical experience;
- a list of terms;
- pre- and post-tests for each module;
- a question bank with answers at the end of each module;
- a list of the references used when compiling the course curriculum; and
- the content divided by units, chapters, and/or themes.

SECOND STAGE: COURSE ARBITRATION

The scientific content of the course is arbitrated by two arbitrators in specialization from outside the university whom are selected through the National Center for e-learning. The arbitrators use an evaluation form to evaluate the scientific content of the course.

THIRD STAGE: DEVELOP A TIMELINE AND START PRODUCTION

In the case of a recommendation of the arbitrators accept the scientific content and the approval of the National Center for e-learning is taken to start the production then a timeline of the work for the implementation of scientific production is done. A contract is signed with the author at this stage.

FOURTH STAGE: EVALUATION OF E-CONTENT

After completion of the production process, the e-course is sent to the National Centre for e-learning for evaluation by the Centre's experts. Arbitration recommendations are then sent to the Alexandria university center.

FIFTH STAGE: ADJUST AND UPLOAD

In this stage adjustments and modification should be made and the course uploaded to the e-content management software on the servers of the National Center for e-learning.

SIXTH STAGE: FINAL ARBITRATION AND PUBLISHING

When arbitration experts clear an e-course for publication and activation, the course can then be used for training and teaching purposes.

THE TASKS OF THE E-COURSE PRODUCTION TEAM

The production of e-courses is subject to a great effort from the production team. During the production process, each member of the team has specific tasks, which are summarized below.

A: INSTRUCTIONAL DESIGNER TASKS

- Assist in the identification, preparation, and production of necessary educational resources.
- Provide necessary advice during submission for optimal viewing of e-course components.
- Assist in determining the appropriate educational goals of both the content and the students learning it.
- Assist in determining the appropriate method of teaching the course.
- Choose the best presentation sequence for the course's components.
- Choose teaching and learning strategies appropriate to the course.

- Assist in the development of tools to evaluate students' performance.

B–E: CONTENT DEVELOPER TASKS

After the educational design work is complete, the outputs of the design process are delivered to an electronic content developer, who develops e-content based on teaching and learning strategies appropriate for the course as developed in the earlier stages of the development phase (analysis and design), taking into account the appropriate sequence of the content's components. The e-content developer begins to create pages and convert text into HTML in accordance with the segments and content messages given by the selected educational designer.

This stage of e-content development includes:

- help lectures in the use of tools and continuing the e-learning process;
- helping the lecturer and the learner to use both synchronous and asynchronous interaction tools;
- working with a graphics designer on the creation of Web pages that look interesting, simpler, and more attractive to the learner;
- the creation of pages and support programs necessary for the learner; and
- converting and encoding text and other educational media to HTML.

The e-content developer uses programs such as Macromedia Dreamweaver and Microsoft Front Page to create pages, text, and other multimedia educational material in HTML. They also use programs such as Reload Editor to break retail digital content down into its original components and making them part of the overall assembly.

C: GRAPHICS DESIGNER TASKS

The graphics designers' teams are the most important disciplines required in the development of e-content. They must begin their work in a workshop with a designer tutorial that sets the rules for the e-course's design, whether ordinary pictures, animations, or virtual labs. They begin this process by distributing work to each member of the team. A graphics designer uses a set of application programs. After the completion of each task the remainder of the team works with the designer to review the educational value of the animated graphics and shapes (El-Kasas 2008, p. 40; Kelly 2004, p. 24).

COURSES DESIGNED AS BLENDED LEARNING COURSES

Blended learning is a form of education that integrates e-learning with traditional classroom education. It employs e-learning tools based both on the computer and on the network, such as computer labs and smart classrooms; teachers in most cases have at least some face-to-face interaction with their students (Zytoon 2005, p. 30). Blended learning takes advantage of the best techniques from each teaching method (Milheim 2006, p. 101).

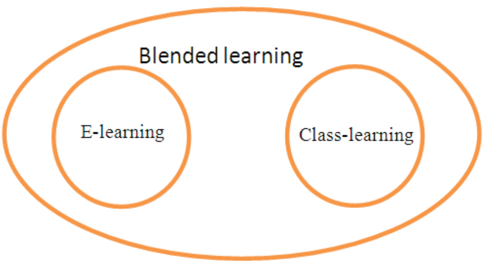

***Figure 4**. The relationship between traditional education, e-learning, and blended learning. Source: Ismail 2007, p. 55.*

BLENDED LEARNING

There are major benefits to be gained from taking a blended learning approach now that so many tools and options are so readily available in so many organizations. Blended learning can, for example:

- accommodate different learning styles in a way that traditional teaching cannot, thereby increasing opportunities to learn effectively and efficiently;
- be more cost-effective by reducing face-to-face contact time with a trainer while not reducing overall study time;
- be more time-efficient by encouraging learners to study at times appropriate to their needs and availability outside normal working hours; and
- provide an opportunity for varied and creative training techniques to be introduced in a way that was not previously possible.

Creating a blended learning program does, however, require an approach that is more innovative, creative, and forward-thinking than has traditionally been used in training departments. It also requires skills that may not be currently available within a training department or management team, especially with the increased use of technology and distance learning (Blended Learning 2012, p. 133).

Practical framework

A museums and exhibitions course contains many different components (e.g., forums, course information, pre-tests, course objectives and requirements, educational materials, course maps, glossaries, grading systems, course schedules, etc.). At the heart of any e-learning experience is the pedagogy that drives it, the learning outcomes, the content, and the context in which the content and activities are presented. This can mean that a traditional course often has to be entirely re-engineered either for a wholly online experience or for a hybrid approach of both online and offline activities (Kelly 2004, p. 25).

One of e-learning's advantages is the capability to provide for flexible learning suited for students with a range of different needs. An example of this is problem-based learning, whereby the content is selectively released to students as they work their way through a series of problems, allowing them to solve the problems at their own pace. Another example is resource-based learning, where students are given a collection of resources. By setting questions to guide their mining of the resources, students can search the resources according to their own needs; for example, some may prefer text-based materials while others prefer graphics- or media-based material (Mourad 2011, p. 6; El-Kasas 2008, p. 30; Kelly 2004, p. 28).

THE SCORM SYSTEM

Museums and exhibition course construction depends on the sharable content object reference model (SCORM) system. The SCORM system was developed as a result of collaboration in the public and private sectors. Published by the Advanced Distributed Learning (ADL) project, the SCORM system is the de facto standard for e-learning content. Some advantages of the SCORM system are:

- Content can last longer because it is easier to justify ongoing compatibility with standard content.
- More places to play and a longer life for the content contribute to better returns on investment.

- The same standard supports content that is very simple and inexpensive to produce, as well as content with very high production value.
- The SCORM system specifies a minimum set of metadata that makes it practical to build catalogs of content, regardless of where the content comes from.
- Content can be purchased or obtained from the most appropriate source under the most appropriate licensing arrangements. (Sum Total 2005, p. 3).

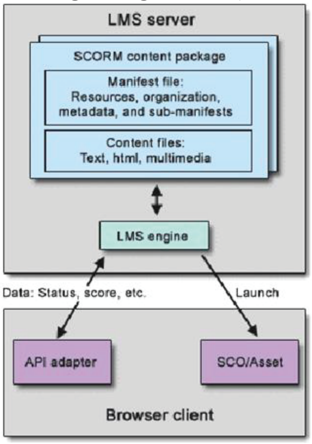

***Figure 5**. The SCORM working system. Source: E-Learning Centre 2008, p. 30.*

The experience of learning through visiting museums and exhibitions cannot be replaced with theoretical study; the experience acquired through design workshops, museum tours, and organizing art exhibitions should be achieved in real situations. Museums can be effective public educational institutions when they meet the needs and expectations of a diverse population of visitors; the museum experience is often personal and individual rather than standard and generic. Museums can be viewed as intermediate kinds of learning spaces. Because social interaction is an important part of the exploratory experience, learning in museums is open-ended and self-directed.

The outcomes of these learning experiences are equally diverse. They may include increased knowledge and understanding, the development of new skills and abilities, or inspiration to learn more. Often, learners use museums to reinforce knowledge that they already have. Learning can also be both short- and long-term. A learner might not use their new knowledge or ability until long after the actual learning event (Hooper-Greenhill 2003, p. 5).

Furthermore, many of the learning outcomes from such environments are so-called "soft" outcomes. These include attitudes, values, emotions, and beliefs. These outcomes are often not even seen as evidence of learning, as the emphasis is on "hard" facts and demonstrable skills (Hooper-Greenhill 2003, p. 8). However, museums provide unique environments for learning, placing an emphasis on learner-centered processes; there is an emphasis on the potential for creativity and innovative thinking, a feature of learning within a cultural context (Hooper-Greenhill 2003, p. 19). This means that learning in museums:

- is focused on learners and their learning experiences;
- is a lifelong process of meaning-making;
- includes changes in and the development of emotions, skills, behaviors, attitudes, and values;

- allows for enjoyment, amazement, or inspiration to provide the motivation to acquire facts and knowledge;
- facilitates a process of identity-building; and
- is both individual and social (Hooper-Greenhill 2003, p. 26).

Here we'll explain the researcher's design of museums and exhibitions e-course through main points which are the construction of a museum and exhibition e-course, the content of a museum and exhibitions e-course, screen shots describe the museums and exhibitions e-course as uploaded to www.cms.nelc.edu.eg. The course was taught to about 120 student of fourth grade, Department of Art Education, Faculty of Specific Education, Alexandria University during a whole semester, and then a Questionnaire was done to know students' opinion in E-Course (Museums and Galleries) which consists of 15 question about Personal background, Didactic efficiency, Technical feasibility, Cost effectiveness in order to verify research hypothesis which is" There are significant differences between the mean degrees of the experimental group students and the hypothesis mean in the post-test opinions of students in the e-course for the experimental group students".

THE MUSEUM AND EXHIBITIONS COURSE

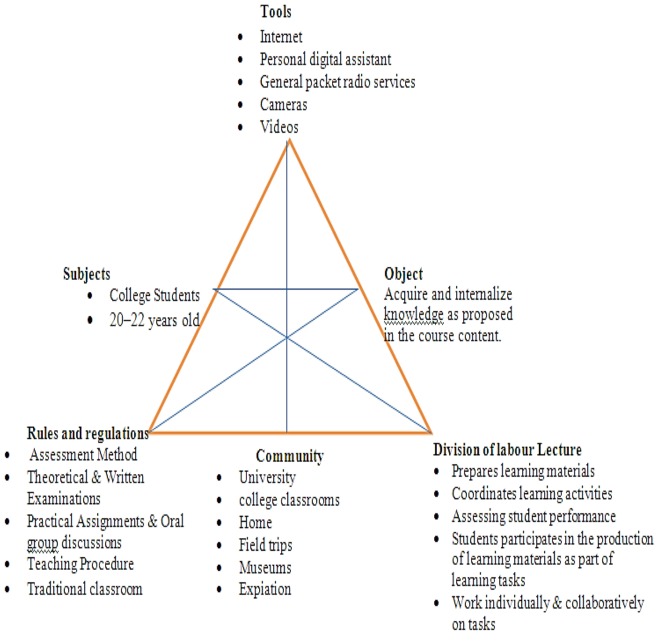

Figure 6*. The construction of a museum and exhibition e-course.*

There are many component parts of the museums and exhibitions e-course. These components include general information about the course (e.g., introduction, general objectives, and an evaluation map), course information (e.g., biographical information on the instructor and information on the course, such as a course description, a general course program, and course style), a course schedule, course content (includes the distribution of lecture elements throughout the semester), learning resources (e.g., references, catalogs and publications, and previous exams), a course map (divided into main units and sub-units), a dictionary and/or glossary, course support (e.g., library programs or technical support), and an overview of each unit's components (e.g., pre-tests, introductions, activities, conversations, forums, tasks, course assignments, and post-test exams).

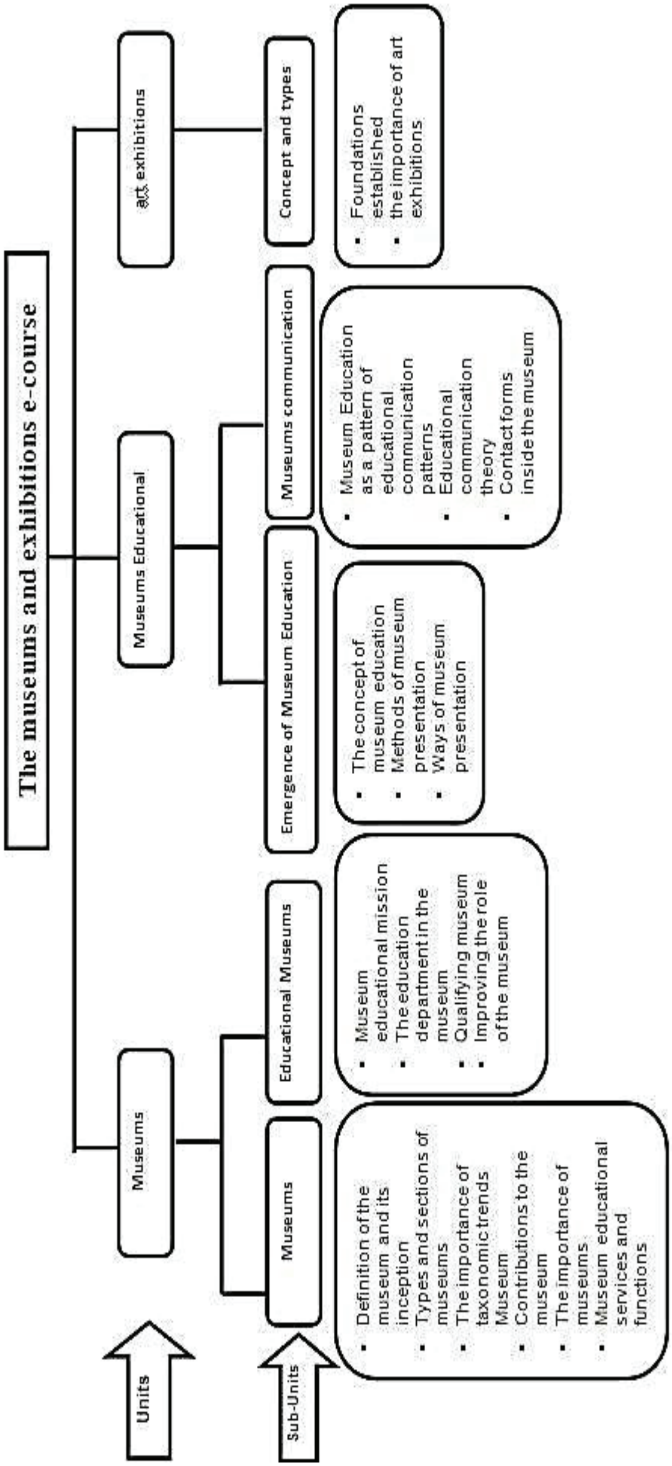

***Figure 7**. The content of a museum and exhibitions e-course.*

The following screen shots describe the museums and exhibitions e-course uploaded to www.cms.nelc.edu.eg.

Figure 8. *This screenshot shows the cover (front) page of the museums and exhibitions e-course (museums &exhibitions) on the Internet shows the title of the course, the name of the lecturer, and the college and university.*

Figure 9. *This screenshot shows the computer programs the user needs to deal with the e-course, such as Internet Explorer, RealPlayer, and Adobe Reader, as well as the screen resolution.*

Figure 10. *This screenshot shows the contents of the course, from which a student can choose a subject to study.*

Figure 11. *This screenshot shows an example design that unites the curriculum; it contains the main unit, sub-unit, educational item, and objectives.*

***Figure 12**. These screenshots show the use of charts and matrices to simplify the context and make categories so that the content is easier to study.*

***Figure 13**. This screenshot shows that the student can return to the original script to see more details.*

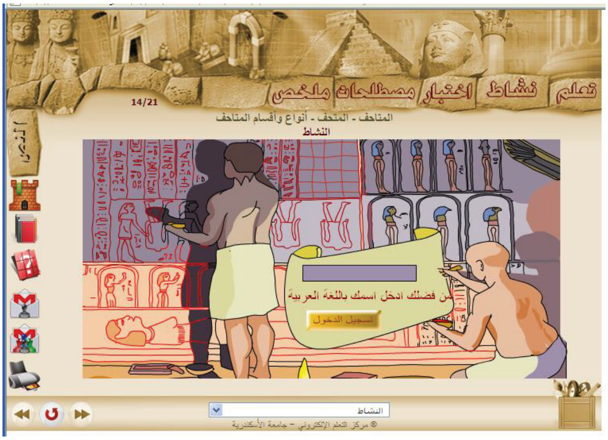

***Figure 14**. This screenshot shows an example of activities that students can do while e-learning.*

Figure 15. These screenshots show the glossary, which the student can search alphabetically or by writer, date, or category.

Figure 16. This screenshot shows the evaluation map, which contains assessment methods such as quizzes, midterms, tasks, and oral exams, as well as the weights for each method.

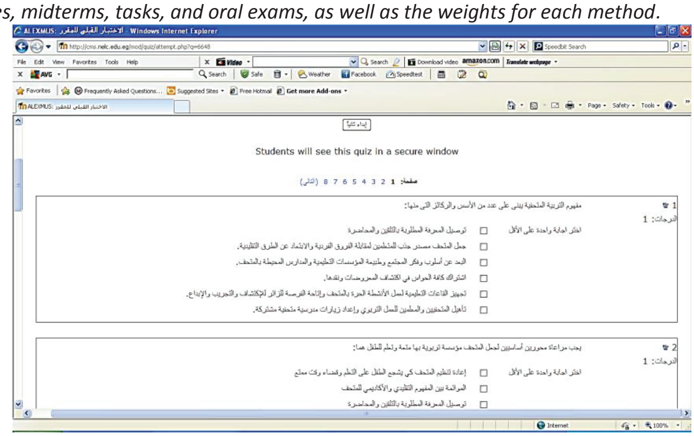

Figure 17. This screenshot shows an example pretest, which the student took before starting the unit. As in the posttest, it is an MCQ question system. This is a multiple choice test.

Figure 18. *This screenshot shows a multiple choice exam. The student gets instant feedback and cannot move on to another question without giving the right answer.*

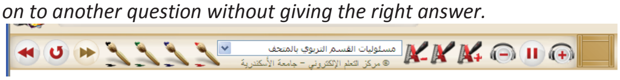

Figure 19. *This screenshot shows the tools that allow the student to control the volume level and the color of the text, and to repeat the explanation for the slide.*

Results

The hypothesis: There are significant differences between the mean degrees of the experimental group students and the hypothesis mean in the post-test opinions of students in the e-course for the experimental group students.
To test the validity of the hypothesis, the researcher used a *t*-test for unlinked groups to calculate the significant differences between the mean degrees of the experimental group students and the hypothesis mean in the post-test opinions of students in the e-course; the researcher calculated the effect size of Eta-squared (η2) to identify the effect size of the differences between the mean degrees of the experimental group students and the hypothesis mean in the post-test opinions of students in the e-course.
Table 1. *Significant differences between the mean degrees of the experimental group and the hypothesis mean.*

It is clear from Table 1 that there are significant differences between the mean degrees of the experimental group students and the hypothesis mean in the Personal background, Didactic efficiency, Technical feasibility, Cost effectiveness and Total

	Experimental group		Hypothesis mean		Significant differences		Eta-squared (η^2)	
	Mean	**Std. Deviation**	**Mean**	**Std. Deviation**	***T*-Value**	**Significance Level**	**Value**	**Significance**
Personal background	11.07	1.31	8	0	14.86	0.01	0.739	High
Didactic efficiency	17.58	2.67	12	0	13.21	0.01	0.691	High
Technical feasibility	6.18	0.68	4	0	20.38	0.01	0.842	High
Cost effectiveness	9.33	0.92	6	0	22.94	0.01	0.871	High
Total	44.15	3.40	30	0	26.31	0.01	0.899	High

* The value (t) indexed at the level (0.05) and the degrees of freedom (78) are (1.99).
* The value (t) indexed at the level (0.01) and the degrees of freedom (78) are (2.64).

categories of students' opinions of the e-course for students in the experimental group, where the value of (*t*) is statistically significant at the level of significance (0.01). The Eta-squared of the differences between the mean degrees of the experimental group students and the hypothesis mean in the Personal background, Didactic efficiency, Technical feasibility, Cost effectiveness, and Total categories of students' opinions of the e-course are high. The below figure shows a bar charts of the mean degrees of the experimental group for students' opinions of the e-course questionnaire and the hypothesis mean.

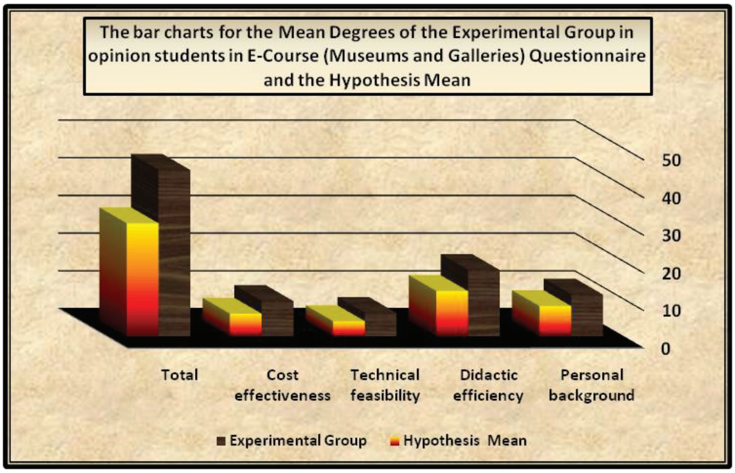

Figure 20*.The bar charts for the mean degrees of the experimental group in the students' opinions of the e-course questionnaire, as well as the hypothesis mean.*

CONCLUSION

Egyptian educators must increase their effectiveness by increasing the rate of learning, which can provide equal opportunities to anyone, anywhere, taking into account individual differences among learners, beside by using a management system for administrative issues; offering students personal tools for construction, presentation, reflection, collaboration, etc.; facilitating networks between students within the same course; and facilitating networks between students and other people working within the field are all examples of the student-centered approach to e-learning.

Blended e-courses depend on the proper proportion of e-learning relative to traditional education. The level of support for blended learning e-courses determines the depth the lecturer needs for such standards, so they must make decisions to help and support the process of traditional education using techniques and tools.

From the experience of the students interviewed in this study, they prefer using e-learning as it saves time to practice and easy to use this is likely to occur when:

- the technology is reliable, accessible, and usable to the point of being invisible in its functioning;
- instructions for accessing the required sites are clear, explicit, delivered up-front, and make no unjustified assumptions as to students' knowledge or awareness of online processes;

- content is designed to make explicit the structure of the material and to facilitate the user's navigation through and awareness of locations in that structure;
- a culture of risk-taking is encouraged in which supportive process are put in place for dealing with differences and experimenting with ideas and possibilities; and

It is clear that emotions play a critical role in the teaching/learning process, and that this role must be addressed in both the theory and practice of teaching and learning.

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Index of Authors

Dr. Janne Beate Reitan
holds a PhD at AHO - the Oslo School of Architecture and Design. She is the Chief Editor of the design and design education research journal FORMakademisk and Associate Professor at the Institute of Art, Design and Drama (EST), Oslo and Akershus University College of Applied Sciences.

Prof. Peter Lloyd
is Professor of Design Studies at the Open University in the UK. His research and teaching interests include: Design Process, Design Ethics, Design Thinking, and Design Pedagogy. He is associate editor for the leading journal Design Studies, and membership secretary for the Design Research Society.

Dr. Erik Bohemia
is a Senior Lecturer in Industrial/Product Design at the Loughborough School of Design, Loughborough University, UK. Dr. Bohemia's on-going research interest is examining product development processes in geographically distributed and cross-cultural product development teams.
See: Global Studio
http://theglobalstudio.eu/

Prof. Liv Merete Nielsen
is designer and professor of Art and design education at the Oslo and Akershus University College of Applied Sciences. Her research interests include: Curriculum studies and Design education for citizenship, democratic participation and sustainability. She is chairing the research network DesignDialog, the project DESIGN LITERACY and DRS//cumulus Oslo 2013.

Dr. Ingvild Digranes
is an Associate professor in Art and design education at the Oslo and Akershus University College of applied Sciences. Her research interests include: Curriculum studies and Design education for citizenship as well as Professional challenges for design educators. She is part of the editorial board for Techne A.

Dr. Eva Lutnæs
defended her thesis at Oslo School of Architecture and Design in 2011. Lutnæs is involved in the research network DesignDialog. She participated in the scientific committee of the MAKING conference at Notodden in 2012 and is currently co-editing an issue of the journal Studies in Material Thinking.

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