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Cristiano Storni, Keelin Leahy, Muireann McMahon, Peter Lloyd y Erik Bohemia.

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Edited by:
Cristiano Storni
Keelin Leahy
Muireann McMahon
Peter Lloyd
Erik Bohemia

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Proceedings of DRS 2018

Catalyst

Volume 6

Editors
Cristiano Storni, Keelin Leahy, Muireann McMahon
Peter Lloyd and Erik Bohemia

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DRS 2018 Design Research Society 2018 Catalyst

University of Limerick
25th–28th June 2018

Editorial

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DRS2018, hosted by the University of Limerick and the Limerick Institute of Technology is the first international biennial conference of the Design Research Society since the 50th anniversary conference in Brighton. This represented both a challenge and an opportunity; a challenge to meet the high standards set in 2016, but an opportunity to contribute to a growing design research field. The balance between these has translated into the conference theme of *Catalyst*. A catalyst is something that precipitates events; it is the coming together of different entities to generate something new; it is the spark for wider change. Framed by the Catalyst theme, these proceedings explore existing and emergent areas at the intersections of design research, practice, education and policy.

The conference itself built further on innovations from the past two conferences; developing more interactive conversation and debate formats, and providing a forum for practice-based research through the increasingly popular workshops. A *PhD by Design* day, first initiated at DRS2016, provided a platform for PhD researchers to learn new skills, present their work, and network with other researchers. The design of the conference, however, was largely formed around the managed theme tracks which included themes relating to the Special Interest Groups of the DRS. In some cases theme tracks emerged from conversations held at previous conferences, representing a pleasing continuity.

From the initial calls for participation there was a great deal of interest in the conference. Once again we had a truly international range of work presented and published in these proceedings. The original call for theme tracks yielded 46 proposals from which 24 were selected. These formed the backbone of the conference and of these proceedings. The theme tracks represent an increasing engagement with new technologies and data but also reflect contemporary social and political concerns, and the need for different types of design research voices to be heard. In particular, the programme committee were committed to bringing diverse global perspectives into play during the conference.

Following the call for theme tracks, the call for papers resulted in 470 submissions of which, after a rigorous peer-reviewing process, 218 (46%) were finally accepted for presentation and publication. This is a slightly decrease in the acceptance rate from the previous conference indicating a corresponding increase in the quality of the proceedings papers. Although some papers were submitted to an open call, the majority of papers were submitted to theme tracks, with each track being managed through the peer-review process by a track chair and all peer-review overseen by the Programme Committee. In total nearly 1000 paper reviews were written by 330 reviewers. The opportunity for authors to rate and comment on the reviews they received has further helped drive up the quality of peer review for future conferences.

DRS2018 reflects the coming together of many different perspectives and themes. As with previous conferences its design has been emergent, developing over the two years prior to the conference. It has been the result of many discussions and collaborations both within the Limerick team and the DRS more generally. The conference, and the proceedings that have resulted, are an extensive

collaboration between many people but we would especially like to thank the local organising committee comprising members from the University of Limerick (UL), The Limerick School of Art and Design (LSAD) at the Limerick Institute of Technology, as well as members of other Irish academic institutions all of whom contributed valuable insight and experience. We'd also like to thank the track chairs who worked tirelessly and diligently to organise their tracks, and the reviewers who have ensured the high quality of the papers within those tracks.

Lastly but not least, we need to acknowledge the system that helped shape the way we worked together and made our decisions: the ConfTool conference management system. For the uninitiated ConfTool represents an awkward and mysterious interface. For the initiated it represents an indispensable way to manage the complexity of every stage of the conference process. In a way that echoes the conference theme, ConfTool has been a catalyst for our collective effort in bringing DRS2018 together.

In this sense *Design as a Catalys*t becomes a *thing*; a thing in the Heideggerian sense of a gathering of different entities coming together to deliberate on shared issues and reaffirming the role of DRS as a leading forum for discussing design research from multiple angles. But also a *thing* in the sense of something that escapes a specific definition, reflecting the impossibility and perhaps undesirability of a specific definition of what design research is, and should be.

With this sentiment in mind, we sincerely hope that these proceedings catalyse positive change and that the changes propagate to DRS2020 and beyond.

Go raibh maith agaibh,

Cristiano Storni, Department of Computer Science & Information Systems
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Muireann Mcmahon, School of Design
Peter Lloyd, Vice Chair of the Design Research Society
Erik Bohemia, Events Secretary for the Design Research Society

Volume 7

Section 23.

Design Education for the General Public

DRS 2018 Design Research Society 2018 Catalyst

University of Limerick
25th–28th June 2018

Editorial
Design Education for the General Public

NIELSEN Merete Liv

Oslo Metropolitan University
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Design education for the general public is regarded as a catalyst for a move towards a better user participation in design processes and a higher awareness of everyday consumer choices. By educating the general public to become design literate, there is a chance for improved cooperation with professional designers and a possible move towards sustainable societies. The challenge is to articulate content, performance and continuity for such a design education.

Some countries have mandatory design education through primary and lower secondary school, while other countries offer design education solely as an elective subject. Comparative curriculum studies can be found in international reports such as 'Education at a glance', but curriculum studies alone do not give insight in the content and quality of the studio/workshop practice. Some of the papers in this track will give such valuable insight into how design education is practiced. Others discuss organizational and/or philosophical aspects for design education.

The concept 'design literacy' addresses the complex matter of objectives, content and practices in design education. Research on multiple literacies has evoked considerable debate and redefinition within several areas of educational research (Coiro et al. 2008); it is no longer bound to the understanding of literacy as the ability to read and write verbal text (Moats 2000). Visual literacy (Stankiewicz 2003), media literacy (Buckingham 2003), ecological literacy (Stegall 2006) and design literacy (Nielsen & Brænne, 2013) are among such newly coined literacies. Design literacy is connected both to the creation and understanding of design in a broad sense, and is not limited to only graphic design. Design literacy is regarded as a competence not only for the professional designer, but also for lay people in their position as users, decision makers, and consumers (Nielsen & Digranes 2007; Dong 2008).

Designed artefacts and services influence our lives and values, both from personal and societal perspectives. Designers, decision makers, investors, and consumers hold different positions in the design process, but they all make choices that will influence our future. In order to solve crucial global challenges, designers and lay people must cooperate; for this purpose, we argue that design literacy is necessary for all. We argue that the design literacies can underpin practices associated with democratic participation in design processes, developing and enacting ethical responsibilities, and understanding and supporting sustainable aspects of production and consumption.

Therefore, the track aims to explore the following points:

- How development of design literacy can be supported in general education from primary to higher education
- How design education for the general public can represent both a foundation for professional design education and a prequalification for lay persons' competence for decision-making
- How might design literacy influence sustainability issues in society?
- What connections exists between the different levels of design education from primary to the university level?
- How design education contributes to perceived and experienced curricula
- What is the relationship between design education and ideological curriculum?

Research addressing above points will be useful to inform changes in policy and educational implementation. The importance lies in the needs to better inform design education itself, to improve the quality of design educators, and to educate reflective consumers.

The papers

The papers in this track represent an insight in how design education for the general public is performed in Norway, Chile, Australia, South Korea, China and in the United Arab Emirates. The approaches in the papers are multiple. Some of them focuses on the content of design education at university level, while other focuses on design education in primary and secondary schools. The two are however interconnected, as design education at university level is closely related to how design education is performed at lower levels. Changes in curriculum is not enough to change educational practices.

Both creativity and technology are central themes in the papers, and there is no focus on excluding the one for the other – rather the opposite. Both creativity and technology are central in developing innovation skills and attitudes. The use of Augmented Reality (AR) and the development of Toolkits can illustrate the complexity. Some of the papers emphasis the importance of combining tradition and technology in design education. Other papers have a focus on how evaluation can influence design practice. Culture and sustainability are also themes in several papers.

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‘Being Cultural’ or ‘Cultural Beings’ – general design education

DIGRANES Ingvild

Western Norway University of Applied Sciences, Norway
ingvild.digranes@hvl.no
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The design and design education professions, also labelled ‘making professions’ have a short history of research, and can be seen as in being the process of establishing their professional identity. There seems to be a shift in both the content and studio practice from solely the making of products, to thinking of design as a step towards the betterment of society as a whole. This change is also seen within the field of subject-matter didaktik related to design teacher training, where the legitimization of design in education at lower educational levels is one of the topics currently debated. The design professions’ justification of purpose – design as a driving force in the development of an inclusive and sustainable society, is mirrored in the debate in general education regarding the content and justification of design education in schools. At the same time, schools across Europe outsource art and design education to external artist led «culture and creativity programs». This outsourcing can be questioned in terms of how it can erode the national repertoire of values, evaluation criteria and collective considerations (Lamont & Thévenot, 2000) attained through knowledge, skills and attitudes formed in teacher led workshop practice in design (Enger et al., 2013).

general design education, culture education, professions, professional jurisdictions

1 Introduction

The field of design education and design professions have a relative short history of research in what Dunin-Woyseth and Nilson (2012) see as vital for the practice related making disciplines. The linkages between ‘design research connoisseurs/critics’ and ‘design practice connoisseurs/critics’ is a direction in research that is desirable and now we see that «The development of the field of practice-related design disciplines makes it more and more possible that there will be an increasing number of people being both» (Dunin-Woyseth and Nilson, 2012 p.9). With this new orientation in research, where the practitioners and educators are also the researchers, we see as a result that the educators also develop theory led studio practice in the universities and colleges. A new stage in

what can be called the 'professionalization project' has been reached (Nolin, 2008). The practitioners not only own the studio but the research into professional practice and education as well. With my background, in general education with a specialization in Design education, the continuous learning in design has been one of the major concerns of my research. What do we choose as content for design education at different levels, why this particular philosophy and focus, and how do we solve education in the workshops, studios and classroom? The questions of *What*, *Why* and *How* of design education is asked at all levels and they are never static (Digranes, 2006). They are also hard to see as separate questions; from Why?, follows What?, and from What?, follows How?

2 From Design pedagogy to Design didaktik

The making disciplines have at their core the connection to the practice. Taking my cue from Dunin-Woyseth and Nilson (2012), I also wish to highlight the connection between research and practice in design education. There has between the university disciplines and the institutions that educate for professions been a separation between 'education research connoisseurs/critics' and 'subject-matter education practice connoisseurs/critics' (Dunin-Woyseth & Nilson 2012, p.9). This is why in this article I have chosen to use the concept design didaktik instead of design pedagogy. Before I continue into the topic I find it necessary to explain this choice seen form a Norwegian educational context. In the Scandinavian tradition the research pertaining to subject specific educational questions is often referred to as subject-matter didaktik, in this case design didaktik. The concept of didaktik — and here I use the German orthography of the word — originally from the German education tradition, becomes problematic once applied in the English language without an explanation. The Anglo-Saxon tradition have an understanding of what is encompassed by didactics — and here I use the English orthography of the word — as pointing more directly towards lecture/classroom methods and have instead opted for the use of other concepts. They speak more broadly of educational theory and curriculum theory (Hopmann & Riquarts, 2000). The Scandinavian countries have instead developed their educational research based on the German traditions with the areas didaktik and pedagogy (Myhre, 2001). The Design Resarch Society and design research have opted to start using the concept Design pedagogy (Tovey 2013). The fact that pedagogy mainly focuses on learning and bildung on a wider scale (Myhre, 2001) is what makes it both too narrow and too wide at the same time. This sounds like a paradox, but illuminates a situation where pedagogy offers a general theoretical approach to learning and upbringing, which is necessary, but does not relate specifically to a field of expertise – the specific subject-matter questions related to design education (Klafki, 1997). This makes constructs such as English pedagogy, I would argue that the understanding of the concept pedagogy within Design research seems to be a limited to use of specific design methods. While talking of Design pedagogy, the research describes a specific method rather than the more complex process of learning and upbringing. This is what leads me to suggest Design didaktik is a more suitable approach.

Design didaktik was developed to provide subject definition to a theory base that might otherwise get too comprehensive and narrow at the same time. It is defined by the question: What basic knowledge should the next generation of citizens or professionals have in design, why, and how best achieve it? is more specific than pedagogy, but at the same time it covers more than methods of teaching or the written result in the curriculum or course plan (Klafki, 1997). It includes the questions regarding work, as requested by Abbott (1988) as it relates to the philosophy of education, philosophy of design as well as knowledge of design history, professional practice, studio and workshop experience, design theory i.e. (Aase, Streitlien, Lorentzen, & Tarrou, 1998). It also articulates the justification of the field in education and in society as a whole. It addresses current needs in relation to development of new directions in design in education or in profession practice, and signals a commitment to the future through the purpose that design is given.

3 Culture in school or separate from school?

This leads to one of the current discussions in Art and design education in Norway at the moment. The design education community (from kindergarten to PhD) is in the process of establishing a common value ground. However, in general education where the boundaries of professionalism is less stable, the concept of *Culture in education* or even *Culture education* has been introduced into the mix. This complicates the questions of What, Why and how, as other professional fields are invited into the discussion with a different agenda and understanding of the concepts involved or even education as a whole.

The thesis *Norwegian cultural policy. A civilizing mission* by Egil Bjørnsen (2009) addresses the problem of education and how different interpretations of buildung can explain the propensity towards accepting the understanding of culture as something children can access through art projects visiting the schools. External resources are brought in to ensure that children have access to culture. He mentions the two ways of approaching buildung the *Object oriented* and the *Subject oriented buildung*. The Subject oriented buildung has an open view of culture as something that makes society what it is, and that it is through participation in all areas of life that you will develop a moral sensibility and cultural repertoire. In this thinking the school as an institution becomes one of the main cultural arenas of a nation, without dividing it into subject that are cultural or subjects that are not. This understanding of culture and buildung has the potential to foster a sustainable cultural répertoire and change the rules that people follow in justifying their consumption or quality of life (Lamont & Thevenot 2000, p.1).

The object oriented building has as its premiss that the «educational potential of legitimate/elite fine art» for children. In certain initiatives culture is defined as something specific related to a narrow interpretation of fine art (Bjørnsen, 2012), and as such culture education is narrowed down to acting in a specific way – as «being cultural». You go to the 'right' exhibition, or listen to the 'right' music, read the literary canons and discuss cultural heritage through craft and art. To be exposed to the «right» art is believed to lead to moral growth and better humans. In this approach, the few will on behalf of the many decide what aspects of art and being cultural can enhance the human potential.

Culture then becomes not something that constitutes a community of reference in terms of national values and considerations, but as fragments of the world seen as separated from general knowledge. It is followed by words such as creativity that also serves to cloud the discussion of a common ground. Documents and initiatives targeted towards the areas culture and education, seem to mix the uses of art education, aesthetic education and culture education (Birkeland et al. 2014) - all which can be said to hold different connotations in an education setting. Culture programs where pupils form the audience and not the practitioners, and where content an values are outsourced to an object oriented take on culture, might it not lead to an understanding of Art and design in compulsory education as appreciation of fine art, rather than basic values relating to citizenship and the role of design in "the common good" (Digranes, 2009b)? If culture remains something of the creative individual in art education, it will lose the potential of education for citizenship in a civic mindset geared towards a shared future. To simply accept that something can be distinguished and separated into a school area called cultural education, and that this corresponds only to a small part of the everyday world of a pupil leaves me with a question mark. The least that is necessary is a discussion into what is meant by this division, and if it is fruitful in terms of developing an education with a focus on sustainable design. The focus might need to change back to youths as active agents of change in changing culture, rather than forming appreciative audiences in external projects where they themselves become passive «culture consumers». Beneath these questions lies another important issue – By whom and how is the content of general design education established? Who is recognised as the professionals in general education?

3.1 Establishing a Community of reference

A community of reference gives room for more than the practice — also inanimate objects, artefacts, and, importantly, the lack of a common practice. The community of reference holds judgements, voiced as a critique by the actors, and is seen in how the actors unveil their stand towards the world. The products — thing-beings — that come out of projects, student work or knowledge gain, are 'negotiation events' in a discussion of the power to define the common good and as such quality and goals in the future execution of the project. We place value in what is important to us, and how it is important to us — is it beautiful, a tool for economic gain, or sacredness? It is not enough to justify yourself from an individual point of view, so the actor therefore refers to the higher common principle that forms the value set in the conviction that the arguments also will convince others. "To be able to converge towards an agreement, persons really have to refer to something which is not of persons and which transcends them. This common reference we call a principle of equivalence"(Boltanski & Thévenot, 2000, p. 213). With the Kyoto design declaration of 2008: «A statement of commitment by the members of Cumulus to sharing the global responsibility for building sustainable, human-centered, creative societies» (Sotamaa, 2008)

> *«Designed artifacts 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's competence for informed decision making» (Sotamaa, 2008)*

It is in the ambiguous situations (Boltanski & Thévenot, 2006) that occur, like when professionals and lay people meet, that the justification narratives are told and the boundaries between the professions are activated, and recognised, as they are articulated through purpose and the distribution of perceived relevant knowledge. In my view this can be said to according to their understanding of the Higher Common Principle (HCP) and world-view as well as the expertise. This is particularly relevant in design education, where a large part of the expert knowledge is making knowledge that is based on practical experience in a tactile understanding that can sometimes be difficult to access due to it being concept poor (Schön, 1995). This is why the practice — the argumentation in and through the work itself — has to be considered vital in design and design education (Digranes, 2009a). Through the discussions but also actions on the practice level, conflicts in the value sets that guide the practice will surface. This focus on the work practice is not mainly a way to study the process of professionalisation but rather a step towards what Nolin claims to be the next stage in professional research and theories: "… does not start with the empirical question 'what are professions really like and how do they really work?' Rather, there is a point in asking: 'what kind of professional work does society need?'" (Nolin, 2008). It moves in a more normative direction, dealing with the professional mandate and tasks, asking if they are good or bad for society in a moral sense. It is a question of quality: "… professionals are knowledge workers and as such they should be steadily working to improve the quality of their work (professionalism) and on their professional identity" (Nolin, 2008). Even if the professionals involved in justify their presence and establish boundaries for their work practice, it is necessary to then apply the question whether and how it will benefit the society in the long run. Sometimes in design this is built purely on purpose, and as such the professionals seem free to base their jurisdictional claims in the sphere that is most suited to the specific situation: "… if there is one thing you cannot do in the actor's stead it is to decide where they stand on a scale going from small to big, because at every turn of their many

attempts at justifying their behaviour they may suddenly mobilize the whole of humanity…" (Latour, 2005, p. 185).

3.2 Professionalism and culture education – who owns the right to diagnose, infer and treat

Professions have at their core professional knowledge, where the education institutions play a vital part. If you graduate for a professional education you are certified with a professional title that sets you apart from those educated in disciplines such as i.e. design history, sociology, pedagogy etc. This signals that the educational institutions have given you both the academic and practical knowledge necessary to contribute to this specific professional field as a practitioner (Grimen, 2009). This process of establishing a field of knowledge is often referred to as the 'professionalisation project'. Professionalism and the 'professionalisation project' is often addressed through structural theories (Nolin, 2008), where the process is seen at system level, and described as a rather uniform process with stages that will occur in the 'professional project'. Professionalism can then be labelled within the two orientations, as: "… normative value system and as controlling ideology" (Evetts, 2003). The difference lies in how professions are perceived and portrayed — as a positive contribution to society through a wish to contribute positively, or as a control mechanism for economic gain for a social group. In a way these two takes on professionalism might be seen to correspond to the difference between the concepts calling and occupation, presented as work concerned with values or as an organism in an ideological capacity. Professionalism as ideology, discuss monopoly on competence as the aim of professionalisation (Evetts, 2003). The professions are seen as new, created markets where knowledge can be gathered and harvested as capital by a group of practitioners (Larson, 1977). To do this it is necessary to limit the access to the knowledge, and as a result educational institutions teaching expert knowledge are organised, with gatekeepers to exclude all but the accepted. The disciplines to set the standards were medicine and law, and many occupations with a very different set of practices would covet the professional model instigated by these groups. Teachers have, for instance, a propensity to belong to 'the teaching profession'. An occupation is bestowed the status of profession on the basis of prerequisites, such as specialisation of function and the accumulation of bodies of expert knowledge (Abbott, 1988). These processes have roots back to the guilds, which were a very important prelude for the making professions later on (Dunin-Woyseth & Michl, 2001; Dunin-Woyseth & Nielsen, 2004) of which design and design education are seen as parts of. The formation of specialist education and examination for the elite, connection to the universities, and certificates of expertise distinguished professionalism from the guild tradition: "From dependence upon the power and prestige of elite patrons or upon the judgment of a tightly knit community, the modern profession came to depend upon specific formal training and anonymous certificates" (Larson, 1977). In this lies the seed to gain control over the market — not a part of it — as even a market of knowledge contains tools for bargaining for position or influence. "The professionals claim the exclusive right to practice, as a vocation, the arts which they profess to know, and to give the kind of advice derived from their special lines of knowledge" (Hughes, 1984). The area of expertise is the professions jurisdiction. Witz (Witz, 1992) uses the term 'demarcation' as boundaries for professional control, even though he speaks more broadly in terms of occupation (Witz, 1992). This is the field where the professionals control the diagnosis, inference and treatment. Those with power use this to intensify their hold on the right to infer treatment. "The jurisdictional claims that create these subjective qualities have three parts: claims to classify a problem, to reason about it, and to take action on it: in more formal terms, to diagnose, to infer, and to treat" (Abbott, 1988). It is in this process according to Abbott that the concept of work has to be introduced. It is in the practice that the professions separate in style, solutions and manner of execution, and where they put forth their claim to legitimacy, to jurisdiction.

4 A Norwegian Case of Outsourcing culture education - DKS

DKS is a permanent funding program, using lottery funds, aiming to bring professional artists into schools to collaborate with teachers, and by doing so, to strengthen the general education from 1st to 10th grade (6-16 years) within the arts. Visual arts (Fine art, Craft, Design and Architecture) overlaps with the school subject Art and design, and is one of the areas within DKS. Artists and teachers are supposedly given the opportunity to jointly develop projects within the subject content. Thus the 'art world' and the 'school world' are brought together within one frame with a set of goals to fulfil. What can be seen from research and evaluations, is that what Dunin-Woyseth calls the 'subject-matter education practice connoisseurs/critics' are constantly question by the external participants of the initiatives. The initiatives becomes a professional battleground where the educational content becomes the weapons of choice to bash each other's opinions in.

Narratives of justification of professional choices within DKS will therefore not only present the reason behind choices in the professional practice, but also present the opposing choices as somehow not justifiable. In other words, they might present the *hero* and the *obstacle*. The media adds to these narratives by adding their own focus on the conflicts. In lived tales, it is the ambiguous situations of instigated critique that stand out, and the need towards justification that tells the story. Narratives are what people turn to, to explain themselves, also in different settings — as opposed to or in concert with others (Bruner 1991). It might take different forms, and it is a socialisation project (Lave and Wenger 1991). Justification is performed through patterns of narration that you are taught, and it is performed through given tools, such as worth and value. The *identifiers* presented in the theory *On justification* in forms of concepts used, aims to strive for, and people of authority, help define the value sets, or worlds, that the actors use as their basis for justifications. The Higher common principle surfaces in how actors approach a conflict, and criticize the befallen. They reflect on and judge their own choices and those of others, although it is not always explicitly stated: "… actors rarely make explicit the general principles of their actions" (Boltanski and Thévenot 2000:210). They are tools towards isolating the critical points in the narratives of justification of the professionals from the two worlds. The most important indicator in this case is the HCP, as all the other indicators are correlated to this.

Thus artists and A&C teachers operate within their professional traditions and values that underlay their understanding of education and art while involved in DKS. The actors involved are forced to make an argument where they justify their actions and their position through values, but also laws and regulations that have impact on the practice. This justification will be tied to a world, and it will correspond to the values and worthiness that constitute this world. The efforts towards persuasion in argumentation and justification can be seen on several levels in the DKS collaboration in professional justification narratives, where the involved actors choose to explicitly state their position through exclamations such as: … *But you have to agree that* … or *… Even you must see that…* In light of a theory of justification, the actors do not *have to* agree or see the other actors' point of view as valid, not if it is in contrast to their own value set. They can disagree on the basis of the worldview that infuses their practice. The values possessed by the actors in regards to their professional practice, the identifiers, surface in the arguments they use while trying to organise the chaos into new and more harmonious stories. Justification both departs from value sets, develops them further, and gives them away, and one of the ways to find the governing values is through the narratives of professional justification.

Education has as its core the professional aim both within subject education and building. The children should develop both a strong knowledge base as well as a moral compass - a cultural repertoire of values. However as seen in recent evaluations and collaborations, the narrow concept of culture is dominating the discussion. It becomes impossible to criticize as well, as the initiative is laudable – culture to all children. Validating professional stereotypes of what I have chosen to label the *artist hero* and the *teacher obstacle*. The creation and distribution of stereotypes are one dimensionally positive — negative, and one sided — told by artists and artist organisations.

Whether this is a deliberate choice, or more an unconscious process by the media I have no basis to comment on here. As it stands, the A&C teachers are not given the opportunity to tell their representation to the public via the media, and as such the construction of these stereotypes is made on the basis of one profession's value sets. They are created by the artists' and artist organisations' agenda, rather than by research into the field. Selmer-Olsen cautioned against such a predicament already at the start of the program in 2003.

> *"The development of knowledge in the field is defined by special interests and a lack of a unifying perspective. The distribution of culture is to a great extent guided by good will, politics and ideology, and not by research based knowledge and systemized experience. The professional educations (from teaching, to health, and art), traditional teaching and narrow interests related to the different areas of art and culture are prominent" (Selmer-Olsen 2003:3).*[205]

The value set that guides educational practice within state legislation is based in the Civic orientation of social democracy, common causes and opportunities, and the Industrial values of professionals, expert knowledge, and results. These values surface occasionally in the media narratives, but are subordinate to and dominated by the inspired orientation, and often listed as the obstacle. This is alarming in light of the DKS program and its placement within the school institution.

In the retelling of a situation of conflict, points of view are accentuated as oppositions to easier identify sides in a conflict (Latour 2005). The end result is to present your side of the matter, your value sets, as the only way to go; "Like all social actors, I seek to persuade myself and others that I am a good person. My narrative is inevitably a self-representation" (Riessman, 1993:11). These narratives are used to enhance the values that underlie any professional choice, and are, as such, an invaluable tool towards understanding the basis for a conflict on both a professional as well as a personal level. In these lie the transitory occurrences that mark the conflicts of your value sets and the return to harmony with a new agreed upon value set after the conflict is settled. The narratives will give an opening into the ambiguous situations, as the narratives themselves are a form of criticizing the moment, either justifying the narrators' own choices or criticizing the other party's solution to the problem (Czarniawska, 2004). Artists are seen as 'survivors' of the toil and monotony of the classroom, liberating the children from the notion of society in favour of the individual focus. Craft, Design and Architecture are not often included in these initiatives, even as these parts of the curriculum can be seen as an integral part of culture education, both in the wide and narrow sense of the word.

5 What, how and why in design education.

While discussing culture in general education, culture is transcending the subject specific and as on overarching sets of values. As criteria of evaluation in «…a national cultural repertoire and the rules that people follow in justifying their use» (Lamont & Thevenot 2000, p.1). Culture can then be seen as the values and positions that permeates society as criteria used to define what is good for society, moral standards that should be met, what constitutes a democracy etc. This position will in education, give a ricer approach in all subjects. However, the narrow interpretation of culture can be seen growing in policies regarding art and culture, especially in relation to art and design education (Bjørnsen, 2009). Even as they try to frame it as inclusive, it still becomes subject specific to art and culture education.

> *«Two kinds of learning aims can be distinguished: those that are specifically defined by arts and cultural curricula and those identified by the overall*

[205] OQ: "Kunnskapsutviklingen på feltet preges av særinteresser og mangel på samlende perspektiv. Kulturformidlingen styres i høy grad av god vilje, politikk og ideologi, og ikke av forskningsbasert kunnskap og systematiserte erfaringer. Profesjonsutdanningene (fra lærer- til helse- og kunstfagutdanning), tradisjonelle formidlingsmetoder og snevrere interesser knyttet til de forskjellige kunst- og kulturområdene råder grunnen".

> *curriculum but which can be linked to arts and cultural education and creativity. The primary goal of this chapter is to show what aims are identified as inherent parts of the arts and cultural curriculum in European countries» (Education, Audiovisual & Culture Executive Agency 2009, p.17)*

Culture is no longer defined in terms of being a national cultural repertoire of values and evaluation criteria, but as fine art/culture defined by the few for the many. At the same time Culture as a concept is often substituted with Art, so that the push for culture education becomes a mission for Art education and as such including Artists into schools. «Schools in Europe are developing initiatives to connect pupils more closely to the world of arts and culture. In most countries, initiatives are taken to organise visits to places of artistic and cultural interest, or to establish partnership with artists (section 3.2)" (Education, Audiovisual & Culture Executive Agency 2009, p.15). In light of this the landscape of culture education can be perceived as somewhat paradoxical. For some time now, the trend in art, design or craft education across Europe is to slowly outsource the education to external forces through projects such as i.e Teaching artists (KKD, 2007), Creative partnerships (Orfali, 2004), Den kulturelle skolesekken (KKD, 2003), Skapande skola (Lindqvist & Blomgren, 2015) etc. At the same time, citizenship education with a focus on creative problem solving, 21st century skills, and designing a better future is pointed out as the way to go. It is worth asking if culture really exists in a separate realm apart from education. Culture in the understanding of "being cultural", can even be read as something separate from education. Something of an opposition, and not a part of the school day. In education and education policy the concept of culture is more often than not connected to the understanding of «being cultural» in the sense of appreciation of fine art. Rather than understanding culture as a wider societal platform consisting of values, attitudes and choices as well as designed artefacts and solutions, culture becomes limited to something of the few for the many. In this article I wish to outline the two different approaches to culture in education, and how there is a need to reawaken and reintroduce the wider concept of culture in relation to sustainable design education. A curriculum presents a vision of future society and how design and if design will play a part in a sustainable development, both nationally and globally. In this sense it is important to deliberate on how the culture of the many, strengthened through compulsory education based on values and ethics, can be a step towards a sustainable future. I ask the question: Do we have a culture for sustainability in European compulsory design education?

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Being-and-Becoming a Sustainable Practice

CODDINGTON Alicen* and AYERS James

Swinburne University of Technology
* Corresponding author e-mail: acoddington@swin.edu.au
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This paper reports on the case of the Engineering Practice Academy, where an emergent transformational change process was designed and implemented to not only re-conceptualise engineering education but further transition the Engineering Practice Academy towards being-and-becoming a sustainable engineering practice. This paper presents a framework, grounded in the everyday social reality of the Engineering Practice Academy community and framed through a *Theory of Change* methodology. The Engineering Practice Academy utilised the strategic framework presented within this paper to guide its decision-making processes. This paper articulates both the framework developed and conceptualises why a framework designed to create a sustainable practice was utilised. The value of this paper lies in the communication the method used for transformational change, one of inclusion, collaboration and community of practice, used by the Engineering Practice Academy to create a distinct pathway by which to reach its goals and become a sustainable practice in line with shifting engineering and educational requirements.

transformational change; being-and-becoming; social sustainability; engineering education

1 Introduction

A central question for undertaking a transition is how the change will be brokered within the practice. Negotiating change is complex because it entails a dynamic interplay of actors each with their claim of competency, knowledge, and agenda that are aligned or misaligned to the overarching vision for the change. The *Theory of Change* method presented in this paper provided tools to initiate transition towards a sustainable practice. This paper reports on the reasons and processes undertaken by the Engineering Practice Academy located at Swinburne University of Technology to design a structure to assist the transition to being-and-becoming a sustainable engineering practice. The Engineering Practice Academy designed its strategic framework by using a *Theory of Change* method and produced the outcomes of a vision statement, high-level objectives, theory of change maps and the development of program narratives in consideration of definitions of sustainability utilised by the Framework for Strategic Sustainable Development. The change process undertaken by the Engineering Practice Academy was iterative and this paper presents only the initial phase of

the process thus being the rational for change within the context of the Engineering Practice Academy and the planning and participation processes pertaining to the *Theory of Change* method.

The term 'practice' within the context of this paper concerns the acknowledgement that individuals working and learning within organisations are being-and-becoming practitioners. An individual practice is complex, multi-modal, and continuously implicitly and explicitly responding and adapting to social, cultural, political, technological, economic and historical influences. Predominantly, this paper presents a case of a practice being-and-becoming sustainable and considering sustainability as an integral element to the core functioning of the Engineering Practice Academy's practices in a way that places sustainability as a cornerstone of its operations, functions and learnings.

1.1 Reengineering engineering: A complex sociocultural transition

There are many different aspects of organisational transition that are systemic and influenced by social, cultural, political, technological, economic and historical influencers. Within this study, the change from traditional academic and industry expectations of engineering education to a new practice-based approach presented a systematic transitional challenge for the stakeholders involved. The development and implementation of the Engineering Practice Academy and its associated Bachelor of Engineering Practice (Honours) degree transpired in part because of social, cultural and political influences and needs. Engineering education within an Australian context presently has systemic and structural barriers to overcome and has recognised that engineering education needs to consider the social, cultural, global, political, and environmental responsibilities of engineering education and the profession of engineering moving into the future. The field of engineering as a system has encountered continuous change "brought about by new scientific and technological knowledge, and to changing economic and regulatory forces" (King, 2008, p. ii). Beanland and Hadgraft (2014, p. 8) stated that engineering education within Australia "is still to implement the transformation that is required to enable the next generation of engineers to effectively operate within this changing profession". Engineers Australia, the national industry peak body, recently released its 'Implementing Sustainability,' report guiding the Australian engineering sector on the standards and responses to sustainability it has set across the sector. Furthermore, the report considered and encouraged the implementation of sustainability into the pedagogy of engineering education in order to develop a sector of individuals capable of responding to and influencing local and global sustainability challenges (Rice, Davies, Fitzhardinge, & Jones, 2017).

Negative perceptions towards engineering education and the profession of engineering are a further reason behind the need for systematic transformation. Engineering education and "engineering has not historically been on the cutting edge of inclusion and social justice" (Riley, Slaton, & Pawley, 2014. p. 350). Engineering education and engineering as a profession being profoundly exclusionary extends beyond gender diversity with diversity being a measure of heterogeneity across a given population; whether that be gender, sexual orientation, race, ethnicity, age, or socio-economic status (Hunt, Layton, & Prince, 2015).

Furthermore, the communication of engineering as a discipline within the context of Australia presents barriers in regards to attracting school leavers into the profession. Within Australia, there are:

> *widely-held concerns that the societal value of engineering as a profession, and the broad merit of engineering a study pathway that increases graduates' career opportunities, are largely invisible to the public at large and within the school education sectors (King, 2008, p. iii).*

Australian universities have been slow to address the negative perception of engineering and take responsibility "for the problems created by the current deficiencies in engineering education" (Beanland & Hadgraft, 2014, p.viii).

Engineering education within the context of Australia is in need of sociocultural change to not only transform the perception of engineering education but also engineering as a profession in a future dominated by questions of automation and algorithms. Transformational change is however complex and challenging to realise in an academic context. Change in universities is a multifaceted process because:

> *while there are many forces resistant to change in universities that need to be overcome for transformation to be implemented, there is also goodwill to consider changes that can be demonstrated to be justifiable. The difficulty of achieving change cannot be used as a reason to justify widespread failure to address fundamental problems associated with the design and delivery of a core activity (Beanland & Hadgraft, 2014, p. 62).*

The Engineering Practice Academy is just one example of an Australian university initiative addressing the systemic barriers surrounding engineering education. The Engineering Practice Academy responds to the social, cultural, political, technological, economic and ecological contexts in which the Bachelor of Engineering Practice (Honours) degree operates within. The Engineering Practice Academy works as an engineering practice being both a professional service provider and a higher education institution. The Engineering Practice Academy reacted to the recommendations specified by King (2009) within the report published by the Australian Council of Engineering Deans. Specifically, the Engineering Practice Academy aimed to design and implement a curriculum "based on sound pedagogy, embrace concepts of inclusivity and be adaptable to new technologies and inter-disciplinary areas" (King, 2008, p. iv). Furthermore, the Engineering Practice Academy intended to:

> *address shortages in the engineering workforce by attracting and retraining people from non-traditional backgrounds e.g. women, mature age engineers, engineers with overseas qualifications, engineers who have left the profession, and engineers wishing to articulate between qualification levels (King, 2009, p. iv).*

Additionally, the Engineering Practice Academy recognised that "engineering educators and industry practitioners must engage more intensively to strengthen the authenticity of engineering students' education" (King, 2008, p. iv). The process undertaken to re-position engineering education requires transformational change and seeks to be done in a way that encourages the creation of a sustainable practice and model.

To transform and present an alternate model for engineering education that celebrates diversity in all its forms, provides an environment that challenges unsustainability and considers deeply the idea of 'who an engineer is', required the Engineering Practice Academy to transform their individual and collective vision of engineers, engineering education and engineering as a profession. This paper considers and articulates the process by which the Engineering Practice Academy undertook the conceptualisation and development, and implementation of this challenge.

2 Becoming sustainable: a framework to create sustainable practice

The definition of sustainability (and sustainable development) has long existed in a realm of ambiguous discourse. The heavily utilised Brundtland definition, "development that meets the needs of the present without compromising the needs of future generations to meet their own needs" (Missimer, Robèrt, & Broman, 2016b, p. 43), has been considered the universal definition. However:

> *the vagueness of the definition… allows business and 'development' interests (and their government supporters) to claim they are in favour of sustainable development when actually they are perpetrators of unsustainability (Jacob, 1994, p. 24 as cited in Missimer, Robèrt, & Broman, 2016a, p. 32).*

With many definitions available, there has been a distinct challenge developing a scientific, robust understanding and definition of systematic sustainability and its models. John Elkington's 'Triple

Bottom Line' approach, that places environmental, economic and social systems in a tripartite model of equal weight (Slaper & Hall, 2011), is often cited and utilised by business sectors as a way of introducing sustainability into the language and planning of their practice. As has the 'Overlapping Circles Model' which places economic and social systems inside an environmental one (McKenzie, 1994) highlighting the social and economic reliance on a healthy ecological system. Yet to define sustainability in terms of compliance and violation, especially in its social realm, continues to be a challenging proposition.

2.1.1 Utilising a comprehensive sustainability framework.

In order to clarify this challenge and construct a definition of sustainability, a definitive robust scientific framework was developed by a group of academics in the early 1990's. The Framework for Strategic Sustainable Development (FSSD) is a structured and coordinating framework that includes a unifying and operational definition of sustainability at both ecological and social levels (Broman & Robèrt, 2015). The FSSD articulates the system conditions of sustainability using ecological and social sustainability principles to provide a robust definition of sustainability by providing an understanding of when sustainability is being complied with or violated. By creating the measurable conditions to sustainability these sustainability principles can be used to aid organisations as they transition from unsustainable to sustainable practices. It does this by creating a thorough understanding of the global sustainability challenge, how organisations are interrelated and entwined within the ecological system and the dangerous context of risk for organisations that refuse to adopt sustainable measures. The principles provide the conditions of sustainable success by which organisations are able to move strategically towards sustainability (Broman & Robèrt, 2015). The FSSD provides the robust definition that Brundtland lacks and is determined on the premise:

> *that humans are dependent on the ecological and the social system to meet our needs, what are the essential aspects of the ecological and social systems that need to be sustained (or restored) in order to not systematically undermine the capacity of people to meet their own needs (Missimer et al, 2016b, p. 43).*

It was within this understanding that the FSSD provided the Engineering Practice Academy with a comprehensive sustainability framework.

2.2 The sustainability principles: Adopting a definitive understanding of sustainability.

The Framework for Strategic Sustainable Development (FSSD), originally consisted of four sustainability principles. Three ecological principles and one social sustainability principle. The three ecological principles of sustainability (Sustainability Principles 1,2,3) and the fourth social principle (Sustainability Principle 4) were developed over 25 years of robust, peer reviewed scientific investigation, and have been defined as:

In a sustainable society, nature is not subject to systematically increasing...

1. ...concentrations of substances from the earth's crust. (SP1)
2. ...concentrations of substances produced by society. (SP2)
3. ...degradation by physical means, and: (SP3)

In a sustainable society;

4. ...people are not subject to conditions that systematically undermine their capacity to meet their needs. (SP4)

However, the social dimension of the framework (initially Sustainability Principle 4) was found to be not sufficiently science based and operational, a challenge faced in the wider social sustainability field, requiring further scientific development (Missimer et al, 2016a & 2016b). This development has led to emerging models of social sustainability being defined and developed conceptually within

the FSSD expanding the social sustainability principles to become the sustainability principles 4-8. This expansion means the resulting definitions for ecological and social sustainability are:

Table 1: Adapted from Broman & Robèrt's (2017, p.7) definition of social and ecological sustainability principles.

Definitions for ecological and social sustainable societies	
"In a sustainable society, nature is not subject to systematically increasingly… 1…concentrations of substances from the Earth's crust. 2…concentrations of substances from society. 3…degradation by physical means".	[social] "people are not subject to structural obstacles to… 4…health. 5…influence. 6…competence. 7…impartiality. 8…meaning-making".

2.2.1 The challenge of social sustainability

Social sustainability remains a contentious topic due to the subjective nature of its form, the number of differing definitions that exist in the social realm and the difficulty in measuring these definitions. There is also the challenge that in many realms the term sustainability is associated with ecological and environmental contexts requiring 'social sustainability' to be discussed and emphasised as a separate individual area (often social impact or corporate social responsibility). While this has led to increasing awareness on the implications and considerations of social impacts "rigorous definitions for corporate social responsibility and social sustainability have yet to be established" (Hutchins & Sutherland, 2008, p. 1689).

The Framework for Strategic Sustainable Development (FSSD) aims to be a platform to tackle sustainability challenges and has focused on creating testable social sustainability definitions which unlike definitions of ecological sustainability remain under-utilised or considered in general terms. The research conducted by Missimer et al (2016a & 2016b) aimed to develop these social principles by investigating into the essential elements of the social system. From this investigation, the above social principles were created as part of the FSSD. However, measurement and understanding of the impact of the principles when used as the basis for developing strategic sustainable transitions and planning is still in formation and testing, however initial feedback concludes that the social sustainability principles are valuable in being able to provide an analytical tool to the sustainable transitions of social systems.

2.3 From principles to planning: Building a socially sustainable practice.

In order to create a community of practice in which actors are able to be-and-become authentic engineers and people (an aim in the Engineering Practice Academy vision). The system they inhabit must not violate the above principles of sustainability. This requires an awareness of and action that encourages:

> *the elimination of mechanisms of systematic degradation of essential aspects of both the ecological and the social system (Missimer et al, 2016b, p. 43).*

Therefore, utilising the FSSD sustainability principles the Engineering Practice Academy created the boundary conditions in which the practice can move towards sustainability. For example, to comply with the social sustainability principles and create a sustainable practice, an organisation can use the SSP's to highlight the structural and systematic impediments for each indicator and create an action plan by which they can be removed (using the strategic processes of the FSSD). For example, the question could be asked for Social Sustainability Principle 1 - Health:

> *Are there health and safety concerns for employees? For example, excessive working hours, unsafe or unhealthy work environments, harassment and abuse of works, and forced labour / child labour? (Missimer et al, 2016b, p. 48).*

In creating a process by which these challenges are identified and overcome, the transition towards a sustainable practice (in line with the vision) can be developed. The principles could be investigated within an organisation as such:

> *SSP 1… health.*
>
> *(This means that people are not exposed to social conditions that systematically undermine their possibilities to avoid injury and illness; physically, mentally or emotionally, e.g., dangerous working conditions or insufficient wages).*
>
> *SSP 2… influence.*
>
> *(This means that people are not systematically hindered from participating in shaping the social systems they are part of, e.g., by suppression of free speech or neglect of opinions.)*
>
> *SSP 3…competence.*
>
> *(This means that people are not systematically hindered from learning and developing competence individually and together, e.g., by obstacles for education or insufficient possibilities for personal development.)*
>
> *SSP 4…impartiality.*
>
> *(This means that people are not systematically exposed to partial treatment, e.g., by discrimination or unfair selection to job positions.)…*
>
> *SSP 5…meaning-making*
>
> *(This means that people are not systematically hindered from creating individual meaning and co-creating common meaning, e.g., by suppression of cultural expression or obstacles to co-creation of purposeful conditions) (Missimer et al, 2016b, p. 47).*

After the principles are investigated and once structural obstacles are removed (through strategic processes) the system reaches a level of compliance, thus creating the conditions for social sustainability to occur. Thus, the conditions of a socially sustainable practice as the condition in which individuals, as part of a community of practice within the social system, are freed from all structural hindrances to the social sustainability principles.

3 The case: Connecting being-and-becoming and social sustainability.

The Engineering Practice Academy is a case where a transformational change process (framework) was designed and implemented to not only re-conceptualise engineering education but further shift the Engineering Practice Academy and the individuals that make up its parts, towards being-and-becoming a sustainable engineering practice. A practice that is socially, culturally, economic and ecologically sustainable that addresses the challenges of current engineering and education paradigms. Being-and-becoming recognises that an individual's way of being provides meaning to what they do and who they are "both personally and as members of shared practice" (Dall'Alba & Sandberg, 2014, p. 292). Being-and-becoming and identity-forming processes are influenced by the social context an individual is exposed to. This includes engagement with peers, and practice members in conjunction with the material world, being the physicality of the environments the individual experiences and sees. While undertaking a university degree, students begin to identify themselves as being-and-becoming a practitioner within the field of their studies. For example, engineering students start to recognise themselves as an engineer as:

> *engineering education provides a crucible for becoming engineers – activities, historically salient understanding about engineers and engineering, and routines for recognition as engineers – all of which frame how students navigate educational opportunities and, for some, become engineers thought to belong (Tonso, 2014, p. 277).*

The students who engage in the degree and experiences delivered by the Engineering Practice Academy are to become the future engineers who will go onto inform and construct the discipline of engineering. These students whilst undertaking their studies are establishing themselves as an engineer and:

> *being recognizable as engineers, and in time as engineers who constitute what counts in engineering education they mold educational processes (Tonso, 2014, p. 278).*

It is thus important that the Engineering Practice Academy replicated practices that prepare the students for being-and-becoming an engineering practitioner and this is only possible in a space conducive to being a socially sustainable practice. Furthermore, it is important that the Engineering Practice Academy delivers and brokers experiences that inform the students and the collective cohorts recognition of being-and-becoming an engineer.

It is through mutual participation in a practice that individuals become part of a collective. However, this process of becoming part of a practice is individual, requires brokering from both the perspective of the individual and the collective and is impacted by time. Brokering entails an individual or a collective's articulation "of competence across boundaries" (Wenger-Trayner & Wenger-Trayner, 2015, p. 18). Articulation of competency is the "dimension of knowing negotiated and defined within a single community of practice" (Wenger-Trayner & Wenger-Trayner, 2015, p. 13). In other words, individuals obtain knowledge through participation in communities of practice and through the sharing of knowledge both an individual's knowledge and the collective knowledge of the community of practice changes. A community of practice is a complex, continuous, evolving learning practice where knowledge is aligned and realigned because of members competencies and personal experiences (Wenger-Trayner & Wenger-Trayner, 2015).

3.1 Implementing social sustainability in a complex system of practice

Humans themselves can be considered to acquire an individual landscape of practice that comprises of multi-membership to separate and interwoven communities of practice. Humans operate within, between and across communities of practice brokering boundaries of practice and obtaining new knowledge that informs their being-and-becoming process. However, brokering boundaries of practice is

> *never unproblematic, in the sense that they always involve the negotiation of how the competence of a community of practice becomes relevant (or not) to that of another (Wenger-Trayner & Wenger-Trayner, 2015, p. 17).*

Brokering boundaries of practice can be moments of contestation because of the lack of shared experiences, meaning and knowledgeability between practices. Furthermore, brokering boundaries of practice can be considered thought-provoking events because it is through pushing boundaries, breaking boundaries and connecting boundaries that practices change and new knowledge is obtained. Moreover, knowledge is obtained through engagement with a socio-material world meaning, knowledge is a co-construction of engagement in a social world in conjunction with the engagement in the material world. In other words, individuals not only "learn knowledge or activities within practice, but also our relation to our world is transformed in the process" (Dall'Alba & Sandberg, 2014, p. 301). Engagement within this paper is defined as the activities of being-in-the-world and it is through engagement with the socio-material world that individuals consciously and subconsciously be-and-become.

Being-in-the-world from a *Heideggerian* perspective positions humans as being in a world of multiple practices where humans "grow up in, embody and enact various ways of being-in-the-world" (Dall'Alba & Sandberg, 2014, p. 286). The communities of practice that individuals are members of have variants in structure, engagement levels, context, history, culture and being self-organizing. These variants and the level of engagement individuals have within communities of practice can

span from being peripheral to full participation and are dependent on the individual, the community of practice and relationship to time.

3.2 Vision alignment coaches: Facilitating the transition.

In the case of the Engineering Practice Academy there was a nexus of connected and disconnected communities of practice exclusively within the landscape of individuals who were considered staff members and consultants of and to the Engineering Practice Academy. The communities of practice were both emergent self-organizing communities and communities formed because of project delivery requirements. This paper specifically looks at the *vision alignment coaches* who as a community of practice were individuals with domain specific knowledge, learning, designing and implementing an emergent transformation strategy for the Engineering Practice Academy. Learning within this community of practice was considered a "collective, relational, and social process" (Wenger-Trayner, 2015, p. 260). Each member within the community of practice contained domain specific knowledge and expertise to one of the vision elements and collectively the communities of practice wisdom informed the design of the vision elements and eventual change strategy. The *vision alignment coaches'* community of practice comprised of six full participant members and four peripheral members.

A community of practice should possess three basic attributes, "mutual engagement, a joint enterprise and a shared repertoire" (Wenger, 1998, p. 362). However, diversity of thought and opinion is paramount within a community of practice because it challenges the perspectives of the community and builds upon the joint knowledgeability of the practice. It is through the diversity of thought that a community of practice can develop and continues to become. Within the case of this project, the *vision alignment coaches'* community of practice developed through engagement with peripheral members. Peripherality concerns there being:

> *multiple, varied, more- or less-engaged and –inclusive ways of being located in the field of participation defined by a community (Lave & Wenger, 1991, p. 36)*

In other words, a practice is entwined within the everyday events of a human, it is concerned with the 'doing' of everyday. Practice and the everyday coexist because humans exist within an entwinement of others and things that co-construct the specific practice world (Heidegger, 2011). Therefore, individuals' alignment to a community or practice is dependent upon their position in the community which is both informed by them, the collective practice, time and the cycle of a community's development. Time is important because it is through prolonged exposure with a practice that knowledge and understanding is obtained. In the case of the Engineering Practice Academy consultants, because of their diversity of thought, they challenged the community to approach the framework of being-and-becoming a sustainable practice from diverse perspectives. Being able to challenge the community extended beyond their articulation of competency as it was their position as being peripheral members to the core community of practice of the Engineering Practice Academy that presented the opportunity to look beyond the Engineering Practice Academy and bring external knowledge to the practice. The *vision alignment coaches* brokered knowledge from the following five domains which informed the strategic vision and the high-level objectives for the Engineering Practice Academy. The domains were:

- Future engineering practices
- Sustainability
- Being-and-becoming
- Diversity and inclusion
- Transforming engineering education

3.3 The Engineering Practice Academy's vision and the role of high-level objectives.

In the case of the Engineering Practice Academy the *vision alignment coaches* (coaches) were responsible for setting the parameters of the *high-level objectives* relative to the vision domain they were a coach of. The coaches employed a *Theory of Change* method to guide the planning, participation and evaluation of the transition process through the development of a domain narrative vision and four high-level objectives to complement that narrative. This paper specifically outlines the planning and participation process concerning the creation of a vision statement, high-level objectives and a program narrative.

3.3.1 Articulating the vision.

A transition process "needs to incorporate a vision of a future, a desirable sustainable society by which we can orient ourselves in the present" (Kossoff, 2016, p. 26). That is the transition occurs between the stated vision and the current reality of a practice. The vision domains had been predetermined by Engineering Practice Academy stakeholders and the coaches were required to use the domains to build a vision statement. A vision statements is a widespread tool utilised by management within practices to articulate the reasoning for a practices existence and to guide the direction of its strategic planning. Why practices use visions is a less clear and less studied phenomenon, and while:

> *most futures practitioners confirm that a (shared) vision is needed for successful action and the development of vision is therefore to be encouraged. However, theory development has been limited and many authors do not go beyond the confirmation that it is important to have or develop [a] vision (van de Helm, 2009, p. 96).*

Understanding this and with the intention of creating a sustainable practice, the Engineering Practice Academy developed and utilised a vision statement for each domain, directly linked to a number of high-level objectives. In order to create actionable vision statements, the vision needs to be tied to more specific objectives because it provides the ability to move towards a desired future state by creating definitive actionable stepping stones towards success. However, articulating a desired future state using current trends and thinking can be problematic as it is often those current trends that have created challenges in the first place. Thus, to adopt a principles-based approach provides flexibility and allows the question to be asked, "what shall we do today and subsequently to get there" (Broman & Robèrt, 2017, p. 3) in order to reach the vision. The Engineering Practice Academy adopted *high-level objectives* to support its vision by utilising the high-level objectives as the principles, by which the Engineering Practice Academy can backcast towards its vision, rather than forecast which projects current trends into future states (Broman & Robèrt, 2017). In the case of the Engineering Practice Academy each vision domain had been allocated a coach who was supported by an external consultant. Thus, in total ten Engineering Practice Academy members, who were considered either core or peripheral to the Engineering Practice Academy constructed the Engineering Practice Academy's vision statement through a process of backcasting.

The Engineering Practice Academy generated the vision statement:

> *The Engineering Practice Academy is a collaborative community and dynamic practice engaging and empowering engineers by disrupting convention to improve the world. We will do this by creating a culture and practice that develops* ***future engineering practices****, celebrates our community* ***being-and-becoming professionals,*** *operates in an advocates for* ***sustainability,*** *promotes and embraces* ***diversity and inclusion*** *and ultimately* ***transforms engineering education****. These are our five vision domains, chosen and owned by our community. They will keep us accountable, inspired and provide a clear direction forward in the Engineering Practice Academy journey.*

3.3.2 Developing high-level objectives

As the coaches were developing the vision statement, they were simultaneously developing high-level objectives. High-level objectives provide a flexible, non-prescriptive method by which planning and actions can occur as they create the boundary conditions by which a practice can define whether or not it is reaching its vision. For example, using a high-level objective that states *to actively become a sustainable organisation* (and understanding the definitions of sustainability utilising sustainability principles of the FSSD) you can maintain and reach that objective despite and shifts in the political, social, technological and economic environments (Broman & Robèrt, 2017).

The coaches constructed high-level objectives under the following predetermined categories:

- People and culture: The people we create and how we create them
- Service: The knowledge we create, value and exchange through our services
- Operations and infrastructure: The systems to support the delivery of the Engineering Practice Academy
- Community and clients: Our broader community and how we engage with external stakeholders.

An example of the realised high-level objectives (HLO) for the domain of sustainability were:

- HLO 1: The Engineering Practice Academy community understands sustainability and feels a personal responsibility to act on it.
- HLO 2: The Engineering Practice Academy actively becomes a (socially and ecologically) sustainable organisation.
- HLO 3: The Engineering Practice Academy supports and services its partner organisations as they undergo sustainable transitions.
- HLO 4: The Engineering Practice Academy promotes and advocates sustainability thinking to its wider community.

3.4 Utilising program narratives

The high-level objectives were enfolded into program narratives used to narrate what each "program aims to achieve" (Dart, 2012, p. 25). Program narratives outline the pathways to change addressing the incremental steps required to achieve the high-level objectives. These incremental steps where developed through a process of mapping, in the context of acknowledging any assumptions the underpin the program narrative. Each of the five vision domains had program narratives created to address their high-level objectives. Mapping the logic of each objective signified the relevance of the program and the incremental steps required to achieve the overarching strategic vision. Mapping further documented the element of time and resources presenting a comprehensive overview addressing both the macro and micro perspective of each high-level objective. The development of program narratives was an iterative process that discussed both the immediate now of designing and implementing a new engineering degree in parallel with strategically planning for and implementing practices for the transition to being-and-becoming a sustainable engineering practice.

3.5 An inclusive framework

Distributing a practices vision statement and high-level objectives require brokering as the buy-in of other practice members is paramount to the success of the vision. Without practice members accepting the vision and associated high-level objectives as being theirs, ownership and authorship to employ the vision can be limited. The vision alignment coaches were strategically transparent with their process of generating the vision statement and high-level objectives. The coaches utilised the Engineering Practice Academy existing project management tool to publish all work-in-progress and outcomes within the open platform. Meaning, external members of the vision alignment coaches community had visibility to the process being undertaken and could opt-in or out of being exposed to the work occurring. The coaches also conducted a formal meeting whereby they

presented a document outlining the vision and high-level objectives once they had reached a stage of high resolution and asked the Engineering Practice Academy members to comment.

Transformational change takes time and requires community members, both core and peripheral, to be brought into the process. The data and outputs generated from transformational change can "often be complex, and… difficult to demonstrate progress in the short term" (Dart, 2012, pp. 4-5). Therefore, such a process requires brokering and mitigating differences in competency and knowledge. In the case of the Engineering Practice Academy making the process transparent was used as a tool to reduce the complexity of negotiating the connected and disconnected communities of practice that co-exist within the landscape of the Engineering Practice Academy. The process of change within the Engineering Practice Academy is ongoing and will continue to develop as the Engineering Practice Academy matures and the future vision of the Engineering Practice Academy adapts to the changing landscape of engineering education and engineering as a profession. It is thus essential that the current community of the Engineering Practice Academy have shared-ownership of the strategic vision and objectives of the Engineering Practice Academy and become advocates of the transition process to being-and-becoming a sustainable practice.

4 Conclusion: Creating a sustainable practice - an Engineering Practice Academy framework.

With the intention of creating a sustainable practice in which the community can be-and-become authentic engineers and individuals and in order to respond to the evolving needs and requirements of engineering and engineering education, the Engineering Practice Academy, used a community of practice to develop and articulate a framework to achieve this. This framework included the creation of a vision, complemented by a number of high-level objectives that play an important role in the development of the Engineering Practice Academy by defining its success at an operational level. In the Engineering Practice Academy's case, a vision was defined as:

> *a desired future state… [one that is] ambitious and challenging to achieve as was set far enough into the future to set goals that are aspirational and plausible (McPhearson et al, 2017).*

By articulating the desired future state, the vision, with its high-level objectives creates the opportunity to introduce backcasting processes that promote a flexible, stepping stones approach to strategic planning that is required to fulfil the practices' purpose through the creation of program narratives. This approach is used to identify both the point of success (vision) and the gap between success and the current reality (Broman & Robèrt, 2017) and plan how to reach that success.

While there are a number of ways to define a practices' vision, which may include, traditional visions:

> *seen as a particular type of leadership, based on the leader's capacity to inspire and motivate his/her followers (van de Helm, 2009, p. 98).*

The Engineering Practice Academy has chosen a process and articulation of vision developed (through participatory process) as a community vision during the infancy of the practice by and for staff. This method creates agency, ownership and shared purpose within the internal community. By utilising a participatory, community based approach, the Engineering Practice Academy vision:

> *fulfils an important function in research, planning and decision making, as it provides a key, shared reference point for developing strategies to transition from the current state to a desirable future state and to assess progress (McPhearson et al, 2017, 6).*

Most importantly, through inclusion, visioning creates ownership and investment within the Engineering Practice Academy. Stakeholders are no longer simply producing outputs of work, rather they are contributing to something in which they built the scaffolding and determined the direction,

tied together by shared language, shared purpose and distinct direction. Broman and Robert (2017, p. 19) argue that the creation of a shared language allows for organisations to coordinate "across disciplines and sectors while avoiding creating new problems for each problem solved". As the creation of being-and-becoming a sustainable practice within the Engineering Practice Academy takes shape, this commonality can be a powerful tool. It is this ownership and connection to personal values, created by inclusion, that has benefits. As Ellen Shapiro argues:

> *The reality of visionary management is that people do truly stretch more when they can put their actions in the context of goals that they can care about – and they truly do withhold potentially valuable contributions in the absence of such goals (cited in, van de Helm, 2009, p. 102).*

The Engineering Practice Academy vision, in its ambition, has utilised a method on inclusion, collaboration and community of practice to create a distinct pathway by which to reach its goals and become a sustainable practice in line with shifting engineering and educational requirements. While many challenges lie in the conflict of undertaking a strategic and futuristic perspective of the role and function of the Engineering Practice Academy while it is in operation and 'being.' The method, understanding and use of distinct and robust frameworks create optimal conditions for success.

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About the Authors

Alicen Coddington is a design researcher who investigates the built environment as a change agent. Her research interests include being-and-becoming, placemaking, and the intersections between boundaries, rhythms and signs. Currently, Alicen is a Research Fellow with the Engineering Practice Academy.

James Ayers is a sustainability and communications practitioner who works with organisations to understand and embed social and environmental sustainability thinking and practice. He also educates university students on the importance of embracing sustainability personally and professionally.

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Innovation Development in Norwegian Public Schools. The relationship between innovation, creativity and imagination

VITTERSØ Jorid* and REITAN Janne Beate

Oslo Metropolitan University
* Corresponding author e-mail: Jorid.vitterso@gmail.com
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This paper focuses on current research related to innovation development in the Norwegian public school system and investigates the relationship between innovation, creativity and imagination. Using Vygotsky's theory of creativity, the paper describes the concept of innovation and explains how it relates to the Norwegian public school system's creativity education curriculum. The paper explores the importance of hands-on experience and tacit knowledge when developing creativity and innovation. It explores the practice of using assessments in creative subjects and questions whether the current assessment practice allows students to truly develop creativity and innovation skills. This paper argues that although Norwegian public school teachers are knowledgeable about innovation development, the public school system lacks a concrete understanding of innovation and creativity in relation to education, as in how to teach innovation.

innovation, creativity, imagination, public school

1 Introduction; Innovative Norway

Norway prides itself upon being an innovative and forward-thinking society. As such, the concept of innovation has been given great importance in Norwegian public schools. The terms 'innovation' and 'innovative skills' are mentioned throughout the Norwegian curriculum—not only in traditionally creative subjects such as Art and Crafts but also in traditional STEM subjects (Science, Technology, Engineering and Mathematic) such as Mathematics and Natural science (Kunnskapsdepartementet [Ministry of Education and Research], 2006a, 2006b, 2006c). However, it remains unclear to both teachers and to the public school institution how to actually teach creativity or develop innovative skills in students. How can teachers create an innovative learning process if it is not clear how innovative skills are developed?

To underline the importance of innovation in the Norwegian public school, Torbjørn Røe Isaksen, the previous Minister of Education and Research, invited the Norwegian association of local and regional authorities and the other partners to a meeting about innovation and entrepreneurship in the school system in 2016. The partners reviewed subjects and competences in preparation for the future national curriculum for primary and secondary education and training (Lindheim, 2016)**.** This can be considered as a clear indication of how important the Norwegian government considers innovation to be for our future generations. Despite the general consensus, both in the government and in the educational system that the development of innovation is important, there are little to no strategies employed to describe how to achieve innovation development.

In order to teach such a complex set of skills, teachers must understand the principles around innovation development as well as its conditioning factors. It is critical to understand that innovation is founded on a basis of creativity and imagination in order to be able to teach it to future generations. It is important to examine where the creativity education is at this current time and how the concepts of innovation and creativity is understood in the Norwegian public school system in the present day. Is there a general understanding of the concepts of innovation and creativity? Since both concepts are complicated to define, it is important to assess the basis for current practices. This paper aims to evaluate the current practices of innovation development in comparison with the premises for innovation development researched in other fields of knowledge.

2 Innovation development in the Norwegian public schools.

A NOU (Norwegian Official Report) report from 2015 outlines the future of education in Norway. The committee, chosen by the Ministry of Education and Research, highlights a number of areas in the current educational system in need of development and change in order for the current education supplied by the public school to remain relevant. One skillset focused on in said report is described as `Being able to explore and create´ (NOU 2015:8, 2015), with a particular focus on creativity and innovation. The committee describes creativity and innovation, although related and based in many similar skills, as two separate concepts. Creativity is seen as mostly based on the ability to develop ideas, whilst innovation is the ability to take action based in those ideas.

The report *Creativity, innovation and entrepreneurship* (Abrahamsen, Berg, Henriksen & Sjøvoll, 2011) evaluates Nordic countries' school system's integration of creativity, innovation and entrepreneurship from kindergarten to university. The report describes creativity, innovation and entrepreneurship as interlinked and in many ways dependent on eachother. It could therefore be argued that each concept is equally important and further argue that you cannot have one component without the other. For example, you cannot have innovation without creativity, which in many ways mirrors the arguments from the NOU report.

The foundation of the abovementioned reports are in many ways based on the [St.Meld. nr.7 (2008-2009), 2009) issued by the Ministry of Norwegian Ministry of Trade and Industry - Modernisation, IT- and Competition Affairs. In this white paper, issued in 2009, the government's innovation and sustainability policies are outlined and highlights `creating people´, as in people who creates and innovates, as one of the key components. The Norwegian Governments focuses on innovation and encourages innovation development in all parts of the Norwegian society. Furthermore, this is also directly related to the research and innovation programme `Horizon 2020´ initiated by the European Union in 2014. The value of innovation in all aspects of society, both nationally and internationally, is widely recognized and encouraged.

A review of the general curriculum for the Norwegian public school suggests the concept of innovation appears not only in traditionally creative subjects, but also those based on more scientific principles like mathematics and natural science (Kunnskapsdepartementet [Ministry of Education and Research], 2006a, 2006b, 2006). Terms like 'problem solving' and 'idea development' are used as assessment criteria in most subjects, but there are very few concrete and specific guidelines concerning how to define such skills, let alone develop them. There seems to be a disconnect

between what is being taught, as defined by the curriculum, and what is being assessed, as there is no clear definition of what 'problem solving' or 'idea development' really is. How can educators teach and assess something undefined? Teachers are free to improvise but their assessments must strictly adhere to the curriculum. The curriculum's vague definitions of creativity and innovation creates a predicament where teachers are expected to assess a skill according to the curriculum without clear definitions of how to do so. It therefore important that terms like innovation, problem-solving and idea development are clarified and standardised to ensure common ground between teachers and students.

The Norwegian Council of Higher Education defines innovation as a modernisation or recreation of an existing element or phenomenon or the invention of a completely novel element (Universitets- og høgskolerådet [The Norwegian Council of Higher Education], 2016). By choosing to use terms like innovation, or terms connected to innovation such as 'problem solving' and 'idea development', the Norwegian government implicitly suggests that the Norwegian public school curriculum is focused on innovation development and creative thinking, and that it plays an integral part in the education and development of youth.

The mathematics curriculum states as follows:

> *The subject of mathematics contributes to developing the mathematical competence needed by society and each individual. To attain this, pupils must be allowed to work both theoretically and practically. The teaching must switch between explorative, playful, creative and problem-solving activities and training in skills (Kunnskapsdepartementet [Ministry of Education and Research], 2006a, p. 1).*

The description does not just mention terms like 'explorative' and 'problem-solving.' It also directly links the development of innovative mathematics skills with the future needs of society at large.

The curriculum for natural sciences, on the other hand, uses the term 'creativity' when describing the core concepts of the subject:

> *Practical and theoretical work in laboratories and in the field using different problems and questions is necessary to gain experience with and develop knowledge of the methods and approaches in natural science. This may contribute to developing creativity, critical abilities, openness and active participation in situations involving natural science knowledge and expertise (Utdanningsdirektoratet [The Norwegian Directorate for Education and Training], 2006b, p. 1).*

Unlike the description of mathematics, which argues for a creative teaching method in order for students to develop the necessary knowledge, the description for natural science argues that a practical and theoretical approach to the subject may lead to development of a multitude of skills, including creativity. Creativity and innovation may not be at the core of the subject, but the curriculum suggests they play a vital part in achieving a complete and well-rounded understanding of the subject as a whole.

The curriculum for Art and Crafts also highlights the importance of creativity and innovation for society. The general description for Art and Crafts, like the one for mathematics, connects the importance of the development of creativity and innovation to individual growth:

> *The subject [of] arts and crafts has an important position in developing general cultural education. It also prepares pupils for a number of further education[s], trades and occupations. Aesthetic competence is a source of development on several levels, from personal growth, via influence on one's personal surroundings, to creative innovation in a larger social perspective (Kunnskapsdepartementet [Ministry of Education and Research], 2006, p. 1).*

Whereas the natural science curriculum suggests the subject could help develop creativity, the curriculum in Art and Crafts states that the development of aesthetic competence is without a doubt a source of creativity and innovation. The description signals the Norwegian governments belief in the value of the subject Art and Craft as well as the impact it could have on other subjects or on the individual as a whole.

3 Innovation and creativity

Creativity should not be overlooked when considering the development of innovation. Although the relationship between creativity and innovation is strong, these two concepts are not equal, neither in definition nor in reputation, and have notable differences. Eva Lutnæs defines in her article *Imagining the Unknown - Responsible Creativity for a better tomorrow* in *FORMakademisk* creativity as "the ability to create valuable and meaningful new ideas based on knowledge of previous work" (2015, p. 9). This definition agrees with Vygotsky's conception of creativity as the ability to assemble experienced elements in new ways into a new product, whether physical or conceptual (Vygotsky, 2004 [1926]).

There is a clear connection in Vygotsky's research between creativity and imagination, suggesting the importance of understanding the place of imagination within creativity and innovation. The components of creativity is based in the imagination, something Vygotsky charts in his article *Imagination and Creativity in Childhood* (2004 [1926]). Vygotsky argues that children develop imagination and creativity in the context of their cognitive development and day-to-day experiences. According to Vygotsky, imagination is an essential part of being human that first develops in early childhood and he argues that imagination and creativity develop as a child's increased sensory awareness expands. Early in a child's development, imagination fills a gap between what the child has experienced and what he or she understands. The more the child has experienced, the less it needs to resort to imagination in order to understand or justify the world around it.

At the same time, imagination is a product of a child's experiences (Vygtosky, 2004 [1926]). The building blocks of imagination are created through experience, meaning that the older a child becomes and the more he or she experiences, the more potential imagination they have. This may seem like a paradox given that adults, who would seem to have the greatest potential for imagination based on their experiences, do not use imagination to the same extent as a child (Vygotsky, 2004 [1926]). There are many indications that adults generally do not need to fill the space between their experiences and reality since they have experienced larger parts of the world and acquired a greater understanding of it (Vygotsky, 2004 [1926]). Lev Vygotsky describes it as follows in his article *Imagination and Creativity in Childhood*:

> *[The] creative activity of the imagination depends directly on the richness and variety of a person's previous experience because this experience provides the material from which the products of fantasy are constructed. The richer a person's experience, the richer is the material his imagination has access to. This is why a child has a less rich imagination than an adult, because his experience has not been as rich. (Vygotsky, 2004, s. 15)*

Vygotsky describes imagination as a product of humankind's future-oriented evolution (Vygotsky, 2004 [1926]). Imagination plays a large role in creative activity that combines familiar elements with the unknown in what Vygotsky calls combinatorial creative activity. Combinatorial creativity is the ability to combine two seemingly separate experiences into a new one, which is largely exercised by children in order to understand the world around them, as mentioned above. This kind of creativity shows how imagination is deeply rooted in the real world, as each individual component is an experience based in reality, and what could exist in the future by combining separate sensory experiences in new innovative ways.

An imagination based on a multitude of diverse experiences is a prerequisite for combinatorial creativity (Vygotsky, 2004 [1926]). All innovative, creative acts require the actor to have experience with the media with which they work, whether in design, science or art. If you see imagination and combined creativity in the light of an action that creates something tangible, it is essential that the creators making new tangible objects must have a real understanding of its constituent elements and its potential for development in a given field in order to achieve a functional product (Sennett, 2008).

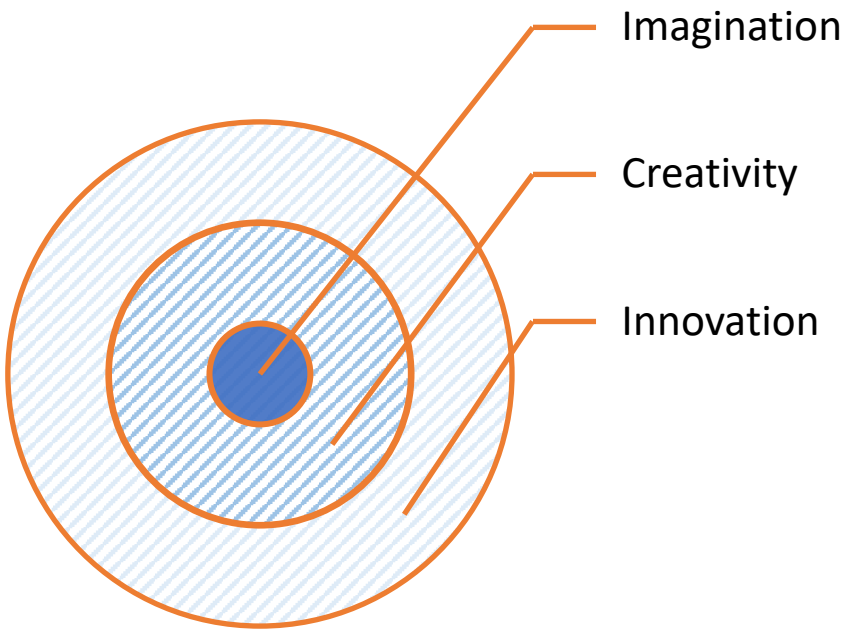

Figure 1 is a visual representation of the relationship between imagination, creativity and innovation (Jorid Vittersø).

Figure 1 shows that the core is the imagination created in childhood, at the middle stage is the development of creativity and the skills to develop ideas and the exterior ring represents the realization of those ideas and the ability to apply those to an innovative act. If making the assumption that an idea springs from imagination (and therefore a combination of experienced elements), the true success of an innovation lies in the implementation of the actual design of a product. That success rests on whether the creator has a relationship with the product and a hands-on knowledge of desirable improvements or changes (Sennett, 2008). One can say that innovation is about making imagination real. If innovation is a product of creativity that requires an element of imagination, innovation in many ways is an act of imagination. The question then becomes; how to facilitate the in-depth knowledge necessary to create a successful innovative product?

3.1 Circular metamorphosis

Past research has shown the concept of repetition to be a vital part of the creative process. As previously discussed, Vygotsky (2004 [1926]) argues that imagination is determined by the richness of an individual's experience. Knowledge and understanding of the surrounding world is created through immersion in the physical or metaphysical world, broadening the horizons of an individual. In many ways, this resonates with the arguments made by Richard Sennett in his 2008 book *The Craftsman*. An advocate of hands-on experience and tacit knowledge, Sennett (2008) highlights the importance of life experience as well as the repetition of tacit knowledge (Polanyi, 1958). The author argues that repetition creates an intimate knowledge of a given subject that allows individuals to go beyond their past learning.

Sennett describes a creativity paradox within architecture in which computer-generated drawings have taken over hand drawings in the design process. With the help of so-called computer-aided design (CAD), architects can create visual tools quickly and efficiently and can immediately change the same drawings without having to rewrite their work. CAD drawing software gives an architect not only a plan or section drawing, but also a three-dimensional model where lighting conditions can be added by means of a keystroke.

Although CAD tools seem to be the best friend of the architect, Sennett (2008) argues this is not the case. He argues that by relating only to a computer-driven model, the architect loses a certain part of his or her understanding of the building, the space and the project itself. It is through repetition of drawings, small changes and reconfigurations that need to be rewritten that the architect has a solid experience with the project and how it will be built. The process of going from original sketch to architectural drawing to visit the building site and then back to the drawing board to change the drawings creates an intimacy between an architect and a project. Sennett calls this type of repetition and exercise a 'circular metamorphosis', where the architect can create one or more changes in a project based on inherited conditions in the building.

Another side effect of the repetition and exercise of circular metamorphosis is that the architect or craftsman is constantly developing his or her concrete dexterity with architectural drawings. Sennett describes in his book The Craftsman a conversation where a student at the Massachusetts Institute of Technology related her experience with circular metamorphosis:

> *When you draw a site, when you put in the counter lines and the trees, it becomes ingrained in your mind. You come to know the site in a way that is not possible with the computer. . . You get to know a terrain by tracing and retracing it, not by letting the computer 'regenerate' it for you. (Sennett, 2008, p.40)*

The quotation highlights Sennett's argument about skilled experience as a kind of knowledge. Experience creates an invaluable bond created between craftsmen and his or her aesthetic process because the craftsman continuously has to circle back to the starting point to make changes. Repetition creates a deep anchoring of the task or the work of the practitioner. It also creates a different and more complete understanding of the work itself. The practitioner will, after a finite number of repetitions, know the site like the back of their hand and will therefore be much better equipped to make informed decisions and alterations to the drawing.

3.2 Innovation and creativity in the Norwegian public school system

In *Imagining the unknown: Responsible Creativity for a better tomorrow*, Lutnæs (2015) describes an interview with an Art and crafts a teacher who questions the need for originality in the field. The comment pinpoints the difficulty of having an assessment of student work in a class in which students largely work from a template designed by the teacher. "The students had redesigned the teacher's model and her doubts about expectations of originality were most reasonable", Lutnæs writes (p. 7).

From an innovation and creativity standpoint, however, it can be argued that copying is only a form of search for material knowledge and experience, even if it is problematic for assessments. This need to copy and reproduce existing work is in many ways similar to Sennetts argument for tracing and retracing an architectural site. The practitioner acquires knowledge by copying their own, or others, work. The Norwegian school system may place too much value on the requirement for originality. Lutnæs argues that this is partially due to the Norwegian public school practicing a product-oriented assessment form. This type of assessment is largely, if not only, based on the final product of any educational situation, as in a finished painting or end of year final exam (Lutnæs, 2015).

The Swedish public school, however, mainly focuses on a process-oriented assessment form, where the documentation of the learning process is vital to the assessment. Lindström's (2006) study of Swedish school with pupils aged 5 to 19 showed how the school emphasizes portfolio assessments

focused on individual students' progress as well as their self-reflection around their work. The school system investigated by Lindström is comparable to the Norwegian school system culturally and systemically. Based on Lindström's researchthe Swedish educational system is more process-oriented than product-oriented, which could be a possible solution for the Norwegian school system. At the same time, Lindström points out that although the students were reflecting on their own creation process and abilities, there was a clear difference between the students' knowledge and skills and their understanding and recognition of their own creative process (Lindström, 2006).

If this finding is linked to the theory of experience-based creativity (Sennett 2008; Vygotsky, 2004 [1926]), the Swedish students show a greater degree of experience and conscious decisions in relation to their creation processes. Lutnæs (2015) problematizes the Norwegian school system's focus on product orientation rather than a process orientation. The author questions why Norwegian schools do not aim for a process-oriented learning arena where the goal is learning itself rather than the product of the class.

3.3 Creativity as knowledge

Larsen 's (2007) master thesis explains the psychological development of creativity, the extent to which it can be learned, and whether it is an innate individual trait. Larsen concludes that creativity is a form of knowledge that can be learned and taught. She also describes the concept of flow theory, as described by psychologist Mihaly Csikszentmihalyi. As illustrated in Figure 2, flow theory is a description of the individual's development potential within a given area. Larsen describes this as "the optimal interface between the individual's competence and the requirements of the task" (Larsen, 2007, p. 30, my translation from Norwegian).

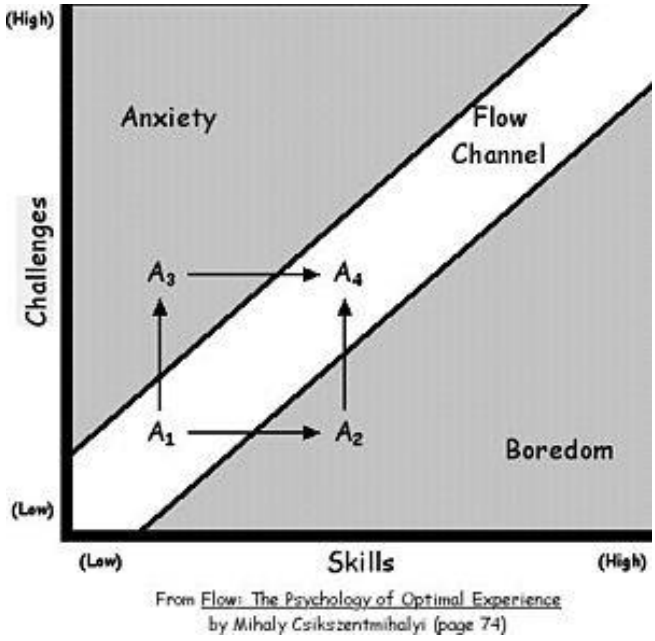

Figure 2. Flow theory model.: The Psychology of Optimal Experience (https://en.wikiversity.org/wiki/Motivation_and_emotion/Book/2011/Flow)

Looking at this model in relation to the development of creativity and its connection with experience illustrates the importance of experiencing creativity as a kind of skill. When creating a learning experience the object should be to work at level A1 aiming for level A4. The mark A2 is covered by what the individual already knows and provides no further learning opportunities, the mark A3 is beyond what the individual is able to grasp. The individual should therefore, based on the known experiences in level A2, aim towards A3 through the more achievable level of A4. The existing experiences at level A2 serves as building block to achieve the levels above. Seen in connection with

an experience-based learning form, experience arguably must serve as a basis for possible learning in all subjects. These points are supported by Sennett's thoughts on repetition and hands-on-experience (2008) as well as Vygotsky's theory of imagination (2004 [1926]).

However, one can question whether this process is the reality of Norwegian creativity education, especially when considering Lutnæs' findings (2011). In Norway, creativity and originality are considered a requirement for assessment. But looking at creativity through flow theory, such a mindset undermines the entire creative and innovative process. If school administrators want to introduce innovation to their students' learning perspective, hands-on experience with the materials will be invaluable and should be continually developed.

Is it reasonable to expect a student to develop a solid expertise within a particular topic, as argued by Sennett, and then to create something innovative and creative, through Vygotskys theory regarding combinatorial creativity, given the limited time frames with which the Norwegian school system operates today? Vygotsky and Sennett argue for the continuous development of innovative capabilities, whether in cultivating imagination or creating crafts. A condition to both Vygotsky's and Sennets' theories is the concept of *time*, and the *time and space* do develop a skill or acquire new experiences. Process learning can become a key tool that opens for a lasting connection between experience and innovation. Set against Lutnæs' description of a product-oriented school system in Norway, one can argue that the development of innovation in the Norwegian school system today is at best challenging.

3.4 Convergent and divergent creativity

In *Convergent Creativity: From Arthur Cropley (1935-) Onwards*, Ai-Girl Tan (2015) outlines developments in creativity research over the past few decades. The article addresses the view of convergent and divergent creativity and the legacy of J. P. Guilford as well as that of Arthur Cropley, who challenged Guilford's theories surrounding creativity. According to Guilford, convergent creativity is a process based on a predetermined outcome at the start of the task. A divergent creative approach is dependent on absolute freedom after the task has been set (Guilford, 1964). This difference can be described as an opposition between *radical and disassociate* creativity on one side and *responsive and combinatorial* creativity on another.

When considering the two types of creativity, divergent creativity is often considered the optimal form because, its proponents argue, its radical and free form enables a true originality (Cropley, 2006; Tan, 2015). Cropley (2006) argues that convergent creativity is preferable in an educational setting, as this type of creativity teaches a sense of purpose in its process. Convergent creativity is dependent on an aim and requires achieving a goal, whereas divergent creativity appears to be a source of unruly chaos in comparison (Tan, 2015). However, the two types of creativity work best if combined. In Cropley's article *In Praise of Convergent Thinking* (2006) it is argued that although divergent thinking previously had been thought of as the only creative way of thinking, convergent and divergent thinking are more interlinked than what was once assumed. Cropley believes that convergent thinking is better suited for educational purposes as it offers a wider range of teachable skills and is a goal-oriented process that builds on previously attained skills. Although both divergence and convergence are a part of a creative process, a process based only on divergence will create a haphazard result, while one oriented around convergence will arrive at a predetermined goal.

The preference for divergent thinking may lie in the assumption that convergent creativity is bound and constrained in its thinking. As Joy (2015) points out, there seems to be an inclination toward the divergent method amongst those who evaluate creative products, but is this the best approach for educators? The absence of structure in divergent tasks could create not only a complex learning environment, but also an inconsistent assessment.

3.5 The originality paradox

As outlined in Eva Lutnæs' (2015) article *Imagining the unknown. Responsible Creativity for a Better Tomorrow*, Art and crafts educators in Norwegian public schools struggle with the concept of originality in an educational setting as originality is hard to teach and hard to assess, yet often expected in the product-oriented assessment form. The expectations of originality in student work is sometimes counter-intuitive, much due to the fact that the students develop their skills through repetition and imitation of example work, particularly the examples and techniques provided by the teacher. In light of Sennett's (2008) arguments around tacit knowledge and circular metamorphosis, it seems in many ways unfair to judge a student's ability to produce a novel element when they do not have the necessary experience with component materials.

One part of the problem may lie in the general public's conception of novelty and originality as deeply linked with what they see as true creativity. The public seems to prefer the divergent creative method (Cropley, 2006). However, the divergent approach often leads to a haphazard result (Cropley 2006). Although divergence is an established creative method, the result is often a product of complete accident. The final result cannot be predicted and the process is as much in danger of failing as it is likely to succeed. In an educational setting, the concept of assessing a learning situation where the final product could be coincidental seems farfetched, and the prospect of teaching such creativity even more so. It is therefore surprising that the divergent creativity seems to be preferred in an educational setting. Stephen P. Joy (2012) describes in his research article *Origins of Originality: Innovation Motivation and Intelligence in Poetry and Comics* a study in which students were given the task of writing and illustrating poems before arguing for a new understanding of divergent thinking. In said study Joy makes the following argument: "Divergent thinking is associated with superior creative products, and judges respond to divergent thinking in their evaluation of creativity" (Joy, 2012, p. 211-212).

This preference seems to also be present in the Norwegian school system (Lutnæs, 2015), even though it is not necessarily the best approach to creativity teaching. Joy further argues that although divergence might be a vital component of the creativity process, it is not necessarily sufficient as the sole creative approach. That being said, convergent creativity may not be sufficient on its own to inspire innovation.

In the Norwegian public school system, there seems to be a favouritism towards goal-oriented learning, which in many ways lends itself to the divergent creative method (Lutnæs, 2015). This is particularly true as the concept of originality is valued as the epitome of a creative task. Compared to the process-oriented assessment practiced in the Swedish public school system, the Norwegian system is based on the final product (Lindström, 2008). One could argue that due to the fact that the assessment in the Norwegian public schools depends mainly on the quality of the final product, the level of originality becomes increasingly important. However, if Norwegian schools adopt a more process-oriented type of assessment and a convergent method to creativity, assessments and teaching methods would need to change.

Sennett (2008) describes the concept of master-novice learning as a process where the master teaches the novice through hands-on experience. The knowledge acquired through observation and replication is essential and deepens the student's understanding of the material. In master-novice training as Sennett describes it, there is no concept of originality, but rather the value of deep understanding. Seen in relation to the Norwegian public school system, this would translate to a teacher-student relationship. The teacher should be seen as a master teaching its novices through demonstration and observation. The concept of originality is not essential in this process as the object of the process is learning through trial and error. The master creates a structure within which the student is allowed to explore, guided by the teacher. The crossover between this relationship and the concept of convergent creativity is apparent.

Relating this understanding back to the research of Lutnæs (2015) reveals that the concept of originality should not lie outside the constraints of the assigned task, but rather on how the student approaches the tasks within the frame itself. Perhaps the originality lies within the frames, not beyond them. The tacit knowledge the student has acquired should allow him or her to experiment within the structure of the task (Sennett, 2008). The ability to work within the compounds of a task and its manipulations of its elements would demonstrate a student's knowledge of it. The process is arguably much more worthwhile than a finished product created by chance, regardless of how original it is (Lutnæs, 2015; Lindström, 2006).

This does not mean that the value of divergent thinking should be completely disregarded. The ability to make explorative decisions and choices beyond the task should be encouraged to a certain extent (Joy, 2012). Perhaps divergent tasks become convergent once a student has reached a high level of tacit knowledge, allowing him or her to make informed decisions. The ideal instruction style would teach creativity with a purpose and but give students the ability to move beyond structures provided by their teachers.

4 Innovating innovation

The Norwegian government and society at large place a great deal of importance on the idea of innovation, especially in the school system. Creativity and innovation are in some form or another specified in most curriculums, regardless of the subject. Whether the topics are variously considered to be a by-product of the teaching method, a possible arena for development, or a certain source of personal growth. Lately there has been a shift in focus where creative subjects such as Art and Crafts have been seen as a valuable arena for development and innovation. However, there is a disconnect between what is written in the curriculum and what is practiced in schools.

There seems to be a divide between the intention of the curriculum and what is actually being taught, much of it due to the vagueness surrounding the terms innovation and creativity. There needs to be a standardisation of the terms and development of a more hands-on approach on how to develop creative and innovative skills in a school setting. There also needs to be further research into the individual components of creative skills so that educators are able to understand develop each skill individually.

The inconsistency of current innovation education seems to be the Achilles' heel in the Norwegian public school system, whether in relation the form of assessment practiced, the preferred type of creativity or the time and resources dedicated to teaching innovation as a whole. If teachers across all subjects do not know how or what they are teaching or do not have the resources available to them, we cannot expect the development outlined in the current curriculum to be realised. Perhaps, then, the current innovation practice needs to be innovated.

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About the Authors:

Jorid Vittersø is a master student in Art and Design Education. Her special research interests are perspectival drawings and creativity development. Her master thesis revolves around perspectival drawing taught in Norwegian schools, which has been largely influenced by her interior architecture background.

Janne Beate Reitan. Her special field of interest is the phenomenon of vernacular design and practical knowledge in design education from kindergarten to Phd. She is also the editor-in-chief of FormAkademisk - Research Journal of Design and Design Education

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Developing Chilean Teaching Capability Through Design Thinking

CORTÉS Catalina [a*]; BRAVO Úrsula[a]; RIVERA Maritza[a]; HONORATO María Jesús[a]; LLOYD Peter[b] and JONES Derek[c]

[a] Universidad del Desarrollo
[b] University of Brighton
[c] The Open University

* Corresponding author e-mail: catalinacortes@udd.cl
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The current state of economic development of Chile requires human capital with thinking skills such as, analytical thinking, creative problem solving, and collaboration; all skills deployed extensively during the design process. At the primary and secondary school level, this problem is not solved only with curricular changes, but requires teacher training and support. There is empirical evidence that the international application of design thinking has been successful in education among students and teachers. However, directly importing such models may not be effective given the particularities of the Chilean education system. This paper reports a research project that sought to identify opportunities for design thinking in Chilean education by developing and testing a training program for 20 teachers and managers. During extended design thinking training a range of resources were used to collect, systematize and analyse the information generated by participants (practical exercises, questionnaires, interviews, focus groups, arrays, etc.). This paper gives an account of the context of the study, the variables chosen for an analysis of the training programme and preliminary results.

design thinking; teacher professional development; problem solving; design methods

1 Introduction

Traditionally, the contribution of design to education has focused on the generation of teaching materials, textbooks, development of fonts for the learning of reading and writing (Sassoon, 1993), space design, equipment and furnishings, among others. In the field of visual communication, Frascara (2001) identifies the characteristics that differentiate educational design from design for persuasion, information and administration, stating that in addition to facilitating access to knowledge, it is responsible for generating behavioral changes mediated by reflection.

In the field of space design, Bruce Mau (2010) explores the relationship between the physical environment and the acquisition of knowledge and skills. With the development of information technologies and communication, the forms of collaboration have been expanded into graphical interfaces, virtual environments and multimedia systems for learning. In areas of non-formal education, the limits may be extended up to museography and the design of information, bordering with other areas of design that seek to reduce the cognitive complexity of abstract data types to facilitate their understanding.

In recent years, design has also begun to contribute to education its approach to address problems, transform them into opportunities and propose creative solutions, in other words, their particular way of thinking. The implementation of design thinking is one of the forms that this collaboration has taken.

In Chile, projects have focused in anthropometric surveys that define ergonomic requirements for the design of school furniture (Rojas, Almagia e Ilardi, 2013), as well as modeling the space for pedagogical habitability (Adlerstein, Manss & González, 2016). In the area of editorial design, the system of evaluation of school texts design prepared by the Ministry of Education stands out (Zepeda, 2007).

Due to the continuous educational reforms taking place in Chile in the last years, teachers are demanded to not only communicate basic knowledge, but also develop advanced thinking and problem-solving skills among their students (Garet, 2001). Design thinking can contribute to reflect and actionate teachers´ ideas and needs regarding aspects such as classroom behaviors, group collaboration, active learning as well as student performance.

2 What is design thinking

Design thinking is a systematization of the design process, which is part of a long academic tradition emerging in the last 50 years. However, the term recently became popular at the end of the first decade of the twenty-first century, as a method to encourage creativity among managers, challenging them to combine the capacity of both hemispheres of the brain, with the objective of generating innovations that translate into economic benefits (Dunne & Martin, 2006; Brown, 2008; Gloppen, 2009; Dorst, 2011; Hassi & Laakso, 2011; Johansson-Sköldberg et al., 2013). The existence of both perspectives, usually generate confusion regarding the meaning and methodological scope of design thinking.

The study of the design process seeks to identify and characterize the activities, skills and competencies that are deployed in professional contexts, with the purpose to understand, formalize and show them to the new generations of designers. Most of the theoretical production comes from the academic journals Design Studies and Design Issues. Different authors point out, as foundational milestones of this tradition, the realization of the Conference Design Methods, in 1962, and the publication, two years later of, Notes on the Synthesis of Form, by Christopher Alexander. A third milestone of great relevance is the publication, in 1969, of the Sciences of the Artificial, from Herbert Simon (Johansson-Sköldberg et al., 2013; Hassi & Laakso, 2011; Cross, 2006; Cross 2001). Although over the course of five decades, a vast academic production in the field of professional design has developed, it remains rather ignored in education (Johansson-Sköldberg et al., 2013).

The second is associated to the implementation of practices and competences proper to design on the part of professionals from other areas. In this context, design thinking is a simplified version of the “designerly thinking”. Dorst (2011) explains in the following terms why design thinking is so interesting to other disciplines:

> *Studying the way designers work and adopting some designerly practices could be interesting to these organizations because designers have been dealing with open, complex problems for many years, and the designing disciplines have developed elaborate professional practices to do this. The challenge of dealing with these open,*

complex problems leads to a particular interest in the ways designers create 'frames', and the way design organizations deal with frames in their field of practice (Dorst, 2011, p. 522).

Cross describes design thinking as a 'style of thinking that combines empathy for the context of a problem, creativity in the generation of insights and solutions, and rationality to analyze and fit solutions to the context' (Raffaghelli, 2014: 276). Throughout this process, the ability of thinking about 'ill-defined problems' is developed enabling the design of possible solutions.

In the field of school education, design thinking has also been applied and adapted to different users—teachers, managers and students of different ages—and with various objectives—curriculum, spaces, processes, tools and systems (Carroll et al., 2010; Scheer et al., 2012; IDEO, 2012; Kangas et al., 2013; Goldman et al., 2014; Watson, 2015). Valuable experience of implementation of design thinking to education have been led by the Department of Education of Ideo, such as the Design Thinking Toolkit for Educators developed in conjunction with Riverdale School, the School Retool program and the Innova Schools system in Peru.

Also close to the Ideo model are the K12 Lab Network and the d.home.team, of the Institute of Design at Stanford (d.school). Other noteworthy initiatives, which incorporate elements of design for education, are Design for Change, FabLab Teacher Studio and Index in Denmark. In Chile, some programs that incorporate certain tools relative to the design process are: Elige Educar, Rómpela, Tinker Trak and Movimiento Aula.

Probably due to the focus on consultancy, training and transfer of the majority of these initiatives, there are still low academic publications that focus on results. In the United States, Carroll (2010, 2015), Goldman (2014), and Watson (2015) have analyzed cases of application of design thinking in school and university contexts. Nevertheless, in the field of educational research, learning design has experimented a growing importance and constitutes an emerging trend as a process that enables educators to 'explore their educational problems and make more grounded decisions to plan/implement their pedagogical practices' (Raffaghelli, 2014:277).

In Chile, there are no academic studies to identify: Which elements of the design process are more suited to the different educational challenges, and in which areas of the teaching activity are they more effective.

3 Demands of the Chilean School Curriculum in the 21st century

What is there in design thinking that is attractive for education? The answer seems to relate to the twenty-first century skills that the knowledge society demands from the educational system. Skills that help individuals face the university, professional career and their role as citizens successfully – particularly with an unpredictable and uncertain future. Among these skills are, critical thinking, the ability to respond flexibly to problems, collaboration, agility and adaptability, the ability to access and analyze information, curiosity and imagination (Carroll, 2009; Trilling, 2009; Scheer et al., 2012; Watson, 2015).

In Chile, since 2012, the curriculum has experienced a strong process of renewal, incorporating an approach focused on the development of thought through prescribed content. This approach is supported with multiple lines of research and the application of a variety of educational programs, which indicate that thought, is susceptible to being taught (Dweck, 2012).

On the other hand, there are challenges imposed by the new policies of inclusion, after the implementation of the Decree 83, whose purpose is to ensure the flexibility of the curricular measures for students with special educational needs (Decree No. 83/2015 -3; MINEDUC 2015). This legislation requires that educators draw upon disciplines as design, to generate effective pedagogical responses to common educational needs, both individual and special.

In this context, it is necessary to develop strategies that will help to implement curriculum and evaluative innovation, and to attend to diversity. Thus, in the coming years, schools will have to promote creativity in their pedagogical teams, understood as that novel answer that becomes expressed and valuable for the social context in which it is deployed (Beghetto, 2007a; Csikszentmihalyi, 2014). The binomial Education and Design is highly relevant as it evidence about how to facilitate the response to the diversity in the classroom, through the development of different types of tools.

4 Purpose of the study

The purpose of the study was to identify which elements of the design process are more suited to the different types of problems and challenges that Chilean teachers face, and to test in which areas of the teaching activity are they more effective.

In the field of design, this study provided the opportunity to explore new areas of professional and academic performance. In addition, it moves towards the understanding of design as a way of thinking, and strengthens research and the generation of new knowledge and theory from the design discipline.

The main objectives included:

- Identify opportunities to transfer the design thinking method to teachers of Chilean schools
- Test design tools as a resource to make findings on teacher training actionable
- Develop and test an intervention program through collaborative work between British and Chilean researchers

5 Teacher training

In addition to the skills that enable adapting to changing scenarios and dealing with complex problems in the knowledge society, continuing vocational training is an imperative throughout life and is expressed in a new professional culture forged on values such as collaboration and social progress (Ramalho, 2004).

The United Nations Educational, Scientific and Cultural Organization (UNESCO) has defined the concept of lifelong learning as: an education without limits, which requires the generation of open opportunities, flexible and relevant, to acquire the knowledge and develop the skills and attitudes that are needed in the different stages of life. Gravani (2007), defines teacher development as a ‘sub-set of adult development and is underpinned by adult learning theories; hence, when designing programmes for teachers, the premises of adult learning should be considered’ (Gravani, 2007).

The development of adult education, in the past 60 years, has enabled the realization of a growing number of investigations, which represent solid examples of the design of public policies. These perceive continuing education as a key element in the economic, political, and cultural transformation of individuals, communities and societies in the present century (Eutyduce, 2009). In this context, teachers are demanded a great amount of flexibility to adapt to curricular proposals that change constantly and develop cognitive skills different from what they are accustomed, for themselves and their students (Ávalos, 2006).

Two critical poles of tension intervene in the design of successful teacher training programs: a personal component related to the will of learning and the organization of the training activities in relation to the needs of the educational systems to which teachers belong (Ávalos, 2007).

Garet (2001), studied the effects of different characteristics of teacher training programs on teachers' learning, using a national probability sample of 1,027 mathematics and science teachers. Among the relevant findings, the structural features (form and duration of the activities) of the taining program are described as fundamental to increase teacher knowledge and fostering meaningful changes in their classroom practice.

Traditional forms of training as workshops have been criticized in the literature as ineffective mainly because they usually occur outside the teachers' own classroom. Ávalos (2007) explains that cases in Great Britain, USA and Chile have had problems dealing with conventional structures offered to teachers, which were not focused in comprehension. Therefore, new forms denominated "reform" types are encouraged (study groups or mentoring and coaching). Introducing activities in a teacher's regular day enable to make connections with classroom teaching, and they may be easier to sustain over time (Garet, 2001).

Teacher training built upon real needs of the participants which use observation, evaluation, coaching, collaborative workshops, and iteration enable the building of knowledge through collaboration, sharing significant ideas and the generation of solutions coherent with the real demands of today´s classrooms (Ávalos, 2007).

6 Research and programme design

The study focused on the development of an emergent training program, which was planned to be iterative, being influenced by the reaction of the participants in the various stages. This methodology, previously explored by British researchers (Lloyd, 2013), added complexity and uncertainty to the transfer proposal, but at the same time, added a high component of empathy and involvement of teachers in their learning process, and in the assessment of a significant training experience.

Laudrillard (2013) defines teaching as a design sicence, because its aim is to 'keep improving its practice, in a principled way, building on the work of others'. This study considered the participants as direct contributors to building the knowledge in collaboration with the research team.

The project consisted of a training program for 20 Chilean teachers, from schools of various levels of dependency in the Metropolitan Region of Santiago, Chile. Among them, were two directors, two coordinators and 16 teachers of various subjects.

The planning and organization of the training programme was structured using core and structural features described by Garet (2001) which have proved to have significant positive effects on teachers´ self-reported increase in knowledge and skills and changes in classroom practice:

1. Focus on content knowledge: degree to which the activity focuses on deepening teachers' knowledge in a specific subject.
2. Opportunities for active learning: extent to which the activity offers teachers opportunities for active learning. Among them, observing expert teachers and being observed in their own classroom obtaining feedback and being able to link the ideas introduced during the training to their real teaching context.
3. Coherence with other learning activities: designing experiences consistent with teachers' goals and aligned with state standards and assessments. And encouraging professional communication among teachers.

Structural features:

1. The form of the activity: reform or traditional types
2. The duration of the activity: total contact hours and span of time
3. The degree to which the activity emphasizes the collective participation of groups of teachers from the same school

The following table displays the described features and how they were translated to the training programme designed for this study:

Table 1 Core features of professional development activities and training program features (Garet, 2001).

CORE FEATURES	TYPES OF ACTIVITIES	TRAINING PROGRAM FEATURES
A. Focus on content knowledge Deepening knowledge in subject area		Teachers worked with the problems they experienced teaching their own subject area
B Active learning Involve teacher in meaningful discussion, planning and practice	Observing expert teachers, being observed and obtain feedback	Researchers observed classes and gave feedback to the teachers
	Linking professional development experiences to their own teaching context	Teachers identified and defined a problem within their teaching context. This meant that each teacher worked with a highly relevant problem in terms of their teaching and/or administration position.
C. Coherence with other learning activities Activities that promote coherence in teachers' professional development	Consistent with teachers' goals and established standards and assessments	
	Experience that encourages communication among teachers	The program included hands-on activities, group work, presentations, discussions and feedback from researchers and among peers. These activities generated multiple collaborative opportunities, both for the definition of the problem and for the development of possible solutions.
STRUCTURAL FEATURES		
D. Form of the activity Structure and format of the activity	Traditional Type (i.e. workshop, conference)	The program was designed with a mixed format. Including brief presentations, discussions, group work, workshops and networking.
	Reform Type (i.e. study group, network)	
E. Duration of the activity	Total number of contact hours	The program was conducted over a period of six months. It included 20 contact hours, 6 hours of follow up at a distance and 2 hours of observation and coaching.
	Span of time over which the activity takes place	
F. Collective participation of groups of teachers from the same school		Teachers from the same school and/or teachers from the same subject area worked collaboratively.

6.1 Dimensions of design thinking applied to the training programme

The design process has been represented in various ways, with highlighting stages, phases, key moments and attitudes that characterize it. In the case of this project, several sources were used for reference. All of them described and categorized relevant aspects of design thinking and their main attributes and features. The RedLab Prototype Performative Task Assessment Rubric (for teacher training assessment) by Maureen Carroll and Melissa Pelochino (in process of development), made it possible to understand design thinking mindsets fundamental for educators such as: human-centered approach, motivation toward action, radical collaboration, culture of prototyping, and capability of visualizing while being aware of the process (Carroll, 2015).

The cognitive process associated with design thinking is highly relevant because during the development of its stages, different areas of the cognitive process are triggered (Wilson et al., 1993). For example, the resolution of problems focuses on the interrelationship of processes such as motivation, cognitive flexibility, and even emotionality (Newton, 2013).

The research team defined two main dimensions for the design of the training program and labeled them as: 'problem framing' and 'productive collaboration'. All the training program is based on the concept of 'bias towards action' (Carroll et al., 2010), focused on developing action-oriented mindset rather than discussion-based work. Prototyping and testing was used during the program to communicate and inspire new thinking.

6.1.1 Problem framing

Problem framing is defined by Lloyd (2013), among four key concepts of the design process, which must be addressed for teaching: Problem framing, productive dialogue, quiet design, and using the expertise of others. The ability of framing problems refers to the capacity to discover, define the scale, and re-define problems. This reflexive and iterative process maximizes the generation of innovative and creative solutions, which may even consider removing something existing instead of developing something new. The criteria used to evaluate the evolution of problems throughout the training program were: manageable, comprehensive, precise and with potential of solution.

6.1.2 Productive collaboration

The dimension of 'productive collaboration' considers Lloyd's productive dialog key concept, which relates to the skill of designers to communicate their ideas and receive feedback from others. The dialogue is not just restricted to the communication with another, but includes the dialogue with oneself. Using the expertise of others is also an aspect related to productive collaboration, as it refers to the capacity to identify what is necessary to carry out a project and who are key actors in achieving the purposes. Carroll (2015), describes the concept of 'radical collaboration' as one of the skills and attitudes that the design thinking process develops.

6.1.3 Iteration

Iteration was a fundamental aspect of the training program, both for problem framing as for productive collaboration. Monitoring the error and the repeated feedback, associated with iteration, develops cognitive flexibility, an essential dimension of the executive function. The inherent flexibility of design thinking granted the capacity to adapt to changes and tolerate uncertainty during the process. On the other hand monitoring actions, receiving feedback and having opportunities to retry and improve (Dorst, 2011; Darling-Hammond, 2006) becomes critical for the process of consolidation of learning.

Table 2 Dimensions of design thinking applied to the training program.

DIMENSIONS	CRITERIA	INDICATORS
1. PROBLEM FRAMING Capacity to discover, define the scale, and re-define problems	Manageable	The problem is framed according to the skills and strengths of the subject that formulates it.
	Comprehensible	The problem evolves becoming clearer, easy to understand and consistent.
	Precise	The problem evolves becoming more precise and delimited.
	Potential of solution	The problem evolves in its potentiality of solution, and the necessary resources to address it are available.
2. PRODUCTIVE COLLABORATION Skill of designers to communicate their ideas and receive feedback from others	During the definition of the problem	Incorporates the suggestions of peers in the redefinition of the challenge or problem.
	During ideation	Incorporates the ideas of others in the process of ideation.

6.2 Program content, time distribution and data collection methods

The duration of professional development enables teacher change. Almost all of the recent literature on teacher learning and professional development calls for professional development that is sustained over time (Garet,2001). Longer activities facilitate in-depth discussion, allow teachers to try out new practices in the classroom and obtain feedback on their teaching.

When teachers engage in joint professional development, they may be able to integrate what they learn contributing to a shared professional culture and developing common understanding. At the same time an organizational culture that supports reform instruction can facilitate individual change efforts.

The program included five training sessions during a period of seven months, the first and last with the participation of international research partners.

Eight participants were chosen as stakeholders for whom detailed case studies were developed. Studying these in-depth cases aimed to map the design process of each participant and their results, and also to obtain a qualitative description of their experience, difficulties, needs, and projections in each of their specific contexts.

The training, in addition, considered activities between workshops that participants developed individually. These activities provided continuity to the program and maintained the connection and interest of the teachers in their respective projects.

At the end of the last session, each teacher was intreviewed to collect information about their experience and the impact of the training program in their pedagogical practices. Based in Garet (2001) teachers were asked about aspects such as: discussing their learnings with colleagues or administrators who did not attend the activity, and whether they had communication, outside of the formal training program, with participants in the activity who teach in other schools. Teachers were also asked if they made any changes in their teaching practices after the training program.Table three describes the contents, activities and data collected during the duration of the complete programme:

Table 3 Program content and data collection methods.

Date	Contents / Activities	Information collected
Session 1 April 2016	Introductory workshop on design methods focused mainly on empathizing about everyday problems with the other participants and generating interest and motivation. This session counted with the participation of two British researchers.	Questionnaire about understanding of the concept of design and applicability in the field of education on the part of the participants. Photographic and video registration.
Follow up activity 1	Identify and visualize a problem about the own teaching context	First problem definition and first mind map problem
Session 2 May 2016	This workshop focused on problem framing: how to identify problems, frame them and collaborate with peers in the definition of problems as in the envisioning of possible solutions.	Problem framing and collaboration worksheets, about problems identified by peer participants. First ideation mental map developed individually and with peer feedback to enrich the process.
Follow up activity 2	Planning the test activity, define proposal, pedagogical objectives and evaluation activity test	Planning and evaluation test
Session 3 June 2016	Workshop focused on communicating the results of testing carried out by participants in their specific school contexts, collaborate with peers and the research team and reformulate their proposals in response to the feedback received.	Questionnaire about understanding of the concept of design and applicability in the field of education on the part of the participants. Focus group to collect experiences, perceptions, valuations and ideas of the participants about the transfer of the design thinking model. Individual worksheets of problem re-framing. Second ideation map.

Session 4 August 2016	Fourth workshop held with the eight selected participants for detailed follow up. Each teacher revised their design process in the course of the workshops and activities carried out earlier. In addition, there was dialogue and direct collaboration with a mentor of the research team. Participants reformulated and narrowed their proposals, and designed the final intervention in conjunction with their peers and researchers.	In-depth interviews with each participant. Final problem definition in conjunction with experts. Design of specific intervention to implement in the particular context of each participant. Third ideation map.
Session 5 October 2016	Finally in the last workshop, researchers reviewed and explained the intention and methodology of the training process to the teachers. They presented the preliminary results of the detailed case studies and projected collaboratively ideas for future continuity. This session counted with the participation of one British researcher. The second British researcher participated via videoconferencing.	Evaluation registered by means of a survey and a closure activity.

7 Methods of analysis

Based on the dimensions of design thinking, criteria and indicators applied to the training program (detailed in table 2), the analysis is being conducted using the following approach and methods:

7.1 Problem framing

Problem framing is being systematized by generating an array with all the problems that the participants developed during the training process using the four dimensions previously mentioned: manageable, comprehensive, precise, and with potential of solution. The method being used is content analysis.

7.2 Productive collaboration

Productive collaboration throughout the training program is being analyzed using two data sources; the worksheets used by the participants and transcriptions of personal interviews. Methods being used are: Thematic Coding Analysis (Robson, 2016) and the recommended analysis suggested by Miles and Huberman (1994). These include: coding extracts of written data; labeling them as examples of relevant topics for the study; identifying similar phrases, patterns, themes, relationships, sequences, differences and between subgroups. Consistencies found in the data will be linked to the literature review on professional development, teacher training and design thinking. Interviews are being analyzed using meaning interpretation (Kvale & Svend, 2008), and transcripts and observation notes are being grouped together under codes with visualization memos. Patterns are being grouped according to selected dimensions, criteria and indicators of the design process.

7.3 Iteration

Iteration during the design process of each participant is being mapped as it influenced problem framing and productive collaboration.

The following images are examples of the worksheets developed by one of the participants and of the analysis posters being developed by the research team.

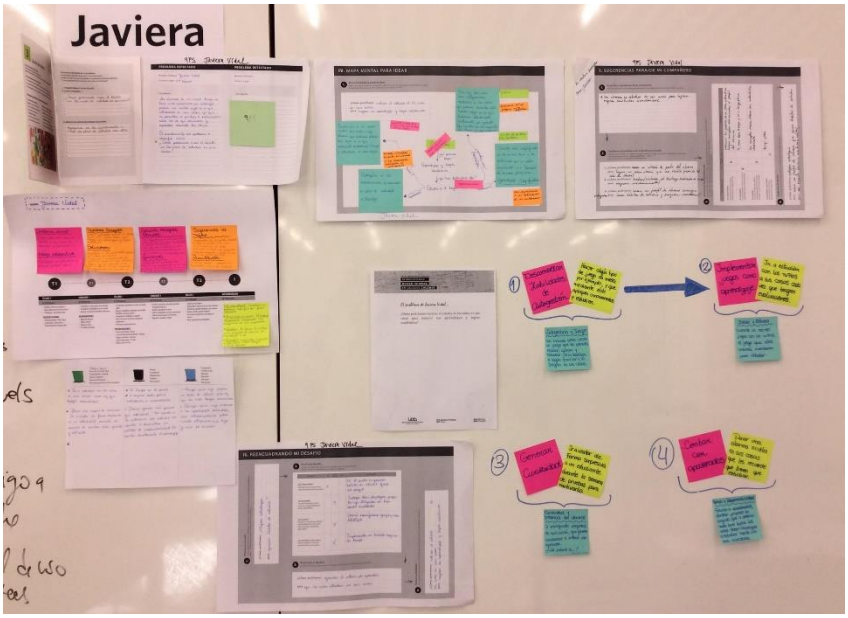

Figure 1 Display of design process by one of the participants.

Figure 2 Design process analysis by each participant.

8 Preliminary results

8.1 Multidimensional collaboration format

Collaboration activities constituted a high percentage of the program and, in them, the students paired with experts, participating in the discussions and moderating, which facilitated a deep knowledge of them and their problems. Collaboration between peers and with Chilean and British experts provided teachers with shared reflection, enrichment of ideas, and the incorporation of other perspectives, pointing to improving their problem-solving strategies. Interdisciplinary and cultural differences and approaches between researchers contributed to amplify perspectives for the participants. Teachers valued the possibility of working with colleagues from other schools, the systematic reflection, feedback, and share experiences and effective practices.

8.2 Useful design thinking tools

In relation to the acquisition of design thinking tools, the training program was able to generate impact, by providing participants with practical tools to face challenges in their own context, in terms of improving commitment to learning, and the welfare of their students and results.
Participants used the tools presented in the training in concrete interventions, in their specific contexts, through planning and teaching strategies they designed. This way, participants understood the depth of the method as a tool for current and future work, applicable to adapt and meet new and unexpected challenges.
On the other hand, Chilean researchers acquired the necessary skills to project and expand a future scaled transfer of the method, with greater scope in a next phase.

8.3 Identification of education areas to transfer design thinking

Feasible opportunity areas to transfer the design thinking method were identified in Chilean schools at different levels of intervention: curriculum, school atmosphere, and system organization.

8.4 Opportunities to improve future interventions

Although the proportion of cognitive commitment of students was very high, the research team believes that the systematization of the method and the content was insufficient, particularly in relation to the design of practical activities.
Improving the systematization of data collection, by using precise monitoring tools to register data effectively (especially during observation), could enable better understanding of the whole process.

8.5 Future of the project

In the future the team is planning to use the results of this research as a starting point for the design of an effective, significant, lasting and scalable design thinking transfer model for teachers and students in Chile and other countries of South America.
The team intends to develop a larger pilot program of longer duration and impact in order to formalize the program through the design of a specific interface of wide applicability.
In addition, the team aims to design a common but at the same time differentiated program, for various recipients—teachers, managers and students—in order to meet their specific needs and requirements. This program would also consider a precise study of the transfer of the method from educators and administrators to students, with a focus on measuring their impact on students' learning results.
Developing a program incorporating design thinking in the curriculum of educators within the schools of education at undergraduate and graduate levels is also relevant in Chilean education.

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About the Authors:

Catalina Cortés is a researcher, curricular committee member and instructor at the Design School of Universidad del Desarrollo, Chile. Her research explores the incorporation of the design process in educational settings at the spatial, methodological and curricular levels.

Úrsula Bravo is an Instructor at the Design and Education Schools of Universidad del Desarrollo, Chile. She has advised the Ministry of Education in evaluation of school texts. Her main interest are: Design, Education, Creative Economy and Innovation Promotion Policies.

Maritza Rivera is the Director of the Master in Psychopedagogy and a Regular Professor in Universidad del Desarrollo, Chile. Her main research interests are: family-school partnership and pedagogical strategies for inclusion in the school context.

María Jesús Honorato is an Associate Professor and curricular consultant of the Faculty of Education of Universidad del Desarrollo. Her research explores the impact of the design process as a key element of teacher professional development and how to incorporate design in the curricular construction.

Peter Lloyd is Professor of Design at the University of Brighton, Editor-in-Chief for *Design Studies* and Vice Chair of the DRS. His research looks at all aspects of the design process through design discourse and textual analysis.

Derek Jones is a Senior Lecturer in Design at The Open University and part of the OU Design Group. His main research interests are: the pedagogy of design and creativity, embodied cognition in physical and virtual environments, and theories of design knowledge.

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A Toolkit for Teaching the Design Process: A Case of Korean Elementary School Students

TUFAIL Muhammad; LEE Seonmi and KIM KwanMyung*

[a] Ulsan National Institute of Science & Technology
*Corresponding author e-mail: kmyung@unist.ac.kr
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South Korean elementary schools mainly focus on increasing students' proficiency in subjects related to science and engineering, while early education in design is ignored entirely. As a result, the concept of design and its value have become unpopular among the general public. Creative, young students are not exposed to environments that use design to develop problem solving approaches to improve integrated creativity. The present study demonstrates the design of a toolkit for teaching elementary school students the design process. The purpose of the proposed toolkit is to help students learn the concept of design with in-class problem-solving activities that can improve integrated creative thinking. We conducted a problem-solving activity with elementary school students based on the existing creative thinking models we incorporated in our proposed toolkit. Initially, we found that the proposed toolkit's instructions were too complicated for the students to understand the context of the activity, and the entire process was observed as difficult. Based on our initial experiment, we revised the toolkit to minimize the difficulties students faced. We hope that the proposed toolkit will allow students to experience a problem-solving design process to enhance their integrated creative thinking.

toolkit; elementary school students; design process; integrated creativity

1 Introduction

Design is conceiving and providing form to artefacts that solve design problems (Ulrich, 2011). However, the definition of term 'design' remains controversial. In most cases, people get confused when it comes to separating design from art, because design's aesthetic component is often over-emphasized. Thus, design is expressed as a field of aesthetic rather than a discipline for analysing and solving problems creatively (Kim & Kang, 2012). While aesthetic efforts may improve creativity, they also have the potential to develop biased creative thinking devoid of the essence of integrative thinking. Actually, creativity is the ability to produce work that is both novel (i.e., original, an unexpected) and appropriate (i.e., useful, adaptive to task constraints) (Lubart, 1994). This requires integrative thinking ability, which enables one to not only to produce a novel idea, but to

appropriately apply the idea. The type of creativity our society really needs would contribute to society's development by leading new scientific findings, new movements in art, new inventions, and new social programs (Sternberg & Lubart, 1999). However, creativity education constrained to a specific subject can hardly support the type of creativity we need. Design education integrated as a part of a single subject such as art, cannot teach both the essence of design and creativity.

Typically, South Korean schools teach design-related knowledge in the subjects of art, technology, and household management. Few teachers have a background in design (Gye- Won and Soo-Bong, 2008). The majority of teachers do not understand the concept of design or the design process, which has created confusion between design and art. Thus, design is generally regarded as the process of making something appealing. Design's problem-solving component, however, a component that requires interdisciplinary knowledge, is different from art work. Moreover, teaching fragmented parts of design under the respective names of art, technology, and household management, results in the failure of genuine design education. Unfortunately, the aforementioned subjects completely ignore the problem-solving process.

In Korea, practical art is another design-based subject that emphasizes aesthetic effort while considering more functional aspects such as the field of engineering (Jung Jin, 2008). The problem with this subject is its lack of explanation about the concept of design.

Subjects of design are taught differently in the elementary schools of the United Kingdom, and South Korea. United Kingdom elementary schools teach subjects such as 'Design & Engineering' and 'Art & Design' in their regular coursework (Yeoun-Suck, 2005). Yet, a majority of countries' elementary schools do not provide adequate design education due to a lack of consciousness regarding the concept and understanding of the importance of design. In fact, early design education is an interesting subject to many people as it emphasizes creativity in educational curriculum. In South Korea, however, there is a little understanding about the importance of design education and few educational contents and textbooks have been developed (Hyun, 2014). This is a big issue as design plays an integral role in a variety of areas, but the foundations of design education have yet to be fully developed in the context of early education.

Design education fostering a design approach to thinking is important for children. Design is generally an analytic and creative process type of thinking which engages an individual in opportunities to experience, create and shape models, gather feedback, and redesign (Razzouk and Shute, 2012). As such, designers become capable of assessing the conditions of a given situation, and quickly adjust their actions according to the set of needs (Stempfle and Badke-Schaube, 2002). Similarly, design thinking can prepare young students to deal with difficult situations and enable them to solve complex problems.

In order to bring early design education into schools, there needs to be activities that help teachers and students alike to understand the concept of design by improving creativity through problem-solving practice. To this end, we developed a toolkit that helps teachers and young students learn the concept of design through an in class problem-solving activity. To demonstrate this toolkit's efficiency in cultivating knowledge about the design process, and creativity we arranged an experiment with South Korean elementary school students. Subsequently, we arranged a qualitative study with the students, which helped us to make revisions to the toolkit accordingly. Our study shows the development process of the toolkit, which includes important insights from the experiment, and subsequent interviews with the students and teachers.

2 Creativity in problem solving

When solving a design problem, we begin by collecting information. Questions at this stage include: 'does information directly related to the design problem help us to produce a creative solution?' and, 'would considering the design problem from a different perspective with information irrelevant to the design problem lead to creative solutions?' Based on our experience, we believe that

creativity is relevant as it enables us to view the design problem from a different perspective. We conducted our study based on this assumption.

Previous research and cases support our assumption. According to Norman and Verganti (2014), the use of a human-cantered design approach engaging various user research methods to collect problem-relevant information renders innovation impossible. They argue that human-cantered design approach produces only incremental innovation, while radical innovation is achieved by adopting new technology or imposing new meaning to the design process (Norman & Verganti, 2014). Here, new technology and meaning are not directly related to the design problem. This implies the possibility of producing innovative ideas by applying irrelevant information, rather than systematically analysed information, to the design problem. A bladeless fan known as the 'Dyson fan', and 'Juicy Salif' design by Phillps Starck, serve as representative examples. The former adopted a scientific principle that had never utilized in electric fans, and the latter is a sculptural product that imposed a new meaning of an artistic object. Another example can be found in our everyday life. An innovative invention, known to us as 'Velcro', is the brainchild of Swiss engineer Georges de Mestral, who adapted the clinging phenomenon of burrs to a new invention. (Suddath, 2010). These examples are very interesting to design researchers investigating creativity methods, because they demonstrate that creativity is achieved by connecting seemingly irrelevant information to vaguely defined design problem.

It is not easy to for us to generate a solution immediately confronted with a design problem. Designers first try to understand the problem based on their knowledge and past experience. Upon achieving an adequate understanding of the problem, they proceed to build cognitive connections between the problem and their knowledge; this is called schema (DiMaggio, 1997). When a problem is complex and/or vague, a designer should spend more time organizing his knowledge around the problem. He/she tries, as much as possible, to build connections to his own knowledge, effectively trapping him/her as it reduces creative capability to generate a solution. When fresh information comes to mind, he suddenly begins to understand the problem in the context of a clear solution. This phenomenon is called 'mental reorganization' led by 'mode of attack' (Lawson, 2006).

The way designers practice their work explains these theories well. Designers usually deal with new design problems because they are always given new design projects. They often gather information that is not directly related to the design problem in order to generate unique, novel ideas. For example, when designers design a product, they collect various reference images from variety of domains regardless of their relevance to the problem. While doing this, they draw out design elements, features, structure, and so on, to apply to their new design (Baxter, 1995). The designers' reliance upon information that is not directly related to the problem at hand can be described as intentional mental reorganization.

Taken together, the manifestation of creativity seems to occur by viewing and interpreting design problems from different perspectives. Thus, it is worthwhile to test how information, irrelevant to a design problem, helps children to see the design problem from a new perspective.

3 Research Approach

3.1 Toolkit design framework

South Korean schools typically use a teaching guide document for each subject in an academic term. These guides contain information about the entire process, specific activities, necessary tools, and rules for creative activities (Hyung Kyu et al., 2012). We utilized this type of document as a reference point as we developed our own toolkit. We simplified the main contents of the documents to three factors per classroom activity. These factors are (a) design process for an activity that provides the design's concept, (b) activity per process, and (c) overall activity rules. With these factors in mind, we first created an education activity process using the IDEO process (Bandyopadhyay et al., 2013) because it is simple and easy to understand compared to other design processes. To describing the

activities required by each process, we used creativity theory from the studies of Laxton (1969) and Lawson (2006) to help students develop fresh ideas during the process. Subsequently, we used group activity because it is more effective to share cognitive viewpoints in problem-solving activities compared to individual work (Hanham and McCormick, 2009). Finally, we made rules that apply to all educational group activities, and decided which activities were required for the following stages: process, creative way, and whole rule (see Figure 1).

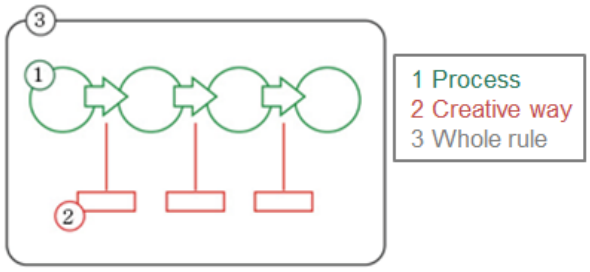


Figure 1 Blueprint for the Framework

3.1.1 (a) Design Process for activity

In order to teach the concept of design, and create a design process that helps students conduct their respective term projects, it is crucial to decide which design process to use. Although design processes differ in practice according to design context, the overall process is very similar. A generic design process is composed of defining a problem, understanding the user and design space, ideation, prototyping, and testing (Plattner, Meinel, & Weinberg, 2009). We selected the IDEO design process model as a framework (see Figure 2) for this study, as it is the basic version of design process thinking proposed for a general public unfamiliar with design process (Bandyopadhyay et al., 2013). The process model itself does not give instruction on what should be done in every step. However, when combined with step-by-step methods and activities, it can be used as an effective process structure. Indeed, it is well known that IDEO utilizes this process in a systematic approach (Kelly, 2002). For this reason, our study used the IDEO process model as a basic framework for children's educational toolkits.

The IDEO design process model divides the whole design process into three parts: hear, create, and deliver. 'Hear' is defined as discovering problems. 'Create' is to solve problems, and 'deliver' is to propose solutions. The problems can be discovered using observation through a series of in-depth interviews. The problem-solving parts can be initiated using creative methods such as brainstorming, or even observing activities. Finally, the outcomes are shaped by a prototype containing a final solution, which can be evaluated later on. In summary, these steps comprised the main process skeleton for our mini design project for elementary school students.

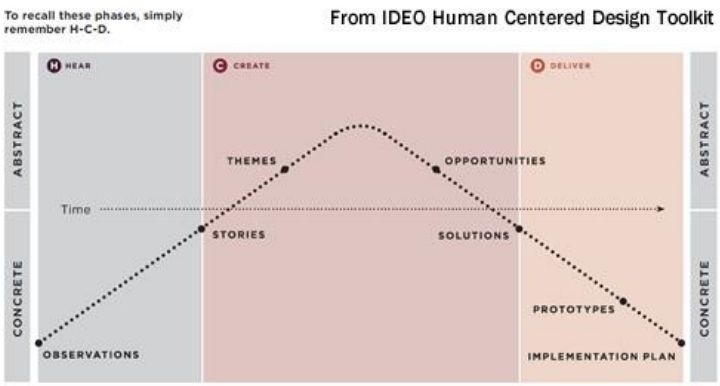


Figure 2 IDEO human centred design toolkit. Source: Bandyopadhyay et al., 2013

3.1.2 (b) Activity per process

Activities are crucial to each process. This section describes the activities in each step of the process, which were adopted by our proposed toolkit. Ulrich (2011) describes the stage of problem finding as opportunity identification with a charter. At this stage, students must collect multiple problems with a charter in order to determine the appropriate one. The process of opportunity identification is divided into three parts: (1) making a charter, (2) finding multiple opportunities, and (3) selection. There are many methods of finding opportunities including following one's personal passions, compiling bug lists, studying individuals, and mining sources (Ulrich, 2011). Considering the limitations of classroom activity time, we adopted compiling bug lists for our study. In this collection method, participants find opportunities by listing the troublesome or uncomfortable things they perceive in everyday life. Consequently, we set a charter 'to improve the classroom settings' by solving the problems perceived by students.

The problem-solving step certainly requires creative thinking. However, most students are unfamiliar with generating new ideas. In order to overcome this, we implemented Laxton's hydro-electro theory (Laxton, 1969), and Lawson's creative thinking principles (Lawson, 2006). Laxton (1969) explained that creative ideas come from reservoir of knowledge and experiences. If people are equipped with an abundance of background information, they are often able to initiate or express new ideas. Additionally, these people can access the new idea from a generator, and critically evaluate by means of a transformer. Lawson (2006) describes mental re-organization as a situation achieved by applying various mental modes of attack. These models represent two critical factors in creative idea generation: requisite knowledge, and triggering points to re-organize knowledge. However, when students don't have enough knowledge to initiate a new idea, they are hardly capable of generating creative ideas. Thus, in the creativity process, it is critical to determine how to help students trigger their mental re-organization by filling their knowledge reservoir.

In product design, a design solution direction is usually determined by how the product works (function concept) and how it looks (style concepts) (Baxter, 1995). In practice, industrial designers commonly use mood boards to come up with new ideas. In our proposed toolkit, we adopted style and function cards to fill knowledge reservoirs abundantly, with the assistance of external information. To apply the concept of 'mental mode of attack' to trigger new idea generations, we employed two methods: taking pictures irrelevant to the problem, and rearranging cards. We expected that this intervention would stimulate participants to interpret the design problem from a different perspective.

Finally, we provided a white board for the students to present solutions on. As with the IDEO process, a 3D prototype was made and evaluated. In this study, we modified this step on the accounts of time limitations, and the participants' inexperience in 3D prototyping.

3.1.3 (c) Overall activity rules

In Shepard's study (1991), the contents of design are classified as aesthetic and symbolic expression, and practical and functional attributes as well as social and emotional attitude. Social and emotional attitude content can be linked with the cognitive communication part of the design process. Based on this assumption, we conducted group activities in which students were able to interact with their classmates and teachers. Teachers could efficiently manage the activities within the given time, and present detailed step-by-step activities to the groups. Students were able to share their opinions easily. It is more effective when the students' interaction with one another is positive and constructive (Salonen, Vauras, & Efklides, 2005). Such interaction also relates to teachers when students are given full attention. Thus, paying attention to students is crucial for conducting classroom activities. A student who gets a lot of attention feels confident in the classroom activities (Yeoun-Suck, 2005). Children rarely spend much time considering and evaluating information, and ideas are often only partially expressed when there is no teacher to direct group activity (Mercer, 1996). Thus, we made rules for the teacher to use in each step. We incorporated rules allowing

teachers to ask students about their work, and enabled them to concentrate on each student during the activity.

There have been confounding effects, such as competition between groups, which may have caused conflicts between students (sub, 2009). We used cooperative learning skills to solve such conflicts, thus forming neutral groups. Cooperative learning uses small groups, where students work together to maximize their own learning skills (Johnson, 1992). Therefore, we kept groups to a maximum of four students.

3.2 The role of instructor in creativity process

The instructor has an important role in creativity process education. First, we must help instructors gain a better understanding of design. Since most school teachers do not come from a background in design, they do not have an adequate understanding of it. Accordingly, we added an explanation about the concept and importance of design to our toolkit's introduction. It is difficult for children who are unaccustomed to creative thinking to interpret and solve problems from fresh perspectives outside of natural, logical viewpoints. Thus, we adopted intentional interruptions using irrelevant objects to change the course of participants' natural cognitive process'. The instructor guided the children to select an object devoid of any logical connection to the problem. After the children selected an object, the instructor asked them to analyse its characteristics. This helped the children to acquire new information about the object, and filled their respective knowledge reservoirs with new information. When they go back to the problem, this new information triggers new interpretations of the problem, leading to a creative solution. However, it is not easy to connect the problem to the information acquired from the object. This requires an instructor's guidance based on an accurate understanding of the purpose of our experiment. For this experiment, we used cards to accelerate the process. By exchanging cards or putting a new card on the white board, children received help generating new ideas. As children played with the cards, the instructor helped them to initiate creative ideas through new interpretations of the problem. The instructor also managed the overall process to ensure that children did not get lost in the creative process.

3.3 Components of the Toolkit

The objective of the proposed toolkit is not only to engage students in the activities, but also to help teachers understand design process. It consists of an instruction manual, and tools. The manual has three sections: (a) an introduction, (b) components, and (c) activity guide.

3.3.1 (a) Introduction

This section provides the teachers with explanations about the concept of design, design process, and the toolkit's purpose. It also provides information about the difference between design and other subjects, such as art and engineering.

3.3.2 (b) Components

This part includes graphical and object-based explanations regarding the tools, and different types of cards utilized for analysing the problem and synthesizing solutions. They consist of problem, red, blue and yellow cards. The kit also includes a camera, white boards, markers, tapes, and scissors that teacher uses to prepare for the activities.

3.3.3 (c) Activity guide

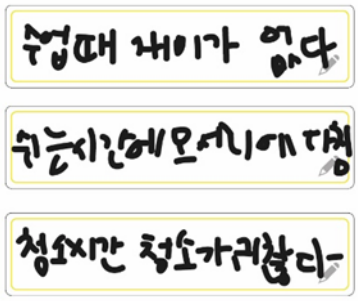
This part includes an instruction manual that demonstrates detailed activity processes for each step. It is comprised of four sub-sections: grouping, defining problem, ideation, and explanation. Each sub-section contains graphics relating to its topic. Precautions are written in red letters. The explanations of the sub-sections are as follows:

3.3.4 Grouping

The teacher forms groups with a maximum of four students per group. Teachers are advised to consider mixing genders in groups to increase opportunities for generating a variety of ideas.

3.3.5 Defining problem

At the beginning, students should identify problems to solve. First, the teacher notes the charter and asks the students 'what problems do you observe in the classroom?' (see Figure 3). Subsequently, the students write down three different problems on three separate problem cards. To help students identify problems, the teacher guides students in utilizing the method of compiling bug lists. In this step, groups of students are encouraged to freely speak about classroom problems. After that, students put the problem cards on the white board, and select an appropriate problem. Each student is asked to put stickers on their choices of the three biggest problems. The problem with the most number of stickers is selected. In this process, students are not allowed to speak out their opinions. The purpose is to prevent a particular student from influencing the other students' decisions.



(The class is boring, I can be hurt by edge of desks, I can't be bothered with cleaning the classroom)

Figure 3 Writing problems on the problem cards

3.3.6 Ideation

Students are allowed to use any object that is not related to the problem (see Figure 4). Our intention was to help students interpret the problem from a different perspective, so we allowed children to select an object freely, regardless of the object's association to the problem. With this process, students are able to gain an understanding of how they can solve the problem differently. Meanwhile, the teacher must encourage the students' productivity. For example, if students face difficulties in choosing one, the teacher encourages them to choose any object in the classroom. Each group is allowed to take a picture of an object, print it out, and put it at the centre of the whiteboard.

Figure 4 Taking pictures of the objects that the students want to transform

Subsequently, each group observes an object and describes its characteristics on blue and red cards to induce a mental mode of attack. Students write and draw instructions on how to use the object on red cards, and what it looks like on blue cards (see Figure 5).

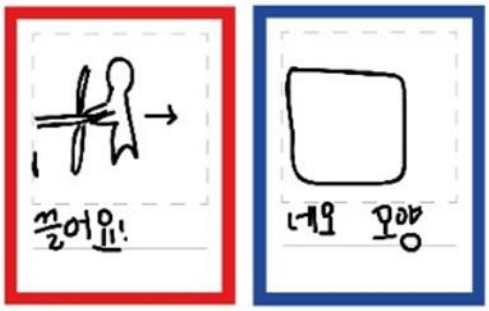


Figure 5 Red and blue cards (left: drag, right: rectangular shape)

Afterwards, students categorize the cards based on contents' similarity, place them on the white board, and make connections between each group and a related part of the object (see Figure 6).

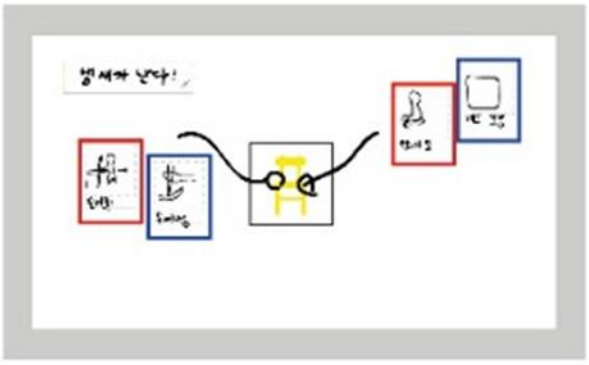


Figure 6 Making connections with groups of cards

In the last stage, students are asked to use the cards to help solve the problem. When they come up with a new idea, they draw it on a yellow card and put it on the board. Students are encouraged to move cards freely from one group to another while continuously creating better, more novel solutions. They also add or remove cards to make room for new objects to solve the problem. New solutions can be added to the yellow cards (see Figure 7).

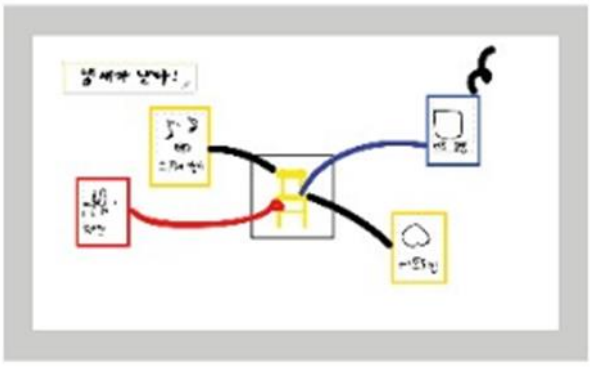


Figure 7 Objects re-arrangement with cards

3.3.7 Explanation

The explanation section allows students to express their complete ideas on 'how to use' and 'how it looks'. Students use the cards and the links on the board to explain how they solved the problem, and how their solution works.

3.4 Experimental procedure and qualitative study

Basically, the proposed toolkit was designed to teach the process of creative problem, and solving it in the context of a classroom activity. If we directly test it in an environment where group dynamics

are an issue, it would be difficult to observe the effectiveness of the tools and methods we devised. Thus, in this study, we tested it with an individual activity scenario first, to check if the tools and methods work properly.

We recruited three local elementary students (one female and two males ages eight to eleven years of age) for the experiment. Three teachers were assigned, each to a separate student. In order to control the effect of group dynamics, the experiment was conducted at the homes of respective participants. The experiment time was one hour, which is basically the length of an average classroom period.

During the experiment, a charter was shown to the participants with the objective 'what are the difficulties in your house life?' Teachers were given a toolkit containing instructions for the entire process. The activity was initiated when the teachers fully understood the contents of the activity. At the end of the activity we collected all materials including pictures of the final outcome. Participants and teachers were all interviewed about their experiences. The details of the experiment and the interviews are presented in the following section.

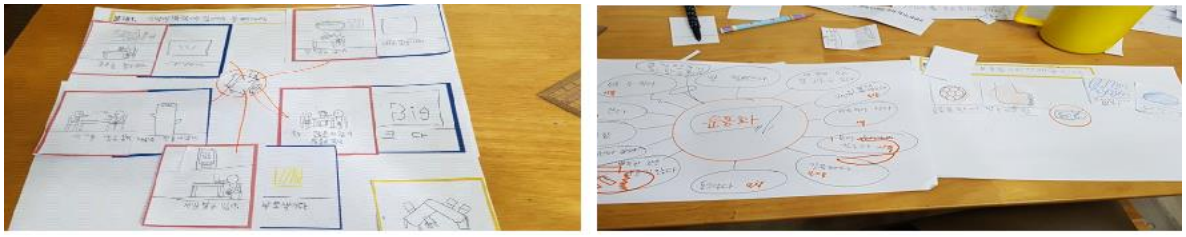
3.4.1 Experiment outcomes

The detail of the final work of each participant is presented in Table 1.

Table 1 Experiment outcomes and problem identification

Participant	Problem identified	Object selected	Red cards/blue cards	Solution
A	Trouble with the table as it is quite close to the wall	Table	• Study, eat food, interaction point, people set around, play the game • Hard, rectangle shaped, made of wood, big, yellowish	Participant A put two rectangular shapes to form 'L' shape to create a free space.
B	Sneakers/heel drag	Sneakers	• Notice the size of foot • Easy to be torn, protection of foot, prevent heel drag when walking on a sharp surface • Round, long, strings, bunch of holes	Participant B failed to draw or express the solution
C	Making a home for Beetles and Larva	Container	• Maintain insect breathing, outside view • Rectangle, hard, no colour, cover, holes	Participant C made a partition with a hard rectangle with holes

Graphical representation of the problems and solutions proposed by participants A and B are shown in Figure 8 below as examples.



Participant A Participant B

Figure 8 Examples of final outcomes

3.4.2 Subsequent Interviews and comments

To explore improvement points of the toolkit and the activity, we conducted interviews consisting of three questions with the teachers and the students. The interview data was transcribed and analysed qualitatively. The responses of each question and the insights are summarized below:

Question 1: Do you think the activity performed by the students help improve their creative skills?

The interviewees were positive about the activity. They agreed that such activities would be beneficial in a classroom setting to help students improve their creativity. They agreed that the approach is interesting and could also help the students who are always silent and isolated in the classroom. They believed that the group activities would be interesting for students.

Question 2: What is your personal opinion about design education and what design deals with?

They noticed that design may solve latent or complex problems. They added that design education is needed in school, and that education material should be simple and doable since students are not fully exposed to the outside world.

Question 3: Have you faced any difficulties to run the activity and the instructions presented in the guide?

The interviewees found that the process of ideation is complicated. Two of them stated that they didn't fully understand why they were asked to choose objects that were not related to problem settings. An interviewee's notes:

> *'Ideation in the design process is too complicated. I didn't understand how I could make a new object with the features of the object that was previously shown'.*

We interviewed the students about the activity, and the difficulties they faced throughout. Participant B stated that he was not able to concentrate on the activity for long. Others found difficulties using different tools. For example, when they were asked to use the two types of cards (red and blue) to write 'how to use' and 'how it looks', they couldn't easily figure out which card they should use. Moreover, we found that they had difficulties in understanding how to apply the red and blue cards to the features of an object to create something new. For example, the purpose of one activity was to change the cards freely in order to come up with new ideas for replacing its existing functions and features. We demonstrated how to replace features by adding or removing the cards by drawing replaceable features such as wheels in place of legs of a chair. However, they didn't follow the process, and tried to find solution directly instead. It seems that first, the process was complicated, and second, students jumped to the solution drawing step directly, without taking time to complete the process. They also faced difficulties when finding an object to solve the problem. They chose the object as the direct cause of the problem, which could not be used as a triggering effect as we had aimed. This is because they did not fully understand how to choose the object they had to use for solving the problem.

After analysing the students' final work, we noticed that the teachers' role is crucial, as it affects the students' ability to understand the instruction. Therefore, teachers should have sufficient knowledge about the design process. We revised the toolkit based on information observed during the activity, and subsequent interviews. These revisions are as follows:

- Instructors did not understand why students are told to pick an object which seems to have no rational relationship to the problem. Also, they had difficulties understanding the reason for writing/drawing an object's features. From these points, we can determine that the supplementary explanations for each step of the process were not sufficient.
- Compared to demonstration, written instruction has a limited capacity of demonstrating activities and their flow.
- The design process takes a long time, so this toolkit cannot be used for short classes. This causes decreasing the level of concentration as time goes on.
- There are too many functional cards for each process, which makes it difficult for students to remember how to correctly use the cards in the activity.
- It is difficult for students to come up with an idea that changes parts by applying feature and function analysis with red and blue cards.
- The step to find an object for solving the problem cannot be used a triggering point because students tried to select one directly related to the problem.

3.5 Revised toolkit

The toolkit was revised by adding the purpose of each step to the role of the specific activities. This will enable instructors to better understand the flow of the activity. A tutorial video was also added to supplement written instructions.

In the revised toolkit, we minimized ideation steps by removing the components of taking photos and analysing an object's features. We also reduced the types of cards and changed the cards' function from analysing features to generating ideas. We removed the step of analysing an object's features, and added a variety of ways to transform an object to help children create solutions from unexpected objects. In this experiment, children selected an object related to the problem. As a result, children failed to view the problem from a new perspective. Thus, in the new version of the toolkit, we intentionally guide the children to select objects that are irrelevant to the problem. Thus, children are forced to view the problem with knowledge acquired by analysing the object. This breaks children's natural cognitive process, leading them to make connections between the irrelevant information and the problem. We expect that through this process, children will experience mental reorganization. Therefore, we fixed the objects so that participants have little freedom to choose an object that is relevant to the problem.

3.5.1 Components of the revised toolkit

The guide was also re-designed for the revised toolkit (see Figure 9). The first part shows the purpose of design and individual activity. The second part includes defining the problem, and the third demonstrates the ideation step. The final part shows an explanatory step and precautions.

In the defining problem section, students are instructed to write classroom problems on the problem cards as shown on the left side of Figure 9. The defining rule is that students should write the problems down in the form of 'when/what/who, and the status'. Subsequently, students should collect cards from all group members, and choose the best one. There are four sticker sets with three stickers in each. Each member of the group is told to vote on problem cards according to their preference. In the ideation section, students are told to choose one or more objects of four classroom objects: a desk, a rag, a blackboard, and a locker (see Figure 9 on left below), and put them on the whiteboard.

In the beginning of the ideation section, the teachers instruct students about activities such as 'transform an object' and 'remake version' so that students can freely think about the required solutions. Students are instructed to use scissors and cards to add new functions to an object, or erase its existing functions respectively. Students alter an object's form spontaneously with transparent and white cards. For example, if a student wants to add an additional feature to the object, they can draw it on a transparent card and place it over the object. White cards are used to modify an object's features by adding and erasing.

In the explanation section, every group should explain the solution.

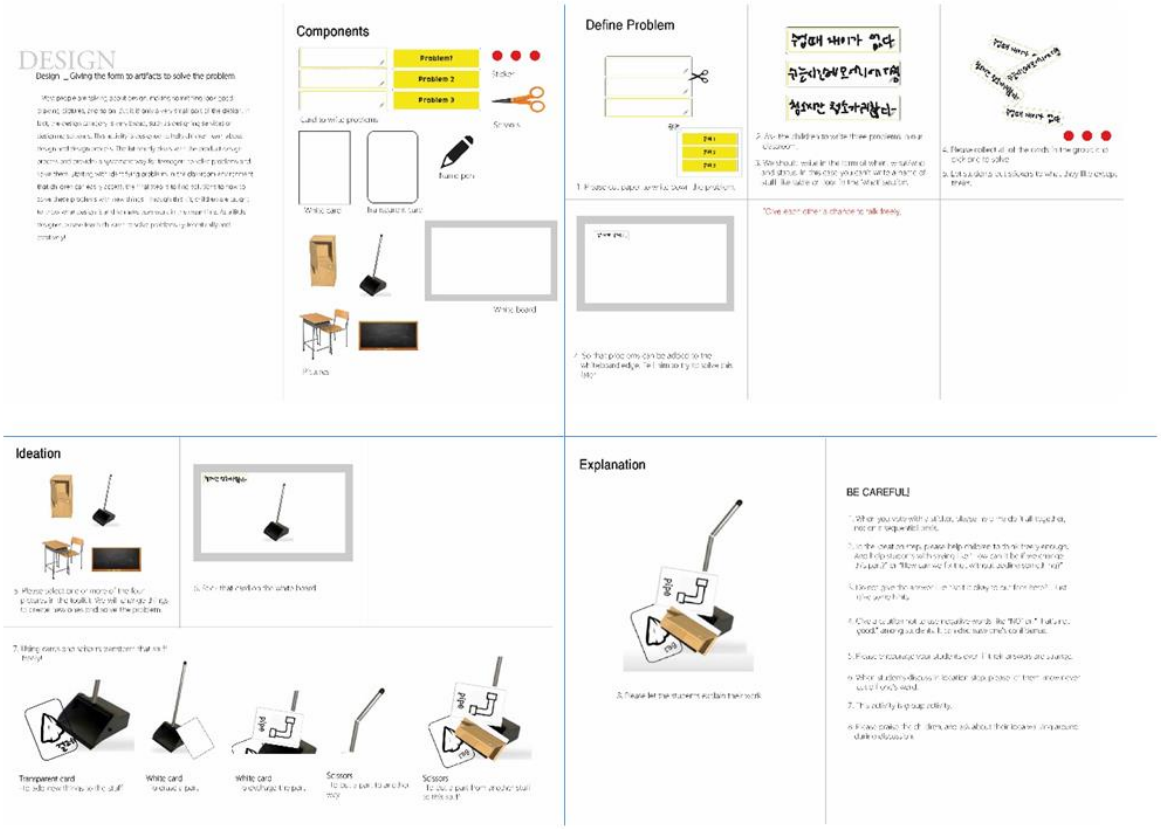


Figure 9 Components of revised toolkit

The revised toolbox with a card set including white, transparent and problem cards is shown in Figure 10.

Figure 10 Revised toolbox for activity

Based on our initial analysis, and the insights from subsequent interviews, we defined the following rules for our revised toolkit:

- A group should consist of 3 to 4 students.
- In the ideation step, students should not intervene in each other's' activities.
- Teachers should provide questions leading students to develop their ideas but should not give the exact solution. For example, 'How do we solve the problem if we cannot use the way you assumed?'
- Praise the students' ideas to increase confidence levels.
- Sequential voting is banned because students may easily consider or adopt their colleagues' work.
- Negative wording such as, 'Your idea is not doable', should not be used in the comments.
- Teachers should walk around class for the entirety of the activity and talk to students about their thoughts.

4 Discussion and Conclusions

South Korean schools mainly focus on increasing students' skills in traditional subjects related to science and engineering, while early design education is mostly ignored. Accordingly, the concept of design and its value have become unpopular. Moreover, young, creative students are not exposed to design thinking, which has the potential to improve creativity and problem-solving skills. Consequently, future students may find dealing with complex situations to be difficult. Therefore, design education is essential for students in their earliest years of education.

South Korean schools have started to focus on early design education. They teach various methods of invention with examples (Jung Jin, 2008) and demonstrate how to come up with new ideas instead of simply connecting or analysing the problem they intend to solve. However, these approaches are still limited tools that focus on and support integrated creative thinking. With this firmly in mind, we have designed a toolkit for teaching the design thinking process, and concept of design. We developed a tool based on the IDEO design thought process consisting of three steps: discovering problems, making solutions, and presenting and evaluation. To design the activities for creating solutions, we utilized the creative thinking theories from the studies of Lawson (2006) and Laxton (1969). These models demonstrate the need for abundant background knowledge combined with triggering factors to come up with new ideas. In addition, we adopted group activity as a rule in our proposed toolkit as communication throughout the design process is important to the development of a better design education.

The main parts of our proposed toolkit consist of an instruction manual and tools. Red, blue, yellow, and problem cards were used as tools. During the activity, students define a particular problem by using the problem card. They select an object from the classroom, transforming it to solve a problem they identified. In the next step, students use blue and yellow cards to analyse features of the selected object, which serves as the solution's triggering effect. At the end of the transformation, students explain their final work on the whiteboard. During the experiment, and subsequent interviews with the students and teachers, we found that students had difficulty understanding the instructions; the process was too complicated for the students. Therefore, we revised our toolkit to minimize the difficulties the students faced. We added a tutorial video that demonstrated details of process to the students. We modified an activity to the problem-solving section's main activity, where the students select an object. In the revised toolkit, we provide four classroom objects: a desk, a rag, a blackboard, and a locker. Moreover, we minimized the number of cards, and created a new activity in which students use scissors and cards, to transform an object by adding new functions, or erasing the object's existing functions with the figure. At the end, students present their solutions.

This is a preliminary study to propose a method of helping children's' creativity processes, based on the assumption that new interpretations triggered by irrelevant information to a design problem lead to a process of creative problem solving. Although the revised toolkit was not tested, we hope that it will allow elementary school students to experience the design process for solving problems around them, thereby enhancing their creativity. Moreover, the proposed toolkit could also be helpful for creative middle school, and high school students to utilize design thinking as a foundation. However, these hopes could be more convincing if the proposed toolkit is deployed on an appropriate sample of students in school group settings, and its effectiveness is confirmed. Future study should continue to investigate the effectiveness of the proposed toolkit on students in the classroom of an appropriate sample size. A deeper study on cognitive issues surrounding learning process, and pedagogical approaches is also required.

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About the Authors:

Seonmi Lee is a senior student in Design area at UNIST. Her major is human factor engineering and industrial design. She is interested in developing design methods and tools for young students.

Tufail Muhammad is PhD candidate in Design area at UNIST. He has done MS in Culture Technology from KAIST, South Korea. He is pursuing his PhD research in design-integrated innovation to design pervasive systems that can provide innovative services to a number of mobile technology users in their daily lives.

KwanMyung Kim is an associate professor at Graduate School of Creative Design Engineering UNIST and a director of Integration and Innovation Design Lab. He has done PhD in Industrial Design from KAIST. His research interests includes design-integrated innovation, product development, and design process.

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Combining Craft and Digital Tools in Design Education for the General Public

STRAND Ingri* and NIELSEN Liv Merete

OsloMet – Oslo Metropolitan University
* Corresponding author e-mail: Ingri_s@hotmail.com
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The use of information and communication technology (ICT) in the Art and crafts subject in general education in Norway is examined through a survey and qualitative interviews with teachers. Both the survey and the interviews reveal that teachers prioritise traditional crafts over ICT. Several teachers view youngsters as *digital natives* who will master the digital tools anyway, while they fear that material knowledge, motor skills and craftsmanship will be lost. The writings of Vetlesen (2015) and Sennett (2008) on the relationship between craft and technology are used to shed light on the teachers' priorities. The term *digital natives* is discussed against Nordkvelle and Fritze's term *medialized*, which suggests that mastery of ICT does not apply to a whole generation. This leads to the conclusion that the Art and crafts subject should include both ICT and craft. In this article, we introduce practical studio work that combines crafts and digital tools, and we discuss if such a combination can meet future challenges in the education of youngsters.

ICT, craft, art and crafts education, design

1 Introduction

Digital tools and crafts are often viewed as contradictions in general design education in primary and lower secondary schools. A growing number of schools and municipalities in Norway have a priority focus on information and communication technology (ICT), where digital tools shall be implemented in all subjects at all levels. In some of these schools the pupils get their own iPad already as six-year olds. Due to the traditional crafts' prominent position in the Art and crafts subject, a priority focus on ICT may not affect this subject.

In this paper, we present three assignments for use in the Art and crafts subject, aiming at building a bridge between these contradictions. A study of how digital tools are used in Norwegian primary and lower secondary schools, with pupils in the age range 6 to 16 – both schools with and without a digital focus – and what the teachers report about their priorities between ICT and craft is also

presented. We discuss how the presented assignments may accommodate some of the challenges identified in the study.

2 Building a bridge between digital tools and crafts: Assignments for use in the Art and crafts subject

Artistic research has been used in developing assignments to be used in the Art and crafts subject. We build upon artistic research as a method for research through artistic work. This method may include both theory and practice (Berg, 2014, pp. 22–23). Similar terms used are *research by design* (Sevaldson, 2010) and *research through art and design* (Frayling, 1994, p. 5).

In this study, different ideas and solutions for assignments were tried and evaluated in a reflective, artistic practice. The projects most suitable for educational purposes, which allow the youngsters to develop their knowledge of traditional crafts and physical materials, as well as their digital skills, were chosen for discussion in this paper.

2.1 Making a digital collage from drawings and paintings

This project started out with an exploration of artistic mediums, in this case, aquarelle, acrylic paint and crushed charcoal mixed with water. It is therefore suitable as an introduction to these artistic mediums. The work was then digitalised and put together in photo editing software, such as GNU Image Manipulation Program (GIMP) or Adobe Photoshop.

The artistic mediums were applied to different surfaces, such as canvas and smooth and rough paper, to make different-sized paint samples, as shown in Figure 1. The youngsters learn how the paint behaves with different amounts of added water, observe how the different pigments in aquarelle paint blend into each other and how the different surfaces affect the overall appearance. It is also possible to sprinkle salt over the wet aquarelle paint to observe its effect.

To create figurative images, it is possible to combine these paint samples with drawings or sketches. A scanner was used to digitalise the paint samples and drawings. Scanned with a high resolution, even quite small paint samples, such as 5 x 7 cm, can be used in larger digital images. If a scanner is not available, it is possible to photograph the samples and drawings.

In the photo editing software, the youngsters are introduced to basic tools and features, such as marquee tools, layers and masks. The scanned paint samples were inserted into separate layers over a neutral background. If working with circles or squares, the software usually has marquee tools in those shapes. The students simply choose an interesting area of the paint sample, select it with the marquee tool and either use masks or the eraser tool to remove the rest from that layer. For different shapes, they draw each shape on a separate layer and use it to make a selection. This is shown in Figure 1.

Figure 1 Left: Paint samples. Right: Screenshot of using a triangular shape to make a marquee.

Drawings can be used in a similar manner to cut out pieces from the paint samples. The students use a marquee tool suitable for selecting an irregular shape or area, such as the magic wand tool or quick selection tool, and select a particular area of the drawing. They use that selection to mask out or erase the parts of the paint sample layer outside this area. They can keep only the lines from the drawing layer by marking and erasing the paper parts or use blending modes that subtract the light parts of the layer. They should feel free to experiment with blending modes on the other layers as well, to create new and exciting effects. Figure 2 show two finished products from such a process.

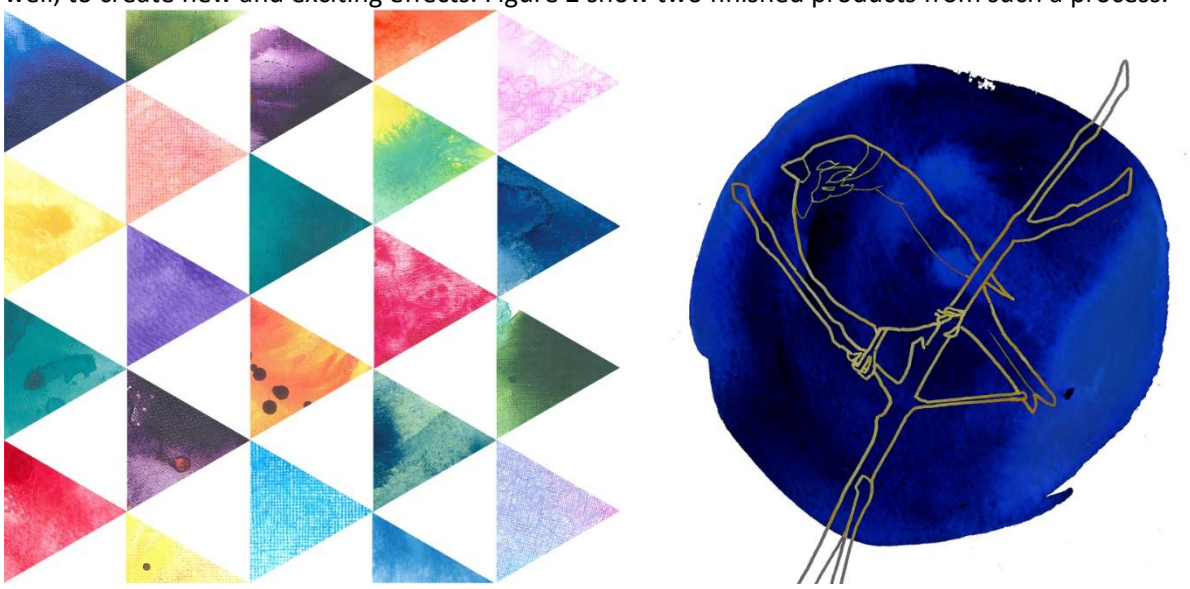

Figure 2 Left: Digital collage assembled from paint samples cut in triangular shapes. Right: Digital collage assembled from a drawing and a paint sample.

2.2 From photo to cross-stitch embroidery

This project emphasises the craft part, but the digital work is essential to get started, as this is where the pattern for the cross-stitch is made.

The students use a photo of their own choice, preferably one with a simple motif. They should ensure that the photo is not protected by copyright and that they can freely do their own work based on it. To make a clean and simple cross-stitch pattern, some of the details should be edited out, and the number of colours reduced in a photo editing software of their choice, such as GIMP or Photoshop. If the image size is very large, it should be reduced to less than 1 MB.

Once the picture is ready, it is simply uploaded on the free web application KnitPro by Microrevolt. This translates the image into patterns for knitting, crocheting or cross-stitch embroidery. A cross-stitch pattern, as well as a finished embroidery, is shown in Figure 3. While uploading, the students must select which kind of pattern they want (in this case, cross-stitch) and choose among three sizes. It is worth noting that all three sizes are quite large for beginners. It is possible to cut the pattern into smaller pieces and divide them among the youngsters, so that each of them makes one segment, all of which are later assembled into a larger picture.

KnitPro generates a cross-stitch pattern based on a photo. Even though the photo has a reduced number of colours, the pattern may contain more colours. It may therefore be necessary to tweak the pattern while embroidering in order to decrease the number of colours and not overcomplicate the work.

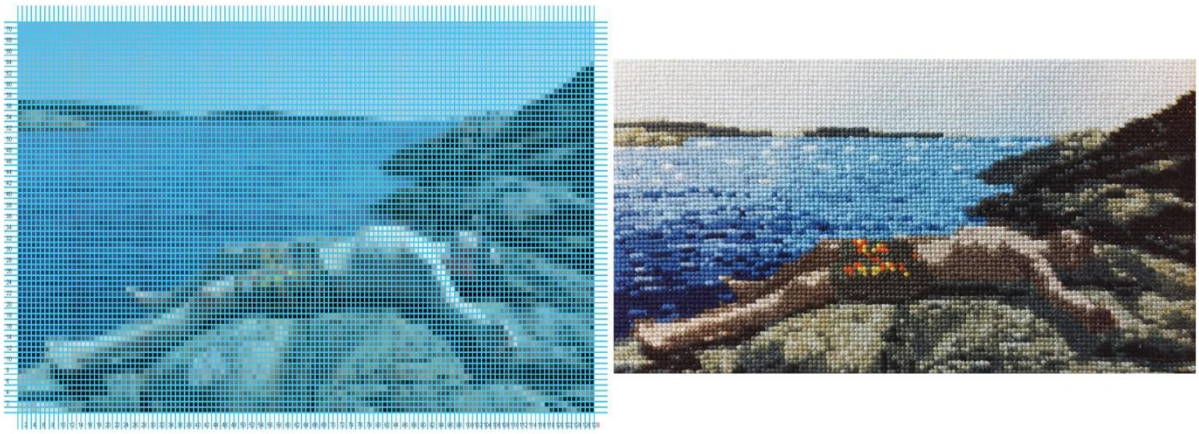

Figure 3 Left: Cross-stitch pattern generated, using KnitPro by Microrevolt. Right: Finished cross-stitch embroidery.

2.3 Using SketchUp to plan a gingerbread house and wooden chess pieces

SketchUp is a suitable tool for sketching and planning three-dimensional (3D) work, as it allows users to gain an understanding of proportions, rotate the model to look at it from different angles and work with real-world dimensions. In the planning of gingerbread houses, they are first modelled in three dimensions and then cut into individual pieces to make the stencils used in cutting the dough. This turns the sketches into useful tools in the process. Outside of the holiday season, the houses can be built of cardboard or similar materials. When designing chess pieces, the software helps the students see how each piece looks and evaluate how all pieces work together.

The gingerbread houses can be designed in an intuitive manner. A simple house is first built in the shape of a rectangle, which is then pulled up to form a cuboid. A line drawn across the top of the cuboid forms the ridge of a gable roof when pulled farther up. In just four steps, a shape resembling a house is created. Such a house is shown in Figure 4. Using the line, rectangle and circle tools, it is possible to add or subtract parts of the model, for instance, adding a chimney or cutting window holes. If a rectangle is drawn on a wall, it is possible to use the push/pull tool to create a different shape. It is interesting to experiment with different architectural styles and building types, such as building a small village with small and large houses and a church. As the houses will later be made of gingerbread, the project does not call for a realistic representation or richness in detail. To make the stencils, each piece is selected, copied and rotated to face the same plane, as shown in Figure 4. This operation will challenge the youngsters' understanding of the software's three dimensions and will develop their navigating skills. By using the text tool, the pieces can be marked to keep track of them. Before printing the stencils, the students set the camera to show the pieces in parallel projection so that the measurements are not distorted by the perspective. The pieces are then exported as jpg files, printed and used as stencils to cut the gingerbread dough.

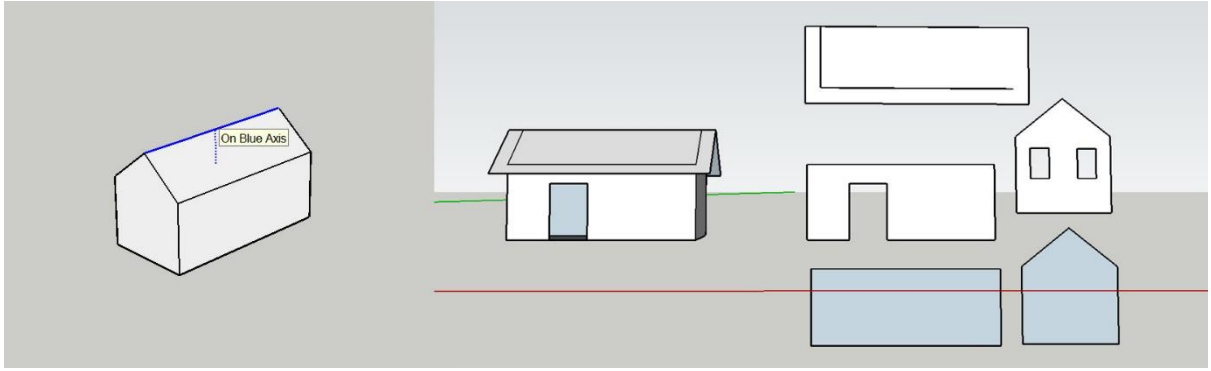

Figure 4 Left: Screenshot from SketchUp, constructing a simple house. Right: Screenshot from SketchUp, making stencils for cutting the gingerbread dough.

Designing chess pieces in SketchUp gives the students the advantage of seeing each piece's proportions and appearance, as well as how well the pieces work together when placed on the chess board. A full set, as shown in SketchUp, is shown in Figure 5, along with three pieces carved out in wood. One negative aspect of using SketchUp is that the students' knowledge of the software or the software's possibilities may restrict their creative outlet. Nonetheless, as the pieces will later be carved out in wood, a simpler design may be better. When the pieces are designed, the youngsters can make blueprints in SketchUp by exporting images of the parallel projected pieces, as seen from the top, bottom and sides.

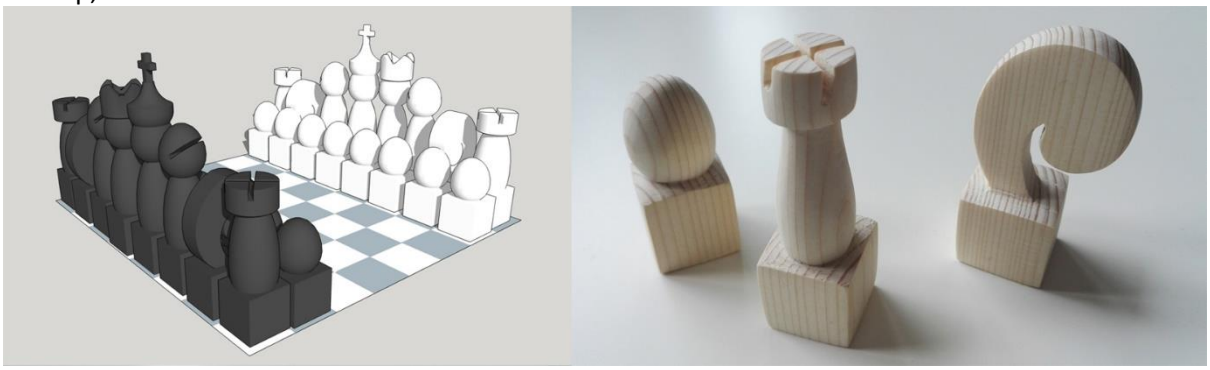

Figure 5 Left: 3D model of a chess board with a set of chess pieces, exported from SketchUp. Right: Chess pieces carved in wood.

3 Methodology

A mixed-methods approach was used in this study, including a survey and five qualitative interviews. The selection of participants and execution of the study are presented below.

3.1 Survey

Randomly selected Art and crafts teachers participated in the survey; the participants are called *respondents* in this paper. The respondents were chosen through a random draw in Norwegian public schools, both at the primary and the lower secondary levels, with pupils in the age range 6 to 16. The selected schools were contacted and asked to reply with the contact information of their Art and crafts teachers. The survey was sent by email to 168 teachers whose information was provided by the schools; 82 teachers responded, equivalent to a response rate of 48.8%.

The survey was a digital questionnaire consisting of 10 questions of different types. The respondents were asked to rate how much they agreed with different statements, answer multiple-choice questions and finally, write comments about their positive and negative views on the use of ICT in the subject in a text box.

3.2 Qualitative interviews

The interviewed teachers are called *informants*. The informants were strategically selected and divided into two groups. The first group consisted of three teachers working in schools or municipalities with priority focus on ICT, and they were assigned the code Gr1Teacher(X). The second group comprised teachers working in schools or municipalities without such a focus, who received the code Gr2Teacher(X). The informants in group 1 were chosen through a search for schools with a publicly known priority focus on ICT. The schools were contacted and asked to provide a list of Art and crafts teachers who were willing to be interviewed. The second group was recruited through the survey. A question about whether the respondents' school leaders required the use of ICT was used to identify the relevant informants. Less than 10% gave a negative answer to this question, so the respondents who also answered "partly", combined with little to average use of ICT, were considered relevant. Two of the contacted respondents agreed to be interviewed. All five informants were well educated and highly qualified to teach the subject. They had between five and thirty years of experience as Art and crafts teachers and worked at primary or lower secondary levels in public schools.

The interviews were semi-structured and lasted between 30 and 60 minutes. The contents of the interviews somewhat varied. However, the main topic was how the teachers used digital tools in their classes, as well as which factors, such as access to equipment and their own digital competence, and which parts of the subject they wished to prioritise, might explain their use.

4 What does teachers express about digital tools in Art and crafts?

4.1 How are digital tools used in Art and crafts?

In the survey, the respondents were asked to rate how often their pupils used different digital tools or software and how often they worked on different tasks in class. None of the respondents answered that they used any of the given tools or software in all or almost all classes. The most widely used tools were software for text treatment and presentations, such as Microsoft Word and PowerPoint, and internet search engines. Additionally, the most common tasks were internet searches and working with text documents. These are common tasks that can be used in most projects, so it would only be natural that they were the most prevalent. As much as 30% of the respondents answered that their students never used subject-specific software, such as Adobe Photoshop, GIMP, VideoPad and SketchUp, for digital drawing, photo or video editing or 3D modelling, as shown in Figure 6.

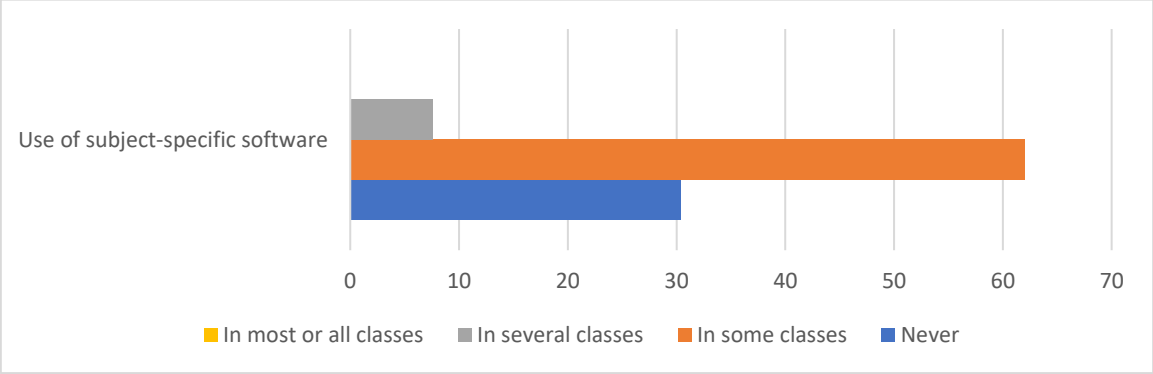

Figure 6 Diagram showing the respondents' rating of how often subject-specific tools were used in class. Approximately 30% answered that their pupils had never used subject-specific software, while 62% had used it in some classes. None answered "in most or all classes".

In the last survey question in the open field, many respondents praised the easy access to inspiration and information provided by internet search engines. Almost as many wrote about great experiences working with photo editing, animation and so on.

The interviews told the same story. Two of the informants, Gr1TeacherA and Gr2TeacherA, only let their pupils use digital tools for making presentations, writing texts and searching for inspiration or information. The other three, although some were limited by the lack of software, also taught subject-specific use of ICT. Their pupils worked on tasks, such as animation, 3D modelling, mobile photography and photo editing, often combined with traditional techniques, such as drawing or woodwork.

4.2 Teachers prioritise traditional crafts and experience with materials over ICT

The main aim of this study was to find explanations for teachers' use of digital tools. Limited access to relevant equipment and insufficient digital competence were both cited as explanations for the lack of ICT use, but the most important factor might be the teachers' prioritisation of traditional crafts and opportunities for the youngsters to gain experience with materials. Many of the informants reported that the Art and crafts subject was not allotted enough time to fulfil the demands of the curriculum; thus, they needed to prioritise some parts of the subject over others. There seemed to be the perception that crafts constituted the subject's core element. As Gr1TeacherA expressed in the interview, "[…] I think, in a way, that the main task as an Art and crafts

teacher is to teach them [the youngsters] some craft, whether it's sewing or drawing or ...". A similar view is illustrated in the following response from the survey:

> *Art and crafts is first and foremost a practical subject. ICT is used a lot in all subjects. In the Art and crafts subject, I want to focus on the practical, to teach techniques and practical designs. I use the digital format a lot for the presentation of finished products and in the process of sketching. Otherwise I do not wish to spend time on a computer; rather I want to create and make physical products. (Respondent #50)*

Gr1TeacherA worked in a school where all pupils received their own iPads upon starting school at age six. The iPads were used in all subjects, and Gr1TeacherA reported that if a teacher did not want to use this tool, he or she ought to find another place to work. Although everyone was required to use the iPad, Gr1TeacherA clearly stated that she used it as little as possible in Art and crafts; instead, she put a lot of emphasis on crafts. In the interview, she admitted that this could be a reaction to the school's digital focus.

> *They [the youngsters] get a lot of knowledge about digital tools.. all sorts of digital tools really, but what they have less knowledge of, is how to use their hands. It's a lot of touch system and using your index finger to navigate, but somehow.. fine motor skills are very under-stimulated. (Gr1TeacherA)*

Gr2TeacherA showed a similar attitude towards ICT and crafts. With about 30 years of teaching experience, she claimed to have observed a decline in the youngsters' practical skills. She no longer expected them to have basic skills, such as cutting with scissors and threading needles, and felt the need to prioritise the training of practical skills through crafts. She also expressed the opinion that ICT should not be the focus in Art and crafts: "(…) it is supposed to be a practical subject, and I think that it isn't the use of computers that should be the most important".

Many of the respondents and the informants had a positive attitude towards ICT and made use of digital tools in a wide range of ways. However, it appeared that many of them valued the craft part of the subject most highly, as shown in the following comment from the survey: "(…) But it [ICT] can never replace the value and importance of using tools and materials". Another respondent emphasised the importance of the tactile dimension of working with materials. "What can be negative [about using ICT] is the eventual lack of direct tactile experience of materials in different processes. An understanding of the material and physical world in Art and crafts is still significant and important".

A more positive attitude towards ICT was apparent in the interview with Gr1TeacherC. Her pupils had worked with photography, photo and video editing, digital drawing and 3D-modeling, but she also had reservations concerning too much ICT in Art and crafts:

> *I have to tell you that I put extra weight on the use of practical materials and tools, so really, we are a bit sceptical about using it [ICT] too much. Now, we see that if we use digital tools more, we are afraid of being assigned larger groups of pupils. But we have really good teacher competence, studios and tools here, both for woodwork, sewing, ceramics and everything like that, so it is important for us to work most with that.* (…) *But it is a supplement to do it [work on ICT] a little, but definitely not too much, I think. It can be too easy to just take out the iPad and do something fun there. It is really important to maintain the quality of materials, knowledge about tools and using pencil and paint and all that. It is really important. (Gr1TeacherC)*

Again, traditional craft and working with materials were valued the most, while working on an iPad was mentioned as something easy and fun. It is also noteworthy that Gr1TeacherC was reluctant to use digital tools more for fear of being assigned larger groups of pupils or losing her well-equipped studio, due to economic cuts. Although she also regarded ICT as an important part of Art and crafts, her prioritising of crafts was also apparent. Based on this, the potential changes mentioned above would be detrimental to the subject.

In the survey, the respondents were asked to rate how much they agreed with the following statements: "In my classes, I put weight on ICT", and "I prioritize traditional craft and materials over

ICT in my classes". The responses clearly showed that many of the respondents prioritised traditional crafts and materials, while quite few put weight on ICT. For both statements, about a quarter of the respondents placed their responses in the middle of the scale, but most of them seemed to have clear opinions on these matters. Figure 7 shows the respondents' answers.

In the open field at the end of the survey, many of the respondents chose to express their views on the relationship between crafts and ICT. Some of these comments are quoted in the preceding paragraphs, while others are cited in the following ones.

The curriculum implemented in 2006 included a prominent position for ICT. Digital skills are regarded as one of the five basic skills that should be incorporated into all subjects to develop youngsters' abilities. This might be the reason why some of the respondents reported that ICT was taking over their teaching curriculum at the expense of more traditional techniques, as shown in the following comments from the survey:

> *"Find it unfortunate that the focus on practical craft disappears; everything drowns in the digital."*
> *"[ICT] may* "steal" too much of the time and the craft *part will be compromised."*
> *"I don't see a lot of negative sides if it [ICT] is used with sense. It must not take over for the craft where you work with your hands."*

In these quotations, it is possible to recognise the fear of ICT dominating Art and crafts, pushing out the crafts. In the interviews, Gr1TeacherA and Gr2TeacherA expressed worries about the neglect of youngsters' practical and motor skills. Craft still **occupies** a prominent place in the curriculum, but many youngsters spend a large part of their spare time on computers and other digital tools. Gr1TeacherA did not consider it necessary to spend time in school on teaching the youngsters about this.

> *Well, I think that everyone now has so many digital things at home, at least I see my children spending time with this, taking pictures, manipulating them and doing so much with these pictures, adding filters and.. it's not necessary to teach them because they know how to do it. (Gr1TeacherA)*

Gr1TeacherA expressed her view on the youngsters as "digital natives" who would master ICT anyway; as a result, she was comfortable with her priority of crafts.

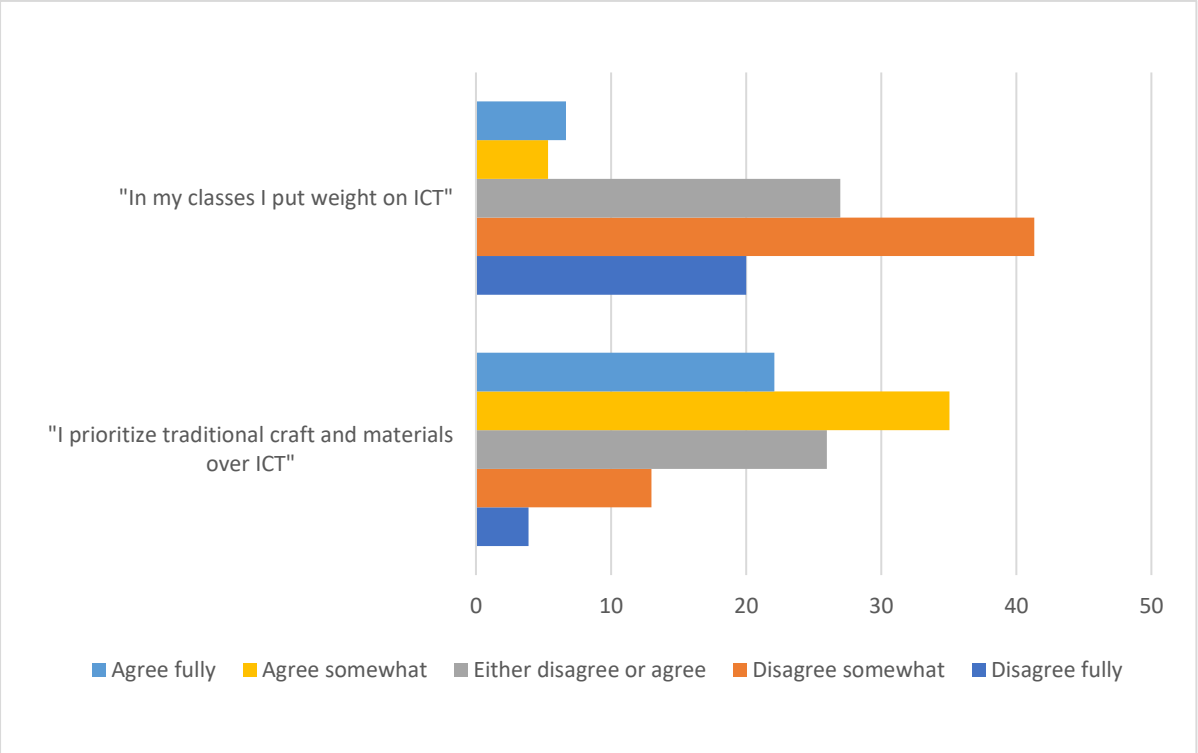

Figure 7 Diagram showing the distribution of the respondents' answers, rating how much they prioritised ICT and crafts in

their Art and crafts classes. Around 12% reported that they agreed fully or agreed somewhat with the first statement, "In my classes, I put weight on ICT", while 61% disagreed somewhat or fully. The second statement, "I prioritize traditional craft and materials over ICT", received opposite responses; 57% agreed fully or somewhat, and nearly 17% disagreed fully or somewhat.

5 Combining ICT and craft in perspective

The study showed that many teachers prioritised craft and teaching youngsters to work with their hands and materials over ICT. This preference was justified through their observation that youngsters lacked motor and practical skills, while they might be able to acquire digital skills on their own. The teachers also seemed to place the highest value on the craft aspect, perceiving that teaching such skills is the Art and crafts teacher's most important task. To understand these findings, they are discussed in relation to Arne Johan Vetlesen's (2015) and Richard Sennett's (2008) writings on the relationship between technology and craft. Marc Prensky's (2001) and Yngve Troye Nordkvelle and Yvonne Fritze's (2015) articles about digital natives are also discussed.

According to Vetlesen, technology allows for less physical and sensuous experiences with the surrounding world, as sight is favoured over hearing, smelling and touch (Vetlesen, 2015, p. 167). Much content in the Art and crafts classes stimulate all four of these senses. Youngsters hear the difference when knocking on wet and dry ceramics, smell various types of wood and touch different types of yarn, while sight is prioritised in all parts of the subject. The lack of physical and sensuous experiences from ICT may explain the teachers' fear of losing the crafts part of the subject.

Sennett's (2008) broad definition of crafts includes musicians, glass blowers, scientists in a laboratory, architects, Linux programmers and weavers. His definition therefore exceeds the limits of the Art and crafts subject and does not distinguish between work with materials and digital work. For Sennett, *craftsmanship* is about the wish to do good work for its own sake (Sennett, 2008, p. 20). However, Sennett still warns against replacing experience with the physical world with digital simulation when he writes about architects using 3D modelling or computer-aided design (CAD). By using only digital tools in planning instead of spending time on the location, making sketches and drawings by hand, the architect loses an understanding of materials, proportions and other physical properties. Without such understanding, critical design problems may emerge (Sennett, 2008, pp. 39–45). Some of the dangers here relate to the quick calculations of digital simulations, while drawing each brick in a building takes a long time. Several times in the book, Sennett emphasises the slowness of craft, both in gaining skills and working with single products, as important. Time allows for reflection and creativity. Quick solutions, such as digital simulation, do not provide the craftsman enough time to reflect on his or her choices (Sennett, 2008, p. 295), and the final product may exhibit flaws that should have been discovered earlier in the process.

In Sennett's warnings against digital simulation, there is also a valuation of physical, sensuous experiences with materials and places. Vetlesen has written more on technology replacing these experiences with the surrounding world, comparing the traditional felling of trees with the use of a modern forestry vehicle, a discussion inspired by encountering such a vehicle. The forestry vehicle is operated by pushing the right keys while looking at a screen, in a similar manner to writing text, although the task is completely different. The operator's main attention is oriented towards the screen, with occasional glimpses at the tree to ensure that the process is going well. This process is in huge contrast to the traditional felling of trees, where the carpenter physically engages with the trees, using his or her senses and handling the different obstacles at hand. In the forestry vehicle, every tree feels the same, making a single tree an almost abstract entity that is not experienced in a physical or sensuous way. The machine stands between the man and the tree – subject and object – making the direct contact between them superfluous (Vetlesen, 2015, pp. 147–149).

> *The change that interests me is not primarily a matter of man's relating to the tree being mediated by a machine (computer) that literally is an in-between between subject and object. Rather, and more profoundly, it is a matter of the subject-outer reality relationship – a two-way affair, as we saw – being replaced by a man-machine (technology) one. (Vetlesen, 2015, pp. 148–149)*

Vetlesen explains a phenomenon that may be difficult to express in words. Based on this study, it is apparent that experience with materials is highly valued among Art and crafts teachers. However, none of the participants in this study justified *why* this was the case; rather, they simply stated that it was extremely important. Accepting Vetlesen's assertion about the use of technology leading to abstraction makes it easier to understand the fear of ICT taking over art and crafts, thereby compromising the crafts component.

Sennett traces the line of crafts backwards, including the 19th century's emerging machine culture. Against the machine's perfection, the craftsman became a symbol of human individuality, directing attention towards variations and small mistakes in the products (Sennett, 2008, p. 84). In the Victorian age, there was a growing concern that the large number of identical objects could dull the senses. The identical, perfect, mass-produced products did not invite a personal relationship (Sennett, 2008, p. 109). Over a century later, after the digital revolution, these thoughts are still relevant. In this study, we encountered the perception that digital artworks were less personal. Gr2TeacherA called this a negative aspect of the use of ICT in Art and crafts.

> *It can be very impersonal, I think. A bit artificial. Lifeless. If you are making stuff on the computer. And it is very, like.. things can look very alike. I'm thinking about a personal expression, that is something I find very important. (Gr2TeacherA)*

Personal expression is highly regarded, along with craft skills, by Art and crafts teachers in their evaluation of the youngsters' work (Lutnæs, 2011, p. iii). One may consider whether Gr2TeacherA's statement about digital drawings being impersonal is indeed true, but it justifies her lower priority of the digital aspect of Art and crafts.

Gr1TeacherA expressed the opinion that it was not necessary to teach youngsters about ICT because they could learn it on their own. This can be linked to the term "digital natives" coined by Prensky (2001). According to Prensky, children born after the digital revolution think and process information differently from the older generation – called "digital immigrants" – because they have spent their lives surrounded by digital tools and media. The digital natives are accustomed to rapid information processing and multitasking; they prefer pictures and graphics over text and favour games over "serious" work. In contrast, the "immigrants" may adapt to the digital community, but they will always be revealed by their "accent", an outdated, pre-digital language (Prensky, 2001, pp. 1–2).

In their article "Digital immigrants or just medialized", Nordkvelle and Fritze (2015) present arguments against the term "digital natives"; instead, they propose the term "medialized". While "digital natives" refer to a certain generation, "medialization" describes how much a person's life is affected by technology and media (Nordkvelle & Fritze, 2015, p. 71), thus transcending generations. Although most Norwegian youngsters have access to some digital technologies, according to the studies discussed in Nordkvelle and Fritze's article, differences related to gender, social class and interests affect their digital skills (Nordkvelle & Fritze, 2015, p. 68). Based on these findings, claiming that youngsters will automatically master ICT seems too easy. Thus, schools need to train all youngsters in some basic digital skills to bridge a potential knowledge gap. If a school focuses on ICT, all subjects should be included and pull the load. Crafts occupy a special place in Art and crafts, but that does not mean that the former should be the only part of the subject. To ensure that youngsters develop the digital skills necessary for the 21st century, along with sufficient practical and motor skills, teachers should find a way to include both ICT and craft in the subject.

The three assignments for use in the Art and crafts subject presented in the start of this article can all be viewed as possible solutions for combining ICT with craft. Cross-stitch embroidery and woodwork develop the youngsters' motor skills and they learn basic skills such as threading needles and handling knives, as well as give them experience in working with soft and hard materials. Building a house made of gingerbread or cardboard trains their practical skills when assembling flat pieces to create a three-dimensional structure. Working with the paint samples for the digital collages provides experience and knowledge about different types of paint on various surfaces, which will offer a solid foundation for further work on paintings. These are all common tasks

mentioned in the Norwegian curriculum and used by many Art and crafts teachers. What are the advantages of combining them with ICT?
First, as many of the teachers expressed their fear of ICT taking over the subject, pushing out the crafts, we believe in the importance of showing that these contradictions can be combined. It is not necessary to choose either craft or ICT; instead, the digital tools can support craft projects, speeding up slow and repetitive parts of the process to leave more time to work on the craft aspect. This might be best shown in the example of the cross-stitch embroidery, where the pattern is generated in seconds rather than spending hours on drawing it manually. Moreover, giving the traditional craft a more modern appearance by using photographs may make the assignment more interesting for youngsters. By working on designs in SketchUp, it is possible to make blueprints and stencils in the same process, instead of drawing these separately. The option to cut and paste allows for rapid duplication to try out small design tweaks or use the same design elements in different pieces. It does not mean that ICT should always replace the hand in sketching, considering the positive aspects of the slow process of drawing manually, as pointed out by Sennett (2008, p. 295).
In the first assignment, working with paint samples allows for a freer exploration, as students are not restricted by the fear of ruining a nice painting. The notion that the samples will be used further on may motivate students to search for interesting and beautiful results. Otherwise, they may find the sample making useless and tedious despite the useful experiences such a process may provide. As opposed to the other assignments, its end product is a digital image. One informant expressed the view that digital images are often impersonal, artificial and lifeless, which seem to be negative characteristics in the Art and crafts. In this assignment, the digital images are based on handmade images that are later digitalised. This process provides a personal touch and richness in texture that may may counter the informant's association of digital images with negative attributes.

Working with software for 3D modelling can enhance the youngsters' understanding of perspective and the relationship between two-dimensional representations and three-dimensional objects. This skill is necessary for creating their own drawings or understanding images, such as architectural sketches.

An important aspect of digital skills is the knowledge of copyright and the laws that restrict sharing of images. When working with photographs in a project such as the cross-stitch embroidery, it is relevant to address this issue, as found images might be used, modified and built upon in making patterns.

6 Conclusion

This study showed no significant difference between schools with and without a priority digital focus, in the Art and crafts subject. In fact, the informant who stated most vehemently that she avoided ICT worked in the school with the highest implementation of digital tools.
Most participants in the study put weight on craft, developing practical and motor skills, working with the hands and gaining experience with materials. In their respective writings, Vetlesen (2015) and Sennett (2008) shed light on the value of craft and materiality. According to them, technology may lead to an abstraction of our surrounding world and offer less physical and sensuous experiences, meaning that we will have less understanding of our surroundings. Art and products made with digital tools may also become less personal, whereas the personal perspective is highly regarded in Art and crafts.
Some participants expressed the opinion that it would be unnecessary to teach youngsters how to use ICT, as they would master the tools on their own. This is not necessarily true for all, as differences in gender, social class and interests affect their digital skills. The schools must therefore take the responsibility to train all youngsters in the necessary skills for the future.
Craft and materiality are highly valued by Art and crafts teachers and should remain so, but there is also a need to include digital tools. Through three examples of assignments for use in the Art and crafts subject, we showed that a combination of ICT and crafts might be fruitful for both developing

digital skills and practising traditional crafts. Art and crafts teachers should not feel the need to choose between ICT and craft but include both in their teachings.

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Redesigning Migrant Children's Education Through Service Design in Shanghai

BO Gao* and QING Deng

Tongji University
* Corresponding author e-mail: gaobotj@163.com
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The issue of education for migrant children has become highlighted in urbanized transformation of Shanghai. The difficulties reflect on the following aspects: the part of education for migrant children is counted out of public educational system; when growing up, migrant children have to come back to their original hometowns to attend the matriculation test in which the contents are distinguishing from what they've learned in Shanghai; because of migration, it is difficult for this group of children to be engaged into social life of Shanghai. Hence new methods of the education for migrant children are supposed to be considered. This research aimed at cultivating migrant children's design thinking through methods of service design, which involved D-STEAM, holistic view and stakeholders. The design process and four design prototypes are presented in this paper. After testing, the prototypes obtained positive comments but also suggestions for improvement, which demonstrated that service design is an effective way to improve the quality of preschool education for migrant children in kindergarten of Shanghai.

service design, migrant children, preschool education, educational transformation

1 Introduction

Since 1980s, a huge amount of rural labors population swarmed into big cities like Beijing, Shanghai and Guangzhou, which led to tremendous changes in population structure and educational requirements. The number of migrant children moving to cities with their parents increased gradually during recent years, from 81.3 thousand in 2008 to 199.3 thousand in 2012(Lu, 2013). The problems that include different education government policy, lack of teaching resources and teachers hinder the development of preschool education for migrant children.

The project team, comprised by research team in Tongji University, the United Way and Yang Design, tried to improve educational service for migrant children in Shanghai through co-operation and co-design among children, parents, teachers, educational institutions and social organizations.

1.1 The situation of education for migrant children in kindergarten

1.1.1 Government polities

As one of the cities that put attention on preschool problems of migrant children, Shanghai government published Advice of The Preschool Education Work for Shanghai Migrant Children (Shanghai Municipal Education Commission, 2008), which emphasized standard management to the private kindergartens mainly for migrant children. By 2014, migrant children, with the amount more than 210.9 thousand, occupied 41.94% of the registered children in kindergarten.

1.1.2 School and teaching resources

The group of migrant children has a high mobility and generally low education background, and the proportion of their school attendance is always in fluctuation. They mainly enter into private kindergartens or nurseries, most of which were rebuilt from old factories or dwellings and had many problems in space and equipment. In addition, the instability of teacher employment intensifies the pressure on those kindergartens.

1.1.3 Domestic education

About 75% migrant labour in Shanghai gained education no further than junior school. 93.6% migrant families rent flats in suburban area with much lower cost or even sheds, tenement houses, which place children's learning and entertainment in a terribly disturbed environment. Besides, the parents are not able to have enough time and energy to stay with their kids, because migrant labours usually are employed in jobs with intensive physical input, which result in the near vacancy of domestic education part. Meanwhile, the communications between are also in a low frequency.

1.1.4 Social organization

Under the rise of public educational requirements, educational charities in Shanghai that focused on emotional care for "left-behind" children, social integration of migrant children and preschool education increased from 150 in 2009 to more than 300 in 2013. Resources donation, voluntary teaching and public welfare projects are still the main services that social organizations offer.

2 Research background

2.1 Service design and educational transformation

Service Design methodology has been adopted in the education model transformation, to use it as the human-centered design process considering "a deep understanding and respect for human behaviors, attitudes, dreams and capacities as the essential premise for any design action." (Meroni and Sangiorgi, 2011). In the past years, service design started to play more and more significant roles in innovation of education. IDEO, a leading design consultancy, who has engaged in couple of educational innovation projects. The Gatópolis, a digital game and diagnostic tool designed by IDEO that teaches reading through games and helps teachers address learning gaps. K12 studio in Stanford has dedicated to the research on design thinking in courses of junior and primary school to improve students' creativities; the trial of "Phenomenon Method", started form 2013 in Helsinki, Finland, rejecting traditional infusion education, concentrated on cultivating initiative learning ability.

2.2 Social innovation stimulated by service design

Types of design connected to social innovation as follows: polity design, organizing design, service design and role design (Whiteley, 1993). It has been proved through the emergence and practice of service design that it is the co-operation not the control by certain classes that brighten the values of design (Wang, 2017). As a consulting institution for the government, Design Council in the U.K. used service design as a strategic measure to meet arduous challenges in society and stimulate the economy. The Social Design Department in Applied Art University Vienna made plenty efforts to solve social problems in public space, urban transportation, refugee employment and multi-cultural integration by art methods.

2.3 Preschool education and social innovation

The relationship between social innovation and education is important but intricate. On the one hand, social innovation plays a necessary role in educational transformation. On the other hand, education itself is a way to build awareness of social innovation and cultivate social designers. The connections between schools and society in improving human and social development were mentioned in The School and Society: Being Three Lectures (John, 1899). The development of preschool education can be influenced and restricted by diverse social elements while it can help the positive development of society. Esping Andersen proposed "a child-centred social investment strategy" (Esping, 2002). Hemerijck extended the impact of relationship between preschool education and society to fields of women employment, lifelong study and social competition (Hemerijck, 2009).

3 Research Methods and Analysis

This project lasted one year (from Dec. 2016 to Dec. 2017), operated by Tongji University, the United Way, Yang Design, Shanghai Charity Foundation and Minhang District Education Bureau. The team did research in Huaning Road kindergarten and Shiji kindergarten,and chose Shiji kindergarten to test the 4 prototypes.

Case study is the first research method we used. The research process was driven by design practices, thus useful tools and methods (questionnaires, customer journey, stakeholder map, etc.) could be selected through case studies. Inspired by the western methods in field research we used this time were adjusted to the specifics of our users. Questionnaire was employed to capture the understanding and demanding of parents and teachers. Participants were asked by questions about their living situation and attitudes toward the preschool education. For children, the team organized a service design workshop instead to observe children' s behaviours by playing games with them, painting together and telling stories. It was proved that cocreation with children is an effective tool for making research among them. SERVQUAL was set for parents to make comparing assessment about expactation and situation about kindergarten service.

3.1 Case Studies

My Dream World project, directed by professor Satu Miettinen of University of Lapland, aims to increase the involvement and inclusion of young people in Namibia and South Africa using innovative service design tools. The project helped community organizations to find innovative even radical solutions to the essential services for the young people (education, health) together with their customer, young people. "Where's Daryl?" Project, is an anti-gun violence educational toolkit, designed by Designmatters at Art Centre College of Design. It asks youth to consider their assumptions about guns and discuss the real negative impacts they can have on their lives and goals. Mission Lab, a design studio embedded in the school and staffed by game designers and learning specialists. They design a new education system for a public school operating within the context of the US Department of Education (DOE). In this new system, teachers developed new identities as teacher-designers (Katie, 2017).

3.2 Field Research

According to the research of National Research Council in USA, the learning gap of children in needy or vulnerable families appears during the first 5-year in their life. In December 2016, the research team visited two private kindergartens on third level in Minhang District of Shanghai. 5 service design workshops worked as field research were organized with some research work involving questionnaires and deep interviews and co-creation with children. There were more than 30 interviewees contained children, parents, teachers, and leaders of kindergartens. To get knowledge of the real requirements of stakeholders, the team observed teaching scenes on class, visited the school facilities, played games with the children there, and talked with parents and teachers. We prepared cameras, recording pens and questionnaires to collect data and information. To break the

ice, the team members made portraits for some kids and sent the works to them to attract their interests. After that, the team invited children to paint together under a theme of “What is your teacher/ school like?” to see children’s impression on their teachers and school. Some common toys, like building blocks, were used in games and co-creation stage as well to know of what kinds of toy shapes or game forms the children prefer to. Except visiting the campus environment by the team themselves, children were encouraged to guide them hanging around to explore hidden problems in facility using and daily activities. When talking with children during painting and games, it was also a chance to gain some basic information from them and acquire their abilities of communication, emotion control and expression. As for teaching activities, the research team joined in some lessons to observe and record interaction of teaching and learning. Several team members even tried to experience the role of teacher to consider the service process empathetically.

A service quality examination system of SERVQUAL was used to test the present educational service and investigate the way to improve service quality as well as promote the relationship between the school and the parents. The SERVQUAL (service quality framework) was used widely as a basis for evaluating the service quality of existing feedback systems and investigating the outcome of the service design from the user perspective. SERVQUAL provides a basis for many quality measurement models/tools, the framework comprises five service dimensions (Zelthaml,1990) :

1. TANGIBLES-Appearance of physical facilities, equipment, personnel, information transparency and communication materials
2. RELIABILITY-Ability to achieve service promise supports for parents/children, high-quality service and emergency measure.
3. RESPONSIVENESS-Working information update, timely response to parents/children’s asks and timely service with enthusiasm.
4. ASSURANCE-Ability to convey trust and confidence to parents/children, politeness and ability to solve problems from parents/children.
5. EMPATHY-Individualized consideration, enough service time for all parents/children, awareness of special requirements and parents’/children’s profits.

From the result of SERVQUAL Test, the team could know parents’ expectation and satisfaction on school service, like teaching contents and quality, and which aspects of children they focus more on, diets, acquired knowledge, grades, physical and mental development. In addition, using and analysing methods of Rorschach Test was quoted to help the team know children’s psychological situation. However, the results did not have enough value for design process: all of the choices of satisfaction they marked were at the highest level and made no negative comments, which might result from that they were designated by the kindergarten.

Table 1 A table outlining the methods used, the participants, the duration, the data collection methods in the service design workshop.

Contents	Methods	Number	Data collection methods	Lasting time
1.Service design workshop with children	Painting with children	20	4 cameras for video and photo	1 hour
2.Service design workshop with children	Playing games with children	30	4 cameras for video and photo	1 hour
3.Service design workshop with children and teachers	Observation and interview with children and teachers	35	2 cameras for video and photo; 2 recording pens	2 hours
4.Service design workshop with parents	Interview with parents and SERVQUAL Test	10	10 testing questionnaires; 2 recording pens; 1 camera for video and photo	1 hour per family
5.Service design workshop with children	Rorschach Test	10	2 recording pens; 1 camera for video and photo	30 minutes

Figure 1 Service design workshops worked as field research in migrant children kindergartens of Shanghai in December 2016.

After on-the-spot visit, the results of field research showed that the actual situation was almost consistent with the expectation on the aspects of family backgrounds and educational contents.

The main issues found during research are as follows:

1. The children were too young to express themselves well. They might have high enthusiasm to be engaged, but the efficiency of communication was not satisfying.
2. The parents were active. But their responses were not consistent with the children's and the real situation. On the other hand, the parents mind of domestic education that it is enough

only to provide sufficient sustenance for children brings difficulties for the project development.

3. Lack of outdoor space and narrow teaching space. Most settled in rebuilding places, the kindergartens meet problems in detail like interior construction and the height of stairs. Usually, a group of children are gathered in a big classroom because of lack of individually playing space. The teaching contents depend on the arrangement of each kindergarten. Most teaching tools were made by teachers, which cost too much time and have got old and shabby.

Figure 2 The main issues found during filed research in migrant children kindergartens.

The critical issues were defined through practical research with tools of service design, four design prototypes were produced after co-creation, which aimed to train children in design thinking and help the educational system rebuilding to achieve educational equality. In the service system (Gadrey, 2002) of preschool education for migrant children (service target), parents (requirement proposer), kindergartens and teachers (service provider) are the main research targets.

1. Service provider (kindergartens and teachers): The kindergartens for migrant children locate mostly around urban outer loop and suburban loop, closed to the living place of migrant families, with the problems of imperfection of facilities, lack of teacher and teaching resources, uneven levels of teaching quality but high standard for registration.
2. Service target (children): The society and parents usually concentrate on the “knowledge” and “skill” that children learn, but ignore their requirements on emotion, psychological health and individual development. Impressive mental problems can easily appear because of the lack of parent-child communication.
3. Requirement proposer (parents): The parents, commonly lowly educated, are mainly working as physical labours whose jobs may be replaced by automation in 10 years. Neither can they provide help on children’s studying, nor do they have spare time or energy to accompany their kids, which cause the absence of domestic education.

Figure 3 Service target research and persona.

After analysing the results of research and confirming the exact issues, the design team groups made desk researches respectively. Delivered from the research, strategies of redesigning migrant children's education guided the following design process.

3.3 The strategies of redesigning migrant children's education through service design

The importance of preschool education lies in how a person's habits, interests and values are shaped. The project team tried to find various touch points from safety, health to mental requirements. What children need more are the attentions and cares on their psychological development. The key points below are results from discussions and co-creation with the project team and stakeholders:

3.3.1 D-STEAM via the Internet

D-STEAM combined concepts of STEAM Courses. STEAM (Science, Technology, Engineering, Art, Mathematics) modularized courses, advocated by the American government, aimed at boosting the education quality in science, technology, engineering, art and mathematics in K12 project, which is the new global educational tendency under backgrounds of integrative subjects. Integrated courses are encouraged to engage diverse fields of knowledge and establish closed connections among subjects, which provides students with comprehensive diversified learning environments and guides them to solve problems by practicing theories from multiple fields. MOOC (Massive Open Online Course) provides interactive user forums that help build a community for students, teachers, and parents against traditional course materials such as videos, readings and problem sets. MOOCs have the potential to serve as "educational positioning systems" that precisely navigate students through their curriculum along individual "pathways and routes to maximize student success."(Linda and John, 2012).

Several points need to be noticed:

- The connections between theories and practices in real life.
- The process of learning, rather than the results of grades after test, deserves more attention.
- It is required to form a legible and interactive preschool education system through methods of information design and games online without the limits of time and location, which will help to fill the studying gap in front of children from needy families.
- Information base (information of parents and students): a collection of parents' contact information will help teachers and parents communicate timely and efficiently. Parents are able to receive information from school on platforms of Wechat or other Apps while they are encouraged to participate in education process.
- O2O instruction for parents: an integrated O2O instructive plan for parents from diverse social fields and income level can help parents acquire their children's learning requirements.
- App service: The App service has functions of timely guidance and updating information, which can facilitate the parent-teacher and parent-parent communications and collaborations.

3.3.2 Engaging more stakeholders in the holistic view

The holistic view in this project is not simply equal to the design for courses or teaching tools. The concepts of "ways of working", "ways of living in the world", "ways of thinking" and "working tools" in cultivation model for future talents in the 21st century (Maria, 2016) helped the research team to consider the system comprehensively and develop realizable design cases.

Participations of NGOs and social corporations can help to build empathy among stakeholders, enhance educational service quality and solve other complex problems. The financial flows can also operate smoothly by engaging commercial models from public welfare organizations. What's more, teachers (the service provider) can be helped to gain professional training and positive vocational management, which is a new way for housewives accessing to employment. As the Early Childhood Family Education Plan in Minnesota, USA, for example, it provided advanced early education for children, based on household nursery recruiting and training house wives as teachers, which helped those women's career development a lot.

3.3.3 Redefining the critical stake holders

The teacher is the key link to the final satisfaction to service and the service quality. Not enrolled in the personnel system of public education department, teachers in kindergartens for migrant children are not able to get professional titles or join the vocational award list. They are under intensive working and stressing pressure but lack of supports form relevant polities, which bring about a general low satisfaction to this job. Therefore, the experience of providing education service needs to be emphasized in design.

The preschool educational model of Community + Kindergarten, developed from aspects of space, teaching contents and personnel support, can help ease the burden on teachers effectively. As Gestwicki mentioned in 1991, more resources in the community are available for teacher to design courses. Communities can offer the natural, human and physical resources that are needed in children's social learning while teachers are capable to access those resources (Carol, 1991). Brief Guidance for Kindergarten Education (Trail) (Ministry of Education, China, 2001), mentioned that, "frequent co-operations should be built among kindergartens, families and communities… all sorts of resources are supposed to be gathered to create beneficial conditions for children's development." Functions of kindergartens and communities need to be integrated organically through the awareness of sharing and collaboration to stimulate educational transformation. For instance, a special space settled in kindergarten, like community caring centre or vegetable-planting area, can offer caring service for children and let children learn more about nature and society, which helps their healthy growth in community.

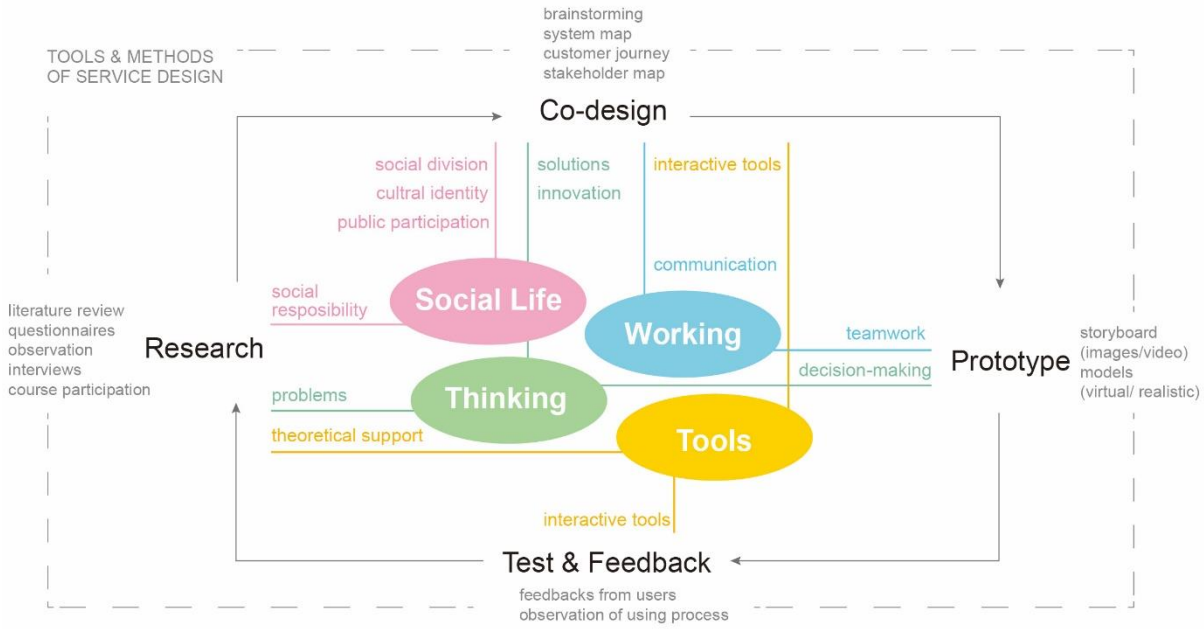

Figure 4 Considering requirements of users and education transformation, the frame work for Service Design for Migrant Children's Education is structured among touch points in service design process.

4 Design process and prototypes

4.1 The Power of Play: teamwork learning

Play, love, and work may constitute separate and distinct dispositions, they function most effectively when they operate together (Elkind, 2007) With multicolour clay as the teaching tool, activities were designed and organized by the design team to build and improve children's awareness of co-operation and team spirit.

The design team used the Rorschach Testing to learn the psychological status of migrant children. They also tried to communicate with the children by playing games with them and shot the process to record their emotions and behaviours in case of their limit on communication ability and emotion control.

According to research, the material of clay was chosen as a new teaching tool to match the redesigned teaching process: 1. Color learning: children learn colors from clays in different colors; 2. Exchange and co-operation: children need to accumulate diverse colors of clays by exchanging or mixing with others' to learn knowledge of color and how to communicate with others as well, which can relieve the children from pressure of unacquainted environment; 3. Co-creation: a group of children are organized to fill colors into a simple pattern frame together by using their own clays, through which they can experience the pleasure of teamwork and art creation. Their works, at last, become decorations of their classrooms. The testing team, comprised of a kindergarten teacher and 6 children, half are boys and half are girls, experienced a 30-minute testing (equal to a class time). It showed from the recording video that the children were excited in learning knowledge of colors and mathematics, and they finally finished a pattern work together, which matched with the design concept. Most process worked by kids themselves while the teacher just gave some supports on organizing. The teacher thought it was an efficient teaching project because it was attractive to kids and easy for teachers to accomplish teaching work with 50% discount on workload. Meanwhile the kids were so interested in the whole process that they even asked more testing time to play with clays.

Figure 5 Service design process: research, brainstorming and testing (left); co-created work by kids and the team (right).

4.2 Mushroom Growth Plan: aesthetic training

The design group was inspired from current inferior decorations in the kindergartens. Aesthetic education, which is easily overlooked in preschool education for migrant children, is the critical point of this project. It also can be regarded as an effort to transfer the aesthetic education service from elite educational content to popularization.

For testing, the project team organized 4 groups of children (3 children per group) to co-operate and create a simple pasteup work.Under the proper guidance, children are able to express their emotions and release their negative moods through art methods. When the teaching way transformed from unilateral to participative, children's enthusiasm can be aroused and teachers' skill can be improved meanwhile. The art works by co-operation has the power to raise children's aesthetic awareness, their self-confidence and also the sense of group honor.

Having co-designed with charity organizations, the design group produced a new service journey: the project will get financial support from sponsors in the migrant labors' hometown through online platform of public welfare organizations; volunteers will be recruited mainly from university students in Shanghai to help teachers with preparation of materials, organization of activities and co-creation about paste-up work, color filling and some easily controlled and low-expense art works. Volunteer recruitment information is published on platforms of university student unions and relevant Wechat pushes. At present, voluntary training is going to be started with more than 30 applications have been uploaded. And the project team is trying to find access between voluntary service and university CETs transferring.

Figure 6 Testing and co-created work by kids and the design team.

4.3 Kuang-kuang: knowledge of hometown

The children migrate to Shanghai with their parents almost have no idea nor memory about their original hometown, according to the research, around 70% to 80% migrant children will come back to their hometown when they get elder. The problem of adaption to unfamiliar environment will confront with them again. Peer tutoring enabled students to critically evaluate cultural stereotypes and reflect upon their own cultural practices (Ghassan & Bohemia, 2015).

To introduce knowledge of different hometowns and strengthen the sense of regional identity, a traditional type of paper-made train as a new teaching tool, named “Kuang-kuang” (imitating the sound of running train), was created by the design team, which carries puzzle pieces of their hometown, local food cards, dialect books and instructions for teachers and parents. Every kid holds one carriage about his or her hometown and learns the place by playing with the stuffs inside under the guidance of teachers or parents. The carriages of train can be connected by nylon tape, which is convenient for children to communicate with each other and play together. Through the prototype testing, parents and teachers showed great interests in this project. Their memories about hometowns were reminded when they join into it and they could share abundant experience and stories with their children. “Peer Tutoring” could be seen as a beneficial intervention or lesson for the parents and teachers, (according to research, most teachers are also migrant from other provinces.) which can help form a positive learning interaction from kindergarten to family, and children may have a deeper affection to their hometowns.

Figure 7 Testing and co-created prototype by kids and the design team.

4.4 Accompanying storybook and App

Family education is the basic support of academic and social education. But the parents of migrant children are seldom aware to spend time on accompanying with their children. The pictorial storybook and App available for parents and children in this project were designed to tackle the very problem. Parents and children complete the illustrations in the storybook together and then upload their works and photos on the App platform sharing with other families, on which an online gallery will be formed to collect precious memories of accompanying time to improve domestic affections. The storybook was finished and gained warm welcome from children and parents. As for the app, the parents praised it, but it kept its step before commercial exploitation because of the lack of financial support.

Figure 8 the prototype of accompanying storybook and App for migrant children and parents.

4.5 Feedbacks

After four-week design process, the project team presented their work and held an exhibition in YANG DESIGN Museum, in which part of stakeholders like volunteers (20%), teachers (50%) and designers (20%) were invited from Shanghai Charity Foundation, the United Way, Minhang District Bureau of Education, Shanghai and kindergartens for migrant children, from whom comments and suggestions were gathered. As the staffs from Bureau of Education said, the educational transformation could be inspired by the service design for preschool education in this project, which was an unprecedented trial. Teachers from kindergartens raised some specific advises on details about material recycling and organizing activities. The presenting process was supported and reported by some mainstream medias in China like IFENG.COM. The whole project was displayed on Shanghai Design Week afterwards and received good reputation. When looking into the results of feasibility election voted online, “The Power of Play” gained most favorable rate (32%), other groups shared the rest percentages in turn as follows: “Aesthetic training” rated 30%, “Kuang-kuang” rated 28%, and “Accompanying story book and App rated” 26%.

5 Conclusion

This research is among the first attempt to solve the issues related to education for migrant children sectors, though their needs to develop more China specific and innovative approaches to fit the local complexities. The working group have mind to validate and optimize our service design approach against the feedback along the way going forward, and bring up the research on the prototype of the diversified service innovation as project subjects in next phase. The future research will pay more focus are as follows:

In this global knowledge-based economy, design requires a brand new and more proactive attitude toward economic and social change. Designers involved in such projects need to take the initiative with all stakeholders together to find new ways and possibilities, and act as guides and organizers to drive the "things" to take place (Lou, 2016). On the other hand, designers' in-depth capabilities are becoming more and more important. In this project, interdisciplinary knowledge such as contemporary tutoring and early childhood psychology help designers create new service design tools to solve complex problems.

At present, it is very difficult for the migrant children kindergartens to bear the cost of expensive equipment. The design of low cost and easy replication is still the focus of current teaching for migrant children. Eventually the ICT (information, communication, technology) based design approach cannot be implemented in this project. From a long-term point of view, high-tech based approach will significantly help establish a clear and cordial pre-school education system and reduce the labour intensity of kindergarten teachers to effectively tutor, and moreover, bringing kindergarten children to online learning is important for their future training. How to control costs and facilitate the replication of ICT education is the research direction going forward.

For the moment design-involved education focuses more on the design of the physical environment, such as the design of kindergarten fields, the environment and teaching aids, but lack of intangible environment design. Intangible refers to the social relations of people in life and related information including: family atmosphere, kindergarten style, kindergarten culture and teacher's ethic codes. Unlike other areas of education, preschool education places strong emphasis on developing the whole child - attending to his or her social, emotional, cognitive and physical needs, in order to establish a solid and broad foundation for lifelong learning and well-being.

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About the Authors:

BO Gao is the associate professor and master instructor of teaching and researching on service design, information and media design, sustainable design in the College of Design & Innovation, Tongji University.

QING Deng is a master degree student majoring in Media and Communication Design, College of Design and Innovation, Tongji University.

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Design Processes and Co-Activity in Design Education

KVELLESTAD Randi Veiteberg

Oslo Metropolitan University
randi.veiteberg@hioa.no
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Co-activity and interaction are necessary in education as well as in design processes. In an artistic design process, interaction occurs between the material, the techniques and the artist. In design education, interaction occurs between students and the lecturer, between students and other students, and between students and the task. To explore the similarity between design and education processes, this article uses the Black Thread project, which involves co-design embroidery, with a focus on design education within higher education. The project involved nine student groups studying design education in the Specialised Teacher Training Programme in Design, Arts and Crafts at Oslo Metropolitan University in Norway and took place over a three-year period. The lecturer's instructions and recommendations were vague in the first year and clearer in the final two years. The groups cooperated and collaborated, showing how they related to the design and describing the communicative and relational processes. Co-design embroidery projects such as the Black Thread project help to develop the patience, manual skill, creativity and ability of the participants.

development work; design education; embroidery; co-activity

1 Introduction

Design participation and cooperation takes place both in education and in professional practice. Participating in a long design process provides opportunities for the development of designs and materials as well as the opportunity to analyse processes and working methods. Professional education is also based on education and practice. It might be helpful to note how research-based teaching relates to the idea of both education and research being required for design and education. Following the introduction of a new common law for universities and colleges in 1996, research requirements became clearer. The term research-based teaching was emphasised to stimulate quality and diversity in Norwegian higher education. The term is multifaceted, and the form it should take depends on the subject area in which it is being applied (Hyllseth, 2001). The strategy of Oslo Metropolitan University is to develop and stimulate interaction between education, research, professional practice and innovation (Havnes, 2011), but it is important to determine how this strategy can be implemented practically and which materials and techniques are the most suitable.

Both Richard Sennett's *The Craftsman* (2009) and Kristine Riis's Ph.D. thesis (2016) about design and the design process support the importance of working with and exploring materials and techniques thoroughly. The master's degree programme offered by the Oslo Metropolitan University's Department of Art, Design and Drama was established in 1976 and for many years emphasised a balance between practical work in workshops and academic anchoring (Fauske, 2014). The programme gave students the opportunity to experience practical work with textile materials and embroidery and, through this experimentation, to gain a deep interest in the subject area. Moreover, the studies involved cooperation with an artist in a textile workshop. The design work became part of a new system for the students and artists, providing with an outlet for experimentation and teamwork based on business and private assignments.

This interaction with an artist was, similar to Schön (Schön, 2000), called internship practice. Alexander Carnera (Carnera, 2012) describes the work between a master and unskilled workers as a laboratory for focused motivation with an emphasis on supporting committed working relationships. Academically, the process evolved from a kind of basic research to the development and application of knowledge. Kristina Niedderer (Niedderer, 2013) discusses which research questions are important to ask in the creative practice of art and design, noting a distinction between art knowledge and design knowledge, which require different questions. In this article, questions related to two areas are presented: the lecturer's development work in exploring materials and the facilitation of student education. In both areas, interaction is important for change and development.

When reflecting on the course of the design process, the study's author identified four main roles resulting from the dynamism and flexibility of co-activity. The roles evolve from practitioner to designer to facilitator and, finally, to researcher (Figure 1).

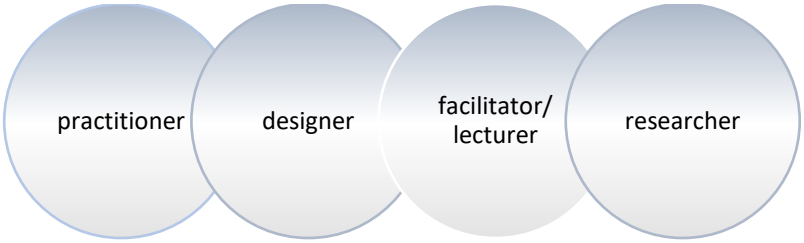

Figure 1: The roles in co-activity: practitioner, designer, lecturer and researcher

The students in the Black Thread project were involved in the lecturer's exploration of synthetic leather and silk thread. The project was a kind of action research in a practical course with materials. Retrospective reflection linked what and how the students designed and improved their performances. Small communities (Wenger, 1998) occur when students discuss design, materials, methods and function, and this dialogue plays a central role in training and preparing them for the teaching profession. Within co-activity, there is a difference between cooperation and collaboration in interaction; in this project, some groups cooperated while others collaborated, with interesting differences in outcomes. Throughout the project, the roles of the students and the lecturer switched between practitioner, facilitator, designer and researcher.

2 From basic research to applied knowledge and development

In 1996 (Kvellestad, 2004), the author of this study participated in the master's degree programme being studied, and it was possible to engage in practical research in materials as a part of the degree. Thus, the practical working method was an exploration in process with systematic work included pre-phase and multiple trial phases on materials, details and the end use of knowledge for new expressions. The work followed the hermeneutical research tradition, with an exchange of understanding and experience between completeness and detail. Thurèn (Thurèn, 1994) calls this a *hermeneutic circle*. An interpretation of the material indicated the further work to be done and the end results. In particular, the interpretation became important when knowledge and experience

were to continue after the original exploration. This research method suited the material field. However, at this time, there were different traditional research methods used depending on the subject being studied (Fauske, 2014). Fauske claims that education was widely oriented with regard to research methods and traditions, opening the door for research and specialisation within the practical field of materials and allowing the field of study to be documented in a more scientific way.

In retrospect, this work seems to be a type of basic research within the field, where the examination of a tool in various ways can indicate a new use of the tool without the aim of a specific application. The use of dialogue and the questioning of techniques played a useful role in the systematic work in the master's degree programme. Through many phases, in which the results were described using categories, there was always a conclusion that led further into a new phase. The material choice was constant, but the pace and direction of the gear varied. There was a dialogue between the researcher (practitioner) and the technique. Figure 2 shows the stages of study and practice that result in the development of design competence. The design process began in a seemingly random way but evolved to have meaning and growth.

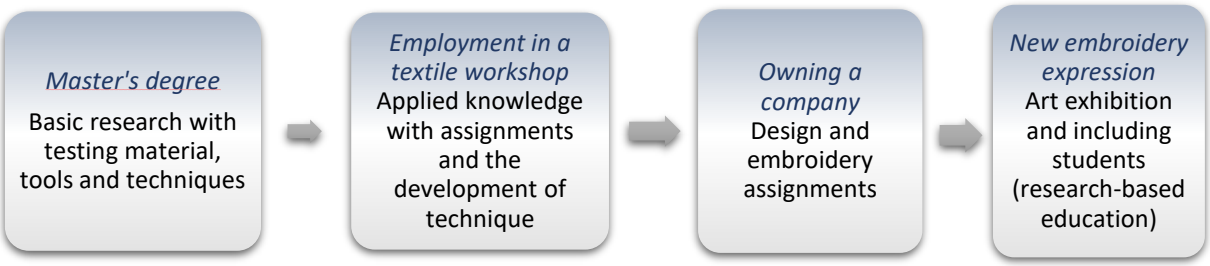

Figure 2: Stages in artistic development work

After completing the master's degree, the author secured a position in higher education in which she participated in additional research and development work. This opened up possibilities for continued practical work in materials. In 1995, the university introduced artistic development as a parallel to research and professional development. That is, artistic development work became aligned with scientific research according to university law. This supported a practical approach in research and development work. In 2007, the *Weight on Artistic Development* report was published, and performance-based indicators were developed in Stortingsmelding (Parliamentary Report) nr. 20 (2004–2005): "Development work is a systematic business that uses existing knowledge from research and practical experience and is aimed at presenting new or significantly improved processes, systems and services" (Kunnskapsdepartementet, 2005).

Research and development work made it possible to remain in the design process over time and to develop personal art while also involving students in the project. Dialogue between thought and action developed in the design processes (of both art and craft). Flexibility is an important property in the creative process and necessitates reflection and judgment. It results in co-activity with the materials and the techniques. In professional practice, expertise and competencies were used in new ways (Schön, 2000), prompting questions related to materials, processes, concepts and the use of objects (Niedderer, 2013).

In 2009, Sennet published the book *The Craftsman*, which emphasised and elevated crafts by discussing them with great respect and insight. He mentioned targeted work as an important part of crafts. According to Sennet (Sennett, 2009), targeting is something that is achieved, not something that is set in advance. You work and work, then you stop and you reflect before you start working again. This process is similar to Riis's creative dialogue, which is characterised by openness, complexity and a dynamic nature. A creative dialogue contains sketches, form studies, solutions and changes (Riis, 2016). Knowledge in design emerges through application, challenge and the development of experiences as well as through knowledge and action rules (Riis, 2016). It is, therefore, useful to have a break in the creative process.

3 Interaction with the materials

In embroidery exploration, a break could mean choosing unknown materials and themes or assembling two or more unusual embroidery materials in an attempt to expand borders. For example, synthetic leather with silk embroidery is not an obvious combination, but this increases the novelty of the materials. In the project, the lecturer was a researcher, a user and the initiator of the material, and there were many questions. It was necessary to take small steps and select clear constraints: only one colour was used, either white-to-white or red-to-red. This limited the possibilities and gave a deeper understanding of the material through experience and reflection in designs and crafts (Kvellestad, 2017). Through different tests with the material, new critical questions arose. A thorough investigation of the combination of materials and stitches was conducted. Combinations with different stitch densities, lengths and directions yielded interesting variations and possibilities (Figure 3).

Figure 3: Randi Veiteberg Kvellestad, details from embroideries in synthetic leather and silk thread, white-to-white, 2016

Exploration continued in dialogue with the simple stitch and by looking at previous works. The material's dull surface provided resistance to the needle, and when the stitches tightened, a relief arose, resulting in the embroidery rising from a two-dimensional surface. Applying only one colour inspired creativity and innovation with new expressions in the material. This was an experiential and procedural type of knowledge—knowledge derived from experience (Niedderer, 2013).

The use of questions and dialogue played an important role on three levels: the material, technique and embroidery topics (Figure 4). To take the material seriously, a sense of co-ownership was required, which was important for creating quality. Among other things, Sennett (Sennett, 2009) highlights the curiosity regarding whether a material will produce a work of great quality. To achieve good craftsmanship, it is crucial to work with great respect and to derive meaning from the works. Quality is a likely outcome when you spend time and have patience with the embroidery in the design process. A creative process takes time, and in a research context, it always includes reflection and judgment (Hansen, 2013). There is a binding working relationship between the artist and the material. Questions are asked, tests are evaluated, new tests must be made, new questions must be asked and, thus, the work and research are established. Carnera (Carnera, 2012) writes beautifully about a binding working relationship, defining it as that which occurs in the meeting between skill development and experience formation and which adds to the learning process an assessment of both poetic and aesthetic judgment.

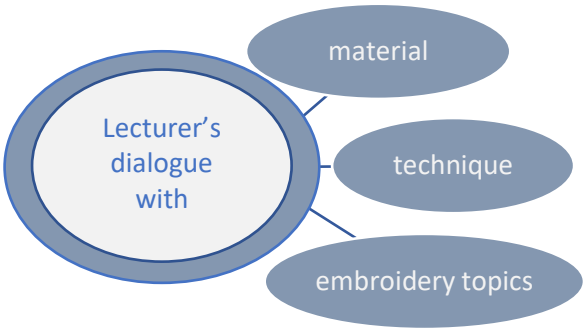

Figure 4: The lecturer's dialogue played a role in three areas: material, technique, and embroidery topics

Other characteristics of embroidery were mentioned by textile artist Annika Ekdal, explaining that "to embroider takes time and time is visible"; this visibility gives the embroidery respect (Robach, 2012). Stitch after stitch is added, a motif is added and the slow becomes visible (e.g., see Figure 5). The material-based creation process is slow, and so courage and patience are important factors (Karlson, 2012).

Figure 5: Randi Veiteberg Kvellestad, embroideries in synthetic leather and silk thread, red-to-red, 2016

4 Co-designing embroidery: The Black Thread

A big advantage to working with students is that they can be included in the research and development work. On one hand, they can do practical work, and on the other hand, they can be informants and critics. Before any of this, however, they must be asked to participate. Oslo Metropolitan University's Specialised Teacher Training Programme in Design, Arts and Crafts, organises several material-based periods, including a four- to six-week textile period. During these periods, the students learn different textile activities through workshops. In most of these activities, the students work individually. They learn the craft and can be creative, testing new ideas at short notice. Later in the study, they are given the opportunity to immerse themselves in the techniques and materials. The present project, the Black Thread project, took about one week and was organised differently than were other activities, requiring students to learn and cooperate in groups—a professional didactic approach with practical material work.

A total of nine student groups distributed over three years (i.e., three groups each year), were involved in the completion of embroidery tasks. Each group consisted of 12–17 students who were required to collaborate in solving challenges concerning the task and the practical work. All student

groups were provided with one piece of light grey synthetic leather and different black threads. The idea was to use different stitches on an uncommon material. The instructions explaining the task became more precise as the years progressed, from the first-year groups in 2013 to the final groups in 2016. The improved explanations were reflected in the results of the project (Kvellestad, 2017).

4.1 First year: 2013–2014

Every day for six weeks, students were asked to make a track on a collective picture according to their sense of humour or other states of mind. They had the opportunity to embroider either on their own design or on those of their neighbours. The final results differed substantially among the student groups. The tracks went all over the leather in a free composition. Although the students cooperated, they worked as individuals, with limited dialogue related to the final product (Figure 6).

Figure 6: Students works, two examples of the Black Thread project results from the 2013–2014 groups

4.2 Second year: 2014–2015

The task was essentially the same as that which was set the previous year, but the lecturer instructed the students to make links between the tracks and to invite their neighbours to continue and finish their embroidery. However, before they began, they decided to have a common subject, which was defined through creative and open-minded dialogue, collaboration, discussion and planning of the composition. Therefore, these preparations provided new experiences. Two of the finished works can be seen in Figure 7.

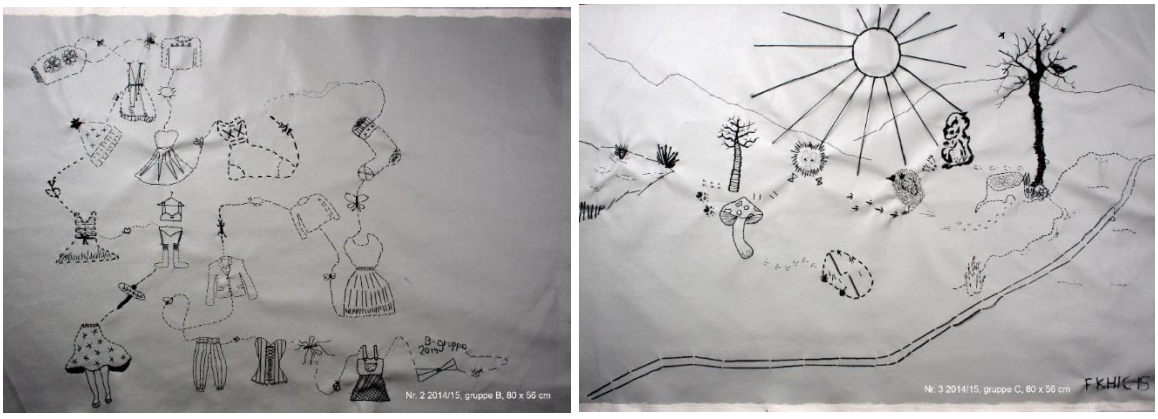

Figure 7: Students works, two examples of the Black Thread project results from the 2014–2015 groups

4.3 Third year: 2015–2016

In the project's third and final year, the lecturer's instructions for the students were even more precise. The students were advised to transfer sketches from their drawing course or from an exhibition in the National Gallery to embroidery, and their neighbours were invited to continue the design. The stitches, textural possibilities with the surfaces and formal composition knowledge were emphasised. The students took photos and discussed and exercised the composition in different

ways. The design process was characterised by openness and appreciation. Examples of student work from this group can be seen in Figure 8.

Figure 8: Students works, two examples of the Black Thread project results from the 2015–2016 groups

4.4 Completion of the project

The differences between the nine resulting pictures were obvious when exhibited in Gallery PP33 in 2016. The three pictures from the first year lacked a planned design process and were characterised by free compositions and tracks with personal messages. The students were not well informed about the project but simply completed the task. Differences in teamwork were observed. In the first year, the students cooperated; their spontaneous embroideries were rougher and their compositions were disjointed and not unified. In the final two years, the students collaborated in the planning of their work and followed material and composition rules. These embroideries were more figurative and the compositions had been planned out. Both approaches to the professional development work required a variety of learning skills and experience with the materials. The observed difference between cooperation and collaboration underlines the role of the lecturer in influencing the dynamics of a group.

5 Co-activity in a design process

The terms co-design and co-creatism evolved from the area of participatory design. Collective acts, including the dialogue between students and other students and the lecturer, borrow perspectives from the area of co-design. In co-design, collective acts of creativity are shared by two or more people (Sanders, 2008). Figure 9 shows a schematic overview of how the co-activity was conducted in the student project, particularly in the last two years.

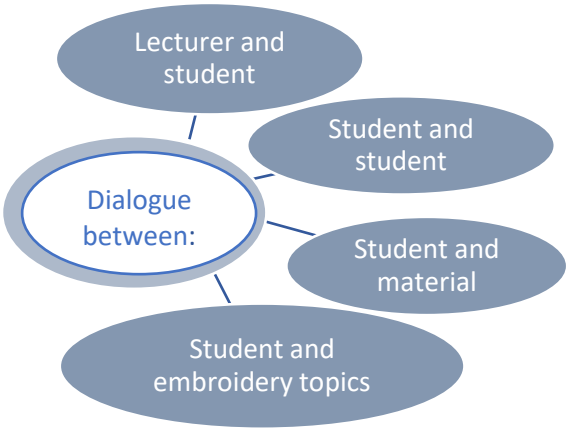

Figure 9: Dialogue in collaboration work: the basic actions at four levels

For students in the two final years (i.e., the last six groups), dialogue in collaborative work was a basic action at four levels: between the lecturer and the students, between the students themselves, between a single student and the material and, finally, between the students and the embroidery topics. The lecturer's role switched between designer and researcher. The lecturer's communication with the students played an important role by initiating the activity and precisely articulating the task. Students were users and designers in completing the embroidery as a whole; they worked with a sense of co-ownership and shared responsibility. In pursuit of a common goal, the dynamics of a group can be characterised as degrees of cooperation and collaboration (Ness, 2016). As the process became more collaborative, recurring challenges gradually disappeared.

In the evaluation at the end of the project, some students mentioned that it was fun to design something without knowing how it would turn out. They used the thread like a pencil—albeit a substantially limited pencil—which could be perceived as beneficial or inhibitory. For example, some students commented that the synthetic leather was nice, solid and comfortable to embroider. The three spontaneous embroideries from the first year were rougher, and their compositions were not unified. Compared with embroideries from the last two years, those of the first were more abstract in composition, as these groups had not discussed a strict framework for the task. They had complete autonomy, free from agreements with the rest of the group, during the creative process.

Before issuing instructions for the groups in the final two years, the lecturer knew more about the material and the possibilities, which allowed the lecturer to explain the task more clearly. These students' plans and discussions contributed to thoughtful and clear compositions with harmonious tracks. It is possible that the lecturer's clarification of the task influenced the results, as the students had to interpret from her instructions whether it was her wish for composition, thoughtful design and the use of the needle and thread. This is a question that should be posed to the students in the evaluation at the end of the project.

The greatest challenge to interaction was the time limitation of the students; their evaluations suggested that they wanted more time to do a better job. Some said they worried about ruining the whole and that it was difficult to get things to harmonise because everyone had different ideas. The majority were satisfied and highlighted their eagerness to see the end result; it was exciting to see how totally different expressions and motives could be conveyed and still constitute a whole. The concept here can easily be transferred to other materials in design education.

In a design process, practitioners take part in collective creativity applied across the whole span of the process. This is one of the strengths of the co-activity method. A designer or a lecturer has ideas and begins a project, and when other users, students or technicians become involved, the ideas change. New ideas, materials and technologies that arise in the process influence the outcome. Co-activity is not rigid or static but rather characterised by flexibility and fluidity, which allow for change

and a greater appreciation of the product. Through collaboration in educational contexts, the lecturer leads the students in their actions, guides them in adapting to changes and provides support for their creations (Kvellestad, 2017). Such interaction challenges the lecturer to ensure that the students take ownership of the task and are users and designers in the process. A good dialogue involves interactions involving mutual inquiry: sharing, exploring, discussing and weaving new ideas, through which newness and possibilities emerge. Responding to one another, a critical aspect of dialogue, is by nature an interactive process (Anderson, 2012). It is, therefore, important to examine the lecturer's influence on the design process and on co-activity, and this examination provides scope for future research within this topic.

6 Cooperation and collaboration

In the healthcare field, a distinction is made between cooperation and collaboration to create better outcomes for patients and their families (Ness, 2016). The definitions of *cooperation* and *collaboration* as they relate to design clearly describe communicative and relational processes. The students of the Black Thread project established such a community, and everyone participated and worked effectively over a short period of time. The project had features common to those in Wengers' (Wenger, 1998) social theory of learning, which can be used to describe and understand elements in a partnership. According to Wenger, learning is created by a social act or in a process between people. Learning is characterized by the situation in which you are and takes place in every practice community.

A thorough analysis of teamwork in the Black Thread project showed differences in participation in the design process, as some groups cooperated while other collaborated. The actors were both users and designers, and they progressed through the levels of doing, adapting, making and creating (Sanders, 2008). All nine groups had about one week to complete the task to achieve a common design. In the first year, the groups cooperated: they communicated, but with minor processual contact. They did not ask questions about the material of one other. Each student completed his or her own task and then passed the piece on to the next person. The contents of the sketches and the topics were fragmented. In the final phase, a few students embroidered wildly and freely and completed the work because there were no group leaders and no common rules for the task. The results appear more abstract compared to those of the last two years.

In the final two years, six groups had a collaborative relationship and dialogical conversations about the material and designs. They asked questions and interacted with one another in mutually responsive ways, and new possibilities emerged. This interaction led to a co-ownership of the project (Anderson, 2012), which was extremely important for its completion. The compositions of the collaborative groups were more figurative. This is an interesting observation, prompting the question of whether it was the lecturer's clear instructions for these groups that impacted the result or whether it was the conversation between the students before they began. The groups had a short deadline, so they had to think and act quickly, and maybe it was easier to embroider effectively when the design was already planned and drawn before the embroidering began. Routines and rules streamline a creative process. A good example of this is in the children's educational context, where it is very important to have clear tasks. Pupils must know what they are to do and what is expected of them. One of the goals of the Black Thread project was for the students to be able to transfer their experiences to their own practice as teachers.

This perspective pertains not only to learning in an artistic context but also to a social phenomenon, with a focus on action and participation; however, it also includes flexibility and fluidity—a community in motion (Anderson, 2012). The students who are creating and exploring together will eventually be teachers and participate in communities of practice. Such co-activity is an action used in school projects in music, language and science courses. Frisch (Frisch, 2010) studied child development in drawing, using the term wildfire effect to explain a drawing activity in which pupils looked at and learned from each other. The sketches progressed and created informal learning. The

pupils were aware of each other's work, borrowed from each other and realised joint development. A fearless approach, with both constructive and instructive interactive moments among the pupils, characterised the activity (Frisch, 2010). By working practically and physically with materials, the students in the present project also achieved a better feeling for touch and a sense of the material and the needle. They might also remember the activity better because co-design embroidery is a long-term process. Even though the timeframe of this project was just one week, which was not a sufficient amount of time for the many students to embroider, students worked on the project at their leisure to complete their portions.

7 Community of practice and interaction

The Black Thread project is an example of a community of practice, which evolved from textile design education involving elaborate dialogue and participation during the design process. Teamwork or small communities of practice (Wenger, 1998) are important parts of training and preparing for the teaching profession, in which the building process itself, as well as dialogue, discussions, co-working and co-exploring, play central roles (Kvellestad, 2017). In design education, small communities emerge and persist when students discuss design, materials, methods and function. Other significant factors include mutual trust and respect for each other's differences. The importance of dialogue is based in the tradition of practical knowledge, such as Molander's (Molander, 2015) knowledge theory.

Participation design emerged within the design community in the 1970s when users were given a contributing role in design work alongside the researcher and the designer (Sanders, 2008). The knowledge building was in a practical field, with dialogue and collaboration with materials, techniques, the artisans and the principals to solve textile assignments. Co-activity as practiced today takes on quite different manifestations depending upon the expertise and mindsets of the practitioners (Sanders, 2008).

Reflecting on the process and results is useful and educational in all professions, although the main focus of this article is artistic development work and the involvement of students in the work. Molander is a pragmatic philosopher who reflects on Donald Schön's main case in *The Reflective Practitioner*: the communication between an architecture student (Petra) and her teacher (Quist) in design learning. Petra was a novice at the University of Architecture, and she had to listen to an experienced practitioner. In their communication, Petra switches between arguing for her own knowledge and being open to the teacher's coaching. Molander mentions four tensions that characterise the action in a dialogic structure: part–whole, commitment/involvement–detachment, criticism–confidence and action–reflection (Molander, 2015, p. 286). In the Black Thread project, students had to work with their own embroidery (the part), select the stitch and thread and make expressive lines. However, it was also important to pay attention to the whole design by looking for balance, repetition and texture effects. They had to discuss, make choices and defend their views with professional arguments, just like Petra. In this little project, they had to trust in those with whom they did not agree. In this dialogue structure, knowledge was maintained and even evolved (Molander, 2015). In a school situation, the teacher will always influence pupils with advice and suggestions for improvement. The same thing happens among students. The lecturer advised, but the students should make their own choices. In this project, the students helped each other, made compositions together, combined designs and explored stitches and textures.

8 The value of being part of a process

In a design process in an artistic development work, both creativity and patience are important for completing the work. This process is similar to Riis's (Riis, 2016) creative dialogue, which is characterised by openness, complexity and a dynamic nature. A creative dialogue contains experiential knowledge or skill that can be described; however, some parts of it evade communication, because we can know more than we can tell (Niedderer, 2013). The concept of tacit

knowledge (Polanyi, 1983 [1966]), however, will always follow a creative dialogue. Long artistic experience, a practical sense of judgment and life experience are of great value in this dialogue. The core of many professions, such as crafts, healthcare and learning, is that human executive judgment is important, being linked to wisdom and reflection.

Meyer (Meyer, 2007, p. 52) describes how skills development occurs through five stages: beginner, advanced beginner, competent exercising, proficient practitioner and expert. Developing skills, crafts or design knowledge takes time. All experience contributes to insight and understanding. Løvlie (Løvlie, 2011) claims that the foundation of experience is developed within an educational environment when one has a reflective relationship with one's own practice. If one participates in a process over time, innovation and development will occur.

This is in line with a professional education based on both education and practice, and there is a close link between education and occupation. Oslo Metropolitan University's goal is to develop and stimulate the interaction between education, research, professional practice and innovation (Havnes, 2011). Jarning (Jarning, 2011) characterises the educational institution as a knowledge triangle, with education/research/knowledge, sharing and innovation. In higher professional education, there is an interaction between these areas. The institution will offer education based on research, professional and artistic development and experience. As a professional employee, one can apply for time allocated for research and development work. This provides opportunities for diverse and non-stagnant work. Jarning also addresses trends in today's Norwegian education race that attempt to remove practical work in education. He points out that performing more research at the expense of gaining experience leads to practical skills and training becoming less valuable (Jarning, 2011). Even when completing one's own research and development work, student participation can help in a practical way as well as allow for research-based teaching.

In the Black Thread project, embroidery students worked within a short timeframe. Their challenge was to make various lines with stitches and texture surfaces and to produce compositions. Schön (Schön, 1991) characterises a second aspect of reflection about craftsmanship as knowledge in action and reflection in action. In action research, knowledge can be both tacit and spontaneous; however, through thought and action, adaptation and adjustments create new knowledge and extend reflection. Dialogue and collaboration aids in the development of curiosity and the understanding of materials, techniques, theses and compositions (Riis, 2016). According to Wenger (Wenger, 1998), groups develop a shared repertoire of resources: experiences, designs, tools and ways of addressing recurring challenges.

In the larger educational context, the present project in design work supports the three themes promoted by the Ministry of Education in the upcoming renovation of the subjects in Stortingsmelding (white paper, Parliamentary report) nr. 28 (2015–2016): democracy and citizenship, sustainable development and health and life skills. The present project stresses life skills, with everyone participating, working, stimulating creativity and demonstrating good attitudes. This knowledge has both academic and social aspects. Interaction is important in almost all professions. Teamwork and participation characterise the work of politicians, educational institutions and health services. The international project *Education 2030* is a framework for the qualifications pupils will need in Organisation for Economic Co-operation and Development (OECD) countries in 2030, including professional knowledge; cognitive skills such as creativity, problem solving and critical thinking; and social competencies such as interpersonal relationships and communication skills (28, 2016). The Black Thread project can serve as an example of an interaction in which these competencies are important to the task's progress. To co-embroider, one must consider the other participants. In the co-design embroidery project, the co-activity was both a method and an action for obtaining results in design education. The value of co-design is that the methodology involves students developing interdisciplinary resources.

Co-design embroidery projects such as the Black Thread project develop participants' patience, manual skills, creativity and abilities. These personal qualities are important for design education and represent the cornerstones of almost every community. The students learned how to successfully manage and complete a project. The forms of cooperation they employed affected the results. Hopefully, they can transform the competences they gained and apply them to teaching pupils of all ages.

9 Concluding remarks

The value of my master's degree programme was greater than originally thought. The degree-initiated processes developed and stimulated both innovation and change as well as the inclusion of students (in the last five years), and experimentation with materials and techniques has been important for artistic development work and design education at the university level. In order to move forward in a design process, violation (that is, the breach of the known or established) is crucial, as this is the only way to try out new materials and possibilities. A crucial issue remains, however, in determining how to use this knowledge in student education. The importance of the Black Thread project was primarily exploring how the students interpreted and reacted to the lecturer's development work (i.e., focused on the subject didactics). This article shows how the organisation of teaching affects the outcomes. Co-activity challenges, but also stimulates, cooperation in several ways, and this concept can be transferred to other materials in design education.

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About the Authors**:**

Randi Veiteberg Kvellestad, associate professor is concerned with education, the teaching profession and practical work in materials as a starting point for research and not least design processes as performing arts in textile and embroidery.

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Augmenting Low Investment Learning Styles

BADNI Kevin

American University of Sharjah
kbadni@aus.edu
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Due to the rapid advances in the use of information technology and students' familiarity with technology, learning styles in higher education are being reshaped. One of the technology developments that has gained considerable attention in recent years is Augmented Reality (AR), where technology is used to combine overlays of digital data on physical real-world settings. While AR is being heavily promoted for entertainment by mobile phone manufacturers it has had little adoption in higher education due to the upfront investment that an instructor needs to undertake in creating relevant AR applications. This paper discusses a case study that uses a low upfront development approach and examines the impact on generation-Z students' motivation whilst studying design history over a four-semester period. Even though the upfront investment in creating the AR support was minimal, the results showed a noticeable increase in student motivation. The approach used in this paper can be easily transferred to other disciplines and other areas of design education.

augmented reality, motivation, technology

1 Introduction

Many students, especially generation-Z students (those born after 1995) have grown up with tablets and mobile phones, and have been able to Google anything they want to know, and as a result do not typically value information for information's sake. Additionally, due to the rapid advancement in information technology, learning styles in higher education are being reshaped. This combination of factors causes challenges for instructors to associate course content to the new learning culture and make the learning outcomes and activities relevant. There are many papers that refer to the numerous technological tools that can be used in the classroom to enhance student learning. However, one of the newest technologies, AR is only now becoming available to teachers due to the prevalence of ubiquitous computing on mobile phones. These phones are now capable of infusing virtual information onto the real world, which is beginning to foster a new neomillenial learning style. The older model of world-to-desktop interface does not have the same psychological immersive effect as overlaying virtual models into the student's real world. This immersion can have an effect beyond the use of high-end computers with associated implications for higher education.

The use of AR and its possible uses in educational settings has attained much research attention in recent years. AR has been described by (Bronack, 2011) as “Bridging virtual and real worlds, AR creates a reality that is enhanced and augmented”. As with many technological innovations, it is not the technology itself that creates a successful intervention, but how the design, implementation and integration into formal and informal learning settings is administered. New opportunities for enhancing learning and teaching by utilising AR which allows learners to visualize concepts with the coexistence of virtual objects and real world environments have been increasingly recognized by educational researchers. (Klopfer & Squire, 2008a) see AR as providing an experience phenomena that is not possible in the real world. While (K. D. Squire & Jan, 2007a); (K. Squire & Klopfer, 2007) highlight the advantages of students being able to ”develop important practices and literacies that cannot be developed and enacted in other technology-enhanced learning environments”.

2 Theoretical basis for AR based pedagogy

Relating to the classroom, (Dede, 2009) describes how students can benefit from AR technologies when conducting investigations of real-world surroundings by engaging in authentic explorations using virtual objects such as texts, videos, and pictures. As with other technology enhanced learning environments, AR systems can help students develop skills and knowledge, however, research has also shown that the use of AR can enhance learning in a more effective way (El Sayed, Zayed, & Sharawy, 2011). The use of AR in the classroom naturally supports one of the three types of interaction needed in education as identified by (Moore, 1989) that of learner-content interaction. Several authors have highlighted the importance of learner-content interaction to foster cognitive tasks such as understanding, memory, and imagination among others (Dalgarno & Lee, 2010); (Neumann & Majoros, 1998). (Sotiriou & Bogner, 2008) state that AR has the ability to increase student’s motivation and interest seeing an increase in motivation and interest helping students to develop better investigation skills and gain more accurate knowledge on the topic. Although AR technologies involve high-end electronics and sophisticated tools, as (Bronack, 2011) argued, these technologies in themselves should not be the driver, it is more important that AR as a concept rather than the use of a certain technology should support learning.

2.1 AR possibilities

AR allows for virtual items and sounds to be overlaid into the real physical environment. This can be in the form of flat images, videos or 3D objects, that can allow the user to inspect the 3D object from a variety of different perspectives to enhance their understanding (Chen, Chi, Hung, & Kang, 2011). An example of this was discussed by (Kerawalla, Luckin, Seljeflot, & Woolard, 2006) who described an example of using 3D AR in teaching astronomy. The AR intervention displayed a virtual 3D spinning earth to allow students to learn about the earth and sun, and day and night. However, what was not investigated by Kerawalla et al. was whether the AR 3D learning experience significantly more beneficial to students than the manipulation of real-world 3D physical models that teachers traditionally used such as a tennis ball on a sting, a football and a torch.

3 Barriers from technological, pedagogical, and learning issues

Numerous AR systems, and in particular those relating to the teaching of science and mathematics have been developed and tested through empirical studies often conducted in lab settings. While lab studies can be insightful, they leave out the complexity of a classroom environment. In addition to normal teaching, the use of AR as an educational innovation raises a number of intrinsic issues such as the peculiarities of the learners, and the principles of educational psychology. Innovation within the classroom can also be hampered by institutional constraints such as the requirement to cover a certain amount of content within a given time frame (Kerawalla et al., 2006).

In recent years, a number of scholars have also been directing their attention to extrinsic constraints that are not related to learning theory, but nonetheless shape classroom practices. This could be physical constraints of the classroom, budgets, time and the requirement to keep a reasonable

amount of discipline in the classroom. (Dillenbourg & Jermann, 2010); (Moraveji, Morris, Morris, Czerwinski, & Henry Riche, 2011); (Prieto, Villagrá-Sobrino, Jorrín-Abellán, Martínez-Monés, & Dimitriadis, 2011). These constraints have been referred to as 'logistics' of classrooms by (Nussbaum & Diaz, 2013) that do not correspond to a grand learning theory but to practicalities that, if they are neglected, may spoil the most effective instructional design.

On first impressions, the use of AR for teaching and learning seems promising, however, some research has indicated negative effects on learning such as low engagement by teachers. A perceived barrier has been the inflexibility and large upfront commitment to create AR apps for the classroom. (Kerawalla et al., 2006) describes how within some AR systems, the content and the teaching sequence are fixed; teachers are not able to make changes to accommodate students' needs or to accomplish instructional objectives. (Bergig, Hagbi, El-Sana, & Billinghurst, 2009) suggest that this issue can be overcome by using authoring tools, or software development kits (SDKs) which allow teachers and students to revise and create AR activities and applications.

3.1 AR considerations in the History of Design

AR has been described as lending itself well to participatory simulations and more studio-based teaching methods. The nature of these instructional approaches as described by (Kerawalla et al., 2006); (K. D. Squire & Jan, 2007b) is quite different from the teacher-centred, delivery-based focus in conventional teaching methods. The History of Design course, is a traditional lecture based course that all students studying bachelor level Art and Design majors are required to take. The syllabus requires as a certain amount of context to be covered within a restricted semester time frame. With this in mind, there were some concerns regarding the amount of participatory activities that would be possible within this class due to the institutional constraints.

To try to minimise the challenges students may have encountered by possible cognitive overload the 'usability' of the app was very important. In the interaction between a user and the app, this variable can be estimated by measures of performance, rate of errors, or user satisfaction. The design had to take into consideration individual constraints such as the student's previous experience of using AR apps. The implementation of AR can be more time consuming and more difficult to manage than presentational instruction (Facer et al., 2004); and has been described by (Klopfer & Squire, 2008a) as more akin to organising a field trip.

To keep usability high, it was decided to keep the AR interaction to a minimum with images and animations simply appearing over exiting images. This was to avoid the issues noted by (Dunleavy, Dede, & Mitchell, 2009) who reported that students often felt overwhelmed and confused when they were engaged in a multi-user AR simulation because they had to deal with unfamiliar technologies as well as complex tasks.

4 AR software development kits (SDKs)

There are many development kits available for creating AR applications, offered by small software companies through to large multinational corporations. In September 2017 during Apple's keynote they announced that they were providing developers with a new SDK for iOS11; ARKit that claims to open up the possibility of developing AR apps for Apple mobiles in a few months compared to previously a few years. Google on the other hand had been touting their Tango AR platform, but as it only worked on a couple of smartphones was dropped and they have unveiled ARCore which will work on millions of Android phones.

It is beyond the scope of this paper to describe each AR SDK's capabilities, but a short summary of some of the main SDKs are shown in table 1. For this paper, the main driver for choosing which SDK to use was functionality versus the time investment required to create the app. The author experimented with a number of SDKs and found the Aurasma ("https://www.aurasma.com/," 2017) SDK to be the most compatible. Aurasma is currently free and very simple to use. To create an AR app first a trigger image is uploaded to the online platform. Then an overlay which the instructor

wants to appear when the student points their mobile at the trigger is selected. This can be an image, video or 3D model. The only slightly more technical issue is for 3D models as Aurasma requires a 'Collada' formatted 3D model, which can be exported from a number of 3D modelling packages. The 3D model needs to be packaged inside a '.tar' archive file which is very much like a '.zip' file. The'.tar' file needs to include the 3D model, textures and a thumbnail. It can also have sounds added. After the overlay has been selected or created the new trigger images are saved to the instructors account and are ready to be used. The author found this to be a very straightforward and a fast process with no advanced technical knowledge required. For the students, they simply need to download the free Aurasma app and then link to the instructor's account.

Table 1 Some of the most popular AR SDK options.

	License	**Supported platforms**	**Cloud recognition**	**3D recognition**
Apple ARKit	Free	iOS	x	x
ARToolkit	Free Open Source	Android, iOS, Linux,Windows, macOS		
EasyAR	Free / Commercial	Android, iOS, Windows, macOS	x	x
Kudan	Free / Commercial	Android, iOS		x
Maxst	Free / Commercial	Android, iOS, Windows, macOS		x
Vuforia	Free / Commercial	Android, iOS, Windows	x	x
XZIMG	Free / Commercial	Android, iOS, Windows		
AR Core	Free	Android	x	x
Aurasma	Free	Android, iOS	x	

5 Measuring Student motivation

(Keller & Litchfield, 2002) defined motivation in the educational arena as the student's desire to engage in a learning environment. The impact of motivation on students' academic achievements and learning outcomes have been addressed in several studies. D. Schunk, cited by (Schmidt, 2007) states that motivation has the potential to influence the what, when, and how of learning, and increases the likelihood of engaging in activities that will help students to learn and achieve better performance. (Theall, 1999) supports this motivational influence so that learning strategies that connect with students' interests and provide them with opportunities to take an active part in their instruction can lead to increased engagement, effort, and eventual success. Based on Theall's survey, (John M. Keller, 1987) proposes a problem-solving approach to applying motivation to instructional design called ARCS, which is directly based on four out of six components reported at M. Theall's survey: *attention, relevance, confidence* and *satisfaction*. The ARCS model was originally developed as a descriptive model for diagnosing problems associated with learning motivation (Driscoll, 2005).

Within Keller's ARCS model there is a motivational design process. The first step of this process is to gain and sustain the students' attention and stimulate their curiosity to learn. The second step should guarantee that learning activities are aligned with the students' personal goals and needs in order to be perceived as relevant. According to Keller's motivational design process, students should build confidence by feeling in control and having expectancy for success because the degree of expectancy achieved will determine the amount of effort students invest to accomplish the activities. Goal-directed effort will also be influenced by external factors such as teacher enthusiasm, social values, quality of instruction and availability of resources (J. M. Keller, 2008). Finally, the students' cognitive evaluation and the reflection students' make on their performance will determine their levels of satisfaction. Adequate levels of satisfaction are needed to help them to maintain motivation (Rodgers & Withrow-Thorton, 2005).

Even though each ARCS component plays a significant role in motivating students throughout the learning process there needs to be some sort of diagnostic tool to determine the final motivational strengths and weaknesses of instructional design. For this paper's case study a modified version of the Instructional Materials Motivation Survey (IMMS) was used. IMMS is an instrument that was developed to measure learner motivation following the ARCS model (John M. Keller, 2010). The IMMS is a thirty-six item Likert scale survey measuring the *attention, relevance, confidence* and *satisfaction* components of instructional materials. The survey is particularly relevant for this paper's case study as it has been validated and used on several research studies using technology as a motivational factor in student learning (Bolliger, Supanakorn, & Boggs, 2010); (Wenhao Huang, Diefes-Dux, Imbrie, Daku, & Kallimani, n.d.); (Rodgers & Withrow-Thorton, 2005).

6 Case study

The study was conducted over a two-year period in the Art and Design department at the American University of Sharjah (AUS), in the United Arab Emirates. AUS is a is a co-educational institution of higher education based on the American higher education model being accredited by Middle States Association of Colleges and Schools in the USA. AUS has 6000 students from nearly 100 countries.

To compare the motivational impact of using the AR app in the case study, the History of Design course was taught using two different learning scenarios, the first one only used traditional PowerPoint slides, and the second one incorporated AR technology.

The study was conducted over a two-year period, covering four different student cohorts averaging 50 students per cohort. The student cohort for the History of Design class is made up of mainly Gulf Cooperation Council (GCC) countries, plus a small number of international students. The History of Design course uses Meggs' History of Graphic Design as the main course text book, which has a distinct Western canon, and covers design history from cave paintings through to the modern day. The experiment was performed over two specific sessions during the module, which covered the Industrial Revolution. The AR app intervention was based on module material comprising of information relating to the development of photography and the moving image. Students were expected to acquire specific knowledge relating to these developments as well as a general understanding of the impact of this technology to design.

Due to extrinsic constraints mentioned earlier, the teaching sessions were conducted in the same tiered auditorium classroom as had been previously used in the PowerPoint based classes. Prior to the lecture, the students had been asked to download the free Aurasma app to their mobiles and link to the class folder. During the lecture when an AR intervention had been created, it was indicated to the students by a small icon on the slide to indicate that an AR app was available. The AR app was then used to enhance an image with added information in a multimodal fashion, including text, video and 3D models.

6.1 Interaction

On being prompted the students were very keen to get their mobiles out and try the application. There was a definite buzz of excitement in the class whilst the students engaged with the images, videos and models (see figure 1).

Figure 1 Students interacting with the AR app

Questions posed by the faculty during this period appeared to be more positively responded to. After the initial excitement and the students had calmed down the lecture continued. It was interesting to note that their attention appeared to be enhanced as whenever a new slide appeared with an AR icon they would immediately get out their phones and try the app again. The interaction with the AR app allowed students to view additional image overlays (see figure 2) or video overlays (see figure 3). The AR intervention also worked on images from their text book so this encouraged more collaborative discussions in the lecture as many students shared a text book. A major advantage of augmenting the text book was the additional interactivity. Students could manipulate the AR 3D model by rotating the book or tilting the pages to experience the AR content from different positions (see figure 4). This interaction with the text book appeared to help establish common ground and served as a discussion point amongst the students.

Figure 2 Louis Jacques Daguerre's busy Paris boulevard image with AR overlay highlighting the only person in the image due to him standing still having his shoe polished.

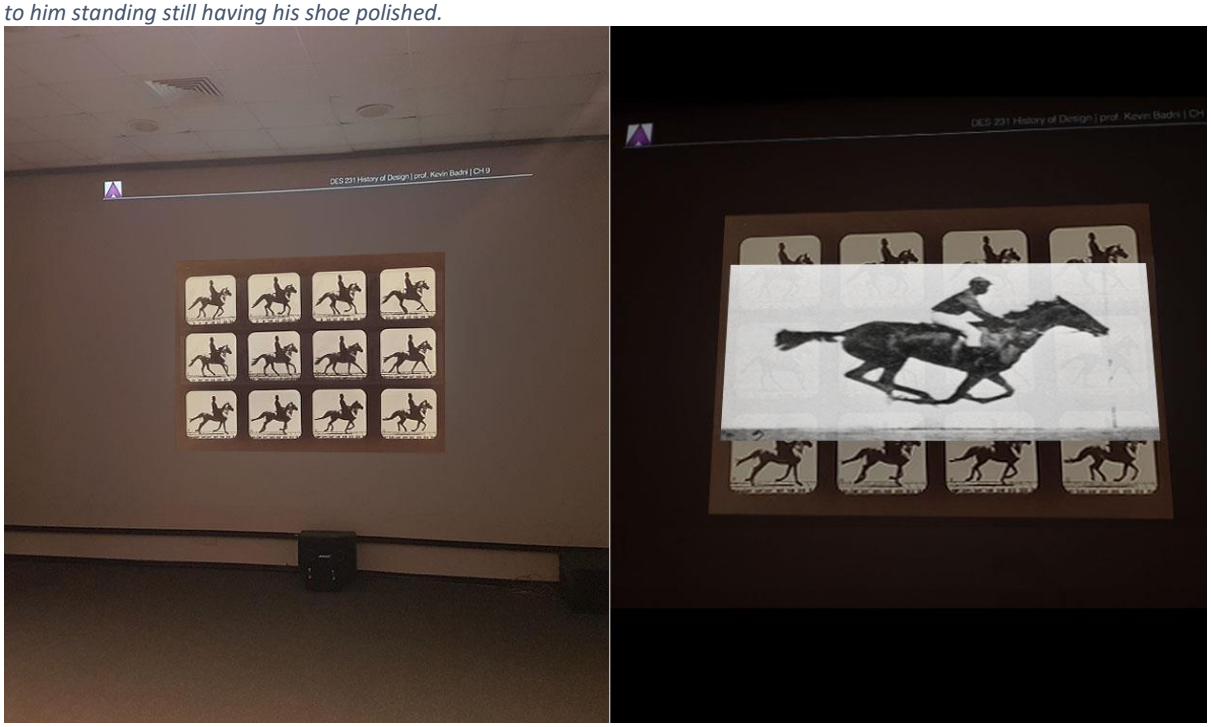

Figure 3 Eadweard Muybridge plate with AR overlay showing the moving images.

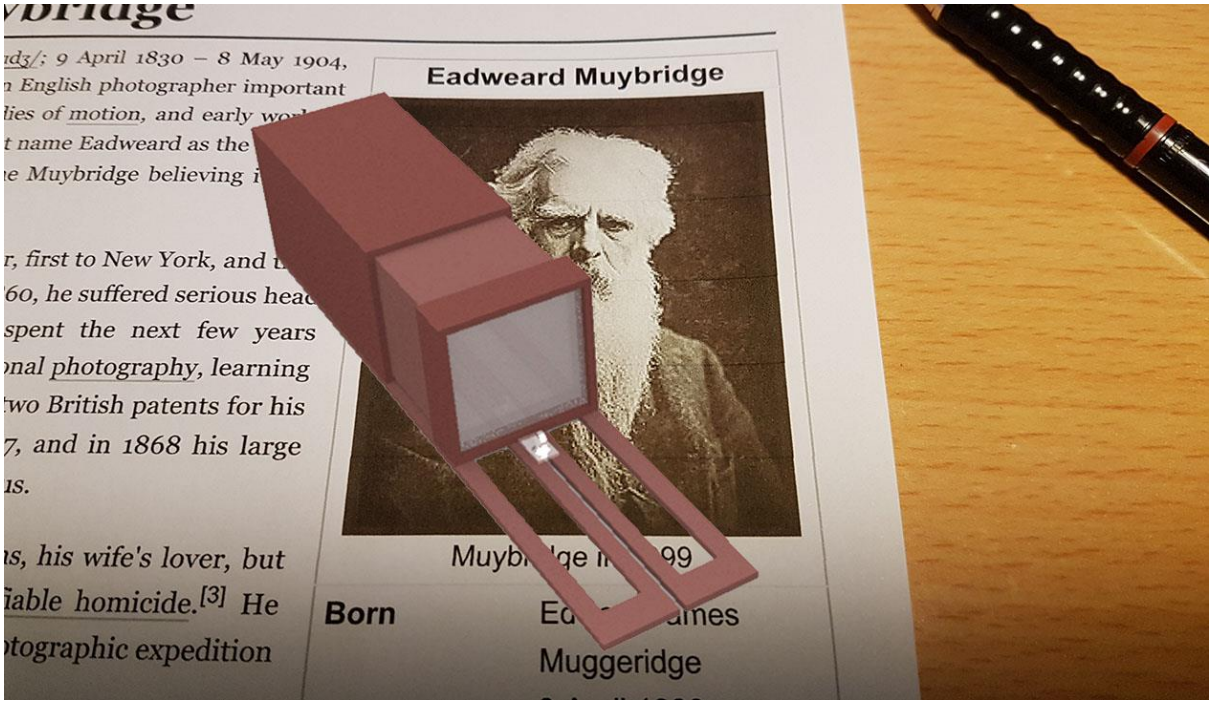

Figure 4 Using a portrait of Muybridge a 3D model of a camera appears in the AR app

7 Research questions

Providing an AR experience does not necessarily mean that students will be more motivated to learn. As with any new technology introduced into the classroom, important lessons need to be learned about how best to use AR in a learning environment.

To analyse the impact of introducing AR apps within the History of Design course on student motivation a number of research questions needed to be answered:

1. When using AR apps within the teaching material, how motivated are students to use them?
2. Was there a difference in student's motivation depending on which teaching method was used?
3. If there were differences, what were they relating to the four areas used for measuring student motivation?
4. What are the barriers that stop AR being accepted?

8 Procedure

The case study was conducted over a four semester, two-year period. Cohorts in the first and fourth semester were taught with only traditional PowerPoint slides (C_ppt), whilst the Spring and Fall semesters, two and three, students were exposed to PowerPoints with the enhanced AR apps (C_ar). After the module had been completed, the students were handed the IMMS questionnaire to collect quantitative data. The data was then analysed to compare the paired-samples relating to the students' motivation in both the traditional teaching environment and with the AR intervention. Qualitative data was also collected by surveying students interacting with the AR app. The students were a mix of sophomore and junior students. Each cohort on average had 50 $^{+/-2}$ students. Within the cohorts, the male/female ratio remained on average 80% female.

8.1 Data collection survey and exams

The quantitative questionnaire is a closed-item Likert style questionnaire consisting of four areas measuring major motivational variables related to instructional materials.

1. The first area, *confidence* comprises of nine questions which measure to what degree students felt they could successfully accomplish the goals and tasks laid out in the class materials.
2. The second area, *attention* consists of twelve questions which measure to what degree the teaching materials initiated and sustained students' motivation.
3. The third area, *satisfaction* comprises of six questions which measure to what degree students felt that they had accomplished a task and the inherent appeal of the teaching materials.
4. The fourth area, *relevance* consists of nine questions which measure the perceived value and usefulness of the materials to the students.

9 Scoring

The IMMS survey was scored for each of the four sub areas and the total scale score (see Table 2). The IMMS survey has a Likert scale of 1 to 5 so the maximum score is 180 and a minimum is 36, with a midpoint of 108. The minimums, maximums, and midpoints for each sub area vary because they do not all have the same number of items. For each sub area, the mean was calculated by dividing the total score on a given scale by the number of items in that scale. This allows for the scores to range from 1 to 5 making it easier to compare responses on each of the sub areas. There are a number of questions that are stated in a negative manner so for these to become relevant they needed to be reversed.

Table 2 Statistics for the four motivation sub areas.

	C_ppt	SD1	C_ar	SD2	Difference
Attention	3.26	0.57	4.02	0.71	0.76**
Confidence	3.54	0.72	3.74	0.77	0.20**
Relevance	3.51	0.55	3.66	0.56	0.15*
Satisfaction	3.19	0.80	3.77	0.72	0.58**
Likert Mean	3.38	0.66	3.80	0.69	0.03

**significant at p>0.05; **significant at p<0.05*

9.1 Research question 1:

When using AR apps within the teaching material, how motivated are students to use them?

Table 2 displays descriptive statistics for the four motivation areas comparing the C_ppt to the C_ar. The highest mean scores were generated by the *attention* scale (M 4.02) and the *satisfaction* area (M 3.77). The lowest mean value was obtained by the *satisfaction* area (M 3.19).

Analyzing the *attention* questions as shown in Table 3 the highest mean score was for question 8 'AR technology is attention-grabbing'. From the students surveyed who experienced the C_ar, 82% of the students indicated that they thought it was mostly true or very true. Similar responses were for question 17, that 'The way the information is arranged using this technology helped keep my attention' with 74% students indicating it was true or very true.

The AR app was also an attention grabber, with 78% of students indicating that it was true or very true that there was something interesting at the beginning of the C_ar lesson that caught the students' attention (question 2).

Table 3 Mean scores and standard deviations for questions relating to Attention.

		M	SD
2	There was something interesting at the beginning of the AR lesson that caught my attention	4.16	1.35
8	AR technology is attention-grabbing	4.47	1.29
11	The quality of the AR material helped to hold my attention	4.13	1.3
12	The material is so abstract that it was hard to keep my attention on it (Reversed)	3.88	1.44
15	The images, videos and text that I discovered through the lesson are unappealing (Reversed)	3.94	1.51
17	The way the information is arranged using this technology helped keep my attention	4.28	1.44
20	The information discovered through the experience stimulated my curiosity	3.83	1.37
22	The amount of repetition of the activities made me feel bored (Reversed)	3.8	1.64
24	I learned some things from the AR that were surprising or unexpected	3.75	1.42
28	The variety of audio visual material helped keep my attention on the lesson	3.81	1.13
29	The audio visual material is boring (Reversed)	4.05	1.42
31	There is so much content that it is irritating (Reversed)	3.77	1.5

Table 4 Mean scores and standard deviations for questions relating to Confidence.

		M	SD
1	When I first looked at the lesson, I had the impression that it would be easy for me	3.9	1.35
3	This material was more difficult to understand than I would like for it to be (Reverse)	4.37	1.45
4	After the introductory information, I felt confident that I knew what I was supposed to learn from this lesson	3.46	1.13
7	The information that I was exploring was so much that it was hard to remember the important points (Reverse)	3.8	1.39
13	As I worked on this lesson, I was confident that I could learn the content	4	1.54
19	It was difficult to discover the digital information associated with the real image (Reverse)	3.86	1.58
25	After working on this lesson for a while, I was confident that I would be able to pass a test on it	3.67	1.3
34	I could not really understand quite a bit of the material in this lesson (Reverse)	3.78	1.55
35	The good organization of the material helped me be confident that I would learn this material	3.93	1.61

The highest scores in the confidence sub area indicated that “the subject matter was more difficult to understand than I would like for it to be” (Reverse) question 3. Fortunately, the organization of the material had 96% of the student’s surveyed indicating that it was mostly true or very true that the good organization of the material helped them feel confident that they would learn this lesson (item 35).

Table 5 Mean scores and standard deviations for questions relating to Satisfaction.

		M	SD
5	Completing the exercises in this lesson gave me a satisfying feeling of accomplishment	3.23	1.32
14	I enjoyed this lesson so much that I would like to know more about this topic	3.56	1.33
21	I really enjoyed studying this lesson	3.69	1.23
27	The wording of feedback after the exercises, or of other comments in this lesson, helped me feel rewarded for my effort	3.37	1.32
32	It felt good to successfully complete this lesson	3.46	1.19
36	It was a pleasure to work on such a well-designed lesson	3.42	1.16

The highest mean score was generated by question 21, where the students enjoyed studying the lesson. 83% of the students indicated that it was mostly true or very true, this was also shown with the amount of extra 'chatter' and responses happening in the class.

Finally, the lowest rated motivation factor is the *relevance* sub area.

Table 6 Mean scores and standard deviations for questions relating to Relevance.

		M	SD
6	It is clear to me how the content of this material is related to things I already know	3.31	1.23
9	There were images, videos and texts that showed me how this material could be important to some people	3.27	1.32
10	Completing this lesson successfully was important to me	3.23	1.08
16	The content of this material is relevant to my interests	3.16	1.18
18	There are explanations or examples of how people use the knowledge in this lesson	2.77	1.29
23	The content and the audio visual material in this lesson convey the impression that its content is worth knowing	3.41	1.08
26	This lesson was not relevant to my needs because I already knew most of it (Reversed)	3.3	1.25
30	I could relate the content of this lesson to things I have seen, done, or thought about in my own life	2.91	1.33
33	The content of this lesson will be useful to me	3.17	1.15

The two lowest mean scores were for questions 18 and 30, it does not appear that the use of AR apps was the cause of these low scores. There was only a low response to questions 6 and 30 where they could relate the information from the Industrial Revolution to things they already know, or relate to things they have seen of done in their own lives, which considering the GCC background of the students is not surprising.

9.2 Research question 2:

Was there a difference in student's motivation depending on which teaching method was used?

Analysing the IMMS survey, the mean score for overall motivation for C_ppt was 123 in a range from 94 to 152 and for C_ar the mean rating was 136, in a range from 102 to 170 showing a higher mean motivation.

In addition to the overall range of motivation, a paired-sample mean-test was conducted to compare motivation through the IMMS Likert scales. The results showed that for the C_ar the mean for

motivation was M3.80 compared to M3.38, (SD M0.66 and M0.69), the t-test resulted in a statistical significance of $p<0.05$.

9.3 Research question 3:

If there were differences, what were they relating to the four areas used for measuring student motivation?

As can be seen in table 2, for all four subscales the C_ar had higher mean scores than the standard C_ppt. For C_ppt all the subscales had a mean below 3.6, whilst for C_ar they were all above 3.6. The highest difference between mean scores was for the attention with a difference of 0.76.

The impact on the attention of students has been noted by (Dalgarno & Lee, 2010); (Dickey, 2005) who predicted this affordance when students work with emerging technologies such as Virtual Reality and AR. This improved satisfaction perception could also be tied to the active participation discovering new information whilst using the AR app.

The lowest difference was for relevance with a difference of 0.15. As the AR app apparently did not make an impression on the relevance factor. Further information on relevance would need to be gathered through questionnaires.

9.4 Research question 4:

What are the barriers that stop AR being accepted?

Beyond the IMMS survey, this research also wanted to gather some information relating to the difficulties or barriers regarding how easily accepted AR technology is in learning environments?

Students had been asked to download the Aurasma app before coming to class. The majority of students had complied with this request, a few downloaded during the explanation of how to use the app. The only slight stumbling block was linking to the History of Design markers, but as most of the students had done this before class they were able to show their colleagues. When the AR graphic indicator was shown to them the students swiftly operated the app and engaged with the images, 3D objects and videos. The only unexpected reaction was the number of students who stood up or came closer to the screen to get a better view of the projected image. After the first use, students were looking out for the graphic indicator and also tried the app on additional images in their text book, 'just in case'. This interaction soon created a collaborative interconnection between students showing others if they found additional images to use the app on.

The comments from the students support the premise that the AR app was easy and enjoyable to use. The small technical issues were not found to be serious enough to have an effect on the students' enthusiasm to complete the learning activities whilst using the AR apps. A selection of the comments from the qualitative survey are shown below:

"It was fun"

"I really liked looking out for the App indicator"

"it was very easy to use"

"Made history less boring"

"I liked the 3D models and videos"

"All classes should have this"

Lastly, the students indicated an interest in using the Aurasma app in other classes.

"This would be great for my other classes"

"Professor can you show me how to use this for my Interior Design class?"

"I'm going to show my friends"

9.5 Considerations on how the study was conducted

All the sessions followed the same pedagogical structure and students received similar learning contents. However, it is worth considering the delivery and content of the course material in order to identify any potential factors that could have biased either of the cohorts.

The attention sub area shows a positive interest from the students towards the activities undertaken in the classes. As both cohorts had the same content and information delivered in the same order, neither the content or order of the sessions can be seen a determining factor in the results.

The introduction of the AR app had an advantage over the PowerPoint sessions, grabbing the students' attention and allowing an additional multimodal interaction with the contents of the class. The quantitative and qualitative data both show that the AR app had an impact on the students' motivation. However, the use of AR may have had an impact on the confidence sub area, as students indicated that they were more confident in what they had learnt in the AR app sessions. This may be due to the fact that the AR app interaction appeared to be easier to remember when students were asked, than the PowerPoint slides.

On the flip side the satisfaction sub area could be argued that it should have been more favourable for the PowerPoint slide sessions as this is something the students are very used to and comfortable with. The AR app on the other hand was a new learning environment requiring the use of an unknown technology. With this in mind it was reassuring to see that the usability study showed that students had very few issues or problems.

Analysing the relevance sub areas on how well the two courses met the students' needs and goals, there did not appear to be any significant data either quantitatively or qualitatively that suggested there was any change in student's perception of the relevance of the course. This was the only motivational score that had a p value of more than 0.05. This is not particularly surprising as History of Design is a required course and not necessarily aligned with the students' own interests. If it was it may not need to be a required course.

10 Conclusions and future work

The goal of this study was to compare design students' motivational responses to traditional PowerPoint instructional materials against AR enhanced materials. The analyses and discussions show that there was a clear improvement in attention and satisfaction motivation factors when using the AR app. These results were also supported by a qualitative study where students stated that the enjoyed using the AR app and found it easier to remember details compared to PowerPoint slides.

The enhancement of memorisation and comprehension was supported by the results from the end of semester exams which showed a statistical impact for the questions relating to the Industrial Revolution. For the AR app, exam results showed an average 74% success rate in answering the questions correctly, compared to the PowerPoint lessons where the correct answers were only 65% correct. Within History of Design, summative exams make up the majority of the course, so this significant difference is an important factor in improved student results, but arguably more important is that this improvement in comprehension and memory starts to give some sort of insight into how to create a more student-centred course.

Much has been written about the different ways in which people learn. (Fleming, 1995) uses a 'VARK' model of learning that identifies four overlapping dimensions, visual, auditory, read-write and

kinaesthetic. With this in mind, and due to the multimodal interactions whilst using the AR app it is the author's belief that the interactive capabilities of the AR app helped the students to maintain higher levels of attention and interest in the content of the course. Due to the preliminary nature of this study, the findings discussed require further inquiry to substantiate the findings. It would also be advisable to undertake further longer-term studies to irradiate the possible novelty aspect.

10.1 Low upfront AR design for the general public

As the upfront investment to create the AR app was minimal it would also be beneficial to investigate where AR technology can provide greater benefits to other areas of design for the general public. With the increasing availability of broadband internet and the proliferation of connected smart products, there will be a substantial amount of real-time public and private based data that can be leveraged through the use of AR. For example in the UAE where this experiment took place, the Dubai government in 2013 announced a project to transform Dubai into a 'smart city'. Their aim is to unleash the greatest value from public and private data. Using low upfront development such as the one described in this paper, AR has the potential to be proliferated and used as a visual portal to overlay data information in the public realm. Through the use of AR, location specific information can be enhanced in a new and engaging way, adding enormous value to the prospect of data being a true public asset and resource.

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About the Authors:

Kevin S Badni Kevin has been teaching multimedia, industrial design and design management for more than 15 years. Before becoming an academic Kevin spent ten years as a professional designer. His research interests are in the personal perceptions and manipulations of vision.

Section 24.

Design Education: Catalysing Design Capability

DRS Design Research Society 2018 Catalyst

University of Limerick
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Editorial: Design Education: Catalysing Design Capability (PEDISG)

TOVEY Michael

Coventry University
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Almost all design researchers are members of academic communities. Their authority comes from a background, which typically includes not only some kind of design activity, engaging in the process of designing, but also a track record in scholarly endeavour. Their pre-occupation is with three areas: the process of designing, teaching design and researching design. This relates to the core mission of the Design Research Society which gives prominence to education ("promoting the study of and research into the process of designing in its many fields, and furthering education…"). It is thus quite natural that design academics should engage in such investigations, and that they should seek to extend our understanding and capability in this area. Whereas designers for the most part get on with designing and leave design research to the academic community, for the latter a core activity is developing the theoretical underpinning of design to inform and develop its pedagogy. The rich array of topics and techniques in this track demonstrates the vitality of this approach.

The relationship between design research and design teaching is important. Design research has the potential for not only informing teaching but also enriching it and giving it added focus. It is necessary not only for the academic respectability of the discipline but also for forging productive links with design practice. This is demonstrated in the papers in this track. One of the features of design education at undergraduate level is that it aspires to prepare design students for the world of design practice. Thus research into the developing nature of designing and how design practice responds to changing circumstances and needs is important in maintaining the relevance of the design course content. Research which gives a better understanding of the professional practice of design and its societal context can help in this aim.

The approach taken to forging links between design research and design pedagogy can be influenced by a number of factors. The nature of the design practice is obviously one such covering as it does a wide spread of activities. Architecture and graphic design both feature and are fairly distinct from each other for example. But the academic context can also be significant in influencing the educational culture and approaches employed. Where it is seen to be occupying a space between arts and humanities, and science, between engineering and creative disciplines then it can be faced with what could be seen as either incompatible traditions or rich opportunities for synthesis. With papers describing the development of both analytical skills and those of creativity the emphasis is more on seeing the context as an opportunity.

A number of the papers are concerned with developing student capability as neophyte designers. In this process the design studio may be seen as being a catalyst for integrating and processing different layers of knowledge, operating at different scales. Indeed the studio could be regarded as the experimental laboratory for the pedagogic research. Along with the other teaching

environments it provides an arena for developing and testing different approaches and techniques. For example it can function as a laboratory for testing ideas about co-creation and sustainability aimed at investigating design strategies. These can be orientated to approach societal problems and developing solutions for specific contexts in a living laboratory arrangement. Another approach is to prototype a competency framework which can employ a visually orientated system directed to the development of the curriculum. This would be personalisable at various scales for individuals, units , courses and programmes, in a student centred approach which embraces the possibility of student designing and controlling their own education. For contemporary designers who aspire to be active in the creative economy it may be necessary to remodel the teaching and learning process to focus on real problems and projects. This could point to a new role for the both the teacher and the learning environment, in which co-designing has a new prominence. Indeed, in one paper this is taken further to explore the involvement of children in performative and narrative based design methods. A key ingredient is the subsequent analysis to reinterpret and reconstruct design insights.

Much of the work described in the papers in this track is concerned with pedagogies which support the development of design thinking. This can be displayed through studying the qualities of learner-generated online content as rated by relevant experts. The focus then is on how these relate to learners' engagement which is investigated through comments and conversations. The dynamic outcome signalled key differences between the areas regarded as important by the design students and the experts. Indeed, design students can become fixated and stuck within the design process, and unable to innovate. The use of design heuristic prompts is a way of stimulating them to develop their concept design thinking ability and thus their ideation skills. Another technique is to use a range of tools to support the thinking process. These can be actual physical tools or abstract ones such as exploiting the resources of design history. Both visual and verbal tools have proved to be productive. Indeed, within the critique context the use of rhetorical techniques can be highly effective. This is well described in one paper which reports on its implicit and explicit use by students describing their designs.

Design pedagogy research directed to applied design has application in a number of areas. The user-centred approach and problem-based learning have found employment in such functional tasks as the design of police uniforms. Such a holistic interdisciplinary pedagogical approach for translational design research has relevance to a range of areas and disciplines, with potential for combining art and engineering within both sciences and humanities. The synergy resulting from the varieties of backgrounds and expertise creates a fertile ground for exploration on both a conceptual and a technical level. This impacts on several areas of design, and emphasises the importance of relating the theoretical and research basis for the development of relevant design education. For graphic design there has been a need to review such research outputs to map their content and identify emergent themes. In another part of the graphic design domain the other key component in matching course content to needs has come from reviewing what companies request from applicants for graphic design jobs. This has helped in identifying the necessary design deliverables, knowledge and skills and personal traits which courses need to inculcate.

Overall it is clear that there is a rich array of studies in the papers in this track. The work reported on demonstrates the clear ambition of making use of design research to develop and re-vitalise design education across the many design disciplines.

DRS 2018 Design Research Society 2018 Catalyst

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Engaging Qualities: factors affecting learner attention in online design studios

LOTZ Nicole*; JONES Derek and HOLDEN Georgy

The Open University
* Corresponding author e-mail: Nicole.lotz@open.ac.uk
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This study looks at the qualities of learner-generated online content, as rated by experts, and how these relate to learners' engagement through comments and conversations around this content. The work uploaded to an Online Design Studio by students across a Design and Innovation Qualification was rated and analysed quantitatively using the Consensual Assessment Technique (CAT). Correlations of qualities to comments made on this content were considered and a qualitative analysis of the comments was carried out. It was observed that design students do not necessarily pay attention to the same qualities in learner-generated content that experts rate highly, except for a particular quality at the first level of study. The content that students do engage with also changes with increasing levels of study. These findings have implications for the learning design of online design courses and qualifications as well as for design institutions seeking to supplement proximate design studios with Online Social Network Services.

online design studio; online social network; learner-generated content; consensual assessment technique

1 Introduction

Interactions in online or virtual design studios have been of wide scholarly interest for nearly two decades now (Arvola & Artman, 2008; Broadfoot, Bennett, & Bennett, 2003; Hart, Zamenopoulos, & Garner, 2011; Kvan, 2001; Maher, M. L., & Simoff, 1999; Robbie, D., & Zeeng, 2012).

The studio is a space for purposeful as well as serendipitous interactions (Ashton & Durling, 2000; Joel, 2007). Discussions usually emerge around the artefacts design students create and share, either by placing them around their desk or in a shared area. The virtual studio discussed here is not unlike this: students upload their designs to present and discuss them. Similarly, social media services like Ning, Flickr Instagram or Facebook can also facilitate design students' interaction around the artefacts that they have created (Fleischmann, 2014; McCarthy, 2013; Robbie, D., & Zeeng, 2012; Schadewitz & Zamenopoulos, 2009; Sharples et al., 2013). These social media and Web 2.0

applications have been used more to augment than replace traditional design studios and often to facilitate collaboration of students across a distance (Fleischmann, 2014; Ham & Schnabel, 2011). However, an additional outcome of this approach is a significant increase in the volume of material shared and available.

This increase in volume applies in an educational context too and has both positive and negative effect. Weller, coining the term 'Pedagogy of Abundance', outlines some significant potential benefits (Weller, 2011), whilst Donelan, Kear and Ramage (2010) note that an overload of information, or 'information chaos', can have a negative effect on students in an online distance learning environment. In online design studios, the positive effect of abundance helping learners to build awareness of the multiplicity of creative approaches and solutions in the creative industries was observed (Lotz, Jones, & Holden, 2015). To navigate the landscape of user-generated creative content, but avoid information overload, learners in creative industries need to acquire strategies to identify quality content with which they may then interact (Mcloughlin & Lee, 2007).

In the discussion of previous findings on social engagement in Online Design Studios (Lotz, Jones, & Holden, 2015; Jones, Lotz & Holden, 2017) we hypothesised that high quality uploads stood out from others because of the strength of image or an unusual, attention grabbing, approach to the task, which might lead to interaction with the contents. It was proposed that exploring the link between the quality of user-generated online content and the engagement with those contents in an online design studio is worthy of systematic investigation. Quality in this sense was assumed to be what we, as design educators and experts, considered to be of quality in a design sense. What we discovered was that students might not see it this way.

2 Background

2.1 Online design studios

The 'studio' has been identified as a signature design pedagogy (Crowther, 2013) and although the elements that constitute it are not defined precisely, they generally include the following principles:

- **Apprenticeship** –learning takes place with expert 'support'
- **Simulation** – a learning experience that is close to actual practice but performed in a safe space
- **Problem-based** – learning is constructivist and process as well as discourse oriented
- **Flexible** – adaptive spaces and infrastructure to allow for serendipity
- **Generative** –a credible, realisable designed visual/tactile output is produced
- **Semi-public** – it is performed, critiqued and judged amongst peers
- **Social** – social and peer support enables the building of a community
- **Transformative** – learning is changing a person

Several scholars have attempted to carry aspects of this signature pedagogy into the online world (Arvola & Artman, 2008; Shao, Daley, Vaughan, & Lin, 2009), initially addressing aspects of technical feasibility (Maher, M. L., & Simoff, 1999; Kvan, 2001), making way for experimentations in distributed global collaboration (Bohemia, Harman, & Lauche, 2009), 3-d immersive worlds (Grove, P. W. & Steventon Dr., 2008), and portfolio and personal learning spaces (Pontydysgu, 2007). In addition to developing bespoke virtual design studio spaces, many contemporary online design studios blend commercial communication, image sharing and social network services as required by the design learning context and brief (Robbie, D., & Zeeng, 2012; McCarthy, 2013; Fleischmann, 2014). As the knowledge of the scope of online design studios evolves, researchers have become more interested in the social mechanisms by which online studios support learning (Sidawi, 2012), an area in which design scholars can learn from studies about the interactions with Online Social Networks (OSN).

2.2 User-generated online content

User-generated or user-created content became a defining term for many Web 2.0 sites and services. Content for sites like Wikipedia or Flickr is generated by users to be published or distributed on these sites, often through linking, reusing of existing content or the creation of entirely novel content. Researchers strongly agree that user-generated online content varies in quality (Agichtein, Castillo, Donato, Gionis, & Mishne, 2008; Chai, Potdar, & Dillon, 2009). Not all content receives the same amount of user attention. In the context of OSN, it was hypothesised that when there is a large selection of content, users of online media only pay attention to high quality content (Wang, Ye, & Huberman, 2012). But what constitutes high quality content? In a recent study on Facebook user behaviour evolution (Paul, Puscher, & Strufe, 2015), high quality content was defined as original user-generated content in contrast to commenting or distributing other contents. From a literature review of quality assessment of online contents in different social network sites, Chai et al (2009) proposed a framework for the assessment of the quality of social media content that encompasses several dimensions. They identified that User Feedback was the most-frequently used measure to assess quality of online content. Currently, there is no single, agreed definition or assessment of what constitutes high quality content in social media beyond such simple measures.

In the education context, learner-generated content was proposed to enhance student engagement and student success, this is content that is dynamically generated in the learning process (Mcloughlin & Lee, 2007). As with user-generated content, the quality of learner-generated content is also of concern. Pérez-Mateo, Maina, Romero, and Guitert (2011) propose defining quality of learner-generated content in terms of the actual content, i.e. its creativity, the format of the content, i.e. its representation, and the process of the content-interaction, i.e. commenting. This twofold content/process definition of quality has been the focus of more recent research as well as improving learner-generated content quality through guided feedback or peer-to-peer feedback (for example Murray, Mcgill, Thompson, and Toohey (2017)). Clearly, a complete definition of quality of user or learner-generated content is still missing, but this work attempts to take into account both the independently expert-rated quality of content as well as the learner comments on the qualities of work uploaded to an online design studio.
It is of great interest to researchers to better understand which user-generated content attracts students' engagement and why. Increased engagement with content drives not only sales or brand loyalty in commercial social networks, but it also improves retention and success in learning contexts (Hamid, Waycott, Kurnia, & Chang, 2015). The motivation for this paper is to better understand the relationship between engagement and the quality of student generated content.

2.3 Conversations around user-generated online content

In tandem with the learner-creation of content, a key principle of interaction and learning in the online design studio is artefact-centred conversation (Ferguson & Shum, 2012). In the proximate design studio, discussions around visual or tactile artefacts help design students to reflect on the creations, iterate and improve on those and learn in the process (Schön, 1987). In most cases though, research has looked at formal 'crits' and student-teacher conversations, rather than peer-to-peer conversations around artefacts (Gray, 2013).

Comparing students' interactions and success in a proximate design studio with an OSN design studio in an experimental setting, Güler (2015) found that students perceived the OSN to be a more participatory and active communication environment, they also perceived peer critiques and viewing the progress of other students' work to be more valuable compared to a proximate design studio. Clearly, informal communication and social engagement in the online design studio is of great value to design students and this value is a significant driver of student engagement.

But we still know very little about how the content itself influences the learners' interaction with the content. This paper seeks to enhance our understanding and asks: "How does the quality of learner-

generated online content relate to learners' engagement through comments and conversations around this content?"

3 Methodology

3.1 Setting: Open Design Studio

The study utilised data collected from learner-engagement with a bespoke Virtual Design Studio used in a Design and Innovation Degree at a large distance education institution in the UK.

The Design and Innovation Degree has three main design modules, one at each level of study. All of these core modules utilise the OpenDesignStudio (ODS), which is an online portfolio and communication space that allows students to post, view and discuss artefacts which they create and find. Digital artefacts can be uploaded to predetermined 'slots' (Figure 1) corresponding to activities in the teaching materials, or to the pinboard where the student is free to post whatever they wish. All posts are viewable to the student cohort by default, though privacy can be set by students. The affordances of ODS enable a range of peer-learning opportunities. The tool is simple enough to use so that no significant time is needed for familiarisation.

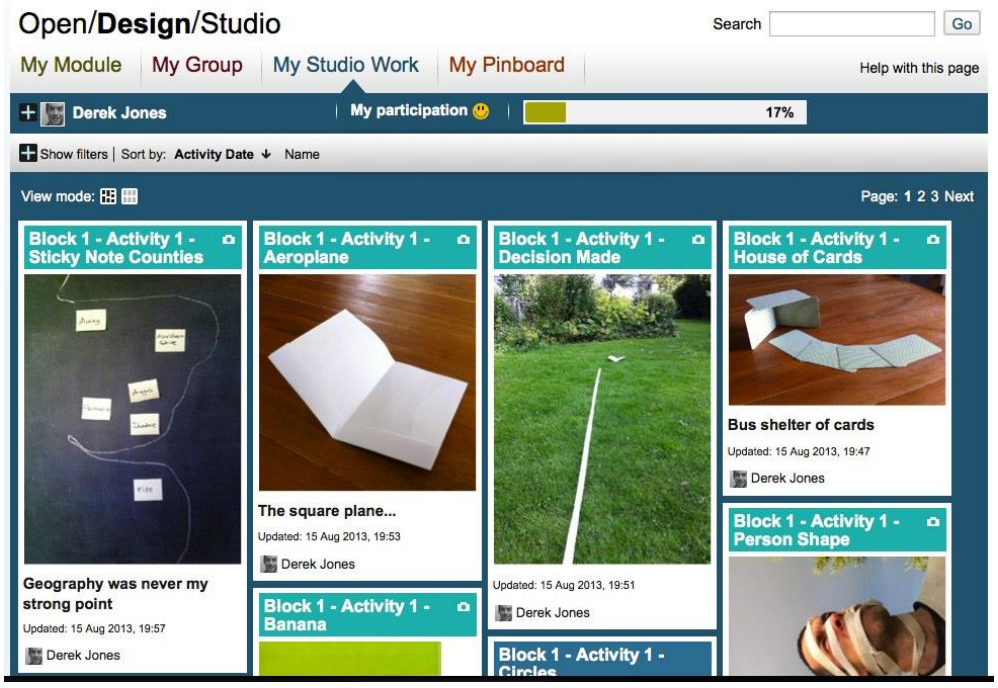

Figure 1 Main interface of OpenDesignStudio online virtual studio tool, showing predetermined upload 'slots'.

Figure 2 shows how students comment on individual posts, primarily through text, like forum replies though audio commenting is also possible. Students can also engage in quick interaction by using simple Favourite, Smile and Inspire buttons that avoid placing any barriers in the way of student communication and interaction.

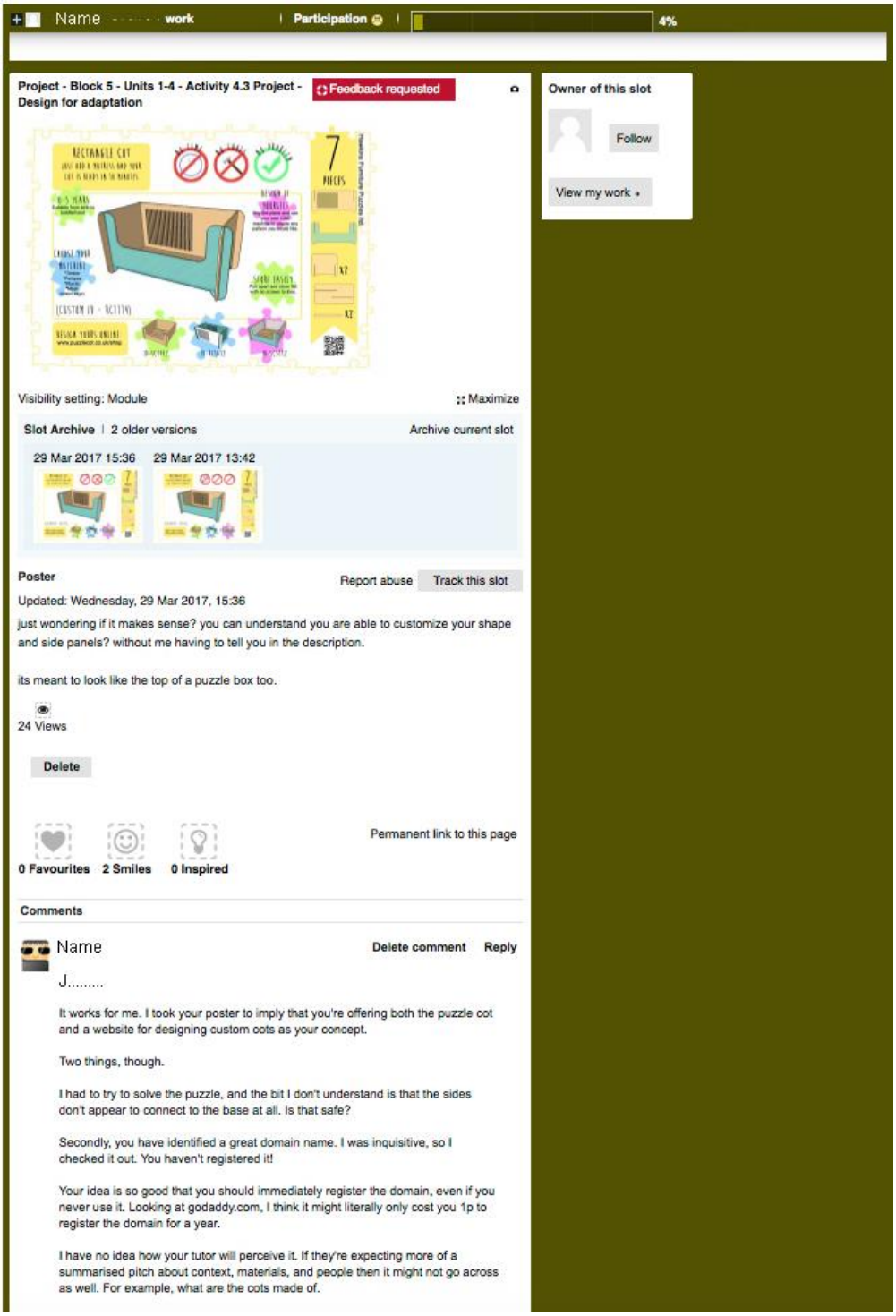

Figure 2 An ODS slot with image upload, showing students questions and comments from a peer

ODS provides, a mainly visual space where students can communicate their own work and see the work produced by other students. Students are free to choose to engage with the tool and are also given options to enable them to maintain privacy on individual posts should they so wish.

ODS is only one part of an overall suite of online spaces within the VLE, including forums, a live chat tool and synchronous/asynchronous online conferencing 'rooms'.

3.2 Data collection

3.2.1 Consensual Assessment of quality of work posted to ODS

The Consensual Assessment Technique – CAT (Amabile, 1982) was chosen to collect quantitative data on the consensual assessment of the quality of students' work uploaded to ODS. CAT has been validated as a reliable technique to assess creativity. This technique has previously been employed to rate creativity of work in art, or literature, but to a lesser extent in design (K. K. Jeffries, 2012). Assessors, who are experienced in the domain studied, independently rate a piece of work on its creativity and several other dimensions. The judges rate the work relative to their own implicit standards of creativity without using a predetermined or pre-selected definition of creativity. Interrater agreement is calculated to check the validity of the rating, which is usually high. The mean of all raters' scores is taken as the consensual score for the qualities assessed, e.g. creativity or originality.

The source of initial samples was a group of students who had completed all modules and for whom a full dataset of work in ODS was available, a total of 37 students. These students were all contacted and asked to take part in an interview as part of the wider project. From this, 9 students accepted, and became the overall sample for choosing material for the CAT process. CAT requires the researcher to make several choices about the rating procedure. Within this sample, the aim was to select one ODS upload from one design activity per level of study for each student. However, not every student had uploaded work for every activity set out in the module affecting the final choice of material. In addition, some material was also rejected for rating because it was not in a format that would allow a rating in some criteria (for example, a text document was judged to be unlikely to be assessed equitably against a visual artefact). Finally, for some of the selected students, no upload could be identified at levels 2 and 3. A further challenge was inconsistency of the medium in which the work was presented, this was adjusted for in the choice of the rated criteria. All of these factors will have introduced some initial selection bias but it was agreed to be appropriate as a *known* bias, compared to the unknown biases that would have emerged without initial selection (e.g. such as how raters would treat divergent output types).

Creativity was the prime category to be assessed, but to aid understanding of the relationship between the quality of work and the interaction around it, other qualities like representation or liking were taken into account. The final selection of qualities to be rated also needed to conform with established standards of CAT. It is advised in this methodology, to keep all main dimensions separate to reach an independence of the judged criteria. This was addressed by introducing related categories to each dimension, i.e. in this case, novelty and originality as subcategories to creativity. However, this increased the number of judgements to be made. Rater fatigue was then a concern. We limited the rating to 20 individual pieces of work. This meant that judges considered work from all 3 levels of study of four students, work from 2 levels (levels 1 and 2) for three students, and work from level 1 only was rated for 2 students.

The final assessment matrix assessed 4 main dimensions: creativity, strength of concept, communication and liking, with 2 subcategories in each dimensions (Figure 3). Assessment was made on 6-point scale ranging from extremely strong to extremely weak.

Assessors of students' work were six lecturers who teach on one or more modules in the Design and Innovation Qualification. As the judges were remotely located, the rating was made in electronic format using the online survey service 'Qualtrics' (https://www.qualtrics.com).

Q6. Rate **TMA03 - My Game Proposal** on the following dimensions, using your own, subjective definition of each dimension.

My game is based on the working day in a library. Librarians have a number of challenges to complete before the end of the working day! The winner is the player with the most completed rota card.

	Extremely strong	Moderately strong	Slightly strong	Slightly weak	Moderately weak	Extremely weak
Creativity	○	◉	○	○	○	○
Novelty	○	◉	○	○	○	○
Originality	○	◉	○	○	○	○
Strength of concept	○	◉	○	○	○	○
Feasibility	◉	○	○	○	○	○
Usability	◉	○	○	○	○	○
Communication	◉	○	○	○	○	○
Representation	◉	○	○	○	○	○
Description	○	◉	○	○	○	○
Liking	○	◉	○	○	○	○
Aesthetic appeal	○	◉	○	○	○	○
Shining example?	○	◉	○	○	○	○

Figure 3 Qualtrics survey example of one rater for one work (showing the dimensions and scale for rating)

3.2.2 Data on learner interaction on ODS

Quantitative and qualitative data on learners' interaction with the rated work was also collected. This included the number of views of an upload (only available in level 3 in this sample, because this measure was not collected in earlier version of ODS), the number of comments made on an upload, and the number of feedback requests. These are flags for students to request help from others.

3.3 Data analysis

Descriptive statistics were used to analyse the quantitative data gained from the CAT ratings and measures of views, comments and feedback requests on the rated work. Linear and Rank Correlations were obtained from iNZight, an R-based Data analysis and visualisation tool. The comments and conversations on the rated work were analysed qualitatively to inform the quantitative findings and correctly interpret these in context.

4 Findings

4.1 Inter-rater agreement of the rated qualities

Cronbach's Alpha for each rated category was calculated using Wessa.net interrater agreement online calculator (Table 1). The combined interrater agreement for all items (Combined) of 0.68 was satisfactory, just slightly below the threshold of 0.7 for acceptable interrater agreement in design (Karl K. Jeffries, 2017). This internal consistency was interpreted to demonstrate that there was a sufficient consensus around overall quality, and good consistency in some qualities, to warrant further qualitative investigation.

Table 1 Inter-rater agreement Cronbach Alpha

Qualities	**Cronbach Alpha**
Combined	0.6803
Creativity	0.634
Novelty	0.5137
Originality	0.603
Strength of concept	0.4842
Feasibility	0.7168
Usability	0.755
Communication	0.6687
Representation	0.7056
Description	0.7663
Liking	0.5737
Aesthetic appeal	0.6828
Shining example?	0.7073

4.2 Average expert's ratings of qualities

Table 2 and Figure 4 show the ratings of the quality of students' work that ranged from a mean of 1.17, being the lowest to a mean of 5.67 being the highest rating, to a maximum of 6. Calculating the sum of all ratings for each work, out of a maximum of 72, 32.16 was the lowest and 59.99 the highest rated upload. Figure 4, shows the summative rating for each upload graphically. The average rating of all uploads was 46. This indicates that the students' work on ODS is rated better than average.

Table 2 Ratings for each quality per student and	**Creativity**	**Novelty**	**Originality**	**Strength of concept**	**Feasibility**	**Usability**	**Communication**	**Representation**	**Description**	**Liking**	**Aesthetic appeal**	**Shining example?**	**Rating sum**
ABr L1	4.67	4.33	4.83	4.83	5.67	5.33	5.17	5.50	4.83	4.83	5.00	5.00	59.99
ABr L2	4.33	4.00	3.83	4.00	4.67	3.67	4.67	5.33	4.33	4.17	4.50	3.50	51.00
ABr L3	3.33	3.67	3.17	3.33	3.33	2.50	3.33	3.17	3.17	3.00	2.33	2.83	37.16
AC L1	4.67	4.67	3.83	4.83	5.00	5.17	5.00	4.33	4.83	4.00	3.67	3.50	53.50
AC L2	4.67	4.83	4.17	4.67	4.67	4.67	4.67	5.00	4.50	4.50	4.67	4.17	55.19
AC L3	2.67	3.00	2.50	3.50	3.67	3.67	3.83	3.33	3.83	3.17	2.33	2.50	38.00
PPS L1	4.00	3.50	3.83	3.50	3.33	2.50	2.67	3.50	2.33	3.67	4.17	3.00	40.00
PPS L2	3.17	3.00	2.83	3.17	2.83	1.83	2.67	3.00	2.00	2.83	2.33	2.50	32.16
PPS L3	4.50	4.50	4.50	3.83	3.50	3.17	5.17	4.83	4.83	4.17	4.33	4.17	51.50
SD L1	4.83	4.50	4.33	4.33	4.83	4.17	5.00	4.83	4.50	4.50	4.17	4.33	54.32
DS L1	3.50	3.50	3.17	3.50	3.83	3.50	4.00	3.50	3.83	3.00	2.33	2.83	40.49
DS L2	3.67	3.50	3.17	3.67	3.50	3.67	4.67	4.67	4.00	3.67	3.83	3.33	45.35
SK L1	3.50	4.00	3.67	3.67	3.67	3.17	3.33	3.67	2.83	3.33	3.17	2.33	40.34
RW L1	3.83	3.83	3.33	3.83	4.00	3.50	3.17	4.33	2.33	3.50	4.50	3.33	43.48
RW L2	4.17	4.33	3.67	3.50	3.00	3.00	4.50	5.33	2.83	3.50	3.33	3.17	44.33
RW L3	4.33	4.33	3.83	3.50	3.00	3.17	4.00	4.67	3.50	3.33	3.83	3.17	44.66
ABu L1	3.17	3.50	2.67	3.83	4.33	4.00	4.33	4.33	3.50	3.83	3.67	3.33	44.49
ABu L2	4.00	4.00	3.67	4.00	4.17	4.17	4.00	4.33	3.17	4.50	5.00	3.33	48.34
FS L1	5.17	5.00	5.00	5.17	5.17	5.17	4.50	5.00	4.33	4.67	4.67	4.33	58.18
FS L2	3.83	3.83	3.67	3.17	2.5	2.67	3.17	4.83	1.17	2.50	3.33	2.33	37.00

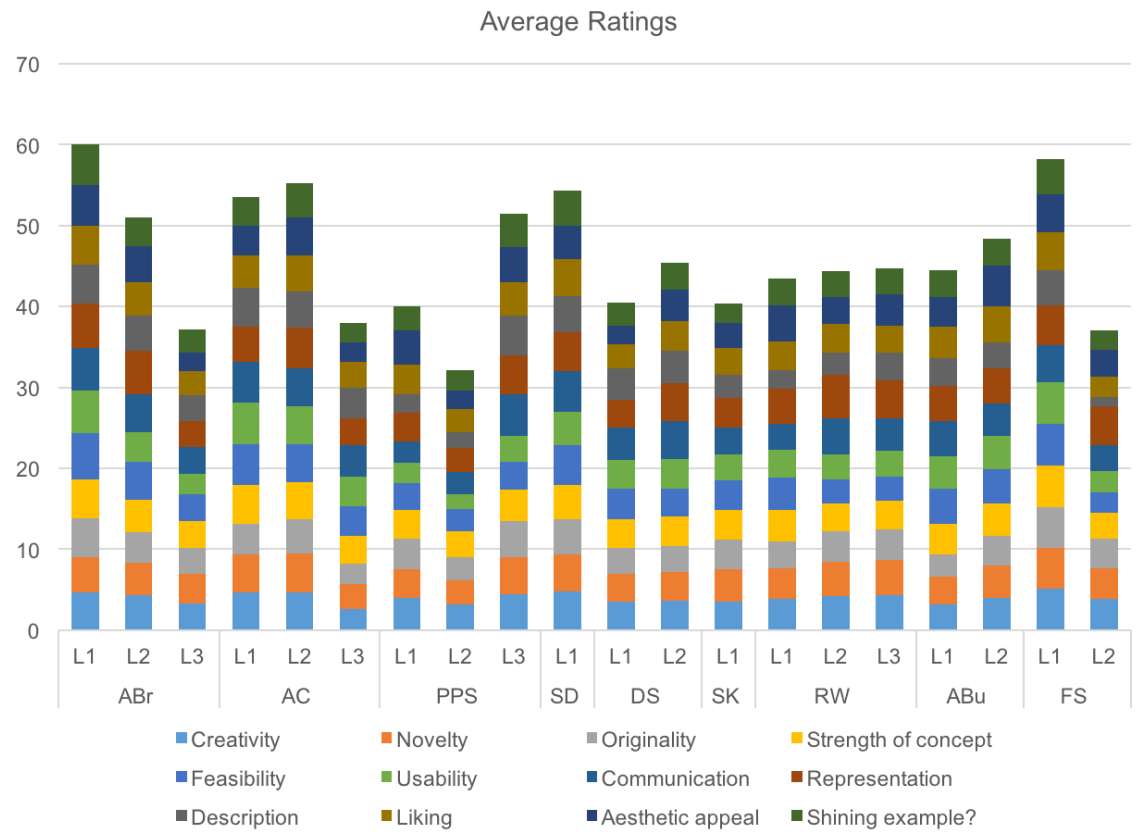

Figure 4 Combined rating of qualities by student (Acronym given) at each level

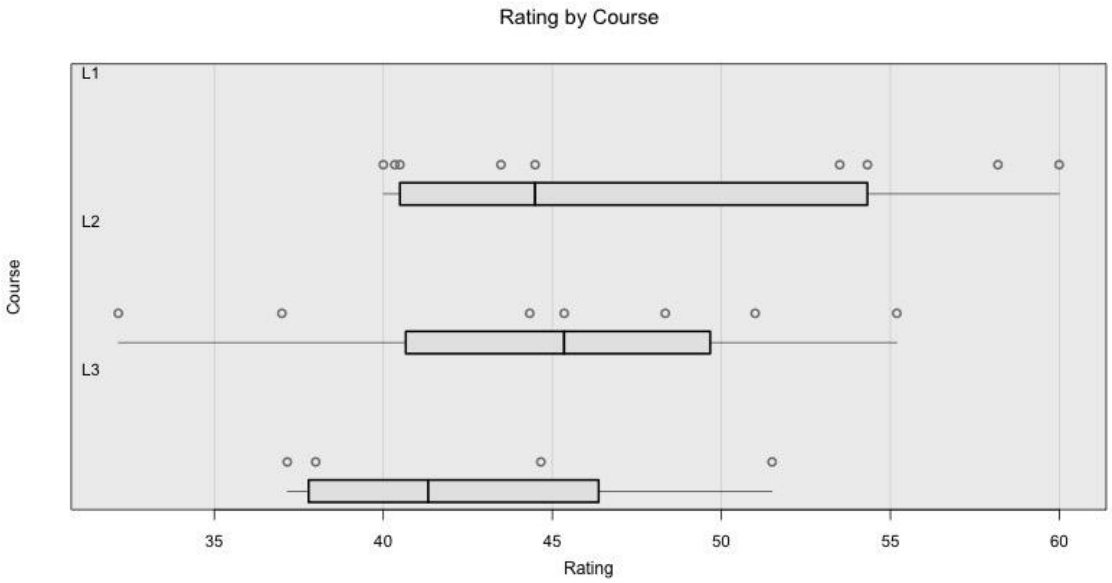

Figure 5 Combined rating of qualities across levels

Figure 5 shows a very light general downwards trend of assessment with increasing levels of study. The median in level 2 is even slightly higher than level 1 (45 in L2 compared to 44 in L1). Comparing the Mean produces clearer results, with 48 at level 1, 45 at level 2 and 43 at level 3. Level 3 produces the lowest overall quality scores.

4.3 Relation of quality of work and comments on work

There were between 0 and 10 comments on the rated work with an average of 2.4 comments (SD = 2.4) per piece of work. All rated work, except two, had at least one comment (Table 3).

Table 3 Sum of rating and engagement per student and level

	Rating sum	Views	Comments own	Comments other	Comments sum	Feedback request
ABr L1	59.99	na	1	5	6	1
ABr L2	51.00	na	0	0	0	0
ABr L3	37.16	6	0	1	1	0
AC L1	53.50	na	0	1	1	0
AC L2	55.19	na	0	1	1	0
AC L3	38.00	14	0	1	1	0
PPS L1	40.00	na	1	2	3	0
PPS L2	32.16	na	1	2	3	0
PPS L3	51.50	7	0	1	1	0
SD L1	54.32	na	1	4	5	0
DS L1	40.49	na	0	1	1	0
DS L2	45.35	na	2	2	4	0
SK L1	40.34	na	0	0	0	0
RW L1	43.48	na	5	5	10	0
RW L2	44.33	na	1	1	2	1
RW L3	44.66	20	0	2	2	0
ABu L1	44.49	na	0	1	1	0
ABu L2	48.34	na	0	2	2	0
FS L1	58.18	na	1	2	3	0
FS L2	37.00	na	0	1	1	0
	45.97	11.75	0.65	1.75	2.4	0.1

Figure 6 shows the correlation of the quality of rated work and comments on that work. The correlation is weak and not significant for both the Pearson Product Moment ($r = 0.18$, $p < 0.64$) and the Spearman Rank Correlation ($\rho=0.21$). Hence, there is little evidence to support a correlation between the sum of rated qualities and student interaction. A previous study using a larger data set, however, identified that overall statistical measures such as this rarely provide insights that are useful in relation to specific learning events or learners (Jones, Lotz & Holden, 2017). This suggests that some students may not be paying attention to those items that expert raters consider to be of high quality.

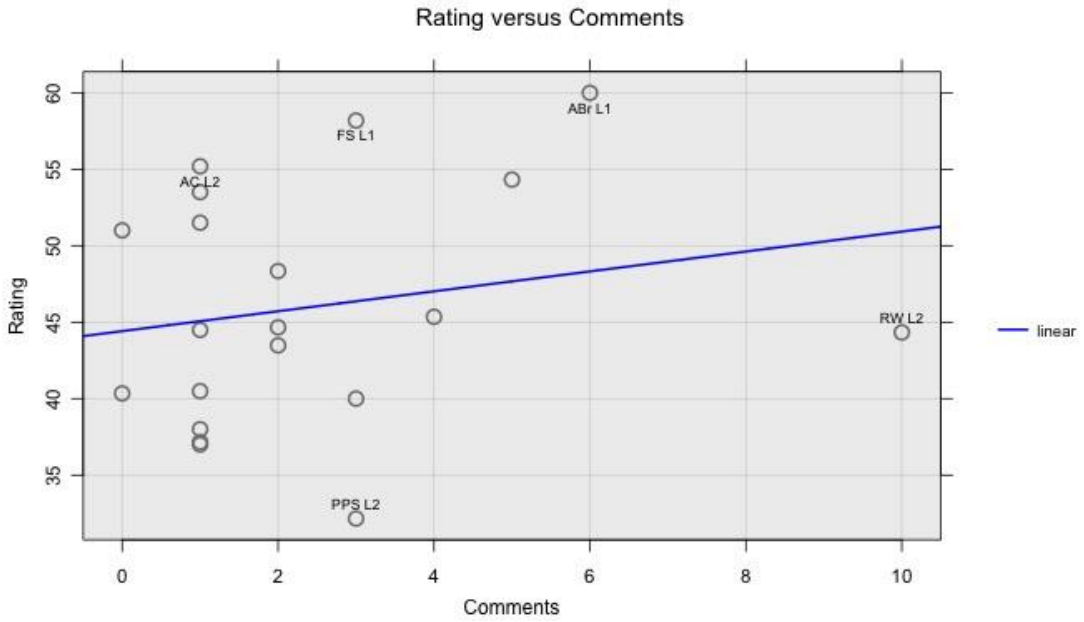

Figure 6 Correlation between the summative quality of students work and comments made on those uploads

If we distinguish between the levels of study, an interesting mix of correlations can be identified. While in level 1 and 3, we can observe some positive relations between summative quality and comments made on the students' work, level 2 has a negative relation. A caveat is the low sample size when the ratings are split across the levels, which renders the results neither significant nor robust.

4.4 Relation of Individual qualities' rating of work and comments

In a next step the correlations for individual qualities were examined. At level 1, the moderate to strong positive and significant relation between Aesthetic Appeal and the number of comments sticks out (Table 4 Row 12). Likewise, at level 2, the one moderate to strong negative and significant relations can be found between Originality and comments made. The sample size at level 3 was too low to produce any significant and robust correlations.

Table 4 Spearman Rank Correlation and Pearson Product Moment for individual qualities at level 1-3

	Level 1 (n=9)			**Level 2 (n=7)**			**Level 3 (n=4)**		
Quality	SRC	PPM	p	SRC	PPM	p	Rank	Linear	p
Creativity	0.49	0.27	0.48	-0.75	-0.68	0.09	0.26	0.48	0.52
Novelty	0.16	0.08	0.83	-0.56	-0.58	0.17	0.26	0.44	0.56
Originality	0.41	0.23	0.55	-0.85	-0.78	0.03	0.26	0.26	0.74
Strength of concept	0.32	0.13	0.73	-0.37	-0.37	0.41	0.0	-0.13	0.84
Feasibility	0.37	0.20	0.60	-0.39	-0.42	0.34	-0.77	-0.87	0.13
Usability	0.30	0.07	0.85	-0.26	-0.28	0.54	0.0	0.06	0.94
Communication	0.15	-0.06	0.87	-0.25	-0.17	0.71	0.26	-0.07	0.93
Representation	0.53	0.46	0.21	-0.65	-0.54	0.21	0.32	0.51	0.49
Description	0.04	-0.16	0.68	-0.27	-0.12	0.79	-0.26	-00.31	0.69
Liking	0.46	0.28	0.46	-0.20	-0.24	0.60	0.26	-0.11	0.89
Aesthetic appeal	0.84	0.67	0.05	-0.33	-0.42	0.34	0.27	0.40	0.60
Shining example?	0.62	0.46	0.21	-0.32	-0.23	0.61	0.26	0.0	1

With this being an explorative, small scale study, it is of course difficult to pick out individual qualities in this way. However, the results provide some interesting patterns worth following up on. Using CAT and engagement measures, this work is easily replicable on a larger scale. Overall, however, it is not possible to rule out that there may be no strong link between what students pay

attention to and what experts consider to be high quality work. To understand why this might be, a deeper understanding of the student comments on user-generated and expert rated work is needed.

4.5 Students comments on qualities

In level 1, the work by Abr (shown in Figure 3) that reached the highest rating of quality overall had made a feedback request (Table 2). The learner had asked for help on the visual impact of their work, which frames the goal of this conversation as appraisal. The student adds the description: *"My game is based on the working day in a library. Librarians have a number of challenges to complete before the end of the working day! The winner is the player with the most completed rota card."* Four comments by other learners were received the same day.

> *C1 "I like this a lot. Looks really well structured and I like the rota cards too. Very well thought out."*
>
> *C2 "It has great impact. You can see immediately what the game is about but it's also intriguing. You've presented your idea to a high standard but I have to say I love the Jelly Babies most of all :) Does the winner get a treat? Well done."*
>
> *C3 "Wow, the development from your prototype is superb!"*
>
> *C4 "fantastic concept and game development well done id play it"*

The learner replied to these comments in one answer, making a playful reply on the topics of process of designing and the use of candies as play figures in the game. *"Many thanks for your positive comments. I've had a lot of fun with the whole family getting involved. The Jelly Baby Librarians kept disappearing, but we had a bowl full of reinforcements!"*

The work by RW with most comments attached (10) at level 1 was average in the overall rating of quality (Table 2). The learner received 5 comments and thanked the commenter for the comment almost immediately, but without engaging in a more detailed discussion about the specific comment made. Comments were mainly around the professional looking representation of the work. And in fact the qualities Representation followed by Aesthetic Appeal had the highest ratings compared to all other ratings for this work.

> *C1: Looks good [Student Name], did it play well?*
>
> *C2: looks great, love the box!*
>
> *S: thank you i spent ages making the box lol*
>
> *C3: Wow, This is the complete package.*
>
> *S: thank you very much! :D*
>
> *S: yep it does play well thanks, I am really pleased with it! :D*
>
> *C4: Your presentation is super! This really stands out and cries out for attention - jolly well done!*
>
> *S: thank you!*
>
> *C5: Well done, very professional looking.*
>
> *S: thank you :)*

Another student's work with five comments (SD) was highly related in terms of Creativity, Feasibility and Representation (Table 2). The student replied on the next day to one comment made, while another student had already joined the discussion. The content creator successfully clarified the question about the layout of the board game, which was acknowledged by the commenter.

Other uploads with two comments had also replies from the creator of the content. The one work at level 1 that had no comments attached received one of the lowest ratings for overall quality. It should also be noted that the student has made no further uploads to ODS in levels 2 and 3.

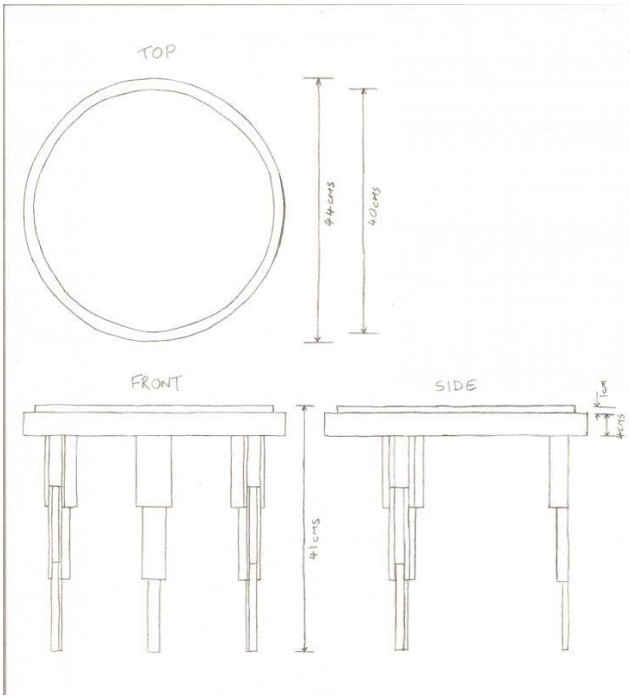

Figure 7 Example of students work uploaded to ODS at level 2

At level 2, the work with the overall highest quality rating (AC) only received one comment. The idea was around a navigation system for children for a nature trail. *"I like your idea of having different cube heights for different age levels. I also like the clarity of your final design, it is all very good. Nice one [student name]".* Although the comment was made short after the work was posted, the content creator did not reply.

Figure 8 shows the student's work (DS) with the most comments (4) at level 2. This work was of average rating overall but received higher quality ratings for Communication, Representation and Description of their work. The comments complemented the creator on the representation of their idea, and critically evaluated points about usability and feasibility, which were lower rated qualities for this work, in fact. The lowest rating for this work was Originality.

> *C1: Lovely clear drawings. I wonder if mud might be an issue when collapsing the legs? I know that sides of football pitches etc can often be pretty muddy and it may clog up the sliding mechanism - could a possible solution be to concertina the legs the other way round, i.e. the widest/outer part at the bottom? Your design certainly looks very compact and portable.*
>
> *C2: I also like the drawings but think it could be a bit higher so that your legs would be a bit straighter.*
>
> *S: Thanks for the feedback. Height has been a real issue as the seat is suitable for children and adults. I ended up taking measurements of a few seats around the home and concluded to the height I have presented. It was also necessary to make it this height in order to fold the legs into the base. If the legs were taller the base would need to be bigger and thus the seat would become less portable.*
>
> *S: Hi C1 [Student name] Thanks for the feedback. I will certainly consider your advice as mud has been something that has been praying on my mind a bit.*

At level 2, the work with the lowest overall rating (PPS) was down-rated by its very low scores for Description, Aesthetic Appeal, Usability and Feasibility, while the comments focused much more on the sustainability aspect of this work, which was not a quality measure in the consensual assessment.

C1: I like the upcycling concept behind this chair

C2: Using paper is a very clever idea. Cheap and environmentally friendly, adjustable to different needs and sizes. Ticks many boxes.

S: Cheers C1 [Student name], its just being a little bit of a challenge to make sure it is strong enough. I have been collecting newspapers for weeks in order to have enough to be able to make it!

At level 3, three uploads received one comment each, and one upload received two comments. The work with 2 comments was of average rating. None of the students replied to the comments that were left on their work. The numbers at this study level are too low to meaningfully draw any conclusions or even comparisons with other study levels.

5 Discussion

To answer the question: "How does the quality of learner-generated online content relate to learners' comments and conversations around this content?", the findings are discussed in the context of an emergent community of inquiry of design distance learners.

At level 1 there is some indication that initial incentive to comment on an upload is related to some of the expert rated qualities of the work, possibly the particular quality of Aesthetic Appeal. The interactions' emphasis on aesthetics are mirrored in other studies on image-based OSNs (Zhu & Chen, 2015). This is further supported by design students' comments, which often focus on the quality of Aesthetic appeal and also Representation of idea.

The comments and discussions at level 1 are relatively short and uncritical but have a vital social learning role, as noted in previous results (Lotz, Jones, & Holden, 2015; Jones, Lotz & Holden, 2017). The affective nature of the comments and discussions points to a social presence being established (Akyol, Garrison, & Ozden, 2009). Other scholars have found that peer feedback to design learners' in commercial OSNs environments does not foster constructive learning conversations (Fleischmann, 2014), but (Lu & Churchill, 2014) suggest that the function of such conversations is to build a sense of community and social presence, which has been found to be essential to retain online learners (Garrison, Anderson, & Archer, 2010). Underlying this may be simple social mechanisms such as students constructing an identity with the contents they create and share, aiming for the highest quality they can achieve to put themselves into a favourable light (You, Bhatiab, & Luna, 2016).

At level 2, different observations can be made. A negative correlation is seen between the quality of work uploaded to ODS and the comments on that work, and in particular a significant negative relation of Originality to comments made. The least original work seems to receive most attention. At the same time, comments become more critical. It could seem as if commenters are attracted to 'lower' or medium quality uploads, to enable them to comment whilst making use of the new knowledge they have gained studying the module materials, for example sustainability issues in design. The purpose of interaction with learner-generated contents in ODS seems to shift from interacting with the content with the highest Aesthetic Appeal at level 1 to engaging with content that gives scope to comment more critically. Again, this may be explained through social learning mechanisms such as how students compare themselves to those that are similar or slightly above / below them (Dunning, 2006; Festinger, 1954). If this is the case then it has important implications for social learning design in online studios in terms of how networks of students are supported and, more importantly, disrupted to provide the greatest opportunities for learning. It may also slightly contradict the typical finding in a proximate social setting, if students can be shown to be so consciously selective.

Students at level 2 seem to use the learners' names in their comments more, which indicates a level of familiarity. We don't know whether this familiarity is related to the fact that they actually know this person or whether they are just more familiar with the learning community and approach as

such. Research suggests that affective expressions and social presence are indicators of a community of inquiry (Boston et al., 2010), which we might see evolving from level 1 to level 2 in the Design and Innovation Degree. A further explanation for this inversed relation of quality of work and comments on this work in ODS might be related to the Learning Design of the modules at the different levels (Garrison & Cleveland-Innes, 2005), who argue that social presence is not enough to feed an emergent community of inquiry, in particular the leaners' cognitive presence needs to be developed to establish a deep and meaningful approach to learning and retain them. Such a procedural view of developing a community of inquiry online starting by developing a shared community identity before engaging in the development of critical facility is shared by Garrison et al (2010). This might also offer some explanation of the differences that are observed in proximate and online design studios. Joel (2007) found that in proximate design studios, students were happy to socialise but not to review the work of their peers, whilst studies in OSN's found that learners are much more task-oriented in their conversations around learner-generated contents (Lu & Churchill, 2014). It might be that these divergent results are due to the specific course learning design and stage of progression through a design qualification and not because one is a proximate and the other in an online design studio.

Finally, student motivation, personality type, learning style and socio-cultural background also play important roles in the creation of, and interaction with, learner-generated content (Murray et al., 2017), which was beyond the scope of this study, but requires further study. What this study does show is that the psycho-social aspects of student activity, behaviours and drivers in an online design studio are more significant than has perhaps been realised. That students are not behaving in the perfectly predictable way we had assumed should be no surprise to anyone with experience of any kind of education. But this still leaves the task of understanding what the actual behaviours are and whether they are positive within the learning context for students. For example, in parallel work for this project, so called 'passive' engagement and its relation to the assessed quality of its work uploaded was shown to be one of the most significant correlates to student success (Jones, Lotz & Holden, 2017).

In this study, and with a small-scale sample, the study is more explorative in nature, intended to investigate possible explanations of this type of behaviour. It needs to be repeated with larger sample sizes and distributions to validate the findings. Social network analysis should be integrated in a follow-on study to investigate the impact of existing or emergent social relations of learners at each level and across a qualification and investigate the relationships of networks to engagement with the uploads.

6 Conclusions

What this study discovered was that design students might not pay attention to the things experts would consider to be of high quality. More importantly, what qualities students do attend to changes with increasing levels of study.

If educators want to encourage critical and constructive peer conversations to support online design learning, then a much deeper understanding of the engagement patterns and commenting behaviour over time needs to be gained. This study has shed light on the changing relationship between the quality of learner-generated content that is uploaded to an online design studio and the comments and discussions around this content. While commenting behaviour for students on an entry level course may be positively related to the quality of Aesthetic Appeal of that content, for more experienced students the behaviour seems to be the opposite. Here they comment on content that is not of the highest quality as assessed by experts, but their comments are more critical and draw on learning and content for the course. What is common to all study levels, however, is that the social learning taking place is an important motivation for engagement and interaction. Precisely what individual students take from this engagement is not simple or deterministic, but it is clearly of value to them as learners.

The implications of these findings are that design researchers and educators need to pay more attention to the changing dynamics of social behaviour in OSNs to effectively support online design learning. We also need to be aware that existing and popular OSNs like Facebook change. A recent study on the changes in patterns of interactions with Facebook from 2009 to 2014 (Paul et al., 2015) detected a maturation of the network, while the number of comments decreased there was an increasing number of likes or shares. These changing OSN mechanisms now seem to be very relevant and important at higher levels of study as we become aware of the importance of socially driven learning and design behaviours. Design scholars and educators need to be aware of these mechanisms when designing or considering OSNs and should challenge and be critical of their use pedagogically.

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Overcoming Design Fixation in Idea Generation

LEAHY Keelin[a*]; SEIFERT Colleen M.[b]; DALY Shanna[b]; and MCKILLIGAN Seda[c]

[a] University of Limerick
[b] University of Michigan
[c] Iowa State University
* Corresponding author e-mail: Keelin.Leahy@ul.ie
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Ideally, designers move past existing ideas to create novel designs. But designers often experience "fixation," where new ideas are similar to existing designs. An example concept in a brief, or early attachment to one's initial ideas, can limit the range of designs considered. This research study explored the use of "Design Heuristics," to overcome fixation in a design education setting. *Design Heuristics* are a set of prompts intended to point designers toward different types of concepts. The 77 prompts are derived from empirical studies of designers, and have been shown to be effective in developing design capability. In the study, novice engineering design students first used brainstorming, and continued to generate more ideas using *Design Heuristics*. The results showed that ideas created during brainstorming were more similar to initial ideas. Concepts created with *Design Heuristics* were judged less similar and more creative. This suggests fixation on initial examples can be mitigated by using tools like *Design Heuristics* during design, which contributes to how educators can help students develop ideation skills.

design heuristics; fixation; idea generation; brainstorming

1 Introduction

In an ideal world, the initial idea generation phase of design results in a set of ideas that are varied in nature, providing a wide variety of possible solutions. However, novice designers often have difficulty in generating a variety of diverse ideas during idea generation, and appear hesitant in considering multiple ideas (Cross, 2001). Research on idea generation in engineering has revealed two types of cognitive limitations in the context of fixation. First, the tendency to become focused on specific options early in the design process has been identified as limiting the variety of designs considered (Vimal, Tomko & Linsey, 2016; Lindsey, 2010; Cross, 2001; Jansson & Smith, 1991; Purcell & Gero, 1996). Second, designers may form an early attachment to their initial ideas, thus leading to few alternatives. Ullman and colleagues (1988) observed that designers did not explore multiple ideas, but pursued a single proposed design at the expense of exploring other alternatives. In the

present study, we examined design heuristics as a catalyst to overcome these two aspects of fixation during idea generation.

1.1 Design fixation

In their seminal study of design fixation, Jansson & Smith (1991) showed engineers an initial example solution along with the design problem. This example was presented as an unsatisfactory idea, with highlighted flaws. Nonetheless, the engineers in the study (both expert and novice) made use of the flawed designs as models for their own ideas. Across four studies, presenting a single, flawed example did not affect the number of new designs created (fluency) compared to a control group without an example (Jansen & Smith, 1991). Instead, fixation was observed by counting the presence of the example's key features in the new designs created. Jansson and Smith (1991) defined design fixation as "blind, sometimes counterproductive adherence to a limited set of ideas in the design process" (p. 4).

Other studies of design fixation also provided example solutions with the problem, and found their continued influence in subsequent proposed ideas (Purcell & Gero, 1996; Chrysikou & Weisberg, 2005). In addition, studies have found design fixation on known solutions related to the problem at hand, or on early ideas generated by the designer (Youmans & Arciszewski, 2014). Consequently, the term "design fixation" has been generalised to refer to any situation where designers limit their ideas by including features of pre-existing designs. These design fixations may be unintentional or intentional, and may be conscious strategies or unconscious influences on the designer (Youmans & Arciszewski, 2014). Even years of professional experience are not enough to avoid fixation (Jansen & Smith, 1991; Purcell & Gero, 1996; Smith, 1995). For example, Condoor and LaVoie (2007) showed that fixation does not differ between expert and novice designers, and that design fixation can occur immediately, during the problem formulation stage. Thus, techniques to help overcome fixation in design may be pertinent across levels of expertise.

What causes design fixation? Sio, Kotovsky, and Cagan (2015) performed a meta-analytical review of over forty design studies using a similar paradigm. They suggest that providing examples leads designers to spend more time in exploring and developing more example-related ideas. As a result, the search for solutions is narrower in focus, consequently reducing variety in idea designs. The narrowing of search seen in fixation may also lead to higher quality and more novel proposed ideas by encouraging narrower, yet deeper, search (Rietzschel, Nijstad, & Stroebe, 2007). Niku (2009) proposed other potential sources of fixation effects, such as making false assumptions, perceiving non-existent limitations, feeling overwhelmed, having incomplete or partial information, and applying ad hoc solution methods. Or, the complexity of provided examples might cause a focus of attention on specific constraints, increasing fixation (Purcell, Williams, Gero, & Colbron, 1993).

What would be the alternative to a provided example? In control groups, no example is provided, so a "base rate" of features can be determined. However, even with no provided example, there is an initial example evident to each designer: their first generated idea. Previous studies have found a tendency for designers to prefer their initial ideas and hang onto ideas even when they realise they may be extremely problematic or have major flaws (Ball et al., 1994; Rowe, 1987; Ullman et al., 1988). In the classroom, students appear to take up their early ideas as their best, and project teams often start and finish with the same idea. Rowe (1987) highlighted that students' ideas are often minor variations on the same idea. Designers also appear to show a "sunk cost" effect, where they develop a commitment to their initial idea, especially when costs such as prototype creation are involved (Linsey et al, 2010). For novices, the difficulty of generating any potential solutions may increase the perceived value of their initial ones. Engineering students may lack awareness of strategies to support the exploration of other solutions that are different from one's initial ideas (Cross, 2001; Sachs, 1999). Crismond and Adams (2012) compare novice to expert designers whereby expert designers "*practice idea fluency in order to work with lots of ideas by doing divergent thinking, brainstorming, etc."* in comparison to novice designers who "*work with few or just one idea, which they can get fixated or stuck on, and may not want to discard, add to, or revise".*

In contrast, if expert designers are more prone to fixation than novices (Kim & Ryu, 2014) it may suggest that experts stick to their early ideas because they perceive it as leading to great designs.

For novices, the difficulty of generating any potential solutions may increase the perceived value of their initial ones. Engineering students may lack awareness of strategies to support the exploration of other solutions that are different from one's initial ideas (Cross, 2001; Sachs, 1999). Rowe (1987) highlighted that students' ideas are often minor variations on the same idea. Novice engineering designers also appear to have a sense of attachment to early solution ideas, and hang onto ideas even when they realise they may be extremely problematic or have major flaws (Ball et al., 1994; Rowe, 1987; Ullman et al., 1988).

1.2 Mitigating design fixation

What helps to mitigate design fixation? Vasconcelos & Crilly (2016) suggest that example solutions may also "inspire" new solutions, giving rise to "new ideas that it (sic) would otherwise be very unlikely to emerge" (p. 1). They review 25 studies exploring factors such as modality of the example, number of examples presented, diversity, and novelty of examples; however, findings are inconsistent across studies. Familiar examples produce more fixation (Dugosh & Paulus, 2005; Viswanathan, Tomko, & Linsey, 2016), though Perttula & Silipa (2007) found it also led to better design outcomes. Logically, the number of examples presented should impact fixation, but Perttula and Sipila (2009) and Dahl and Moreau (2002) found no effect. Sio and colleagues (2015) suggested that providing several examples could even further inhibit creativity, and concluded that providing a single example is better than multiple ones.

In addition to deciding which example to provide, there is the question of when to provide it. Sio and colleagues (2015) concluded that presenting examples at the beginning of solution attempts produces a larger positive impact. Perttula and Liikkanen (2006) found that presenting examples in the middle of the design process resulted in the exploration of more categories. Vasconcelos and Crilly (2016) suggest providing examples when designers are experiencing exhaustion in their solution attempts. Other studies suggest examples are more effective after designers reach an impasse (are "stuck") in idea generation (Moss, Kotovsky, & Cagan, 2007), while Siangliulue, Chan, Gajos, and Dow (2015) add that people must also be aware that they are stuck. Moreno and colleagues (2014) compiled approaches to reducing fixation effects such as ensuring a creative design environment, encouraging analysis of functional and physical models, and providing defixation instructions (Christiansen & Schunn, 2007).

Despite giving rise to fixation problems, examples appear to play an important role in design problem presentation. It may be important to consider why example solutions are frequently presented with design problems. In instructional settings, examples play a variety of pedagogical roles, such as making the design criteria more complete or concrete, illustrating the qualities needed in potential solutions, and even simply confirming that a solution is in fact possible (Crismond & Adams, 2012; Crismond, 2013; Kimbell, 1982). Examples may carry such weight because they are introduced by the "instructor" along with the problem description. Once presented, research participants may simply copy examples in order to avoid unnecessary work (Youmans & Arciszewski, 2014). Thus, some design fixation may appear because participants recognize the example as an existing solution that they can then adopt.

1.3 Using idea generation methods

If designers cling to examples because generating ideas is challenging, then existing idea generation methods, such as brainstorming or TRIZ, might be effective with respect to reducing design fixation (Youmans & Arciszewski, 2012). Crilly (2015) suggested methods that assist designers in generating ideas, such as design heuristics (Daly, Yilmaz, Christian, Seifert, & Gonzalez, 2012; Yilmaz, Seifert, & Gonzalez, 2010), may offset the fixation resulting from examples. Rather than try to mitigate the effects of example fixation, bolstering idea generation processes may "wash out" its effects.

A range of idea generation methods have been proposed to support divergent thinking in the design process, and a systematic compilation of over 170 different idea generation techniques has been compiled (Smith, 1998). Yilmaz and colleagues (2015) categorized generation techniques as 1) facilitating idea flow, e.g., brainstorming (Osborn, 1957) and brainwriting (Geschka, et al., 1976); 2) stimulating of initial idea formation, e.g., analogical thinking (Perkins, 1997), morphological analysis (Zwicky, 1969), and Synectics (Gordon, 1961); and 3) transforming ideas into more or better ones, e.g., questioning (Eris, 2004), lateral thinking (de Bono, 1999), conceptual combination (Finke, 1992), SCAMPER (Eberle, 1995), and TRIZ (Altshuller, 1997). However, few of these strategies have empirically validated in the context of design; as noted by Smith (1998), "*Of the hundreds of existing methods, only brainstorming has been subjected to a substantial battery of performance tests. Moreover, these assessments have generally been inconclusive in their results"* (p. 129).

Design Heuristics are an empirically validated method for idea generation derived from three different sources: 1) protocol studies of industrial and engineering designers (Daly, Yilmaz, Christian, Seifert, & Gonzalez, 2012); a comprehensive analysis of over 400 products (Yilmaz, Seifert, Daly, & Gonzalez, 2016); and content analysis of an expert designer over 200 concept sketches (Yilmaz & Seifert, 2011). The 77 different *Design Heuristics* capture patterns of idea generation -- cognitive "rules of thumb" -- that guide designers in introducing variations into concepts (Yilmaz, Daly, Seifert, & Gonzalez, 2016). *Design Heuristics* have been shown to be effective for both novices (Christian, Daly, Yilmaz, Seifert, & Gonzalez, 2013; Daly, Christian, Yilmaz, Seifert, & Gonzalez, 2012; Kramer, Daly, Yilmaz, Seifert, & Gonzalez, 2015; Yilmaz, Christian, Daly, Seifert, & Gonzalez, 2012) and experts (Yilmaz, Daly, Christian, Seifert, & Gonzalez, 2013). As a well-documented method for aiding idea generation, *Design Heuristics* may be an effective tool for fighting the effects of design fixation.

1.4 Study design

To investigate this question, an empirical study of design students tested whether Design Heuristics use can mitigate fixation. The study design was consistent with the dominant paradigm for design fixation studies as reported by Vasconcelos and Crilly (2016). An educational workshop of entering engineering design students served as the study setting. In this study, we conducted an experiment to increase the rate of idea generation due to the implementation of an additional tool (catalyst) which is not consumed in the idea generation process and can continue to act repeatedly promoting further idea generation, thus overcoming fixation. It is acknowledged that a weakness exists in the context of validity extending beyond the specific setting, as with all experimental studies, thus the authors do not make this claim.

2 Methods

2.1 Participants

One hundred eighty-five first year engineering design students, 122 males (65.9%) and 63 females, at a major research university in the Midwest participated in the study. The students were 17 to 18 years of age (M = 17.9; SD = 0.46). The participants were recruited through a free, two-day workshop option offered to incoming engineering design students. Participants were not compensated for their session.

2.2 Materials

Two design problems from Jansson and Smith's (1991) study of example fixation were used in this study. The 'fixation source' was an example concept sketch (Figure 1) and a description of flaws in its design:

Cup Problem: "Design a disposable, spill-proof coffee cup. The design should be operable with one hand, durable and should not include a mouthpiece or straw. Below is an example of a spill proof coffee cup. Please note, the straw will leak when the cup is rotated 90 degrees from the angle shown. The cup will leak if squeezed and the hot liquid emerging from the straw will burn one's mouth."

Rack Problem: “Design a car-mounted bicycle rack that addresses the following needs: (1) Easy mounting of the bicycle, (2) Easy mounting of the rack, (3) Cannot harm bike or car, and (4) Must be versatile for all bikes and cars. Below is an example of a present-day bike rack. The bicycle is set in the rails and the vinyl coated hook is attached to the seat tube of the bike, and then the hook is tightened down by hand with a wing nut. One should note the difficulty of mounting the middle bikes on the rack.”

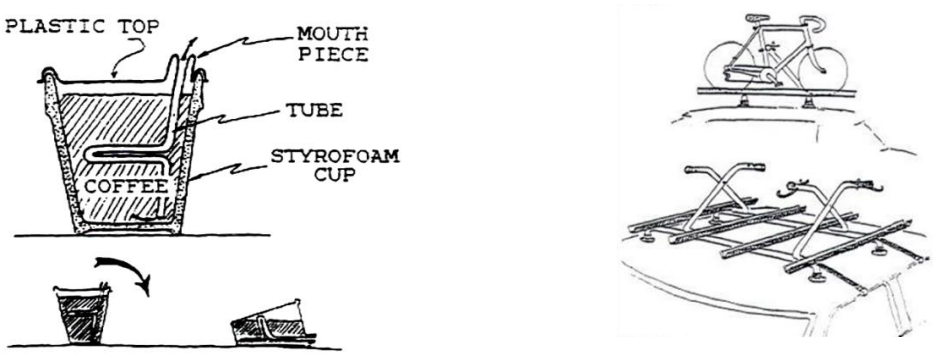

Figure 1 Example concepts provided for each problem: Coffee Cup (left) and Bike Rack (right) (Jansson & Smith, 1991)

Separate concept sheets for recording new designs were prepared. The top of each sheet included a boxed space for sketching, and below it, a prompt was presented: “Describe the idea in detail. How does it work? What are the unique features, mechanisms, and details?” For the Design Heuristic condition, each sheet included an additional prompt: “Did you use any specific strategies or Design Heuristic cards? If so, write the number of each card you used. If you did not use any, write ‘none.’”

Each *Design Heuristic* was presented separately on 3 x 5 cards. *Design Heuristics* presented in this format have been shown to be effective in enhancing idea generation in first-year engineering design students (Daly, Yilmaz et al., 2012; Daly, Christian et al., 2012). Each card names and describes one heuristic, with a graphical illustration on the front side and two example consumer products illustrating the heuristic on the back side (Figure 2).

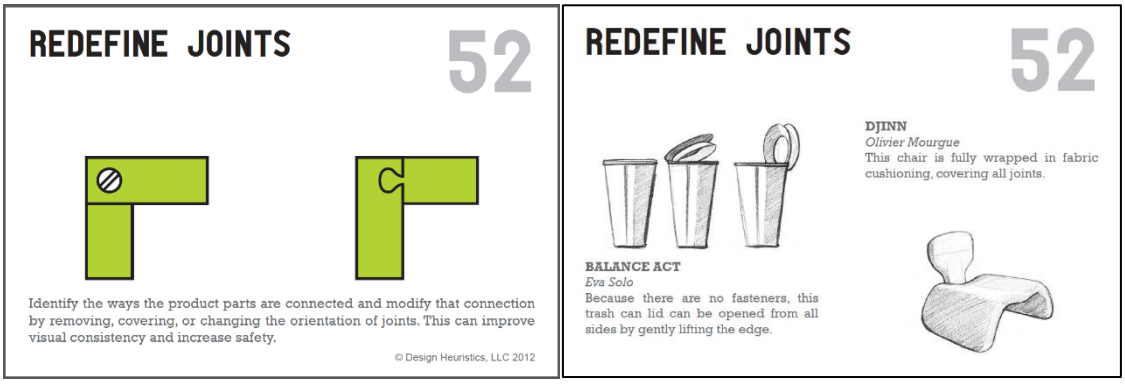

Figure 2 Example of a Design Heuristic card showing its front (left) and back (right)

This *Design Heuristic*, “Redefine Joints,” suggests modifying the way that the product parts are connected by removing, covering, or changing the orientation of joints. This heuristic may lead to the development of concepts that improve the visual consistency of the product, and enhance the safety of product operation.

Packs of 15 *Design Heuristics* cards were prepared. The cards were selected at random into five subsets from the larger set of 77 *Design Heuristics* cards, listed in Figure 3.

1	Add levels	20	Change geometry	39	Incorporate environment	58	Scale up or down
2	Add motion	21	Change product lifetime	40	Incorporate user input	59	Separate functions
3	Add natural features	22	Change surface properties	41	Layer	60	Simplify
4	Add to existing product	23	Compartmentalize	42	Make components attachable/detachable	61	Slide
5	Adjust function through movement	24	Contextualize	43	Make multifunctional	62	Stack
6	Adjust functions for specific users	25	Convert 2-D material to 3-D object	44	Make product recyclable	63	Substitute way achieving function
7	Align components around center	26	Convert for second function	45	Merge surfaces	64	Synthesize functions
8	Allow user to assemble	27	Cover or wrap	46	Mimic natural mechanisms	65	Telescope
9	Allow user to customize	28	Create service	47	Mirror or array	66	Twist
10	Allow user to rearrange	29	Create system	48	Nest	67	Unify
11	Allow user to reorient	30	Divide continuous surface	49	Offer optional components	68	Use common base to hold components
12	Animate	31	Elevate or lower	50	Provide sensory feedback	69	Use continuous material
13	Apply existing mechanism in new way	32	Expand or collapse	51	Reconfigure	70	Use different energy source
14	Attach independent functional components	33	Expose interior	52	Redefine joints	71	Use human-generated power
15	Attach product to user	34	Extend surface	53	Reduce material	72	Use multiple components for one function
16	Bend	35	Flatten	54	Repeat	73	Use packaging as functional component
17	Build user community	36	Fold	55	Repurpose packaging	74	Use repurposed or recycled materials
18	Change direction of access	37	Hollow out	56	Roll	75	Utilize inner space
19	Change flexibility	38	Impose hierarchy on functions	57	Rotate	76	Utilize opposite surface
						77	Visually distinguish functions

Figure 3 The 77 Design Heuristics card titles (from Yilmaz et al., 2016).

2.3 Procedure

Students were assigned at random to one of two design sessions held in separate rooms. Graduate student instructors (with experience in design) were first trained together on conducting the study (Table 1), and then assigned at random to conduct a session.

Table 1 Procedure schema

Short (7 min) introduction	Fixation source (example along with design problem)	Introduced to rules of group brainstorming	Practiced individual Brainstorming (5 min) with the task of designing "a seating device	Individual Brainstorming idea generation session (25 min)	Short (10 min) *Design Heuristics* lesson	Practiced individual idea generation with the Design Heuristic	Individual Design Heuristics idea generation session (25 min)

In an experimental design, each of the two Idea Generation sessions included one of two design problems (Coffee cup or Bicycle rack). Both sessions were conducted following the same procedure and timeline for the study.

First, a short (7 minute) introduction to idea generation was presented using slides, including a definition of divergent thinking, and the goal of creating multiple, diverse ideas for design tasks. The instructors explained that effective idea generation involves thoroughly exploring the solution space. They did not discuss fixation, or other problems, that can arise during ideation. The instructors also noted the importance of sketching, and encouraged participants to "just get the idea down on paper" rather than worrying about their drawing skills.

The 'fixation source' comprised of two simple design problems from the Jansson & Smith (1991) study. The students were provided with an example along with the design problem (as in Jansson & Smith, 1991). Both sessions followed an identical procedure for the rest of the 85 minute study.

Next, students were introduced to the rules of group "brainstorming" (based on Osborne, 1957.

Students then practiced individual Brainstorming (5 minutes) with the task of designing "a seating device," using the concept sheets for their ideas. This practice session was followed by an individual Brainstorming idea generation session (25 minutes) where students created their own concepts for their assigned design problem. They were asked to draw, describe and number each of their ideas on a different concept sheet. They were told they would have 25 minutes to create their designs. For this individual Brainstorming session, there was no indication of whether they followed the Brainstorming method presented, or used another method (such as their own version of natural "brainstorming").

Then, a short (10 minutes) *Design Heuristics* lesson was presented. The instructors explained how to use a card to generate multiple ideas, and that every card can be used in response to a single design problem. The instructors discussed the general format of the cards, front and back. Then, students individually practiced using the Design Heuristics to design new ideas for "a seating device." Next, participants were given an individual packet of 15 cards, and asked to individually generate more concepts for their assigned problem using *Design Heuristics* (25 min). Students were encouraged to select and combine whichever heuristics they found most applicable or interesting. Students were asked to indicate whether they used any heuristics, and which ones by number (shown on each card), on each concept sheet.

At the end of the session, we asked the students to individually evaluate their concepts in comparison to the provided example design. On this post-survey, each student indicated which of their concepts they judged as "similar" to the initial example they saw on the first page of their materials. Students also ranked all of their concepts from most to least creative.

3 Results

3.1 Fluency of idea generation

A total of 1380 concepts were generated across conditions in the study. The fluency score for each student in both idea generation sessions (Brainstorming and *Design Heuristics*) was calculated as the count of the number of concepts generated (*Table 2*). A 2 x 2 mixed ANOVA examined the between-subject effects of Problem and the within-subjects effect of Idea Generation Method.

Table 3 Fluency of Idea Generation

Idea Generation Method	Count	Percent	Mean	SD
Brainstorming	868	62.9%	4.67	.11
Design Heuristics	512	37.1%	2.94	.11
Total	1380	100%		

The students were successful in using the *Design Heuristics* method with only a short (ten minute) training. Students listed at least one *Design Heuristic* in the generation of 360 concepts, and 91

concepts were noted with more than one *Design Heuristic*. Only 61 (12%) of the Design Heuristics concepts were listed without a specific heuristic, suggesting students were successfully following the *Design Heuristics* method in that session.

Because students always brainstormed concepts first, it might be expected that they would produce more concepts in the individual Brainstorming session (M=4.67; SE=.11) than in the *Design Heuristics* session (M=2.94; SE=.11), $F(1, 175) = 201.36$, $p < .001$. A total of 868 concepts were generated during the initial Brainstorming session, and 512 additional concepts were created during the *Design Heuristics* session (Table 2).

The majority of students (78%; n=145) generated more Brainstorming concepts than *Design Heuristic* concepts. This difference may be due to greater fatigue in the second 25 minute ideation session (*with Design Heuristics*) on the same problem. While most students where familiar with Brainstorming as a method, they were using Design Heuristics for the first time; as a result, they may have needed time to read through and understand the cards in their set, leaving less time for creating designs (Daly, Seifert, Yilmaz, & Gonzalez, 2016).

In the analysis of fluency by problem (Coffee Cup and Bicycle Rack), more concepts were generated for the coffee cup problem (M=7.39; SE=.24) compared to the bike rack problem (M=7.63; SE =.27), $F(1, 175) = 18.63$, $p < .001$. This advantage for the coffee cup problem was evident in the first Brainstorming session and may reflect greater familiarity with this product compared to a bicycle car rack. Brainstorming resulted in more solutions than *Design Heuristics* for both problems (Table 3), with an even larger benefit for the Cup problem than for the Rack problem, $F(1, 175) = 6.12$, $p < .05$. Because the two problems resulted in differences in fluency, we also consider the fixation measures across idea generation sessions by problem.

Table 3 Fluency of Idea Generation by Problem and Method

Idea Generation Method	Problem	
	Coffee Cup (mean, (SE))	Bike Rack (mean, (SE))
Brainstorming	4.69 (.16)	4.75 (.16)
Design Heuristics	2.69 (.13)	2.87 (.14)

3.2 Idea Fixation

Jansson and Smith (1991) defined fixation as the presence of specific features from the initial provided example in the later ideas; for example, in the Cup problem, including a straw or mouthpiece in the new idea. However, this "degree of copying" approach (Shah, Smith, & Vargas-Hernandez, 2003) may miss deeper similarities between ideas, and count novel uses of a straw as fixation (see Figure 4A). For this study, we asked the students to evaluate their concepts in comparison to the provided example or to the self-generated example they produced at the start of the study. Thus, each student defined the similarity of their concepts to the initial example. On the post-survey, students were asked to indicate which, if any, specific concepts in their set were similar to the initial example they saw.

Of the 1380 concepts generated by 185 students, approximately 26% (n=363) were marked as "similar" to the first idea. Figure 4 shows ideas from sessions when students had seen the Coffee Cup example (example concepts shown in Figure 1). Across both sessions, the average number of ideas reported as "similar" to the first example was 1.96 (SD=1.93), with a range from 0 to 13, and about 22% (n=40) students did not mark any of their ideas as similar.

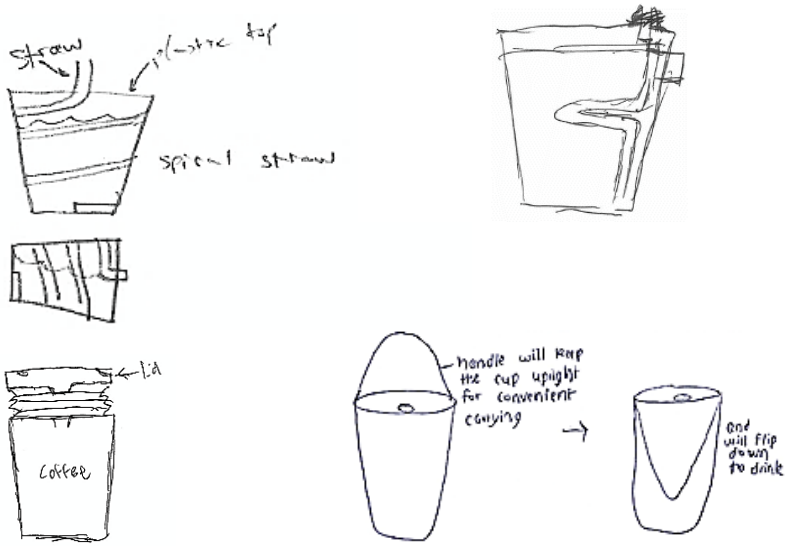

Figure 4 Coffee Cup concepts from students' idea generation sessions. Concept A (top left) corrects for one flaw in the provided example (spilling) by using a spiral straw to prevent spills when dropped. Concept B (top right) adds a change to the provided example with, "Button shift tube to align with opening." This student also generated a Design Heuristic concept C (bottom left) using the "Flatten" heuristic to create a different mechanism to prevent spilling, described as "The lid flatten (sic) so it meets the liquid section." A fourth Design Heuristic concept (bottom right) used "Attach to user" to create a handle that folds away when cup is in use.

The Brainstorming session produced 71% of the 363 concepts judged as similar to the provided example (n=258, M=1.94), with 29% (n=105, M=1.72) identified from the *Design Heuristics* session. Since Brainstorming constituted 868 (63%) of the total ideas, the Brainstorming session had a significantly greater proportion selected as "similar," $X^2 = 17.86$, $p < .0001$. This suggests the prompts provided by the Design Heuristics cards did reduce fixation on the initial example.

We also computed a similarity ratio for each student, consisting of the number of ideas within their Brainstorming and Design Heuristics concept sets identified as "similar" to the initial example. Brainstorming ideas were significantly more frequently identified by students as similar to the initial idea (M=.3, SE=.02) compared to *Design Heuristics* concepts (M=.2, SE=.02), $t(169) = 4.22$, $p < 0.001$.

In sum, the results depict a consistent picture of how fixation impacts idea generation method: *Brainstorming* creates more, but more similar, concepts compared to *Design Heuristics.*

3.3 Creativity of Concepts

At the end of the session, students were asked to indicate their most creative concept by rank ordering the creativity of all of their completed concepts (from both tasks) using the serially-ordered numbers on their concept sheets. Example concepts selected by students as their "most creative" are shown in Figure 5.

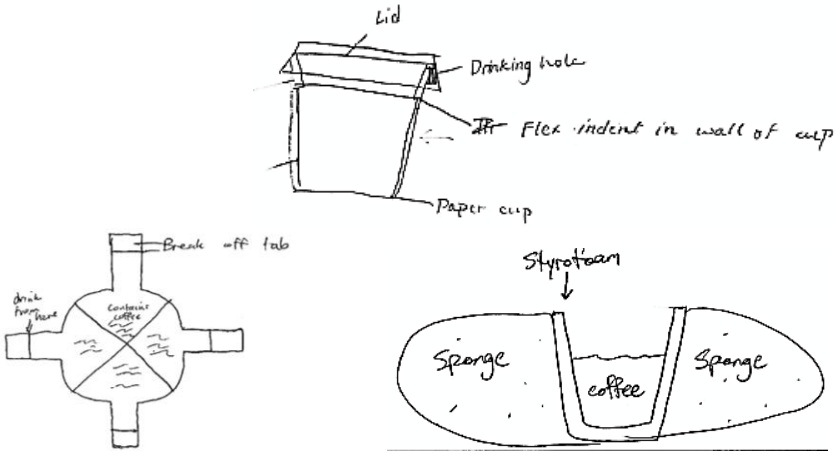

Figure 5 Examples of concepts judged to be "most creative" from the Provided Example group. One concept (top) uses the Design Heuristic, Change Flexibility: "The user squeezes the cup causing the wall to move inward, forcing the portion above the flex indent to be forced outward, which causes the lid to stick up with its drinking hole." Another student's concept (bottom left) is from the Design Heuristics session, and used "Compartmentalize" to divide drink storage areas. A concept (bottom left) was from the Brainstorming session was, "Sponge donut surrounds the cup. If the cup tips over, the coffee will be absorbed into the sponge."

As noted above, students created (on average) 1.5 more concepts during their first Brainstorming session than in their later *Design Heuristics* session; consequently, the likelihood of selecting a Brainstorming concept as their most creative concept by chance is higher. In fact, 97 (52%) students identified a Brainstorming concept as their most creative concept, while 63% of the concepts were generated using Brainstorming $X^2 = 4.72$, $p < 0.03$). While only 37% of the total concepts were created in the *Design Heuristics* session, 48% of the students chose a *Design Heuristic* concept as their most creative. Though students created more concepts while Brainstorming, the lower proportion of these identified as "most creative" suggests the Design Heuristics method was more helpful in producing creative concepts.

4 Discussion

The present study allowed the comparison of two different idea generation methods to determine their effectiveness in reducing fixation. The positive impact of *Design Heuristics* is seen in the lower frequency of ideas that were identified as similar to the initial example. These findings suggest that using an alternative idea generation method, such as *Design Heuristics*, may be helpful in moving the designer away from initial ideas to consider alternatives. In addition, students found a higher proportion of *Design Heuristics* ideas to be creative compared to Brainstorming. This suggests *Design Heuristics* are helpful in moving away from existing ideas towards novel, creative designs.

Brainstorming resulted in more ideas than *Design Heuristics*. The *Design Heuristics* method likely required more learning time than brainstorming, reducing the time available for idea generation. And, because the *Design Heuristics* session was always second in serial order, this second session may have taken place when participants were more fatigued, or had "exhausted" their ideas. In addition, students were already familiar with brainstorming, so may have found that method easier to use. Nevertheless, additional ideas were successfully created in a second idea generation session with *Design Heuristics*.

This study relied upon students to evaluate their own designs for their similarity to the presented example solution. Further support from an independent, expert evaluation of the similarity of the designs to the presented examples may be helpful. In addition, the present study always had the brainstorming session first followed by use of Design Heuristics. A true experiment is needed to compare the effects of serial idea generation methods. In classroom settings, a period of free brainstorming allows the expression of individuals' existing ideas may be helpful before moving on to other methods. Finally, while the fixation effect has been demonstrated numerous times in classroom and laboratory studies (Vasconcelos & Crilly, 2016), the degree of fixation experienced by practicing designers is more difficult to document.

These findings extend those of Jansson and Smith (1991) to explore how to overcome fixation in design creation. While many studies within this paradigm have been conducted, it is often difficult to compare findings across studies (Vasconcelos & Crilly, 2016). While fixation has long been identified as a problem for designers, approaches to reduce fixation have not been identified. These results provide a concrete suggestion: adding a different idea generation method may help to reduce fixation by "restarting" the idea generation process. *Design Heuristics* was a new method to the students, but they were able to make use of it to extend their idea sets with new ideas that were different from the first example. And, these ideas were more likely to be viewed as creative ideas.

The study results suggest that *Design Heuristics* may help to overcome fixation and to generate more creative ideas. When battling the effects of fixation on known solutions, generating ideas with

Design Heuristics may be especially helpful. Design Heuristics appear to promote divergent thinking by prompting designers to consider concept modifications leading to new directions in design. As a result, they may be less likely to perseverate by including specific features of example designs. *Design Heuristics* may help to promote changing directions in designs as more designs are created, resulting in more varied concepts. These benefits may amplify the production of new ideas even after brainstorming a set of new concepts on their own. Across a session using more than one idea generation method, Design Heuristics may facilitate taking more divergent paths through the solution space.

5 Conclusion

Providing examples with problems may provide important information to designers (especially students), such as design requirements, concrete implementations, or simply existence proofs of solution. In addition, providing no example still results in an initial idea (created by the designer) that may take on a special prominence and serve as an initial example, resulting in fixation to its features. While examples also hinder the creation of diverse candidate ideas through fixation, the present study shows that idea generation methods like *Design Heuristics* can counteract these consequences. This paper demonstrates that implementation of an additional tool like *Design Heuristics* can mitigate fixation and lead to more creative outcomes. This research provides evidence about how educators can help students develop their idea generation skills, and promote their development of design capability.

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About the Authors:

Leahy, Keelin research interests lie in design methods and approaches for the development of creativity and design based activities and pedagogy in design education. Also interested in ideation methods and strategies; idea generation; concept development; divergent and convergent thinking; and design education.

Seifert, Colleen M. research interests lie in complex human cognition, including memory, learning, problem solving, and creativity; currently investigating cognitive accounts of creative thinking, and ways to improve the creative process; also invested in improving learning and pedagogy in design, higher education.

Daly, Shanna research interests lie in front-end design processes; idea generation; creativity and innovation; design cognition; design ethnography; design decision-making; design problem finding and framing; concept development; cross-disciplinary design practices; prototypes; divergent and convergent thinking; design education

McKilligan, Seda research interests lie in identifying impacts of different factors on ideation of designers and engineers, developing instructional materials for design problem and solution spaces. She often conducts workshops on design thinking for a diverse range of groups and faculty members at different institutions.

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Pedagogic Power-Tools: knowing what was and what is, for what will be

O'SULLIVAN Glen

Dún Laoghaire Institute of Art, Design + Technology
glensullie@gmail.com
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The tools we choose to derive benefit from and our perception of their significance play a determining role in how successful the designs we create will be. When we think of a tool, the first thing that comes to mind is more than likely a device you hold in your hand. However, the designs we create are not only made with tools of a physical nature but are also birthed from tools of an abstract variety. Therefore not all tools are prosthetic. Some design tools are related to or exist in the form of words. These are verbal tools. In most educational environments the impact of verbal tools – like the knowledge learned from design's history – on the design process is often underexposed. Yet, tools like design history can be exploited for, and can be perhaps even a key to, improving our student's designs. Within contemporary pedagogical contexts, similarly to the way in which we maintain and promote the use of visual tools, there is a great need for our verbal tools to be equally supported and nourished.

design pedagogy; verbal tools; design history; design practice

1 Utilising Tools

Between my finger and my thumb

The squat pen rests.

I'll dig with it.[206]

Across the reasonably pliant bracket of design as a whole, whether one wishes to be branded under the label of 'designer', 'artist' or 'engineer' – or perhaps all of these titles combined – we are all 'makers'. What we make are objects and objects are created with tools. The objects I speak of are designs that you might sit on, drink from, or articles of clothing you might wear; devices you may cherish, throw away or never even give them a second glance; things you might read or fold; fancy items for special occasions or gadgets you use everyday; things made by machine, things made by

[206] Stanza extracted from: Heaney, S. (1966) Digging, in *Death of a Naturalist*. London: Faber and Faber.

man and things never made at all; spaces you might encounter, inhabit or traverse through; we make objects to look at; we create ideas about things, and invent things about ideas (NCAD, 2018). When we design the tools we choose to use, exploit and our perception of their significance play a determining role in how successful the designs we create will be. Having said that, in order to construct the most successful objects, do we make full use of all the advantageous tools that are available to us, or only the ones we are most familiar with? When we think of a tool, the first thing that instinctively pops into our heads is likely a device you hold in your hand. Malcolm McCullough (1998) highlights that it is the hand-held type of tool that "comes to mind because more than any other it demands an especially active sort of skill" (p.59). However, if a tool is something that augments our abilities in order to conquer the impediments of the body, then tools are not just hand-held devices. For example, if tools can extend both our physical and cognitive capacities, a tool can be a piece of technology or even an applied intellect (McCullough, 1998). Therefore, the designs we create are not only made with tools of a physical nature but are also birthed from tools of an abstract variety. It is clear then that although tools are a pragmatic means to an end, they are not always prosthetic.

As it is the hand-held tool or 'hands-on' type of tool that predominantly enters our minds for immediate and efficient use, nowadays, the computer instantaneously seduces us to perceive it as the best option for expeditious designing. Admittedly, it is quite plain to see how the computer is recognised as the most paramount tool of our time; it is a multitasking solver of problems whose power lies in its ability for abstraction (Knörig, 2008). Yet, because of a computer's effectuality what is often consigned to oblivion is that a computer is just one tool that can be used to execute a design. Fred Brooks fundamentally admonishes that the computer is more of a toolsmith rather than a scientist (as cited in Knörig, 2008, p.17). In addition, John Maeda alternatively believes that the computer is "not a tool but a material" (as cited in Hara, 2009, p.125). Maeda warns us that when we use computers we should not credulously welcome whatever software is presented to us, and that we must vigilantly deliberate what kind of cultivated world can be grown from our knowledge of this material (Hara, 2009). That being said, as a result of a computer application's allure, when we design we are now nearly "optimally supported by computer tools" (Knörig, 2008, p.17). However, the computer being the overriding tool of choice and the predilection of immediate computer use remains well defended. This is chiefly due to the current and perpetual perception of the computer as being the almighty 'meta-tool' for design practice (Gänshirt, 2007).

The designer's adoption of the computer has had a significant impact on aesthetic ideas. Since the very establishment of the view of machines as tools for mass production, designers and artists have embraced how such scientific powers can influence their lives (Bayer, 2009). More specifically, this welcome has allowed machines to improve certain aspects of a designer's creative activities. Still, the excellence of computer applications can cause us to turn a blind eye to a key element of our artistry – the human body (Knörig, 2008). Without doubt the human body is an unrivalled 'tool-being' (Molotch, 2018). Yet, in relation to the result or success of a design, some bodily tools like our eyes or our appendages are often misprized. Nevertheless, the tools I mention here are somatic ones. There is a further failure to fully appreciate the pertinence of our minds and the knowledge stored within them. Andy Gossett reminds us that the brain is "the best design software"; the tool "between your ears, so keep it upgraded by looking, reading, and questioning" (as cited in Cleaver, 2014, p.74). Hence, the mind remains the most matchless engine for forging ideas. Despite this the popular under-acknowledgement or even incognizance of such an ingenious design tool is without doubt, due to the fact that the desktop computer has a particular proclivity for absorbing our complete attention (Knörig, 2008). Therefore, the computer's prominence as being the best recourse for immediate use and the current engrossment of its applications can often be to our creativity's detriment.

Before we begin to use a tool we ask ourselves what it is that this specific instrument can do for us, or which type of tools should I call on to get to grips with the project in hand? This is because each tool serves a specialization and when we address problems the tools we choose to help us tackle a

brief depend on the tool's specific purpose (McCullough, 1998). Clifford Geertz (1973) importantly accentuates that a tool's disguised imperfections are only revealed when it is put to use. Therefore, it would be quite folly to even attempt to use a computer for procuring ideas or visuals prior to securing a solid concept. Admittedly, the computer is an outstanding tool available to designers, but be warned, this technology will not give you an idea (Cleaver, 2014). Being creative requires ideas and students must be exhaustively aware that ideas do not live in computers (Altsteil & Grow, 2017). Tom Altsteil and Jean Grow (2017) stress that design begins "in your head, flows onto paper or napkins or backs of folders or inside book covers via your pencil" (p.144). The pen – or any instrument that we use to make marks – holds as the most substantial conceptual tool for designers (Knörig, 2008). It is a vital and extremely precise implement because through its use "the crucial first step in the journey from imagination to reality" takes place (Graham-Dixon, 2005). The pen grants us utter freedom, a freedom that is evident as early in the mark-makings of infants who clearly understand how to utilize this tool in order to communicate their ideas (Knörig, 2008). Even now computational support for sketching is doing its best to exactly mimic practices that are supported by physical tools (Johnson, Gross, Hong & Yi-Luen Do, 2008). Evidently, there is a popular reliance on computer-based tools but not necessarily at the expense of the pen. However, the majority of current hardware still "lacks the portability, responsiveness, and feel of tools of traditional design practice" (Johnson et al., 2008, p.22). Nonetheless, when executing our initial concepts – regardless of whether we use a computer mouse or a stick of charcoal to do so – the pen is ideal for the inceptive stages of design when ideas are speedy and copious. This is due to the fact that this particular tool enables us to swiftly communicate a few ideas, and quickly alter, reject or refine them (Knörig, 2008). When we generate and convey ideas, the use of the pen can be exploited for both visual and verbal purposes. For instance, when we sketch we use the pen as a visual tool, but in contrast if we use it to write down words, sentences, descriptions, critiques, discussions and theories, it becomes a verbal instrument.

Christian Gänshirt (2007) shows us how design tools can be split into these two classifications that complement one another. These are visual tools that create images and forms which emanate from the use of our hands, and also verbal tools from the written and spoken word. While visual tools make it feasible to convey concepts in visual form, the verbal tools we avail of produce textual information and are used to explain, examine and criticise design (Gänshirt, 2007). Hence, the verbal tools we use are principally put to use for developing the meaning of a design. Similar to the way in which Christian Gänshirt has coined the computer as a meta-tool for design practice, Peter Dalsgaard (2014) calls attention to John Dewey's description of how language is a meta-tool: "a tool of tools in the sense that it is the primary instrument for establishing meaning" (p.148). Having said that, it must be noted that language is not always "concerned with correct representation" (Dalsgaard, 2014, p.148). The extent of its truth lies with those who have written it. For that reason, Ludwig Wittgenstein is one philosopher who strongly felt that there is no equal status regarding verbal and visual tools. His writings forewarn that: "there are things that cannot be clearly expressed in language, but can be shown" (as cited in Korst, 2012, p.80). However, with that said language still remains essential "in managing and controlling the conditions" of a "situation and steering it towards transformation" (Dalsgaard, 2014, p.148).

In contemporary pedagogy, the impact of verbal tools on the design process – and the way in which they are viewed – is often underexposed (Korst, 2012). For instance, design theory is an example of one verbal tool that is taught within design schools which is all about the question of 'Why', yet as designers-in-training the current academic procedures put in place are primarily fixed on the practical question of 'How' (Lupton, 2009). That is to say that during the process of becoming a designer we overcome challenges such as how to use tools like the newest computational software, how to operate an adequate camera, how to arrange files and information appropriately, how to develop a client-list and how to competently collaborate with other professional establishments (Lupton, 2009). As a result, within the vehicle of design teaching, verbal tools seem to have taken a back seat. At present, the predominant tools being used or at least the type of tools that are being

given most attention are visual ones. With the prevalent favouritism towards the use of visual tools and the somewhat neglect of the use of verbal tools, all the potential complications of modern design briefs are not being dealt with (Korst, 2012). However, in this paper it is not my intention to place verbal and visual tools at the same level but to establish the effects of underlying pedagogic technologies. I do not deny the brilliance of visual tools, and by no means do I resent their use, but what does not seem to be highlighted enough is that – to the benefit of the designer – the splitting of design tools into the verbal and the visual corresponds with two complementary methods of thinking: "verbal, linear, logical thinking on the one hand and visual-spatial, concrete, simultaneous, associative thinking on the other" (Gänshirt, 2007, p.101). It is apparent then that visual tools go ever so well with verbal tools, for the greater good. Therefore, verbal tools are unequivocally true pedagogical power-tools; they are imperative instruments used to inform and communicate arguments about the qualities of design (Korst, 2012). Within today's educational environments, design students must be impartially exposed to all of the beneficial tools available to them; they must fully comprehend how each tool functions, how they are looked after, and most importantly, how one tool operates with another.

2 Exploiting Tools

The most prominent verbal tools used in contemporary design pedagogy are most visible in the activities undertaken in a student's critical and contextual studies. Namely, when learning about the history, theory and visual culture of design. As a reference for understanding design, design history is one verbal tool that is easily at one's disposal. It is what students absorb here that enables them to derive full benefit from the subject. In that, the knowledge learned can be used as a tool to give rise to new ideas that are built on foundations from the past. Over the course of history separate periods of past design have been typically differentiated by the defining attributes that they share, which set them apart from other epochs (Tonner, 2015). The characteristics that define these eras are observed through the designed objects that the particular period produced. More broadly, for that reason, we can distinguish the "ancient era from the medieval, the medieval from the modern and so on" (Tonner, 2015, p.133). What design historians do is situate design-related events in time, they impart us with an explanation as to why particular events occurred when they did and what objects were produced during that point in history. Essentially their current objective is to "establish links between the present and the past and contribute to an understanding of design as it is currently practised" (Triggs, 2011, p.4). Historically, the subject concentrates on the interrelated conditions in which these objects existed, and stylistically it examines the designed object's distinctive appearance; an appearance that is, in most cases, determined by the principles according to which the object was contrived.

Over the last two or three decades one of the most preponderant propensities within design has been the impact of historicizing it (Jensen & Nygaard Folkmann, 2013). What design historians have done to objects is attributed meaning to them by maintaining that they "have a relation to or are embedded in a historical context of tradition" (Jensen & Nygaard Folkmann, 2013, p.2). When called upon, design history is an instrument that can be used to defamiliarise the present (Wyche, Sengers & Grinter, 2006). In that, it supports designers in envisioning design for the future without the constraints of "present-day cultural assumptions" (Wyche et al., 2006, p.36). We can look back at history, unrestricted, and see what historic designs like the invention of the wheel, canned food or Johannes Gutenberg's early printing press has done to make life easier for us all. Furthermore, we can exploit design history as a tool in order to convey or include an analysis of the merits and faults of these objects that were once created. These merits involve the quality of the object being worthy of appreciation or praise, and on the other hand, the faults I enounce are the inadequate facets and unsatisfactory characteristics of the design in question. In order for the design to be fully understood, and the knowledge from its conception taken in, we scrutinize these merits and faults within the conditions surrounding the epoch in which the object was formed.

Within the scope of design history, every epoch has formed a unique will of the age which has resulted in the creation of specific and identifiable styles of design. Moisei Ginzburg (1982) tells us that each era, or in his words each "vital creative force", is distinguished by specific artistic organisms (p.78). As a result the styles that represent these periods of time have now become "consecutive steps of a consistent historical progression" (Kavas, 2015, p.161). Design history then is usually documented in terms of mirroring a particular zeitgeist (Calvelli, 2010). Furthermore, epochal narratives are those that strive to sum up these zeitgeists "in some kind of overarching societal designation" (Osborne, 1998, p. 17). It is evident then that the circumstances surrounding the advent of a design or "a particular kind of designing involve complex social relations" (Dilnot, 1989, p.227). Therefore, designers-in-training and creatives alike must become conscious of the fact that all objects are part of a more extensive world, which means that they are "never free from context" (Östman, 2005, p.287) For that reason, design cannot be completely understood without taking its social dimension into account (Margolin, 2009). That is to say, the discipline of design and the field of sociology are an example of entities that are far too important to study in isolation. This is because "design is not produced in a vacuum, and its history must acknowledge influences from outside events, discoveries, and policies" (Heller, 2014). Philip Tonner (2015) also stresses that each epoch is now a "historically defined configuration of meaning", which the historian – or designer in this case – can use as a tool to extract useful information and "characterise and criticise individuals, societies and civilizations" (p.133). Peggy Loar (as cited in King & Sisson, 2011) explains how these civilizations define themselves through their everyday things, specifically via their material culture. Loar informs us that through designed objects "cultures are recorded, providing us with tangible evidence concerning transformations in values and politics" (King & Sisson, 2011, p.1). Therefore, a designer's contemporary practice can considerably profit from knowledge of things, past and present. Using this knowledge can even "function as a lens, allowing observers to better see some of the most prominent paradoxes of modern society and culture" (Fallan, 2010, p.viii).

Albert Camus tells us that: "without culture and the relative freedom it implies, society, even when perfect, is but a jungle. This is why any authentic creation is a gift to the future" (as cited in Vinod & Deshpande, 2013, p.358). Therefore, we must be aware that knowledge of the objects we create today for tomorrow may well be called upon by designers in the future and examined thoroughly. Today's latest invention may well be tomorrow's relic. If there were stronger procedures in place to inform and make young creatives fully aware of this, perhaps this particular detail could encourage them to take advantage of all tools, and as a result, produce designs that are more desirable, satisfactory and effective. Although we cannot escape the fact that the needs of the future will not be the same as they were in days gone by, we can exploit design, including it's recorded history, to promptly explore ideas, to discover things and most importantly to question them (Hustwit, 2009). The use of design history as a tool allows us to assess an object's 'situation' and turn this to one's advantage. Designs of the past – those that have worked and those that have not – and the consequences of their efficacy or inefficacy need to be ventilated and learned. In his celebrated statement, George Santayana (2009) declares that: "those who cannot remember the past are condemned to repeat it" (p.312). Recognising which designs have been successful and which have been unsuccessful can allow us to circumvent the errors and flaws of the past. For instance, if we look to what was done before and initially withhold judgment, this suppression may also "be used as a tool to make later judgment more sensitive" and this of course "is a way of learning from everything" (Venturi, Scott Brown & Izenour, 2009, p.71). Le Corbusier, one of the pioneers of what is now called modern architecture, once stated that:

> *To be modern is not a fashion, it is a state. It is necessary to understand history, and he who understands history knows how to find continuity between that which was, that which is, and that which will be. (as cited in Rand, 2009, p.68)*

Evidently, one who truly understands a historical object recognises and understands the reasons for the decisions involved in its making. Due to the documentation of this decision-making a window of opportunity for learning has been made readily available to us. Such information has been made

obtainable because during the design process decisions are made at certain stages about every 'thing' (Hustwit, 2009). The more knowledge we have about these resolutions, the better the selection of information we possess which is freely available to pick and choose from when it is relevant to what it is we are designing. For that reason, it is paramount to acknowledge what history can contribute to the solving of contemporary design problems and how the knowledge gathered from it can be taken full advantage of (Jensen & Nygaard Folkmann, 2013).

Although knowledge is a powerful tool, it must be highlighted that history is not incontrovertible but a means of "continuously changing interpretations, largely dependent on cultural and political interests" (Östman, 2005, p.360). Therefore, given that design comprises of the tools through which designers represent and communicate their concepts and ideas, to some extent, designs are repeatedly the consequence of bias decisions (Korst, 2012). As a result, subjectivity is inseparably part of them. Furthermore, the history of design is not simply a history of designed objects, it is a history of the transforming "views of subject matter held by designers and the concrete objects, conceived, planned, and produced as expressions of those views" (Buchanan, 1992, p.19). It must also be mentioned that design history is relatively short in comparison with "the history of many other academic disciplines" (Fallan, 2010, p.1). This is pertinent to know because the discipline of design history emerged from the discipline of art history and has inherently shared some of its suppositions (Calvelli, 2009). Accordingly, in the same way we ask design students to be critical of design itself, we must also get them to cautiously analyse what has been written about it. This is because the history of design history is "a record of the historian's views regarding what they conceive to be the subject matter" (Buchanan, 1992, p.19). Michael Bierut (2007) informs us that there are two preferred methods of recording the subject that seem to be most apparent: one is the documentation of design history as the product of a series of imaginative designers, and two is its recording as the product of extensive "anonymous historical forces" (p.107). Sometimes we get one, sometimes the other. Occasionally "we get a mix of the two. But what we seldom get is the messy truth in between" (Bierut, 2007, p.107).

As practising designers, there should be a bit of a design historian and design theoretician in all of us. After all, acquiring an accurate and deep understanding of design and the everyday is not something we are terribly unfamiliar with (Venturi et al, 2009). Design permeates our lives and it is "visible everywhere, yet it is also invisible – unnoticed and unacknowledged" (Lupton, 2009, p.6). Ironically, many of the greatest examples of good design or a design goal that is achieved are often objects that people do not consider to be designed at all (Hustwit, 2009). For example, the 'post-it' note. It is something that we fail to properly appreciate. People do not think of things like this as being designed and what they do not understand is that from the minute their day begins "almost everything that has filled their world has been designed in one way or another" (Hustwit, 2009). As a contribution to design and for the use of designers themselves, one could write a gargantuan amount of beneficial information on an object like the post-it note and the narrative behind its conception. Therefore, any supercilious attitude or partiality towards the use of visual tools over the use of verbal tools must be eradicated from our students' minds. Design schools must not only support students in creating designs from our well-loved visual tools, but also encourage them to accumulate "a body of scholarship and critical writing" (Heller, 2014). By doing so undergraduates will cultivate their historical perspective and further enhance their professional practice. In his chronology of design [graphic] it is Philip B. Meggs' view that:

> *If we understand the past, we will be better able to continue a culture legacy of beautiful form and effective communication. If we ignore this legacy, we run the risk of becoming buried in a mindless morass of commercialism whose mole-like vision ignores human values and needs as it burrows forward into darkness. (Meggs, 1998, p.viii)*

Without any doubt then, verbal tools like the documentation of the reasons for former design decisions can facilitate a gateway into the stories of designed objects from the past (Michl, 2014). Design history then can "become a tool for, and perhaps even a key to, better design" (Michl, 2014, p.446). This is because there is a story embedded in all objects. For example, Armin Hoffmann (as

cited in Poulin, 2012, p.152) tells us that objects such as the "poster does more than simply supply information on the goods it advertises; it also reveals a society's state of mind". Therefore, when fishing for knowledge you have the ability to "get as much out of a paperclip as you can from a van Gogh" painting (Godson, 2015). For designers then apophthegms like 'what's in the past is in the past' should never be taken so literally. In more ways than one, we must exploit the bygone.

3 Perceiving Tools

Classically, tools have been perceived as practical extensions of the hand that allow us to "control and manipulate the physical environment" (Knörig, 2008, p.18). Most notably, this perception of tools as physical aides was most prominent during the Eighteenth Century when the use of tools was considered to be the chief characteristic that distinguished humans from animals (Knörig, 2008). However, this view is no longer supported as this perspective is now much more differentiated. Nonetheless, the means to conceptualize and manipulate tools in a complex manner remains a "distinguishing characteristic of humans, and forms a promising milestone in human evolution" (Wadsworth & Kana, 2011). The way in which we think about design – and the particular design tools that we choose to derive benefit from – has a lot to do with how we have been taught about the subject. Additionally, not only do tools we call upon set the constraints for what we can design, they also define how we perceive our work; they structure our approach and determine how much effort the task will consume (Knörig, 2008). Therefore, our perception of a tool's significance plays a determining role in whether we choose to use them or not. Fundamentally, the way in which we perceive things is a process by which we interpret the world around us. However, perception must not be mistaken for vision. Mary Zalla helps us to distinguish between these two abilities, she illustrates how:

> *Vision is concrete. It observes. Perception is more abstract. Perception leaps beyond observation to judgment. We see what we see, but what we perceive is a combination of what we see, our past experience, and our particular point of view on a situation. (Zalla, 2014)*

What the brain does is make assumptions about the world to "overcome the inherent ambiguity in all sensory data in response to the task at hand" (Ward, Grinstein & Keim, 2015, p.82). For that reason, when we begin to answer a design brief, and even before we open our toolboxes, the mere perception of the tools we might use has a huge impact on our design process (Wadsworth & Kana, 2011). When in the hands of the proficient craftsmen, appropriate tool-use is a powerful resource that intrinsically strengthens our capabilities and capacities (Lutters, Van Houten, Bernard, Mermoz & Schutte, 2014). In addition, Jerker *Lundequist* (as cited in Östman, 2005, p.63) emphasises how knowledge is not just simply "knowing a fact about an object" and how it also encompasses an understanding of how to do what it is you are about to do and the meaning behind it. Therefore, if we are able to familiarise ourselves with and correctly perceive the advantage of a particular tool's use, then when appropriate, it is likely that this tool will be chosen for the task at hand. On the other hand, if we have an ill-informed perception of a tool it is highly improbable that this tool will be called upon to help us with what it is we are trying to accomplish. Evidently, the way in which tools are regarded, understood, or interpreted are of pivotal significance to the end result of a design. As a designer, scholar and educator I have a fervid interest in the role that verbal tools play within the spheres of design education, with a specific avidity for the integration of design history, theory and studio practice. However, in many centres of learning the influence that verbal tools exert on the design process is seldom given the appropriate attention it deserves. As aforementioned, this lack of attention is the result of a favoured attitude towards the use of tools that create images rather than those that exist in the form of words. Admittedly, I was once an inexperienced novice unaware of what verbal tools could offer and how they can benefit contemporary design practice. I naively perceived tools like design history as an amalgamation of historical events, obsolete facts and besmirched objects. While I was an undergraduate or a 'designer-in-training' although great efforts were made to integrate the history, theory and practice of design as a holistic experience

rather than as isolated subjects, the majority of my fellow students and I viewed our critical and contextual studies as extraneous, almost burdensome and in many instances as if it interfered with our on-going studio practices. Consequently, the verbal tools available to myself and the other undergraduates were not considered as important a tool for us, especially when compared to the enticement of tools available from our beloved Adobe Creative Suite. This unenlightened thinking was likely because at the end of a student's scholarship, a strong portfolio tends to be the coveted finished product rather than an appreciation of history (Heller, 2004). Unfortunately a lot of callow designers are inclined to think in a similar manner as I once did; that verbal tools are trivial, that they are peripheral and that they are inessential to growth and evolution. They are in fact, quite the opposite.

The current teaching and assimilation of what it is design historians write about, is an activity that most closely resembles that of traditional academic disciplines. Daniel Fallman (2008) highlights that this is because the principal goal of historicising design is "to build an intellectual tradition within the discipline, and to contribute to an accumulated body of knowledge" (p.9). Furthermore, it is when we use verbal tools that the impact and input that associated disciplines have on design is most apparent. For instance, when designers collaborate and work with other fields of expertise such as psychologists, engineers and anthropologists, they soon reference and adopt elements of "another disciplines' techniques, practices, and theories" (Fallman, 2008, p.9). Therefore, when contrasting ideas and opinions are brought to the table and we exploit both the visual and the verbal, the greatest concepts are conceived. As emphasised on the DRS 2018's website, design and designers "flourish in a state of flux and the most interesting work can emerge from the chaos" (DRS2018a, 2017). This is largely due to the fact that design synthesises and catalyses other disciplines (DRS2018b, 2017). Accordingly, a respected perception of design history should inevitably lead to an advantageous understanding of how the subject can operate with and be of aid to other verbal and visual tools. Design's history can be used as an oscillating resource that unites the 'How' and the 'Why' in order to produce the 'Now'. Therefore, my current ardour is not so much verbal tools 'verses' visual tools but, as might be expected, more along the lines of how they compliment one another and work simultaneously to achieve greater design goals. I encourage designers of today and 'designers-in-training', to do their best not to see valuable verbal tools like design history as a multitude of monotonous hypotheses, but as readily available and also as peerless as a mentor as anyone could possibly wish for.

The way in which students perceive design history along with the current nature of design itself "are tremendously important to the future of the practice" (Frimpong Acheampong & Berg, 2015, p.2). Therefore, the subject must be seen from a new vantage point. We must also tackle any ill-informed perception of design history as just being something associated with the 'old'. The fact that a historical object is old is only the investigational tip of the iceberg, there is much more complex details beneath. In addition, Jan Michl (2014) tells us that objects of the past "do not really dwell in a past, in the sense that they disappear from our present" (p.449). For example, many of the objects of the past exist in physical form right now and so do their numerous images (Michl, 2014). Therefore, the defining difference between design past, design present and design future can sometimes only be a matter of perspective. Deep down, we are in some sense, fully aware of this point of view but accepting the truth in it has rather shocking implications (Michl, 2014). As this perspective is quite arcane it is difficult for people to perceive how objects of the past can be contemporaneous with ourselves. Still, in order to exploit design history to the fullest degree we should consider this informative and educational tool in terms of design *present* rather than design *past* (Michl, 2014). Design students must perceive design history "as a pattern book to be plundered at will" (Baljon, 2002, p. 334). Michl highlights that by shifting our perception of what we define as antiquated and what we define as modern we can transform the past:

> *Into a living supply of stylistic inventions and discoveries, a supply that…can be tapped, re-employed and redeveloped by inventive and daring designers in order to satisfy the*

diversity of tastes and plurality of stylistic preferences among the public of today. (Michl, 2014, p.450)

At present, we must extol the currently active designers who do make use of their erudition of the past and add to the development of contemporary design practice (Triggs, 2011). Yet there is still an exigency for more qualified design historians to dig deep, uncover the goods and provide an understanding of objects in their historical and stylistic contexts (Triggs, 2011). There is also a further requirement for designers themselves – and those in training – to deconstruct the boundaries of what was, what is and what will be by understanding the milestones of the past, incubating this knowledge and executing it at will.

By force of circumstance the methods through which design history is taught in each educational context ineluctably differs, and also evolves. Therefore, this body of writing is by no means an unkind castigation on any institution, department or on the methodological procedures that were in place at the time. I must also avow that although experience does provide valuable insight, it does not carry much conclusion beyond opinion. It is from personal observation that I maintain this need for reinventing the way in which student's perceive design's history. More importantly, reader beware, it is a review sparked from the way in which one individual was taught. Nonetheless, if design history is to progress within educational institutions, I strongly feel it is the perception of the use of verbal tools that needs to be challenged in order for up-and-coming designers to acknowledge their crucial significance, their full potential and their value in professional practice. Sadly if the existing attitude towards the value of verbal tools is not questioned, this same deficient perspective will be brought out into the real world and applied there. Graduates will not have changed their minds about it. Thus, the cycle of design history's insufficient exploitation continues. If educators are familiar with this inadequacy, design historians and those who impart the subject's content – or those who are in charge of its administration – may wish to reconsider the placement of its history as it is currently being practised (Buchanan, 1992). Having said that, I must admit that during a student's training three or four short academic years is a compact amount of time to try and 'fit' everything in. Over the course of an undergraduate's scholarship, perhaps this limited timeframe has an effect on why the use of visual tools is given more attention and the importance of using verbal design tools is left understated. Due to my own past dissatisfactory perception of design history, I salute the educators, historians, theoreticians and practitioners who are, at present, working tirelessly to ensure that the discipline retains vitality and relevance to contemporary problems. In recent years I have been lucky enough to witness how some institutions have, in fact, implemented models for design history that are indeed exemplary and supportive to their students' practice. With that said, I write this paper in the hope of provoking thought and instilling initiative in others who have not been so fortunate as to experience such paragons. We must continue to discover additional innovative and instructive possibilities in order to improve the perception of the subject's capabilities in all centres of learning.

Within contemporary pedagogical contexts, it is through the encouragement and use of design history for design future that young designers will come to perceive its true mileage. The subject should be seen as a cornerstone for "understanding theory and practice, not an expendable filler" (Heller, 2014). As thought and visions cannot be communicated directly and can only be conveyed with the help of tools, one has to express their ideas through gestures, by initiating dialogue, sketching them or writing them down (Gänshirt, 2007). Therefore, in today's schools of design, similarly to the way in which we maintain and promote the use of visual tools, there is a great need for our verbal tools to be equally supported and nourished. The knowledge and use of alternative types of tools has immense potential and should unquestionably be used to cultivate contemporary design practice. Clearly, the tools we choose to utilize and make full use of – and our perception of their significance – sway the outcomes of the designs we create. It is evident then that all tools play a crucial role in the creative process and often have paradigm-shifting effects on the designs created (DRS2018c, 2017). Therefore, equitably exposing students to the advantages of exploiting all of the tools available to them is the most powerful pedagogical aid for catalysing design capability. Most

design students are of course skilful makers but they must also “be equally good as thinkers. They must be able to research, analyse, critique, and write” (Heller, 2014). Nowadays, the verbal tools I write and research with are as treasured as the visual ones I take advantage of. When I design I use both visual and verbal tools in order to agglutinate information, conceptualise, and by extension produce the best design possible. I use them to generate ideas, to unearth innovation and to critically communicate arguments of design. Between my finger and my thumb the squat pen rests, I’ll dig with it.

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About the Author:

Glen O'Sullivan is a graphic designer, design historian and associate lecturer at Dún Laoghaire Institute of Art, Design + Technology. His current research has its origins in addressing the gaps in erudition about visual communication and Dublin's early twentieth-century electric tramway network.

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Have I Got a Proposition for You: Developing the capability for compelling arguments through rhetorical practice in the design studio

KELLY Veronika* and THIESSEN Myra

University of South Australia
* Corresponding author e-mail: veronika.kelly@unisa.edu.au
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Designers draw implicitly on rhetorical modes of appeal (ethos, pathos, logos) in the way they talk about their work in terms of its strategic, social, and cultural impact. Rhetorical practice on its own, however, may not align with an ethical position. Yet design's increasing emphasis on values, behaviours, and social action indicates a practice that requires expertise in formulating compelling design propositions that inspire people to act. This has significance for design education in relation to developing learners' capabilities in making more compelling arguments for their design work that emphasise the social and ethical impact of design in use. This paper proposes that such capabilities can be developed by examining the rhetorical modes of appeal integrated with the dialogic aspects of design studio learning (Shreeve, 2015). We discuss results from observations of studio critiques at four Australian universities that sought to gauge the degree to which the rhetorical appeals were implicit or explicit in students' presentations. We argue that examining how design students describe their work and think about their role as designers improves understanding of the value of rhetorical practice within new and developing fields of design.

design education; design practice; rhetoric; criticism

1 Introduction

> *All of my conversations now with clients are to do with language, behaviour and values, those three things (Designer, 2015).*

The statement above is from an interview with a long-established communication designer based in Australia. The interview centred on the kinds of conversations he has with clients, and particularly his approach to formulating design propositions undertaken on behalf of those clients to elicit their engagement and inspire action in audiences. The comment is indicative of a broad shift in

professional graphic and communication design thinking and practice, from one that focused on the value and meaning of an artefact to greater emphasis on values and behaviours, strategy, interaction, experience, use, and social impact (Friedman, 2012; Margolin, 2002; Norman, 2010). In Australia, the term "graphic" is increasingly absent from the websites of professional designers who are redefining what they do for their clients by emphasising their services and practices as design for communication and as a cultural force. For example, design firms are now working in more multidisciplinary ways, they are more concerned with strategy and value that "harnesses culture and creativity" and engages people (Studio Round, 2017). They have redefined their own brief as designers to be more in tune with designing "human experiences that enrich lives" and "improve wellbeing" (Frost* Collective, 2017). In the design literature, Findeli (2001) has also described how a systematic enquiry of a design brief "pushes material artefacts to the background in favour of the actors within the system" thereby inviting designers to become more interested in the "human context yielding the brief" rather than in a brief focusing on the formulation of a product (pp. 14-15).

It is important to recognise these are not new ideas. It can be seen in the literature that this observed shift in thinking about and practice of design has been investigated and debated for some time and we have contributed to this discussion in previous work (Kelly, 2014, 2016; Thiessen, 2017; Thiessen & Kelly, 2017, forthcoming, 2018; Thiessen, Kelly, & Williams, 2015). We do not wish to circle around the same discussion in this paper but rather point to a way forward by exploring how these rising theories can be applied in the educational design studio by developing a practical framework for learners to develop the capabilities enabling them to align their practice more closely with the sort of tasks they are actually expected to do, *now,* as designers.

Changes to the culture and scope of design practice signal not only the way a designer's work is characterised, but by implication the ways available for their clients, and the public to interact with design and designers. For communication designers, an increasing focus on behaviours, values and social action involves being adept at providing alternative stories and propositions to the ones audiences are predisposed to. In this paper we propose that such capabilities can be developed by reflecting on shifts in communication design practice to build on the dialogic aspects of design studio learning where students "practice arguments, explain thinking processes and learn the languages of design" (Shreeve, 2015, p. 88). In short, by integrating learning from the rhetorical modes of appeal, namely *ethos*, *pathos*, and *logos*, with design studio pedagogies.

2 Developing design capability in the curriculum

In higher education contexts, graduate capabilities are broadly understood as the knowledge, skills, and attributes a university or institutional community agrees its students should develop and demonstrate during the course of their study. Local contexts, histories, and cultures, combined with institutional priorities, also operate to shape specific educational offerings. To understand how design capabilities are broadly understood, we draw on two benchmark statements: the Cumulus International Association of Universities and Colleges of Art, Design and Media's "Design Education Tuning Document" (2012) and the International Council of Design's (ico-D)[207] document, "Icograda Design Education Manifesto" (2011). While there are numerous regional professional design codes of conduct and practice standards and design education reports, both Cumulus and ico-D are constituted by international membership (individuals, educational institutions, and design organisations), that broadly inform, and are informed by, design and design education across many countries.

Within both of these documents, the role of the designer as a facilitator concerned with social impact, and the importance of effective communication as a professional capability, are clear. For example, the Manifesto posits communication design as a practice that integrates the dialogue and

[207] ico-D was known as the International Council of Graphic Design Associations (Icograda) until its name change to the International Council of Communication Design in 2011, then the International Council of Design in 2014.

approaches of other disciplines into a "multidimensional and hybrid visual competence" (2011, p. 8), whereby a designer "uses an inclusive approach that emphasises difference; respects human, environmental, and cultural diversity; and, strives to achieve common ground", and "demonstrates cultural, ethical, and professional appropriateness" (p. 9). Similarly, the Cumulus Tuning Document sets out student learning outcomes and competencies by level descriptors, where "First Cycle" is Bachelor-level study. Included under "Key Subject Specific Competencies – General Knowledge" is the capability for learners to demonstrate "awareness of the position of design in social, cultural/artistic, political ecological, economical, and ethical contexts" (2012, p. 3). Under the descriptors for "Key Generic Competencies – Communication Skills" is a "[b]asic understanding of efficient communication in written, oral and visual forms" and a "[b]asic knowledge of rhetorical skills" (p. 4).

Together these point to a need for approaches to design pedagogy that emphasise context, culture, values, and behaviours, that work alongside the impact of design in use; i.e. in social context and where people's responses are a valuable part of the design outcome. University students undertaking design degrees must then expect to develop demonstrable knowledge and skills in criticism so they can evaluate what determines social and cultural value. In parallel, they must demonstrate a capability to make and articulate effective and appropriate arguments for their design work that draws on basic rhetorical practices.

3 Background to the rhetorical model for design education

While we acknowledge the breadth of rhetoric as a field of study, and its extensive history as a cornerstone of western human communication, it is not our purpose, nor is it possible within the scope of this paper, to discuss either in detail. What is important to note is that although it appears the relationship between design and rhetoric is becoming more widely recognised in academic circles (Bonsiepe, 1999; Ehses, 1984, 2009; Gallagher, Martin & Ma, 2011; Halstrøm, 2017; Joost & Scheuermann, 2007; Poggenpohl, 1998; Thiessen & Kelly, 2017; van der Waarde, 2010), evidence of the explicit integration of the art of rhetoric in communication design curriculums remains scant. It is a recognition of this gap that has motivated us to explore a model for teaching approaches that aim to develop necessary knowledge and skills enabling students to construct more compelling arguments and better situate their design work, based on the rhetorical modes of appeal: ethos, pathos, and logos. We posit that explicit learning in the rhetorical modes of appeal or "demonstrations of proof" drawn from Aristotle's *The Art of Rhetoric*, provide a useful theoretical framework for catalysing learners' capability in making more compelling design arguments and propositions. Aristotle's thought is relevant because of his consideration of rhetoric as a practical art, making it suitable for design pedagogy and practice. As an art, rhetoric can be taught, learned, and assessed, and as a practice it is an activity that human beings engage in through public discourses and symbolic exchanges (Gallagher et al., 2011).

3.1 Design, deliberation, and modes of appeal

Of the three kinds of classical rhetoric proposed by Aristotle[208], we draw on deliberation as a key concept underpinning our model describing the relationship between design and rhetoric. This is because deliberative rhetoric is future-oriented, as opposed to forensic rhetoric, which evaluates the past, and display rhetoric, which focuses more on ceremonial procedures. Like design, deliberative rhetoric focuses on the means to an end with the aim of encouraging (or facilitating) a specific course of action. That action is taken with the aim of achieving a desired result that is based on people's values and goals, which for Aristotle is *eudaimonia* and the central assumption of his ethical theory. Although eudaimonia has been translated as "happiness", it is closer to "wellbeing" and "flourishment" than hedonistic pleasure (Gallagher et al., 2011, p. 31). For Aristotle (1991) it was specifically "virtuous welfare, or self-sufficiency in life, or the pleasantest secure life, or material and

[208] Aristotle's three modes of appeal are deliberative (political, advisory), forensic (legal, judicial), and display (praise/blame, ceremonial). As stated, deliberative most closely aligns with design practice.

physical well-being accompanied by the capacity to safeguard or procure the same" (p. 87). For him, the purpose of deliberative rhetoric is to urge people towards that which is more advantageous or to deter/dissuade them from harm. In other words, the proposition of improved wellbeing and a deeply fulfilling life.

Deliberative rhetoric is a useful model for thinking about communication design because, like design, it deals with prospective action or possibility, and centres on human choice (Poggenpohl, 1998). Since design is concerned with how things could (or "should") be, i.e. "better" than how they are, it is tied to both context and free will, and is also closely linked to ethics. The practice of rhetoric can be directed to a person only when they are free to act; rhetoric is redundant when aimed at persons who *must* do something (Burke, 1969). Whilst the purpose of rhetoric is to create "a constraining bond between what is said and the person or persons to whom it is said" the same bond is not required between the "speaker" (rhetor) and what is being said (Foucault, 2011, p. 112). Based on this thinking, rhetoric on its own lacks a critical dimension, so attending to design's (rhetorical) motivations without critical reflection implies "acting without consequence" (Dilnot, 2015, p. 143). But, if connected to a parallel practice of criticism, rhetorical arguments can be tested in social contexts for cultural value. Since audiences are implicit in how meaning is created and understood from design objects (Findeli, 2001; Kimbell, 2011, 2012; Siu, 2003), the intended outcome and how people respond is the priority of the design. If design is held to account in this way, the principle position of a critical rhetorical practice is to act for a greater good.

With eudaimonia (flourishment) as the goal, the approach to creating an effective proposition is through three forms of demonstration or "modes of appeal". In framing the approach to our rhetorical model for design practice to students, we drew on discussions of ethos, pathos, and logos from a range of sources, whose roots align with Aristotle's rhetoric, with Corbett & Connors (1999), and from the design literature, Buchanan (1995; 2001), and Ehses (2009).

In our model shown in Figure 1, ethos is described as character or "voice", the persona of a design which an audience identifies with and relates to (Buchanan, 2001). We describe this appeal in terms of whether an audience would find the argument credible based on whether what it is proposing is believable and reliable i.e. its integrity.

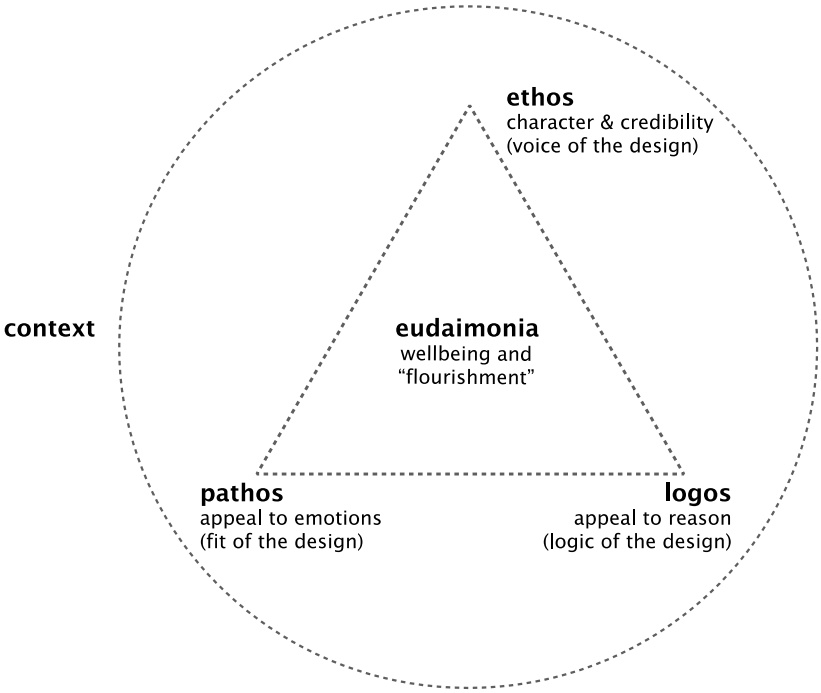

Figure 1 Conceptualisation of the rhetorical model for analysing and structuring design propositions based on context, human values, and goals.

Pathos is explained as emotional appeal; the suitability and fit of a proposition with the disposition (attitude) of a particular audience or community. Pathos is particularly important because emotion and emotional response often drive human desire for fulfilment, which is achieved through action, belief, or behaviour. Logos is described as the appeal to reason; the reasoning and structure of a design such that it is logical, including what comprises a design and its visual language that makes sense in the light of the design voice and fit with the particular audience. The model is conceptualised as an interrelation between these three appeals with eudaimonia (wellbeing and flourishment) as the goal.

3.2 Approach to research

In professional practice, communication designers draw implicitly on rhetorical modes of appeal as evidenced in the way they talk about their work and their practice (Kelly, 2014). However, we propose it is problematic that this practice is not applied in a more explicit and intentional way and suggest it points to limited knowledge about the application of rhetoric as a design practice resulting in its absence in pedagogies used to teach design.

Pilot work revealed design students show preliminary understanding of rhetorical practice but that this knowledge is more apparent when projects are embedded in social contexts rather than focused on crafting designed objects (Thiessen & Kelly, 2017). For example, the students who took part in the pilot study tended to form a more cohesive argument and were more actively engaged with the rhetorical appeals when discussing research-led work compared to object focused practice-led outcomes, and which involved addressing a particular issue on behalf of a cause, client, or concern – a more familiar role expected of designers in professional practice. An implication of that study, however, was a need for a critique of designers' position(s), given that design is fundamentally performed by individuals and socially relational. Rhetorical practice on its own may not align with ethics; however, when coupled with a critical practice a designer's stance informed by their role as a citizen is fundamentally relevant and inescapable.

Since the social understanding of what a design outcome is has shifted, the expectation that designers can more readily and intentionally engage with rhetorical practice seems more apparent. This means new pedagogies are needed for design learners to develop rhetorical expertise. Through the development of a model for professional practice our goal is to inform the way design education could be approached to assist learners to develop this knowledge and capability more explicitly, and critically. In this study, we examine how design students think about their role as communication designers, which informs the larger project by developing a better understanding of the value of rhetorical practice within new and developing fields of design.

4 Method

The aim of this study was to examine how rhetorical practice is manifest in how design students talk about their work in semi-formal educational studio critique sessions. We observed advanced-level undergraduate student presentations of work across four different Australian universities in Adelaide and Melbourne. The presentations were semi-formal in that the students presented final work submitted for assessment and were expected to prepare a short presentation touching on key aspects of the work. However, as a result of typical critique discussions a level of fluidity necessary for productive learning environments was expected (D. Dannels, Gaffney, & Martin, 2008; D.P. Dannels, 2005; D.P. Dannels & Martin, 2008; Whittington, 2004; Wong, 2011). The studio critique sessions were of typical formats for educational studios where students prepare short presentations to large or small groups of peers along with the studio teacher[209]. These were final presentations of work rather than work-in-progress critique sessions. This is significant because the intention of the discussion is different based on whether the work is deemed to be complete or unfinished. Students

[209] The term "teacher" here refers to the educator leading the learnzng task and describes the range of roles, positions, or titles of different individuals who contribute to studio education.

tend to focus more on what they have done rather than what they could still do to improve the work. In this sense, their arguments must be complete to consider how to present what they have done as a viable proposition in response to the design brief.

We observed four in-studio presentations of work. This is a typical practice in the educational design studio, and we did not ask the students to undertake any tasks they would not be familiar with. Since this is a routine expectation of the students, they were likely to respond and discuss their work in a usual way, which meant we were more likely to collect data that was a reliable example of what students would typically say than if the task did not follow a regular procedure. In their own context, each student was expected to prepare a brief presentation. We audio recorded each session to ensure accuracy in how the responses were represented. The audio was analysed for instances of engagement with the rhetorical modes of appeal through the language used in the context of a student's overall design proposition.

There were two participant groups recruited for this study. The groups comprised students in their final term of their final year of a 3-year undergraduate degree in communication design at an Australian university. Group 1 comprised students from the University of South Australia (where the researchers are based). Group 2 comprised students from comparable programs at three other Australian universities. Students across the participant groups presented finalised communication design work accompanied with an oral presentation to their studio teacher and peers. The oral presentations given by each student were for the final stage of a design project in their studio courses, detailed in Table 1. Presentations varied in length and degree of formality. All of the students were also required to present their final design works in material and/or digital form with their oral presentation. The table below sets out the details of participant groups, duration of each presentation, and the type of design project that students presented.

Table 1 Details of participant groups and project types from observations of in-studio presentations.

Group	Participants	No. of participants	No. of classes + teacher/s	Duration of student presentation	Type of design project presented in studio session
1	**Group 1**	68	3 classes; 1 teacher per class	5-10 minute formal presentation	Design research project; Student defined social issue; Student-led approach + outputs; Individual student project
2	**Group 2a**	24	1 class; 1 teacher	Brief, informal presentation	Typographic poster/program; Defined client and output; Student-led approach; Individual student project
	Group 2b	23	1 class; 1 teacher	5-10 minute formal group presentation	Communication design strategy; Defined client and outputs; Student-led approach; Student small group project
	Group 2c	24	1 class; 2 teachers	5-10 minute formal presentation	Design of participatory research method; Defined but broad social issue; Student-led approach + outputs; Individual student project

As the design students participating were all advanced undergraduates, they were familiar with and required to participate in studio critiques and oral presentations of design work, demonstrating their socialisation and known vocabularies relevant to design practice discourses. As such they had developed sound knowledge of design language and practice at their respective universities through studio learning as a site for enculturation into learning ways of being and acting as designers (Shreeve, 2015; D. Dannels et al., 2008).

All participants were informed that we were observing implicit and explicit uses of rhetoric in their presentations, and provided with the following descriptions of the rhetorical modes of appeal:

- **Character and credibility (ethos)** – the character or voice of the design and how it creates a relationship of identification with the values and/or beliefs of the audience i.e. is the audience likely to find the proposition credible and reliable?
- **Emotional appeal and fit (pathos)** – appeal to emotions – how well a design is suited to and fits with the disposition of its audience i.e. is it likely to appeal to and be useful to the audience in its intended use?
- **Logical structure and reasoning (logos)** – the logical structure and reasoning of the design proposition i.e. appropriateness of the structure, medium, and context, to the argument and audience (i.e. visual language).

Students in Group 1 had been introduced to the modes of appeal from the second year of their communication design degree. Following Ambrose, Bridges, DiPietro, Lovett & Norman's (2010) approach to developing expertise, these students have been introduced to and used the rhetorical modes of appeal to: research and analyse existing visual communications (acquire skills); formulate strategies for design propositions (practice and integrate skills); and through studio critique dialogues, learn to know when to apply these skills (p. 96). As part of their individual capstone design research project in their third year, these students were asked to individually construct a rhetorical argument for their design that clearly explained their approach in the light of the three rhetorical appeals.

With Group 2, data comprised the oral presentations given for either individual or small group projects from each university as part of students' regular coursework to examine how rhetorical appeals might be used and/or applied in their presentations of design work. These students had not undertaken explicit education in rhetorical practice in the context of their design curriculums.

All participants granted permission for their presentations to be used in this study and the research was approved by our university human research ethics committee. Participants' identities were removed from the transcribed data during analysis and does not form any part of the results and discussion.

5 Results and discussion

Overall, students across the groups showed a moderate level of skill using the rhetorical appeals implicitly. In line with our pilot work (Thiessen & Kelly, 2017), the results from this study also indicated that the focus of the project brief, either research-led (problem/issue focused) or practice-led (artefact/object focused), had an impact on how students orally presented their work. However, what became apparent in this study is that the expectations of the project brief affected not only how the students spoke about their work but also how subsequent discussion and dialogue between peers and teachers was undertaken in response. Interestingly, the expectation is the critical discussion would be more involved and that the student would consider the position of the work more socially. It is in this space we may be able to prescribe more direct links between rhetorical and critical practices (Thiessen & Kelly, forthcoming, 2018).

For example, with Group 2a, the application of rhetoric was most apparent in language associated with logos, while the application of ethos was least clear. This is not unexpected as students are familiar with and practiced in discussing the formal aspects of their work; skills that have a long history as the focus of learning in undergraduate communication design. For example, the dialogue between individual students below implies a fit between formal aspects such as lines, text, colour, and hierarchy (logos) and the character or intended voice that is projected e.g. "like a mask" (ethos):

> ***Student:*** *… And in terms of the motion, I was thinking about making these lines appear and then the text appears in the background like a mask.*

Student: *… have you tried, you know how in the centre it's the detail about the screenings, have you tried putting that also in the yellow?*

Student*: Oh yeah, I could do that. I don't know, I feel like if I put it – well it's like an orange then it will be almost equal hierarchy to the [Poster Title] and I don't want it to be, I want it to be – I don't know. I'll try it.*

Studio dialogue with this group accentuated the logic and structure (logos) above all else and was more a turn-taking exercise between learners and the teacher than a structured dialogue. This was likely due to the nature of the project, which was practice-led, and because students were finalising a defined output and discussing details to do with typographic variables, structure, and layout. For example:

Student: *But there was also gradient with the text going down with the titles of each film, so the yellow, orange and then the darker orange at the bottom. So I thought maybe there were too many colours, that was probably the main concern. Otherwise everything seems to be fitting in okay.*

Teacher: *Yeah I think the text looks really comfortable in the space, it doesn't look like you're trying to cram too much information in.*

In the exchange above, "comfort" is clearly desired, and indicates a relationship with the experience of the proposed reader (pathos), but is limited to an implicit understanding between the student and teacher. The lack of a clear articulation of pathos may be problematic as emotion is a primary driver for human response. This could point to a clear area for skill development.

The majority of oral presentations in Group 2b started with a brief statement by students (usually a sentence or two) that showed some implicit understanding of the means to convey the character of the client, such as this introduction from one group:

Student: *So we're connecting history. So our communication statement is connect [Client Name] in terms of its local heritage and culture, enhancing the sense of local identity. So this is our brand. Our brand is fairly simple, it communicates well, you feel connected; its history. These are the colours we chose. We decided to keep it simple for families, keep it colourful, keep it a little bit fun.*

The above comment shows how logos is interwoven with ethos and contrasts the discussion observed with Group 2a. For instance, "local heritage and culture" indicate the character and credibility of the client that aims to create a relationship with its audience based on "local identity" i.e. their connection to place. These in turn are related to the visual language being "simple" and the use of selected colours to "keep it colourful" and "fun" intended to appeal to families.

A trend that emerged from Group 2b was an emphasis on what constituted their design (e.g. outputs such as identity/logo design, website, signage) and how these were expected to perform or function, inferring a causal relationship between the design output and its social impact. For example, the comment below from the start of one student group's presentation imbues the design of a mobile application (logos) by being "fun and educational" (ethos and pathos), as the key motivator for its audience (young people) to improve their lives:

Student: *So our group was called [Group Name] and we developed an app that allows the youth of [Client Name] to live cheaper and more sustainabl[y] … And a game was developed to be a fun and educational way to learn to be sustainable.*

While use of ethos and pathos was implicit in all groups to varying degrees, their application was most explicit in Group 1. All but one student in this group structured their presentations into distinct parts, corresponding with the rhetorical model provided. Students began by describing the context, character, and credibility of the design (ethos), interwoven with and followed by the specific audience this would appeal to, and in what way (pathos). Lastly, but also interwoven, students in

Group 1 described specific decisions made about formal aspects; visual language, formats, design outputs, and how these were relevant to the particular audience. The most significant observation about the results from this group is that students did not start with logos such as visual language and design outputs. They spent most of their presentation time on framing the context, purpose and perceived needs of the specific audience. Interestingly, there were far fewer comments from the teacher and peers in this group seeking to unpack the context, design, or how it intended to appeal to the identified audience.

As an example, the following student sought to identify with people who are at risk of natural disasters. The credibility of his approach (ethos) was through its appeal to safeguarding people's safety. Below, he introduces his presentation by explaining why they should adopt his design for an in-home disaster aid kit rather than digitally communicated information:

> ***Student:*** *South Australia is becoming too complacent in regard to natural disasters and not attending to preparedness to a reasonable extent. Storms and floods, heatwaves, earthquakes and bushfires are a part of life in Australia, with [emergency] information advising the widespread community as to what to do in the majority of these situations. With a more technologically advanced society this has led to the information being mostly digitised. There's a large chance it will become unavailable in an emergency situation where power out[ages] are common. Digital information also means that information isn't in direct view and unlikely to be acknowledged prior to a disaster. Information that is not digitised often comes in the form of a brochure which has no sense of permanency in the household and is often disposed of.*

The same student drew on language from the rhetorical model to convey ethos and pathos, such as with these comments: "The voice of my design overall is calming but with a serious undertone, earning a sense of trust in the audience" and a "level of permanency". The reasoning for the design and its fit with the audience was further described as "logical due to its sense of permanence", reiterating an ethos of stability and endurance in a climate of instability due to natural disaster.

The application of ethos and pathos was also clearer with Group 2c, the students who were designing and testing prototypes for a participatory design research method. The majority of student presentations began with a description of the context, character and voice of the design approach (ethos), interwoven with a consideration of the audience they were appealing to and in what way (pathos). For example:

> ***Student:*** *I've been exploring incorporating green infrastructures into densely populated cities as a way to reduce carbon emissions and to improve the environments as well as public opinion and how they feel within the city … changing the way the streets are, the way people move in the streets and whether people would be happy with that … And of course considerations that will always constrain projects like the city budget and the feasibility of the imagined futures because trying to project yourself into the future is really, really difficult.*

The main difference between Group 1, who practised and applied the rhetorical model, and the students in Group 2, who did not, was the way in which the former structured their oral presentations. Group 1 drew on each of ethos, pathos, and logos, and in the majority of cases, showed a notable emphasis on ethos and pathos. The following comment demonstrates how this student from Group 1 sought to create emotional appeal by reflecting on first-hand experience, indicating an enhanced understanding of a specific audience's disposition:

> ***Student:*** *Borderline personality disorder is a complex and often misunderstood mental illness that affects not only the patients but family and friends as well. BPD is extremely hard to diagnose because people's personalities are constantly changing. Also health professionals don't want to label a person with BPD because there is a negative stigma*

surrounding the illness. I decided to focus my research project on borderline personality disorder because when I was choosing a topic, my sister had been diagnosed with it.

Interestingly, in presentations from Group 1, teachers commented less on the need for students to situate their work contextually, or in relation to audience, compared to Groups 2a and 2b. This may be a result of their prior learning, but it might also be due to the project parameters, which were more practice-led for Groups 2a and 2b. In these discussions it was the teachers who frequently drew attention to the need for making context explicit with attention to the ethos of the client and the design strategy so as to establish the value for the client up front, and in making a connection to the "real world" and "real experience" (Group 2b).

A consideration of the specificity of the audience also showed an increased engagement with pathos (Group 1, Group 2c), and was most evident with Group 1. However, in the absence of research examining the particularity of an audience or community of users, students themselves tended to adopt the position of the user/reader in their descriptions of how what they had designed would be interacted with and the relative design components would perform. In these cases, there tended to be a clearer connection between logos (visual language, the "what" of the design) and the character, or ethos, than with pathos or the ability to relate emotionally based on what a particular community of users or an individual would respond to or seek most. A limited interpretation of emotional appeal in communication design indicates a clearer articulation of pathos that addresses the particularity of audiences as a potential area for skill development in design education. The ability to develop this as a capability suggests an expanded understanding of human behaviour, and that communication design students might benefit from theoretical learning grounded more in understanding people (e.g. sociology, psychology, cultural studies).

Design studio learning, as an enculturation to a community of practice, helps students to unpack the culture and languages of that community, including how designers think and act (Shreeve 2015). Communication designers exercise domain knowledge and expert skill with an "unconscious competence" (Ambrose et al., 2010, p. 97) in their use of rhetorical appeals e.g. when they describe what they do in terms of language, behaviour and values. Students who are introduced to design's relationship to rhetoric, along with a critique of that relationship, who acquire skills in the rhetorical modes of appeal, practice and integrate those skills with design studio learning, begin to understand both the value of rhetoric for design practice, and its shortfalls. In this way they are transitioning from an awareness of what they don't know, towards a "conscious competence" where they will have a degree of capability in their domain but "still must think and act deliberately and consciously" (Ambrose et al., p. 97). Furthermore, examining how design students draw on rhetoric when discussing their work and how they position themselves as designers, contributes to understanding the capability of learners to more consciously integrate this knowledge and skill as part of their developing design practice, and indicates that new pedagogical approaches are needed for design students to develop rhetorical expertise. Since rhetorical practice does not necessitate an ethical position by the designer, it also suggests that rhetoric is only one set of knowledge and abilities to be evaluated as part of developing new design curriculums. Alongside rhetoric the social practice of criticism requires social contextualisation and consideration to personal and cultural ethics.

6 Conclusion

Communication design practitioners are increasingly focused on behaviours, values, and social impact which involves expertise in providing compelling propositions in order to engage clients and inspire action in audiences. In this paper we proposed that such capabilities can be developed in design education by building on the dialogic aspects of design studio learning, and by integrating skill and knowledge in the rhetorical modes of appeal; ethos, pathos, and logos, with design studio pedagogies. The results of a series of student presentations of design work from four Australian universities revealed how students' use of rhetoric was either implicit or explicit. We argue that introducing students to the way design is akin to deliberative rhetoric, acquiring skill in, then

practising and integrating the rhetorical modes of appeal with design learning, enables students to develop capability in making more compelling arguments for their design work; theoretically and practically. Additionally, developing cognisance of the particularity of audiences through pathos alongside the social impact of their practice in the light of its intended goals, points to the need for design pedagogy to attend to design's (rhetorical) motivations as a critical practice.

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About the Authors

Dr Veronika Kelly is a Senior Lecturer in Communication Design at the University of South Australia. Her research interests include design, rhetoric, and ethics, design practice cultures, and critical design pedagogy.

Dr Myra Thiessen is a Lecturer in Communication Design at the University of South Australia. Her research interests include typography for reading and learning and the role of criticism in design thinking, education, and practice.

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Why We Need Engineers to Make Art

INNELLA Giovanni [a*] and RODGERS Paul A.[b]

[a] Advanced Institute of Industrial Technology
[b] Lancaster University
* Corresponding author e-mail: g-innella@aiit.ac.jp
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As design practitioners researchers and educators, we constantly find ourselves shuffled between humanities and sciences. In fact, the design departments in the universities around the globe are sometimes placed under the formers, sometimes under the latters, thus becoming a meeting point for academics and professionals coming from both realms. The synergy resulting from the varieties of backgrounds and expertise creates a fertile ground for explorations on both a conceptual and a technical level. This paper reflects on the potential benefits of combining engineering and art research. The authors of this paper look at the increasingly delicate role that technicians, engineers and computer programmers play in developing technologies that impact our social, emotional and intimal lives, and advocate for art as a context and tool to help those professional developing their sensitivity and critical sense, besides their skills. In doing so, the paper makes a contribution to the STEM vs. STEAM conundrum, encouraging an education that merges arts and humanities disciplines with scientific and technical subjects.

art; engineering; indisciplinarity; STEAM.

1 Introduction and Historic Background

If one looks at the way conventional educational and academic contexts have been conceived and organized, artistic and engineering disciplines seem to be two very separated realms. In fact, art and engineering schools, events and qualifications rarely co-mingle and most of the time only out of necessity, rather than out of a true will of exploring the potential of such a contamination. However, historians suggest that such a separation has not always been there.

During the Renaissance (1300 – 1700), artistic and scientific research seemed to go hand in hand. The intellectual man of the Renaissance was a “polymath”, someone who could span art and engineering, design and mathematics, philosophy and science. Many suggest Leonardo da Vinci as the archetype of the polymath; one of the greatest example of the Renaissance Man. In fact, he could work on projects where the artistic and the scientific research and practice merged, to the point that it was hard to discern the two or label the author as either an artist or scientist (Figure

1)(Jones, 2012; Pitenis et al., 2014). Interestingly, many of the Leonardo Da Vinci's studies on anatomy, optics, perspectives, mechanics, production processes were aimed to the making of artworks, whether paintings, sculptures or architectures(Léonard de Vinci et al., 1997). In some ways, we can state that for Leonardo art was the drive and the mean to conduct his research.

As Wilson (2014) suggests, the current separation between science and the creative arts is a consequence of the Enlightenment and the Romanticism movements of the XIX Century. While Enlightenment pinned its hopes on logical thinking and scientific progress, as a reaction, those joining the Romanticist movement gravitated towards emotion and feelings and which manifested through the arts. As a result of these two opposite forces, the distance between the two spheres was highlighted, in spite of the convergence of humanities and science witnessed during the European Renaissance. Since then, we stubbornly separate the science from humanities, engineering from arts, technical skills from conceptual thinking. Two centuries later, we still strive to mend such a tear, however not without difficulties.

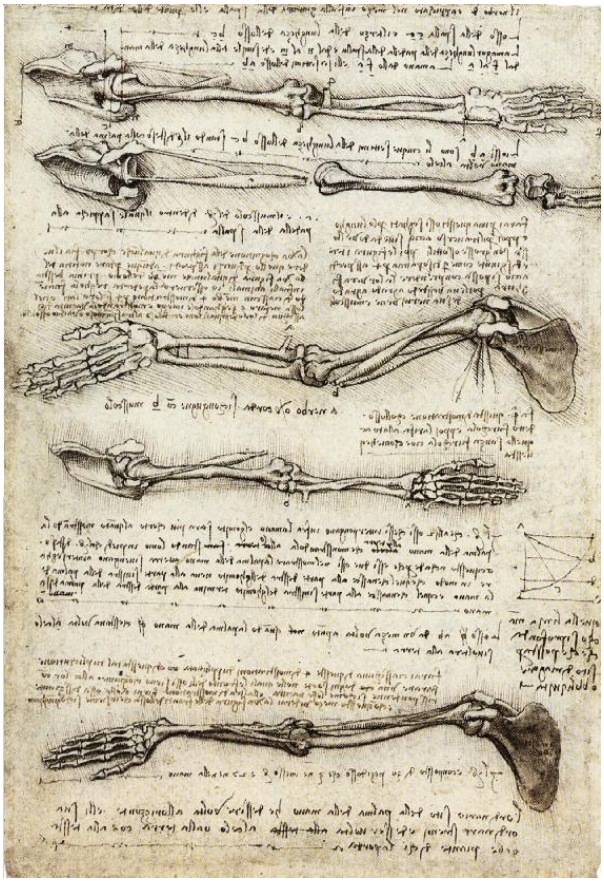

Figure 1 Studies of the Arm showing the Movements made by Biceps, c. 1510, a drawing by Leonardo da Vinci. Source: http://www.drawingsofleonardo.org

2 The Gap Between Art and Engineering in Education

It would not be for nearly 500 years, from the rise of the universities and cities of the later Middle Ages, that the first formal education system to promote a mix of engineering and art, 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, Germany. 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, Gropius, & Gropius, 1952: 13). The main 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 collaboratively 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 their output directly to industry.

Nowadays, most schools reflect the rather sharp division between artistic and engineering disciplines. The rigid division of faculties and departments is a sign of such a separation. It is commonplace for art schools not to include engineering courses in their curricula. Similarly, engineering institutes look at art as a far away world, populated by very differently minded professionals (Zald, 1993).

There are, of course, examples of organizations that bring together the art and engineering worlds, through interdisciplinary teams and processes (i.e. MediaLab, Copenhagen Institute of Interaction Design, Interaction Design Institute of Ivrea, the Royal College of Art and some others) (Ortony, 2003)(Smith, 2007). For example, the now defunct Interaction Design Institute of Ivrea used to enrol students coming from both technical backgrounds, such as informatics, mathematics and engineering, and humanistic backgrounds, such as communication sciences, art and design. The former students were asked to take classes on humanistic and creative subjects, while the latter students had to attend technical courses on programming and electronics. In this way, the institute thought of bridging – or at least narrowing – the gap between the two types of students. The impact of this simple decision was limited, though still appreciable. Thanks to such a diverse education, graduates from the Interaction Design Institute of Ivrea went on to work indistinctively in the arts (i.e. Pors & Rao) (Shackelford, 2012), for technology companies such as Philips and Google, or contributed on innovative engineering projects – Arduino was conceived and developed by people working or studying in the institute) (Frauenfelder, 2011).

Apart from the aforementioned examples, few exceptions exist that do not retain the orthodox separation that sees arts belonging to the humanistic sphere and engineering as part of the scientific domain. This separation is commonly accepted in our educational cultures – certainly in the West – and is also seen throughout our scholastic systems.

Besides the way our culture is shaped, the separation in our schools between the sciences and the humanities is dictated by a number of practical reasons. Among these reasons there is the necessity to organize staff and students, optimize the use of spaces and facilities, award students with more specific academic degrees in order to arguably improve their employability in the professional world. However, such issues should be overcome in order to provide a more holistic education and a better flux among different types of knowledge and thinking.

3 The Gap Between Art and Engineering in Practice

Outside the environments of art and design schools and formal education systems, the separation between the technical and the artistic is much less evident. Of course most art practitioners are labelled as artists and are placed under the umbrella of humanities, whereas engineering practitioners are seen as technical professionals and find their place more in the scientific fields. In recent years, however, the development and widespread use of readily available information and computing technologies to create artworks has helped bridge the apparent gap between art and engineering (Rodgers & Smyth, 2010).

If stating that every art piece has to be designed, engineered and ultimately fabricated may sound obvious, the active involvement of engineering skills and research in art becomes more embedded in

the art process when thinking of kinetic sculptures or interactive installations, for example. In fact, in the case of kinetic sculptures and interactive installations, the artists have to learn how certain technologies work, get inspired by their potential and shape their own thinking around those factors. At the same time, engineers and developers have to understand the artistic concepts, push the technological limitations to achieve the desired results or offer viable options for the project development. In the way, the process can be seen as a flux of notions and processes, in which engineers and artists challenge and inspire each other while working on real projects (Yilmaz, 2014).

Many hybrid practices have arisen at the intersection between art and engineering. Many of them have a more artistic lead. This is the case of British studios such as Troika (Figure 1, 2 and 3) and Greyworld, the Paris-based creative collective HeHe and the Japanese offices TeamLab and Rhizomatiks, for example. There are also the longer-established art studios of Olafur Eliasson (Germany) or James Turrell (USA).

But there are also engineers that rediscovered themselves as artists. Moritz Waldemeyer is among them. Waldemeyer started as a tech consultant for the conceptual fashion designer Husseim Chalayan, before launching his own creative practice. These studios usually begin their projects with an artistic approach, to then start a conversation with technicians and scientists to explore what technology allows them to make. This is when projects may take different routes by pulling and pushing between technological possibilities and artistic explorations. In this process, technical companies, whose expertise lays in engineering and fabricating artworks, are often involved.

Figure 2 Kinetic sculpture "The Cloud" by Troika at Terminal 5 o Heathrow Airport, London. Source: http://www.troika.co.uk

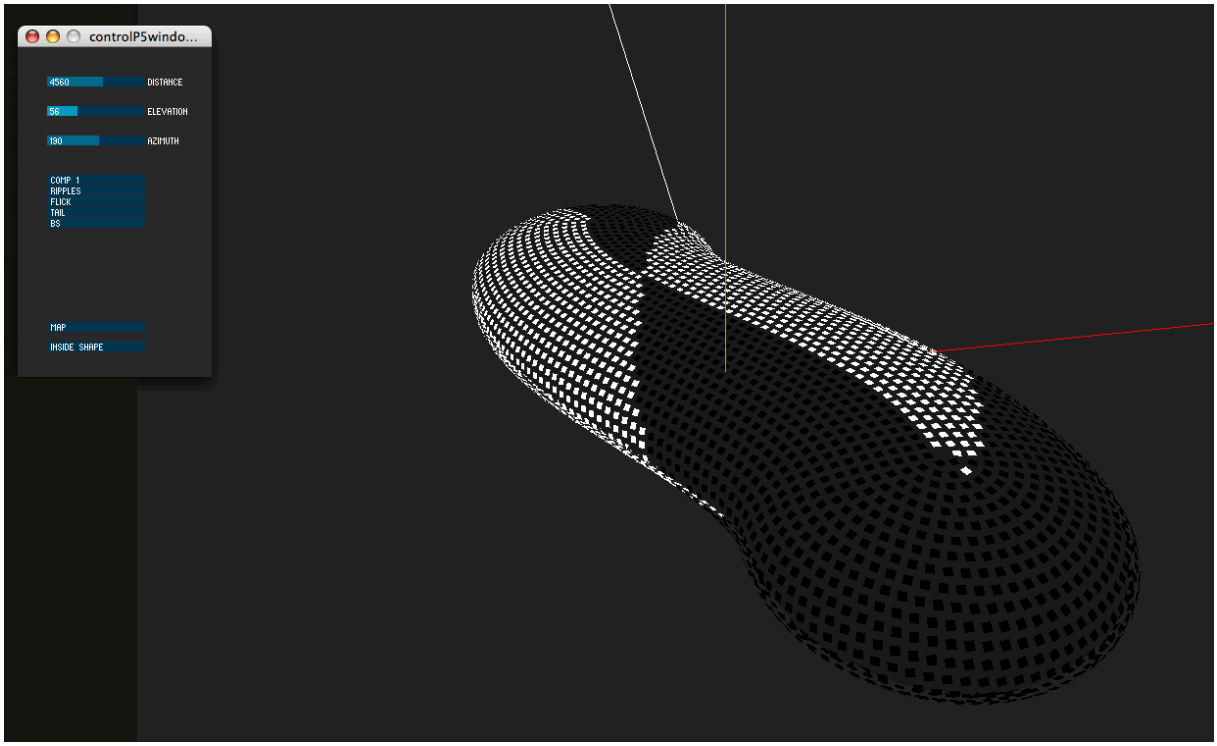

Figure 3 Programming of "The Cloud". Source: http://www.pixelsumo.com

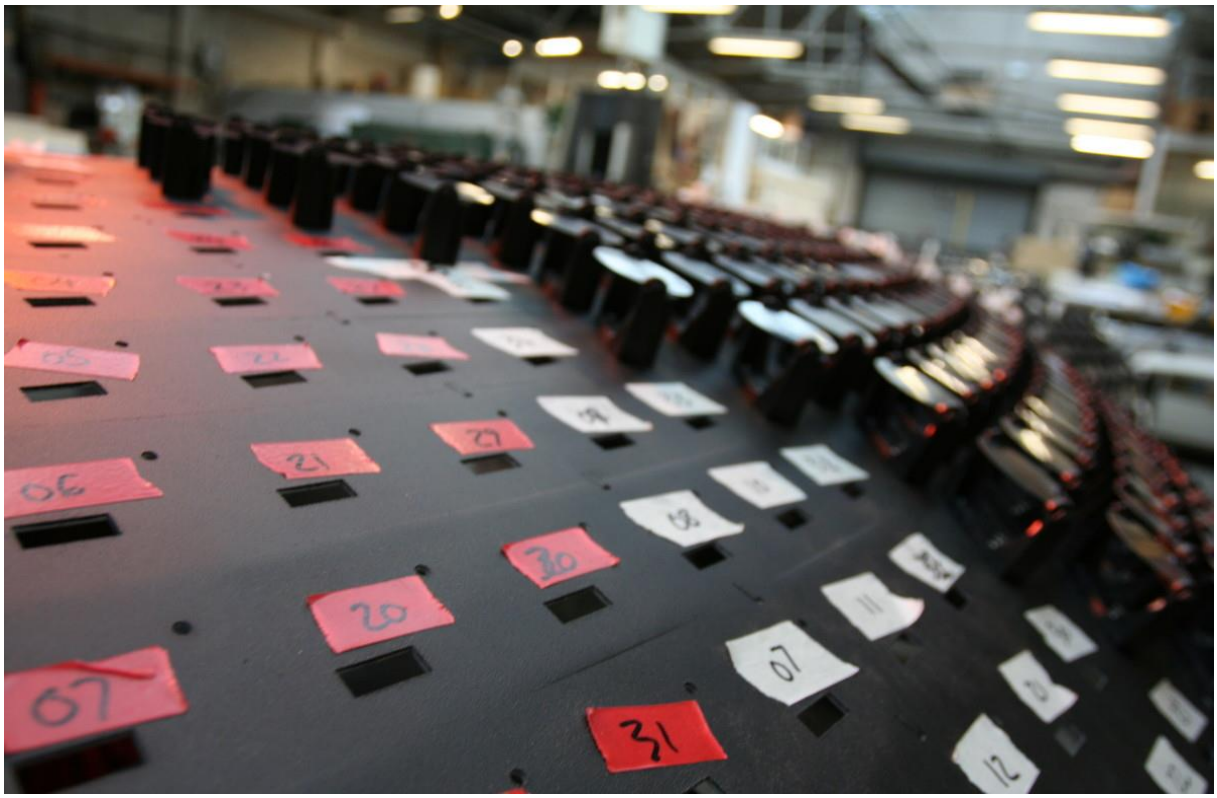

Figure 4 Making of "The Cloud". Source: http://www.mikesmithstudio.com

4 STEM vs. STEAM

In the last decades, educational curricula have mostly favoured a model based on Science, Technology, Engineering, and Mathematics (STEM), which integrates the four disciplines in combined programs, without the sovereignty of one of the four. Those subjects prepare and expose students to different ways of thinking and introduce them to a wide range of careers. Educating our pupils to scientific subjects arguably improves their decision-making abilities, their logic skills and it is also profitable for our economies, thus allowing the students to access secure and well-paid jobs (Atkinson & Mayo, 2010). Statistics tell us in fact that jobs that require scientific knowledge and technical skills are simply more in numbers, significantly better paid and generally more highly regarded by people of developed countries (Dishman, 2016; Provencio, 2015). Fundamentally, the STEM system simply supports the economies we live in, instead of exploring new social and economic models. Notably, the STEM educational system does not aim to bring together humanities and science, but more simply overcome boundaries within the scientific realms.

More recently, the importance of arts for a well-rounded education has been brought into the discussion and the acronym STEAM – where the A stands for arts – has taken on ever-greater significance. Those who push for a stronger involvement of the arts within the scientific-technical education see an opportunity to enhance some soft skills of the students, ranging from sense for aesthetics, real-world applications, playfulness, and communication (Kim & Park, 2012; Land, 2013). Recently, the State University of New York in Potsdam has investigated the potential of a STEAM education with the intention of creating *"a model for the education of scientists who will be able to create innovations in modern science and technology necessary to address the complex problems facing human society"* (Madden et al., 2013).

In the discourse about education, it is being advocated that there is a bit of art in all the scientific subjects and that including design, performing arts and creative planning in the curricula produces more creative, communicative and organized students. In this paper, we try to go beyond the technicalities of how a STEAM model should work in order to reflect on why the arts can represent a context and a tool to train citizens that can more meaningfully contribute to our contemporary and forthcoming societies.

5 A World of Algorithms

From the perspective of a creative practitioner – whether designer or artist – the engineer or scientist might seem just as a helper, a problem-solver, a little wizard that makes things become real or that can open the doors to technical and scientific wonders to exploit. This is possibly an incorrect and limited view of what an engineer, a programmer, a scientist, or a technician is and might be in the future.

The world we live in is increasingly ruled by technology. The permeation of a variety of different technologies in our lives is not a recent phenomenon. Our homes, our appliances, our vehicles have always evolved from a technological perspective, becoming more comfortable, safer, smaller, lighter, faster. Basically, engineers and scientists have always aspired to maximize efficiencies in weight, size, speed, convenience, and so on. However, now that algorithms, artificial intelligence and large data not only impact our possessions, but also increasingly affect our social lives and our inner feelings, efficiency might not be the ultimate aim for technology anymore. Big data, algorithms and other technological innovations have, and increasingly will have, more impact on who we will meet, what information we will access, what places we will visit and ultimately on how we will live our lives.

Think of how algorithms rule the social networks we use, hence suggesting us to interact with certain people rather than others, to add a person to our list of friends, to access certain news rather than others. Our social lives, our feelings and likes and dislikes are not regulated by the concepts of efficiency and improvements in technical terms. But it is not only about social networks; our

relationship with our homes is changing, for example. Our smart homes observe us, they predict our needs and actively interact with us in many ways – including talking to us. Furthermore, our cars suggest us what ways to drive, what places to visit and so on. Engineers – or computer programmers – will have to question the value of efficiency over emotions, feelings, sensations, knowledge, relationships. For example, having more friends is not necessarily better than having less, and a sentimental relationship is, in many ways, inefficient; driving pass the house of our ex-lover might be convenient time-wise, but not emotion-wise; and turning on the vents in the kitchen while our mother bakes the apple cake like she used to when we were kids might make us miss the chance of recalling pleasant memories and emotions.

As the ones who invent and design the next algorithms and artificial intelligences, professionals coming from the technology and mathematical (STEM) worlds all of a sudden find themselves with an unprecedented responsibility – the one of shaping our personal and social lives. Their algorithms, their smart devices are now an integral part of our most intimate and emotional lives. Because of this new role of technology, we need those professionals to be able to reflect on aspects like ethics, feelings and human relationships. Moreover, we need them to critically think of the impact that their decisions have on what really makes us humans.

Besides our personal life, also other apparently scientific, technical or mathematical broader issues, such as global warming, finance, retirement policies, electoral laws, vaccination, etc… might need to be solved culturally, socially or anyway with a humanistic approach, rather than just scientifically. In fact, behind the parameters that control the afore-mentioned issued, which to some extent can be controlled by scientific discoveries and mathematical formulas, there are people with their beliefs, behaviours, feelings and relationships that need to be taken into account.

We are used to think of progressing scientifically and technologically and only later make ethical decisions. Nuclear engineers can equally work on solving power shortage or on future weapons; biotechnologists can help relieving hunger or feed the industry of patents over seeds. We live at a time where we cannot afford anymore keeping the science distanced from the humanistic discourse. Instead, we should put scientists and engineers at its very core and help them build their critical thinking and communication skills. This is when art comes into play.

6 The Criticality of Art

It is extremely difficult – if not impossible – to give a definition of what art is, and it may also not be necessary for this paper. However, the first author recalls having a great teacher, Dutch artist Barbara Visser, telling him what art should do. She said, good art should *"say something about the world"*, about what we desire and what we fear, and it should constantly question what is good and bad. A good artist has a critical eye and is subject to criticisms and analysis.

Art is, in all cases, a critical practice. Beyond the mere exploration of aesthetics and the production of art that manifests inner and intimal conditions of the author, artists are also given the role of manifesting their dissents and the dissent of their communities towards many aspects of our societies. For example, Chinese artist Ai Wei Wei is known for producing work the criticize the Chinese government and its censorship, thus being arrested and put in jail for almost 3 months in 2011 (Sorace, 2014). Similarly, Iranian film director Jafar Panahi's controversial movies about the restrictions placed upon women in Iran have so enraged Iranian authorities that Panahi has been arrested several times (Cheshire, 2012). Beyond political protests, art has also shaped the cultural and political response to the AIDS pandemics during the 1980s, with artists like Keith Haring, Niki de Saint Phalle or Robert Mapplethorpe raising their voice. Art is a great lens through which anyone can observe and act upon he world around us (McDonald & Wessner, 2003).

Working on an art project presents a great opportunity to provoke, raise questions and physically manifest reflection on our societies, cultures, economies, and ethics. Arts naturally create space for critical debate about our politics, ethics, economies, societies.

When we educate our students, whether engineers or artists, we know we are also preparing the next generation of global citizens, consumers, policy makers. Our concern is therefore not only to provide the students with all the tools and knowledge to find a job, but also we push them to train their critical thinking, their reflective mind and their individual will, so that wherever they will operate, they will be able to meaningful contribute to the discussion that surrounds them and not be mere executioners of someone else's agenda.

Furthermore, art also represents a unique way to look at the world, including the STEM world, and to challenge scientists to think further about their own practice and push the boundaries of their realms (Williams, 2017). Some artists have either made scientific discoveries or contributed to develop scientific knowledge. For example, in 1954 composer Lejaren Hiller has develop the first computer-made music contributing to the development of artificial intelligence (Roads, 1980); painter Abbott Thayer with his illustration book *Concealing-Coloration in the Animal Kingdom* has put the basis for theories on camouflage (Behrens, 2009); artist and art critic John Ruskin developed knowledge about tree growth (Ruskin, 1893); without mentioning the countless geometric patterns that artists generated thus making mathematical formulas visible (Jay, 2001), or the more recent developments in digital fabrication made by artists the likes of Joris Laarman (Figure 5)(Doubrovski, Verlinden, & Geraedts, 2011).

Figure 5 An impression of a 3d-printed bridge that artist and designer Joris Laarman's start-up company MX3D is planning to build in Amsterdam in 2018.

7 Five Things Art Can Do

It has often been discussed about the benefits that science could bring from opening its doors to artists and science. From the perspective of a scientist, the creative professional is someone that can embellish and make scientific knowledge more appealing and understandable. This is probably true, but there is much more to gain in educating our scientists and engineers in an artistic context, rather than simply involving creative professionals in scientific research. In the next paragraphs, we list five reasons why art would integrate well in a STEM model.

7.1 Art welcomes technical skills

It is true that there is a lot of art that is completely immaterial and purely conceptual. However, most art manifests itself physically or visually. Therefore, if one possesses technical skills; he or she is able to create. Whether his or her creations are three-dimensional machines, or virtual systems or chemical reactions, the person with technical skills has already the tools to express him or herself and to produce work. That is why it is reasonable to encourage computer programmers, engineers, scientists to dedicate some of their time to art projects. In contemporary art, there are many examples of artists who have a background in scientific subjects. Among them, we can think of Theo Jansen, who studied physics before becoming an artist (Jansen, 2007); movie director Alfred

Hitchcock studied at the London County Council School of Engineering and Navigation (Taylor, 2013); and visionary architect Santiago Calatrava has a background in civil engineering (Tzonis & Rosselli, 1999), to mention a few.

7.2 Art encourages critical thinking

Once one knows that he or she can create, he or she will have to figure out what to create and why. What do I want to say? Why do I want to say that? These are the questions that resonate in the head of an artist before or while producing work. Such a phase in the creative process, forces the author to think critically about the world and build a personal opinion about it. This is a valuable reflective process that trains our critical thinking.

7.3 Art challenges know-how

Often, art pushes the boundaries of know-how and technologies beyond their conventional use. Once one starts working on an art project, and has figured the conceptual or critical messages to send out, it is very likely that he or she will need to tweak techniques, materials and processes in order to achieve the best results. The artwork therefore becomes the drive to experiment and make new discoveries. Painters of the past, for example, in order to achieve the results they had in mind had to develop perspective and colour theories, sculptors had to experiment with unusual materials and new production methods.

7.4 Art teaches you to take critiques

Art exposes you to criticisms, therefore it teaches you how to articulate and defend your reasoning. Art does not end with the exhibition or publication of a work, but it is exactly then that the discussion with others usually takes place. Teachers, visitors, readers, critics will praise and attack your work, you will have to explain what, how and why you sent certain messages. Some messages, you will not even be conscious about the fact that you sent them. You will learn a lot about your work and how others perceive it in this phase. Learning how to receive and respond to criticism is important as it prepares the students to face confrontation and manage a dialogue with others.

7.5 Art trains you as a person

Art provides you with the tools and context develop and express sensitivity towards emotions, feelings and sensations. This is something that engineers and scientists need to be more and more familiar with as the technological, scientific and mathematical discoveries have a greater impact on people's intimate lives.

8 Conclusions

If the engineering world is more concerned with HOW, while the arts focus more on WHY, something needs to be done. Both try to answer to an even more crucial question, the question of WHAT? What to do is the leading dilemma for creators – whether as engineers, scientists, designers or artists – and the two find very different answers to such a question.

WHAT to do is the common ground that scientists at broad and artists operate on. HOW and WHY are the two questions that we must learn not to separate in our schools, unless we want to train future professionals that either lack critical abilities or that lose touch with the reality of making and the possibilities offered by technologies whose potential we do not yet fully comprehend.

In other words, both science and humanities represent two lenses through which one can look at the world. Our culture and society have often preferred keeping those two lenses separated, rather than overlapping them. Thinking artistically allows space to investigate the humanistic side of projects. It allows reflecting on society and culture. Thinking technically means learning practical skills, reflecting on what technology offers and getting inspired by it.

In our schools and universities of the present and future, we should teach our students to understand the HOW and the WHY something needs to be done, and provide both types of answers.

Our students and their educators need to learn about the processes and the networks that are generated by the art and the engineering directions and comprehend the values that lay behind both. In this way, we will produce fully-rounded individuals that can have an impact in the world that we all have to share.

We must not be afraid to advocate that students think of themselves as artists and allow them to think conceptually and learn how to use irony, speculative thinking and sense for aesthetics as part of their language. The benefits of such a contamination between arts and engineering, science and humanities would be numerous. On a higher-level, we would be educating a more complete citizen, who can value and appreciate both spheres. Our students would become technology experts who can better understand how the projects they work on contribute to the shaping of our culture and societies. Professionally, this will hopefully give them more opportunities in the companies that operate at the verge of technology and culture. Or, such an understanding will maybe push the graduates to start their own practices in such a space. Also, in terms of communication, our students would learn how to speak to technical and creative people, adopt – or create – a language that can be more easily understood by both audiences and that can be more appealing to the general public.

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About the Authors:

Giovanni Innella graduated in industrial design at Politecnico di Torino, in conceptual design at Design Academy Eindhoven, and with a PhD in design theory and critique at Northumbria University. Giovanni is an active designer, critic and curator, based in Tokyo. Currently, Giovanni is Assistant Professor at Advanced Institute of Industrial Technology.

Paul A. Rodgers is Professor of Design at Imagination, Lancaster University. He is also the Arts and Humanities Research Council Leadership Fellow for Design in the UK. He is a co-founder of the Design Disruption Group who strives for positive change in health and social care.

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Graphic Design Research: a cause for the concerned

HARLAND Robert George[a*]; CORAZZO James[b]; GWILT Ian[c]; HONNOR Alison[d] and RIGLEY Steve[e]

[a] Loughborough University
[b d] Sheffield Hallam University
[c] University of South Australia
[e] Glasgow School of Art
* Corresponding author e-mail: r.g.harland@lboro.ac.uk
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There is an immediate need to clarify and develop the role of graphic design research for the theoretical underpinning of graphic design education. A report that accompanied the 2014 UK Research Excellence Framework (REF2014) described 'the intellectual and theoretical underpinning of graphic and communication design' as 'generically weak'. We report on progress about a project designed to identify and map graphic design outputs from REF2014, involving both a data analysis of the 'Art and Design: History, Practice and Theory' submissions, and focus group research with graphic design academics designed to elicit feedback on the emergent themes being addressed by the data analysis exercise as well as broader concerns. The aim has been to identify the nature of graphic design outputs submitted to the REF audit. In this paper, we provide a response to this state of affairs from a community of graphic design educators concerned about the perception of research in the discipline.

graphic design research, graphic design education, research excellence framework, graphic design educators' network

1 Introduction

In the most recent national review of research in the United Kingdom (UK) the discipline of graphic design, framed within the wider setting of 'graphic and communication design', was reported to show little, if any, signs of improvement since the 2008 Research Assessment Exercise. Despite an improved showing for Art and Design in the 2014 Research Excellence Framework (REF), the Panel Overview Report for Unit of Assessment (UoA) 34 (Art and Design: History, Practice and Theory) noted 'while there were high quality exceptions, the intellectual and theoretical underpinning of graphic and communication design was thought to be generically weak' (HEFCE 2014: 85). During the same period, graphic design continued to be the most popular discipline in the Art & Design higher education sector in the UK. A course search of the university admissions service, UCAS, returned 151 graphic design undergraduate programmes for the academic year 2016/17.

These opposing positions provide the impetus for this paper as we attempt to understand some of the reasons why this discipline has not been able to respond to the challenge of recent national research excellence reviews.

We report on progress about a project designed to identify and map graphic design outputs from REF2014 main panel D sub panel UoA 34. This initially involved qualitative data analysis of the 2014 UoA 34 submission narratives, but also extends to focus group discussion with graphic design academics to explore their perceptions, feelings and ideas about the REF2014 findings related to the discipline.

The aim of the data analysis has been to assess to what extent remarks in the REF2014 overview report that graphic and communication design outputs were 'generically weak' were justified. Preliminary findings from the data analysis process are shared here, and also formed the starting points for a wider discussion about a community response to an unsatisfactory research performance. By sharing early findings from this project, we hope to raise the profile of these concerns for the benefit of educators in graphic design, communication design, art and design, and those in higher education management positions who are also interested in why this is a recurring issue.

The paper is structured in two parts. First, we present early findings from the REF2014 data analysis exercise, explaining the origin of the project, aims, methods and initial findings. Second, we report on a focus group discussion with graphic design educators who were introduced to preliminary findings from the data analysis. In this second part, we outline issues, some familiar but some less so, that arose in response to questions about why REF performance is considered 'weak'. We extend the discussion by responding to a range of familiar concerns arising from the focus group, such as problems with nomenclature, the need for research in a practice-based subject, and concomitant issues such as workload priorities.

2 Analysis of graphic design research as submitted to REF2014: initial findings

REF2014 assessed the quality of research in all disciplines across all Higher Education Institutions (HEIs) in the UK. Research was assessed under three headings:

> **Outputs** (up to 4 research outputs per researcher, 65% of overall score),
>
> **Impact** (research leading to change or benefit outside academia, at least 2 per HEI linked to headcount, 20% of overall score)
>
> **Environment** (a statement on staffing, strategy, infrastructure and other measures, contributing 15% to overall score)

The census period for REF2014 ran from 1 January 2008 to 31 December 2013 with a submission date of 29 November 2013. Submission data, therefore, provides a snapshot of HE research activity in the UK for the census period at the end of 2013. Results were published in December 2014 along with overview reports at Main Panel and Unit of Assessment level. These are available to view by UoA or by HEI on the REF2014 website (see http://www.ref.ac.uk/2014/), however, individual scores for outputs are not available. Research outputs were assessed using a star rating system reflecting quality as follows: 4* world-leading, 3* internationally excellent, 2* recognised internationally, 1* recognised nationally, and unclassified falling below the standard of nationally recognised work or did not meet the definition of research as defined by the REF assessment criteria. Submissions were made by 154 HEIs to 36 Units of Assessment (UoAs) clustered under 4 Main Panels (A–D). There were 84 institutional submissions to UoA34 Art & Design: History, Practice and Theory, which formed part of Main Panel D: Arts & Humanities. Sub-panel 34 assessed 6,356 outputs across 21 output types (listed further on in this article). Table 1 provides a breakdown of the UoA34 average quality profiles (see Main Panel D report at http://www.ref.ac.uk/2014/media/ref/content/expanel/member/Main%20Panel%20D%20overview%20report.pdf).

Table 1 Quality profiles for UoA 34.

	4*	3*	2*	1*	Unclassified
Overall quality	**26.0**	**42.0**	**25**	**6.0**	**1**
Outputs	18.5	42.6	30	7.7	1.2
Impact	36.6	44.7	13.6	3.9	1.2
Environment	40.5	40.8	15.5	3.0	0.2

All REF2014 submission data, with the exception of staff contractual details, was made publically available in January 2015. Output data and staff data were published separately and so it is not possible to link outputs to individual staff names.

As noted above, in their overview report of the assessment of UoA34, the sub-panel noted weakness in 'the intellectual and theoretical underpinning of graphic and communication design' (REF2014). In the light of this, the authors of this paper approached the Council for Higher Education in Art & Design (CHEAD) about this concern. CHEAD commissioned researchers from [Institution A], [Institution B] and [Institution C] to undertake a retrospective analysis of outputs submitted to UoA34 in REF2014 to assess the contribution of research from the Graphic Design sector. The project was formally announced at the *CHEAD Research Alliance Symposium 2: Approaches to Design Research* at Sheffield Hallam University, in February 2017, and work began on data analysis soon after. Subsequent research team meetings happened throughout the summer both face-to-face and virtually, culminating in the focus group session at the Graphic Design Educators' Network annual conference in 2017, 7–8th September, also at Sheffield Hallam University.

2.1 Methods

Analysis focused on the outputs data for submissions to UoA34 issued from the REF2014 website on an MS Excel spreadsheet. Of the 6,356 outputs assessed by the sub-panel, 6,321 are publically available after the removal of outputs flagged as confidential (for commercial or other reasons). It is important to note that HEIs were free to select which staff and outputs to include in each UoA, so REF2014 outputs do not provide the full picture of all research activity within any given discipline.

To categorise relevant outputs as originating in graphic design research, keyword searches were conducted both on all output titles and 'additional information' fields where used (see Table 2). The 'additional information' field provided the space (max. 300 words) to clarify the research element of outputs, particularly where the nature and extent of the research were not immediately evident. However, in the case of text-based output types (authored books, book chapters, journal articles etc.) this field was rarely used since the research element would be considered self-evident. Attention was paid to text-based outputs where no additional information was supplied to ensure significant numbers of outputs were not missed or incorrectly categorised. In fact, only 30 outputs were identified using the keyword search based on the title where 'Additional Information' was added (all text based). In these cases, library searches were used to assess whether the output stemmed from graphic design research.

A mix of approaches was used to extract the relevant outputs from the spreadsheet of submissions to UoA34. Following initial keyword searches, the project team reviewed the results to assess relevance and suitability. This made the way for a reflexive, iterative process of keyword searches with results refined in line with requirements of the analysis and patterns and categories emerging from the data (it should be noted this work is on-going and, at the time of writing, patterns and themes still emerging and being reviewed and the dataset is yet to be finalised).

2.1.1 Keywords

A shortlist of terms relating to graphic design research was drawn up by the project team (see Table 2) and keyword searches of the UoA34 submissions spreadsheet were carried out. A sample of

outputs containing these key search terms was reviewed by the project group to assess their relevance and suitability. In addition to keywords suggested by the project team, other methods of identifying relevant outputs were used. For example, attention was given to outputs from prominent departments in the field (specifically the Department of Typography and Graphic Communication at the University of Reading).

Table 2 List of keywords

Advertising	History of graphic design	Letterpress	Typeface
Branding	Illustration	Lithographic	Type design
Calligraphy	Imaging	Manuscript	Typography
Cartography	Information design	Print history	Visual communication
Communication design	Inscription	Print process / printing process	Visual design
Graphic design	Interaction design	Page design	Visual media
Graphics	Interaction + design	Printmaking	Visualisation
Graphic	Legibility	Signage	Wayfinding

Some keyword terms – initially envisioned as critical elements of graphic design research – emerged on review as falling almost entirely beyond the boundaries of the discipline. For example, one of the earliest findings was that the categories of 'co-design', 'design thinking' and 'service design' were unlikely to have been used to describe outputs from graphic design research. Thus, precise categorisation of outputs was problematic: many outputs with a graphic design element emerge from interdisciplinary work and may borrow terminology from beyond the discipline, however in many cases 'graphic design' terminology might be used to describe research from other disciplines. In cases where research crossed-boundaries it was necessary to review the additional details to ensure there was a graphic or communication design basis for the research. In cases of 'borrowed terminology' further keyword searches were run to eliminate outputs from beyond the boundaries of graphic design. For instance, it emerged that the term 'visualisation' was frequently used in 'additional information' provided for outputs from fine art practice and dance performance.

Overlaps between research categories have been accounted for by admitting multiple categorisations so that an output might feature in both 'Advertising' and 'Visualisation' or 'Communication Design, 'Print History' and 'Typography'.

2.1.2 Research Groups

Submitting institutions were not required to provide information on the disciplinary origin of outputs, although there was an option to allocate a 'research group' to outputs. 19 of the 84 submitting institutions opted to use this category, and this was predominantly to reflect strategic research themes or internal organisation. None was dedicated solely to graphic design-based research, and so this was judged not to be a helpful category for this research.

3 Initial findings

While the current dataset is still a work in progress, over two-thirds of HEIs submitting to REF2014 had a least one graphic design output (currently 57 out of 84 institutions [67.9%] submitted at least one output featuring a graphic design related keyword). Table 3 confirms a total of 306 outputs out of 6,321 have been identified as featuring graphic design research. That is 4.84% of the total submission to UoA34: Art and Design (History, Practice & Theory). There are strong parallels with the rest of the UoA34 Submission for output types, despite representing only 4.84% of submission. In addition it is clear that the distribution of graphics outputs closely maps onto the spread of output types submitted to the whole of UoA34. For example, the five most commonly used output types ('Journal Article', 'Exhibition', 'Chapter in Book', 'Artefact' and 'Authored Book') were the same for both graphic design related outputs and for art and design outputs as a whole. At this stage, it would appear the graphic design discipline used the 'Exhibition' and 'Chapter in Book' categories slightly

less than the sector as a whole, although submitted a significantly larger proportion to the 'Design' output type (3.39% versus 1.12% for UoA34). See Figure 1 for a more visual display of the data.

Table 3 Provisional numbers for graphics

Output type	Number in UoA34	Percentage of UoA34	Number of Graphics outputs	Percentage of Graphics outputs
A - Authored book	658	10.35%	39	12.75%
B - Edited book	228	3.59%	13	4.25%
C - Chapter in book	1,096	17.24%	47	15.36%
R - Scholarly edition	7	0.11%	0	0.00%
D - Journal article	1,633	25.69%	98	32.03%
E Conference contribution	197	3.10%	15	4.90%
U Working paper	4	0.06%	0	0.00%
L Artefact	679	10.68%	27	8.82%
P Devices and products	19	0.30%	0	0.00%
M Exhibition	1,139	17.92%	26	8.50%
I Performance	119	1.87%	2	0.65%
F Patent/ published patent application	23	0.36%	0	0.00%
J Composition	18	0.28%	0	0.00%
K Design	71	1.12%	15	4.90%
N Research report for external body	38	0.60%	2	0.65%
O Confidential report for external body	15	0.24%	0	0.00%
G Software	5	0.08%	2	0.65%
H Website content	30	0.47%	0	0.00%
Q Digital or visual media	205	3.23%	7	2.29%
S Research datasets and databases	4	0.06%	0	0.00%
T Other	168	2.64%	13	4.25%
	6,356	100.00%	306	100.00%

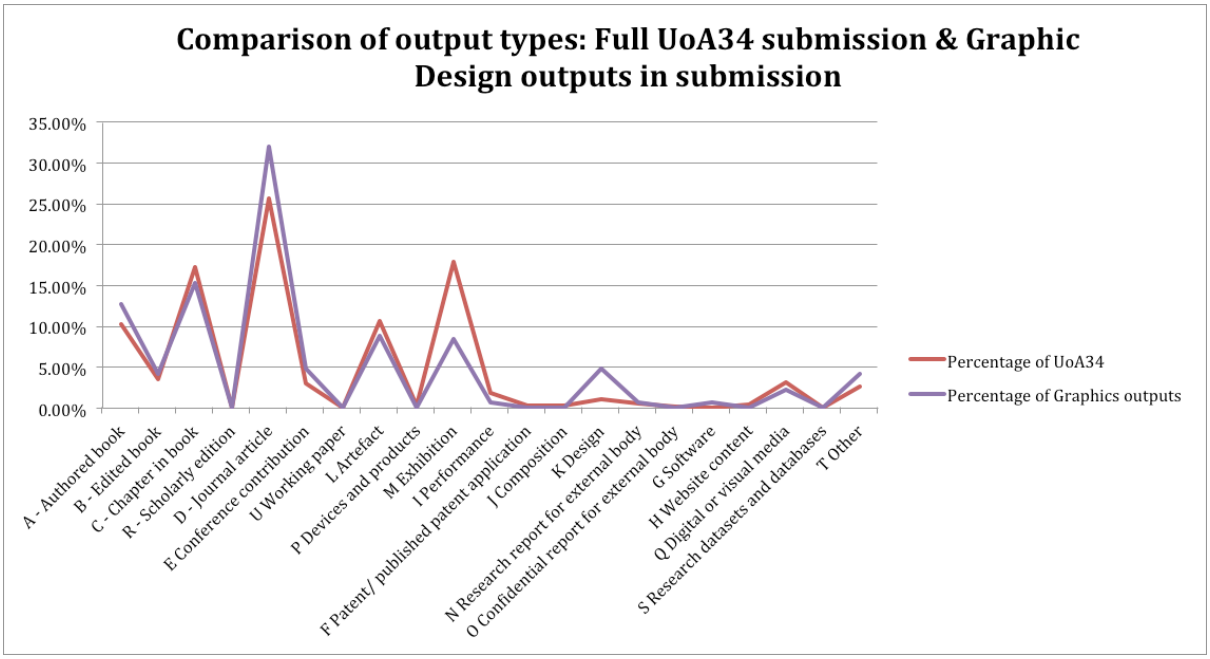

Figure 1 Comparison of output types

4 Focus group discussion

At the early stage of data analysis the motives for the project were shared with twenty graphic design educators at the Graphic Design Educators' Network annual conference, noted earlier. Focus

groups are useful for establishing whether there is a consensus about new areas of research and gaining quick responses and contrasting views to specific topics (Denscombe 2007: 180). In this section, we highlight responses to the claims of poor REF2014 performance from graphic design educators, and offer some further commentary in response to these issues.

The focus group session invited responses to the statement in the REF2014 Panel Overview report. Participants were invited to respond to the question 'What possible explanations might there be for this 'weakness'? Furthermore, set against the assertion that 'Graphic design research … is thriving, if you know where to look' (Walker, 2017), participants were invited to comment on where, in their experience, could it be found? The session convenors began with an acknowledgement about whether there might be a link between the high volume of teaching undertaken by most graphic design academics and the small amount of research produced. This was agreed to be the case.

When pressed further about what possible explanations there might be for 'weakness' the following concerns were voiced:

- Graphic Design is a practice-based, pragmatic discipline and as such does not fit with traditional academic research.
- Graphic Design outputs may not be formally aligned to specific Graphic Design themes, but instead may be placed under more discipline specific practices such as photography or film.
- Being recognised for excellent research is not considered necessary / essential / relevant for a Graphic Design academic (unlike many other academic disciplines that attract much higher levels of grant capture).
- Graphic Design – no agreed use of name.
- Teaching workloads - when other disciplines are gearing down from teaching hours towards a semester of research and other activities, Graphic Design academics are gearing up for more teaching / graduate shows etc.
- Graphic Design is younger discipline and practice-based research degrees still relatively new.
- There are very few Graphic Design academics in university REF teams (more often architects, fine artists, or art historians).
- Does Graphic Design need more representation on REF panels?

A number of issues arise from these points that allude in part to explanations about why REF performance is less than satisfactory, some of which may apply to other applied fields of design. The following is offered as additional thoughts about why the situation is as it is.

During the focus group, it was recognised that graphic design is not alone in being a practice-based discipline, and one need only look towards programmes taught in the same environment that have more successfully embraced a research agenda, such as product design or fine art. Comparison, of course, is not necessarily like-for-like. For example, product design has responded to a decline in a UK manufacturing base over the past few decades by significantly expanding to include emergent areas such as user-experience design or service design.

With regard to the lack of a strong disciplinary focus for graphic design, this reveals not how easy graphic design is to do as a solo activity but how difficult it is to understand its integrative nature. 'Collaborative', 'integrative', and 'combining' are all terms that have been used to describe a practice that is not media specific (Harland 2016: 17–22) but is predominantly interdisciplinary by nature, alluding to the way 'different areas of knowledge within the same discipline' come together (Muratovski 2016: 19). Indeed, practitioners in graphic design claim to engage with a wide range of activities (van der Waarde 2009: 5) suggesting a basic training in the field provides many opportunities for practice compared to traditional academic subjects (see Table 4). Hence, if it has a lack of strong disciplinary focus, this is because the boundaries around the space it occupies overlap with more singular pursuits. Its emphasis on plurality, rather than singularity, provides the key to understanding its objects as a combination of different things that somehow work together. Some of

these things are not exclusively graphic design practices, such as end user research, or house style management. It should not therefore be surprising if researchers are active in areas that are/are not labelled graphic design.

Table 4 The activity of graphic designers (adapted from van der Waarde 2009: 5)

Illustration	Infographics	Marketing
Photography	Font design	Usability
Typography	Desktop publishing	End user research
Copywriting	Film production	Visual research
Image processing	Website design	Visual strategy
Animation	Graphic Art	Concept development
Audio-visual	Spatial design	House style management
Programming	Advertising	Project organisation
Author	House style design	Communication strategy

The issue of whether excellence in research is necessary/essential/relevant for the graphic design academic raises interesting issues. Like many professional knowledge curriculums, graphic design faces two ways (Bernstein 2000) – towards the vocational nature of graphic design and professional practice and alternatively as an academic subject that is understood as a 'visual form of knowledge production' (Drucker 2014). Comparisons can be made to the way dentists or doctors are trained, the way their programmes are characterised, and the way research contributes to the practice. For example, a doctor studies medicine and a dentist studies dental surgery, yet those subjects thrive on research contributing to the evolution of the practice. A simple response here is how can research be dismissed so readily when graphic design is now taught so often as a university subject? Is it that it is not worthy of research? Or, that we do not yet fully understand how research might influence and impact on graphic design practice?

On the matter of name, the issue of 'no agreement' is contentious not only for those involved with teaching across the variations in programme titles that have emerged since the early 1990s, but also for those external to the field who struggle to understand a subject in a seemingly constant state of flux. Positions around terminology and acceptance/authority is part of this process of understanding what graphic design research is. An immediate response to this dilemma is that it is not a dilemma; for graphic designers and graphic design educators, of which there are very many, and graphic design researchers, of which there are seemingly very few, the term graphic design should not be problematic. What may be of concern is the way some argue for graphic design and other terminologies to be interchangeable. For example, in an article titled 'Research in Graphic Design', Sue Walker (2017) suggests that for 'many … the term "communication design" is synonymous with "graphic design"', expressing her preference for the term 'communication design'. As a REF2014 panel member, Walker's view here reflects the perspective of the REF2014 report which refers to 'graphic and communication design'. It is the case that some graphic design degree programmes have changed their name to communication design – for example, this has been a trend in Australia – but it remains that this should not be problematic for graphic design education, practice and research in that communication design, and the many other variations on the theme that have emerged since the early 1990s, must still define how they differ from graphic design.

It is not enough for advocates of communication design to say it 'essentially involves the production of visual solutions to communication problems' (Kennedy, 2011: 4). This is not sufficiently differentiated from what graphic design is understood to be. From the same source, the *Icograda Design Education Manifesto 2011* speculates that the term 'graphic design' has evolved into a plural state of being with many names—graphic communication, visual communication, visual design, communication design, and the term identified as most appropriate by the Icograda General Assembly 2007 in La Habana is 'communication design'. Again, this should not concern graphic design educators as Icograda itself stood for the International Congress of Graphic Design

Associations, placing graphic design at the root of all contemporary interpretations. What should be a concern is when graphic design is depreciated at the expense of new preferences. For example, a desire to champion communication design at the expense of graphic design relegates graphic design as defining the 'object' created by 'visual communication design' (Frascara 2004). This serves to demonstrate how unstable language is at discipline level, meaning the nomenclature associated REF submission might be confusing for panel members.

Teaching workload was also acknowledged by focus group participants as a key contributor to poor performance in REF. The amount of time apportioned to teaching ranges considerably across the sector, but few graphic design educators enjoy the privileges of a workload in research intensive universities where time available for research (on a research and teaching contract) could be as much as 40% of their yearly workload. The majority of graphic design is taught in the post-92 sector where workload is determined by University College Union recommendations that stipulate a minimum requirement for workload planning:

> Work plans should allow sufficient time for scholarship and professional activities for academic (including teaching and scholarship, hourly paid and part time staff) and academic related staff. This may entail reducing elements of routine administration and ensuring there is sufficient time for academic and professional activities. One aspect of this in the case of the post 92 contract for England and Wales is the protection of the period (approximately 4 weeks and 3 days) for self directed research, scholarship and professional development. (https://www.ucu.org.uk)

Consequently, a majority of lecturers in graphic design (and other subjects in art and design) at universities in the UK are limited by this stipulation and in some cases graphic design academics confess that they are required to undertake self-directed research, scholarship and professional development in a block of time during the summer months. Research, of course, is not a seasonal activity so it should not be surprising that time is committed to little more than developmental activities that shun research (Harland, 2017). Add to this the burden of additional duties needing attention outside of a typical 30-week teaching year, such as degree shows or industry focused events such as D&AD New Blood or New Designers, and the picture further unfolds. Such activities maintain good links with industry and alumni, but at the same time accentuate an industry facing education system that does not embrace academic research.

While the practice of what is now called graphic design dates back 5000 years or so (Friedman 1998: 85), the subject taught at university is relatively young and just decades rather than centuries old. Unsurprisingly, a culture of research practice is yet to emerge in this young discipline. Its credentials as a branch of design history are established through a small number of histories written since the early 1980s, but practice-based research degrees are in their relative infancy. Thus, it is difficult to foresee where graphic design academics can benefit from established researchers who participate in university REF teams.

Having expressed these initial concerns the focus group turned their attention to discussion about the early data analysis activities. With the intention to move the conversation on, the session convenors informed the focus group that keyword searches for generic terms often revealed outputs from other disciplines using graphic design terminology but without evidence of specific graphic design input. Interior design and product design were cited as examples. One immediate benefit from the focus group was that graphic design educators offered new key words to the initial listing in Table 2. Additions included book design, exhibition design, graphic novel, notational systems, page design, printmaking, signpost/signposting and visual information. Book design, exhibition design, signposting, visual information, did not identify any new outputs; graphic novel increased the number of outputs already found from 6 to 10; notational systems and page design did not register.

This distinct lack of contextualisation of 'graphic design research' means that graphic design outputs were in the most part invisible. Conversely, during the discussion, exhibition design was cited as an

example of a subject that is more than a presentation service. This is understood as part of a researcher's practice-based submission and offers a useful comparison for future practice-based graphic design research outputs. Coupled with clear statements about the inclusion of graphic design methodology in research proposals, the recontextualisation of practice, definitions about graphic design's own pursuit of knowledge and its approaches to ontology, epistemology, and methodology, physical evidence as required, and explicit statements about research context, provide some indication about how to make graphic design more accountable as well as visible.

The focus group also concentrated on why graphic design outputs that could be found scored low on the 1–4* scale, and how this might be remedied. Suggestions included acknowledgment that graphic design academics publish in many domains; more multidisciplinary recognition in the research design and publication phases, including claiming research territory; providing nomenclature that helps other disciplines extend theirs through greater involvement in the writing-up phase of research. Walker (2017) has also observed the limited number of high quality journals dedicated to graphic design that offer good image reproduction.

When the discussion moved on to locating graphic design research, as in 'where is it?', the discussion was much less fruitful. A range of sources were suggested beyond the discipline for where it should or could be, such as the Journal of Art Research or Cultural Geography, and the most highly regarded design research journals such as Visible Language, but little else. Additionally, it was a concern that despite the size of the graphic design education community there has been limited published research on pedagogy. Finally, there was some acknowledgement that industry is employing research but it is not trickling down to education and teaching.

5 Summary

In REF2014, the graphic and communication design submission was referred to as weak, despite some notable exceptions such as that made by the Department of Typography and Graphic Communication at the University of Reading (rated at the top of the UoA34 table). This followed a similarly poor performance in the equivalent 2008 Research Assessment Exercise. There has been no response from the graphic design community about this state of play, and only very recently has there been any recognition that there might be such a thing as graphic design research, even if graphic design is often conflated with communication design. It is appropriate that graphic design educators respond to this scenario and with very limited research resource, this paper reports on a project undertaken by graphic design academics that examines, first, the REF 2014 submission data, and second, discussion stemming from focus group research undertaken at the most recent Graphic Design Educators' Network conference.

As this paper is only able to report on progress, we have identified a few next steps to take the data analysis aspect of the project forward. There is a need for further work to refine the dataset and remove outputs from other disciplines; keyword searches need clustering to provide data suitable for mapping; more analysis of the use of double weighting in Graphic Design outputs versus the UoA34 as a whole. Finally, the UoA34 sub-panel overview report states that 'a significant number of research outputs were of an interdisciplinary nature (although not necessarily identified as such by submitting HEIs) and were in the form of collaborative, team-driven projects' (REF2015: 84). Initial results suggests Graphic Design research often contributes to collaborative / interdisciplinary projects. Since HEIs were not consistent in their use of the 'Is Interdisciplinary' check box on submission, outputs need to be reviewed by two methods (a) use of interdisciplinary check box and (b) usage of the terms interdisciplinary, multidisciplinary, transdisciplinary and cross-disciplinary in additional details.

A key early recommendation by the project team is that graphic design research, either independently or as part of another subject submission to research assessment exercises, must be labelled 'graphic design research'. If this happens, more understanding about what graphic design research looks like will emerge, more advice will be available to the graphic design research

community to establish the sort of practice that graphic design research can be and some common ground might be identified. And, it should help differentiate graphic design from communication design. This is a challenge graphic design researchers must meet if the discipline is to be considered more concerned with the production of new knowledge rather than the presentation of new knowledge.

What emerges at this early stage of the project is that categories of design research that have much less history, such as co-design, design thinking, or service design have not been inclined to acknowledge the role of graphic design in their discourse. And yet it is there as noted by Walker (2017: 550). Furthermore, the idea of a graphic design research agenda undertaken by graphic design research groups seems to be unheard of despite the large number of academics and students working in the sector. Graphic design programme teams are not engaging enough with a national graphic design research agenda, not to mention their own individual research commitments.

Finally, concerns about graphic design research run much deeper than REF performance, and we have concentrated here on why things are the way they are rather than pointing towards where graphic design research can be found. Although responses to this concern must come from the graphic design education community, accountability and answers must also come from those who determine the working conditions of graphic design educators. These respective positions – individual and institutional – can together rethink concerns about nomenclature and workload to not only provide better understandings for the next REF, but also lay more concrete foundations for subsequent research reviews.

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About the Authors

Robert Harland is a Senior Lecturer in the School of the Arts, English and Drama, Loughborough University, where his research is concerned with the role of graphic design in urban environments. He is chair of the Graphic Design Educators' Network.

James Corazzo is an educator, designer, and researcher. He is a Principal Lecturer in Graphic Design and Departmental Lead for Learning, Teaching and Assessment at Sheffield Hallam University. He is a founding member of the Graphic Design Educators' Network.

Ian Gwilt is Professor of Design at the University of South Australia. His research spans design research, visual communication design, information/data design, design in healthcare, co-design, mixed and augmented reality in creative practice and creative applications of 3d printing.

Alison Honnor is an Impact Researcher at Sheffield Hallam University where she supports the Cultural, Communication and Computing Research Institute in maximising impact across Fine Art, Design, Film and Media Production, Journalism, Public Relations, Media Studies, Communication, Security and Computing.

Steve Rigley is a designer, lecturer and writer at Glasgow School of Arts, where he leads the Graphic Design pathway. He has contributed to a number of journals and conferences including the Association Typographique Internationale, AIGA and the World Design Congress.

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Requests from Companies and Requirements for Design Education in Brazil: where do they meet?

DZIOBCZENSKI Paulo Roberto Nicoletti [a,b*] ; PERSON Oscar [a] ; TONETTO Leandro Miletto [c] and MANDELLI Roberta Rech [c]

[a] Aalto University
[b] CAPES Foundation
[c] Universidade do Vale do Rio dos Sinos (Unisinos),
* Corresponding author e-mail: paulo.dziobczenski@aalto.fi
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In this paper, we study what companies request from applicants for graphic design positions in Brazil. Based on a document analysis of 371 job advertisements, we uncover 35 different types of requests which we structure in terms of (1) Design deliverables, (2) Knowledge and skills and (3) Personal traits. In addition, we explore how the content of job advertisements potentially can inform educational developments by reporting on a group interview with design educators. In the interview we explore the degree to which different requests in the advertisements are covered in a regulatory educational design policy document for higher education in Brazil. Our results show that requests for skills in 2D software, an ability to deliver print and digital design outcomes and knowledge of layout and photography are frequently occurring in the studied advertisements. We also describe how the educators could locate the majority of the requests in reviewing the educational policy document. We end the paper by discussing how job advertisements could be further studied and used by design educators and practitioners.

design education; design competencies; document analysis, Brazil

1 Introduction

Design graduates and students face multiple requests by companies in applying for positions. The professional requirements placed on designers also form an important topic for educators in ensuring the employability of their graduates. As the professional realm for designers evolve in industry (see e.g. Davis, 2006), the skill set required to operate as a designer is also changing. In doing so, an imbalance between the skills demanded by companies and those trained at higher educational institutions can surface an 'education gap' (Todd, McKeen, & Gallupe, 1995, p. 20), which can harm the employability of graduates and hinder companies in effectively recruiting qualified personal.

In this paper, we provide empirical support to explore the possibilities of such a gap. Specifically, we provide an overview of the skill set requested by Brazilian employers in advertising for graphic

design positions. In replicating and extending our previous study from the United Kingdom (Dziobczenski & Person, 2017), we report on a document analysis of 371 job advertisements in terms of what employers articulate as requirements for applying to graphic design positions in Brazil. We classify the requests in the advertisements in terms of (1) design deliverables, (2) knowledge and skills and (3) personal traits. We also explore the possibilities of using the content found in advertisements for educational developments by having design educators compare our resulting classification with guidelines for graphic design education as outlined in an educational policy document from the Brazilian Ministry of Education. The document of study regulates and defines the requirements for institutions providing design education in Brazil.

Brazil is considered one of the 'emerging important players' in design, as noted in a benchmark report from Cambridge University (Moultrie & Livesey, 2009, p. 24). Design education in Brazil began formally in 1963 with the foundation of ESDI (*Escola Superior de Desenho Industrial*) in Rio de Janeiro and has since then spread to a range of educational institutions. Nowadays, there are more than 200 undergraduate bachelor courses in the country offering around 55.000 study places for new students every year (Moraes, 2014; Sebrae, 2014). In terms of exploring the labour market requirements facing design graduates, the skill set needed to operate as a designer in Brazil has been addressed in a number of studies. The design practice and education in the country was explored by Naveiro and Pereira (2008), who found that design graduates were seen to lack skills in areas such as negotiation, project management and production process. The authors also found that design graduates were seen to hold adequate skills in areas such as design and visual methodology, software and ergonomics. Similarly, in assessing how Brazilian academics (students and teachers) and companies value different design skills, Dziobczenski and Galeotti (2017) found that designers are highly valued for their tactical and operational skills (i.e. software and layout skills), while more strategic design skills, such as business and leadership skills, were less valued by companies. In analysing the requirements listed in the job advertisements, we add to past studies by providing a focused perspective on the early stages of recruitment in Brazil by inquiring into how employers articulate their interest in design when advertising for graphic design positions.

Job advertisements represents an emergent area for research on design. Past studies have addressed the requirements listed by employers in recruiting designers by studying job advertisements from the United Kingdom (Dziobczenski & Person, 2017), the United States (Ramírez, 2012) and Taiwan (Yang, You, & Chen, 2005). Job advertisements provide information about the requests made by multiple companies seeking for new professionals and has been used to study labour market requirements in a range of disciplines (for a review into research with job advertisements, see Harper, 2012). For example, job advertisements have long been used to study the requirements on management (e.g. Gatewood, Gowan, & Lautenschlager, 1993) and technology (e.g. Todd, McKeen, & Gallupe, 1995) professionals. Yet, to date, no study has used job advertisements to study how labour market requirements are formulated for designers in Brazil. Further, while the results of past studies on job advertisements in design often hold implications for design education, how to practically use the content of job advertisements in educational developments has to date not been addressed in great detail. Hence, in benefiting developments in both academia and practice, we set to address the following research questions*: (1) What is the skill set requested by Brazilian companies in advertising for graphic designers? (2) How are the requests made by companies in job advertisements covered in a design education policy document?*

Our study is relevant for design educators and practitioners in both Brazil and abroad. Davis (2008) notes that what is requested from industry is important for educators to consider in anticipating professional developments and preparing students. Studies suggest that new design graduates in Brazil struggle to find positions in industry (see e.g. Naveiro & Pereira, 2008). Our study provides a contemporary perspective on how the work of graphic designers is described by Brazilian employers. Design educators can use our resulting classification in reviewing the content of their educational practices; potentially, strengthening the immediate employability of students by considering the

requests of companies in preparing graphic design curricula. Design practitioners can use our results for self-improvement activities; using the requests to tailor their offerings to companies and their own professional developments.

2 Method

We replicated and extended the research approach followed in our prior study in the United Kingdom (Dziobczenski & Person, 2017) in analysing the requests made in job advertisements for graphic design positions in Brazil. We pursued a document analysis of job advertisements in which we combined thematic and content analysis. Document analysis is a systematic form of analysing printed and electronic texts created without the researchers' intervention (Bowen, 2009). Next, in exploring the possibilities of more systematically using the content of advertisements for educational development, we performed a group interview with design educators to understand how the requests in the studied advertisements potentially were covered in a design education policy document. Both job advertisements and the policy document provide natural occurring data (Ritchie, Lewis, Nicholls, & Ormston, 2013), written to the interest of recruiters/candidates and design educators/students.

2.1 Job advertisement analysis

We collected job advertisements publicly available online over a period of 5 weeks (8th of June to 8th of July, 2015). We selected 5 websites that cover both generic and design specific job boards to improve our coverage of job opportunities for graphic designers in Brazil. The generic job boards websites were Linkedin (www.linkedin.com.br), Indeed (www.indeed.com.br) and Infojobs (www.infojobs.com.br). The specific job boards websites were Trampos (www.trampos.co) and Adonline (www.adonline.com.br).

We manually collected job advertisements posted on the websites once a week by doing keyword searches: (1) 'Graphic designer' (*designer gráfico* in Portuguese) in the job title and (2) 'Designer' in the job title and 'graphic design' (*design gráfico* in Portuguese) in the job description. We then performed two refinements of our dataset. First, as companies often publish the same job advertisement in different websites to attract more candidates, we removed duplicate job advertisements from the data set. Second, we only included the positions which had the word 'graphic' in the job title (e.g. graphic designer, web graphic designer, graphic design internship). Following these steps, our initial dataset was reduced to 371 unique job advertisements which we analysed further. The total number of words in the data set is 50,838, with an average of 135.8 (SD = 60.36) per advertisement.

We began by building a coding scheme to analyse the frequency of different types of requests in the advertisements. The coding scheme was created inductively in a process in which the first and fourth authors thematically analysed a subset of the job advertisements (40%). The advertisements were analysed in terms of what was requested from applicants following a first round of in-vivo coding. An initial set of reoccurring themes – depicting what was requested from applicants in the advertisements – was then established in meetings with the other two authors.

Similar to our earlier study, we were inspired by the conceptual learning model presented by Voorhees (2001) in bringing structure to the different types of requests (themes) in the advertisements. In brief, Voorhees (2001) summarises how learning and evaluation takes place in education through a four-level pyramidal model in which, from the base, (1) personal traits and characteristics form the foundation for learning; (2) knowledge, skills and attitude are built through learning practices in education; (3) competencies are abilities that are produced from the learning and finally (4) an outcome is produced to be evaluated (by teachers and peers). Following a similar progression, we structured the different types of requests in the advertisements on three levels: (1) Design deliverables that cover the references to the outcomes produced by graphic designers (i.e. what designers are hired to deliver), (2) Knowledge and skills that cover the references to the

abilities needed to execute design work, and (3) Personal traits that cover the references to the individual characteristics which potentially form the foundation to work as a designer in Brazil. The three levels are similar with those used to structure the data from the United Kingdom.

After building an initial coding scheme, we deductively applied it to the whole data set. In extending the methodological procedure from our prior study (Dziobczenski & Person, 2017), we involved multiple coders and assessed the reliability - and understanding of the coding scheme - through intercoder agreement using Krippendorff's Alpha. In specific, we selected a sub-set of the data (20%), which was coded independently by the first and fourth authors. In order to reduce the mistakes in the coding process, each job advertisement was read and coded in terms of requests for (1) Design deliverables; (2) Knowledge and skills; and (3) Personal traits. In other words, each job advertisement was read at least three times when applying the coding scheme. The intercoder agreement across the two coders was 0.801, which is considered reliable according to Krippendorff (2013). After assessing the agreement, the authors discussed the differences in the coding process and made the necessary corrections. The remaining advertisements in the dataset (80%) were then divided equally and coded by the first and fourth authors. Following this process, we applied the coding scheme; comprising 55 different types of requests (themes) divided across three groups: (1) Design deliverables; (2) Knowledge and skills and (3) Personal traits. The requests for Knowledge and skills were further organised into five themes: (a) Conceptual design skills; (b) Content skills; (c) Process management skills; (d) Software skills and (e) Technical design skills. In unveiling the significance of different requests in the advertisements, we ranked the different types of requests according to their frequency within their respective group or theme. Given the educational interest of our inquiry, we also coded the presence/absence of requests for a degree in graphic design or related fields (such as web design and advertisement).

Next, we reviewed the frequency distribution of the coding scheme across our data set in assessing the significance of different types of requests and, when possible, reducing the amount of codes. When there was agreement among the authors, we decided to merge similar requests with lower frequencies. The goal was to make our coding scheme more accessible to others, including design educators and practitioners.

2.2 Interview with design educators

We carried out a group interview with two design educators (5+ and 20+ years of experience) to explore the broader educational relevance of our coding scheme. The educators currently have teaching management positions within a design department at a University in Southern Brazil.

The aim of the interview was to search for overlaps between the contents of the job advertisements with a document from the Brazilian Ministry of Education. We relied in the last version of the educational policy document 'Guidelines for undergraduate programmes in design' (*Diretrizes Curriculares Nacionais do Curso de Graduação em Design* in Portuguese) published in 2004. The studied document, written the Brazilian Ministry of Education, regulates and defines the requirements for institutions providing higher design education in Brazil. Both interviewees were familiar with the document prior to the interview. We selected sections of the document that describe the students' intended profile upon graduation and the knowledge and competencies that should be developed.

The interviews were conducted by the third and fourth authors, who briefed the design educators about the task and facilitated the discussion. Initially, cards with the different types of requests unveiled in the first part of the study were given to the interviewees. Each card had a short description of each type of request and examples of sentences from the advertisements. We also provided a blank card for the case where the content found in the policy document would not match the types of requests included in our coding scheme. Next, the interviewees were asked to assign the different types of requests to the selected sections of the document. In doing that, our goal was to understand to what degree the requests in the advertisements were covered in the policy

document. The interview lasted 1.5 hour. Several overlaps in content were identified, such as the same code being related to several parts of the document. Therefore, a second interview session was organized to solve doubts in the process; it lasted an hour. A third and senior design educator with more than ten years of experience evaluated the result of the group interview during a meeting with the third author, judging content adequacy within each one of them.

3 Results

Our analysis resulted in a coding scheme which outlines the requested skill set of graphic designers in 35 codes. We structure the requests in terms of (1) Design deliverables; (2) Knowledge and skills and (3) Personal traits (for a detailed description of the different types of requests covered in each sub-theme see Appendix). We found requests for a degree in design or a related field in 203 (54.71%) job advertisements.

The Design deliverables (see Table 1) provide an overview of the main outcomes that are expected from graphic designers in the advertisements. Our analysis resulted in eight types of request (themes) that cover both physical and digital end-results produced by graphic designers. In relation to physical outcomes, our themes cover requests for an ability to deliver (1) 'Print design' in general, such as flyers, advertisings, posters; (2) 'Editorial design', (3) 'Packaging design' and (4) 'Signage and Point-of-sale (POS)' materials. In relation to digital outcomes, the types of requests cover an ability to deliver (5) 'Digital design' in general, such as websites, newsletter, digital interfaces and (6) 'Video and animation design'. In addition to physical and digital outcomes, two types of requests cover more holistic design outcomes in terms of holding an ability to deliver (7) 'Brand design' outcomes, such as visual identity and logos, and (8) 'Service design'.

Table 1: Distribution of each code across the dataset in the 'Design deliverables' theme

Design deliverables	**%**
D.1 Print design	56.87
D.2 Digital design	45.01
D.3 Brand design	21.83
D.4 Editorial design	16.71
D.5 Packaging design	9.43
D.6 Video and animation design	7.28
D.7 Signage and POS design	5.39
D.8 Service design	0.27

In terms of Knowledge and skills (see Table 2) that support the delivery of different design outcomes, our analysis resulted in five different themes: (1) Conceptual design skills; (2) Process management skills (3) Content skills; (4) Technical design skills and (5) Software Skills. In total, we distinguish 23 different types of requests across the five themes in our data set of job advertisements. The requests for Conceptual design skills cover references to 'Business', 'Concept design', 'Design thinking', 'Problem solving', 'Research' and 'User experience (UX)'. Process management skills covers references to an ability to lead and manage the design process in terms of 'Client relationship', 'Project management' and 'Teamwork'. Content skills cover requests for graphic designers in developing and reviewing text in both native and foreign languages. Technical design skills hold the requests for operational skills in terms of 'Coding', 'Design for web', 'Illustration', 'Layout', 'Photography' and 'Production and materials'. Lastly, in capturing skills in digital tools for design work, Software skills cover the references to skills and knowledge in '2D', '3D', 'Animation', 'Office' and 'Web' software.

Table 2: Distribution of each code across the dataset in the 'Knowledge and skills' themes

Conceptual design skills	**%**
K.1 Concept design	6.74
K.2 Business	2.70
K.3 Problem solving	2.70
K.4 User Experience (UX)	2.16
K.5 Research	1.62
K.6 Design thinking	0.54
Content skills	**%**
K.7 Foreign language	11.32
K.8 Native language	7.55
K.9 Content creation	6.20
Software skills	**%**
K.10 2D software	68.19
K.11 Office software	23.45
K.12 Animation/video software	11.32
K.13 Web software	7.28
K.14 3D software	2.70
Process management skills	**%**
K.15 Teamwork	13.75
K.16 Project management	7.28
K.17 Client relationship	1.62
Technical design skills	**%**
K.18 Layout	39.08
K.19 Photography	23.99
K.20 Production and materials	20.49
K.21 Coding	10.78
K.22 Illustration	7.28
K.23 Design for web	5.12

Request for Personal traits (see Table 3) - which potentially support learning and professional practice - were found in a smaller sub-set of the advertisements. We identified four reoccurring types of requests in the advertisements in terms of that suitable applicants should hold 'Acumen', 'Aesthetic sense', 'Creativity' and being 'Self-driven'.

Table 3: Distribution of each code across the dataset in the 'Personal traits' theme

Personal traits	**%**
P.1 Acumen	12.40
P.2 Self-driven	10.24
P.3 Creativity	9.70
P.4 Aesthetic sense	1.35

3.1 What is most frequently expected from graphic designers?

The most frequently referenced Design deliverables across the advertisements is 'Print design' (D.1) in terms of designers being expected to produce print outcomes such as such as flyers, advertisings and posters. Regarding the Knowledge and skills, the most frequent requests are 'Concept design' (K.1), 'Foreign language' (K.7), '2D Software' (K.10), 'Teamwork' (K.15) and 'Layout' (K.18). The most frequently referenced Personal trait is 'Acumen' (P.1).

3.2 How the requests in the advertisements are covered in the educational policy document?

During the interview with the design educators, the interviewees merged the content of our original coding scheme into nine new groups in considering their similarities and in allowing for a more consistent connection with the content of the governmental document. The grouping of requests emerged unprompted. For the remainder of this paper, we treat the groups created by the interviewees as representing Graphic design competencies (see Table 4) in the sense that they seemed to have emerged to comprise '(…) a combination of skills, abilities, and knowledge needed to perform a specific task in a given context' (Jones & Voorhees, 2002, p. 1). The grouping of the 'Design deliverables' does not directly adhere to this definition in combining the different types of design outcomes from our initial analysis but was treated similar to the other groups by the interviewees in comparing the requests with the content of the policy document.

Table 4: Distribution of groups and codes following the 'Graphic design competencies' grouping

Graphic design competencies	**Formed by the following codes**	**% across the dataset**
C.1 Representation	2D Software (K.10), 3D Software (K.14), Aesthetic Sense (P.4), Animation Software (K.12), Illustration (K.22), Layout (K.18), Office Software (K.11), Photography (K.19), Web Software (K.13)	84.10
C.2 Design deliverables	Brand design (D.3), Digital design (D.2), Editorial design (D.4), Packaging design (D.5), Print design (D.1), Service design (D.8), Signage and POS design (D.7), Video and animation design (D.6)	78.71
C.3 Production and management	Production and Materials (K.20), Project Management (K.16)	24.80
C.4 Relationship	Business (K.2), Client Relationship (K.17), Teamwork (K.15)	17.52
C.5 Concept generation	Concept Design (K.1), Creativity (P.3), Problem Solving (K.3)	17.25
C.6 Language	Foreign Language (K.7), Native Language (K.8)	15.09
C.7 Digital/web	Content Creation (K.9), Design for Web (K.23), User Experience (K.4)	12.40
C.8 Research	Research (K.5)	1.62
C.9 Design thinking	Design Thinking (K.6)	0.54

In short, the resulting competencies are as follows: 'Concept generation' covers the types of requests that revolve around tasks of conceptualising and solving design problems. 'Design deliverables' groups all the outcomes that graphic designers are expected to produce. 'Design thinking' captures the methodological references in the advertisements. 'Digital/web' describes tasks related to building digital material. 'Language' refers to fluency in native and foreign languages. 'Production and management' merges themes in relation to technical aspects of the design work. 'Relationship' groups references to collaboration with other professionals in the advertisements. 'Representation' groups requests about skills and knowledge needed to execute graphic design work. 'Research' refers to the task of investigating clients, competitors and trends.

In reviewing the educational policy document, the interviewees connected all the new groups – i.e. graphic design competencies – to at least one section of the document (see Table 5). The different types of requests and competencies were assigned to specific sentences of the document. For the sake of brevity, we only report how the competencies as formed by the educators were seen to be covered in the policy document.

Table 5: Assignment of graphic design competencies in the design policy document. Translated by the authors. The original document in Portuguese is available at the Ministry of Education website: http://portal.mec.gov.br/cne/arquivos/pdf/rces05_04.pdf

Section from 'Graduate profile'	**Competencies assigned**
[Graduates must have] the training to allow their appropriation of reflexive thinking and artistic sensibility, to prepare the designer to be able to produce projects that involve visual, artistic, aesthetic, cultural and technological information systems, observing historical fit, cultural traces and communities' development, and users' characteristics and their socio-economic and cultural context.	Concept generation (C.5), Design deliverables (C.2), Digital/web (C.7), Production and management (C.3), Representation (C.1), Research (C.8)
Sections from 'Competencies and knowledge'	**Competencies assigned**
Creative ability to propose innovative solutions, using creation techniques and processes.	Concept generation (C.5), Design deliverables (C.2), Representation (C.1)
Capability to master their own language, expression concepts and solutions in their projects, according to diverse expression and visual reproduction techniques.	Design deliverables (C.2), Digital/web (C.7), Representation (C.1),
Ability to Interact with professionals from other fields to be able to use different knowledge and act in interdisciplinary teams to elaborate and develop research and projects.	Production and management (C.3), Research (C.8)
Project systemic view, showing the ability to conceptualize it from the combination of diverse tangible and intangible components; production processes; and economical, psychological and sociological aspects of the product.	Concept generation (C.5), Design thinking (C.9), Relationship (C.4)
Knowledge of different steps of a project: setting objectives, data collection and analysis techniques, idea generation and evaluation, solution configuration and communication of results.	Digital/web (C.7), Language (C.6) Representation (C.1)
Knowledge of the productive sector, revealing solid market sectorial view, materials, productive processes and technologies, including furniture, garments, shoes, jewellery, ceramics, packaging, artefacts of any nature, society's cultural traits, software and other regional aspects.	Design deliverables (C.2), Production and management (C.3), Representation (C.1),
Knowledge about production management, including quality, productivity, factory layout, inventory, costs, investments, as well as human resources administration for production.	Production and management (C.3),
Historical and prospective mind-set centred on socio-economic and cultural aspects, revealing awareness of economic, social, anthropological, environmental, aesthetical, and ethical implications of their activities.	-
Sections from 'Educational contents'	**Competencies assigned**
Basic contents: Art and design history in its sociological, anthropological, psychological and artistic contexts, including design methods and techniques, (visual) representation methods, communication and information, studies of the relationship between user/object/environment, studies of materials, processes, administration, and other relationships with production and market.	Concept generation (C.5), Design deliverables (C.2), Digital/web (C.7), Language (C.6), Production and management (C.3), Representation (C.1), Research (C.8)
Specific contents: Studies that involve artistic and industrial production, visual communication, interface, fashion, garments, interior design, landscaping, design, and other artistic outcomes that reveal adequate use of spaces and personal satisfaction.	Design deliverables (C.2), Digital/web (C.7), Production and management (C.3)
Theoretical-practical contents: Integration between theory and professional practice, as well as peculiar performance in a supervised internship, including complimentary activities that fit the desired graduate profile.	All competencies

Three types of requests from our initial analysis were not connected to any part of the document – 'Coding', 'Acumen' and 'Self-driven'. One section of the document was not covered by the resulting competencies of the interviewees: 'Historical and prospective mind-set centred on socio-economic and cultural aspects, revealing awareness of economic, social, anthropological, environmental, aesthetical, and ethical implications of their activities.' Even though it was not explicitly observed in the job advertisements, our interviewees pointed out that all contents in the section represent important knowledge to be acquired by students to deliver high quality design work which holds broader societal implications.

4 Discussion

The results of our study describe what is requested by Brazilian employers in advertising for graphic design positions. Through an analysis of 371 advertisements, we unveiled different types of requests and themes, which we structured across (1) Design deliverables, (2) Knowledge and skills and (3) Personal traits. The structure of our resulting coding scheme overlaps with the one we built in our prior study in the United Kingdom. The specific requests associated with each group were then re-grouped to form broader Graphic design competencies during an interview when design educators were asked to compare the requests in the advertisements with the requirements stated in a design education policy document. Through our analysis of the job advertisements and the educational policy document, we discuss the scope of graphic design in Brazil. We also explore a new path in potentially bridging the gap between academia and practice empirically.

In response to our first research question - *What is the skill set requested by Brazilian companies in advertising for graphic designers?* - our results indicate that employers in Brazil predominantly seek graphic designers for operational activities; 'Representation' as a competency comprising the skills and knowledge needed to execute graphic design work was present in the majority (84.1%) of the advertisements. Concurrently, the five most frequent types of requests across the advertisements were for skills and knowledge in '2D Software' (68.19%); 'Print design' (56.87%); 'Digital design' (45.01%); 'Layout' (39.08%) and 'Photography' (23.99%). We also found that requests for more strategic and/or managerial skills and knowledge were only to a very limited extent referenced in the advertisements. For example, references to knowledge in 'Business', 'Problem solving' and 'User Experience' were present in less than five percent of the advertisements in our data set. The results of our study are similar to the outcome of the survey by Dziobczenski and Galeotti (2017) in which Brazilian companies reported to value the tactical and operational skills of designers (i.e. software and layout skills), while more strategic design skills such as business and leadership were found less valued.

The interest of Brazilian employers in the operational skills of designers is similar as the interest of employers in other countries. Three of the five most frequent request we found in this study were also among the five most frequently requested in our study of graphic design advertisements in the United Kingdom (Dziobczenski & Person, 2017): '2D Software', 'Print design' and 'Digital design. Similarly, when studying the requirements posted for industrial design professionals, Yang, You, and Chen (2005) noted that '2D Software' and '3D Software' were among the most frequent requests listed by companies in Taiwan. Overall, these findings from studies on job advertisements also align with the result of the survey conducted by Bohemia (2002) in which companies were found to often seek for operational (product-related) contributions from designers. At the same time, there is a growing body of research in design that suggests that designers can occupy a more strategic role in companies (e.g. Perks, Cooper, & Jones, 2005; Valtonen, 2016), which suggest that further studies are needed to better understand the origin of current perceptions about graphic designers in Brazilian companies.

In response to our second research question - *How are the requests made by companies in job advertisements covered in a design education policy?* – the interviewees could relate most of the request in the advertisements with the sections we had selected from the document by the Brazilian

Ministry of Education. Exceptions were 'Coding' (K.21), 'Acumen' (P.1) and 'Self-driven' (P.2) which were not assigned to any specific section. The lack of references to 'Coding' in the policy document might be explained by the fact that the educators described it as non-central to design and, from that perspective, 'Coding' might be perceived to not be part of the scope of design education in Brazil. The lack of references to 'Acumen' and 'Self-driven' might derive from the fact that they refer to personal characteristics that might be hard to regulate. Besides these exceptions, all the Graphic design competencies were assigned to at least one part of the document. Based on that, we can assume that the document which regulates the design education in Brazilian tends to mention the vast majority of the requests found in the job advertisements. Given this, graphic design programmes in the country could also be seem to, at large, be instructed to prepare their graduates in a similar way to how companies voice their requirements on future employees in job advertisements.

4.1 Limitations and future research

In this study, we reencountered a number of the methodological challenges and opportunities for future research from our document analysis of job advertisements from the United Kingdom (Dziobczenski & Person, 2017). However, we also surface a number of new opportunities in terms of how to compare the content of different types of documents. As a result, we summarize our suggestions for future research in two main areas below.

First, the limitations that follow our sampling of job advertisements surface questions about what the studied documents reveals about the professional requirements placed on graphic designers in Brazil. Most visible perhaps, we limited our data collection and analysis following two criteria; the studied job advertisements should have been published online and contain the word 'graphic' in their job titles. We found a large share of open positions for designers published online on both the design specific and generic job boards. Yet, similar to the limitations of our earlier study, we recognise that a portion of the job openings available for graphic designers in Brazil might not be published online and/or under titles containing the word 'graphic'. Future research could therefore be directed towards understanding the channels for written recruitments in Brazil and elsewhere to better understand how requirements on graphic designers are articulated in job advertisements. In terms of analysis, we also acknowledge that job advertisements are documents that are built to attract qualified candidates to apply for open positions. For example, companies use 'appropriate' words in order to convince and attract candidates (Backhaus, 2004). Yet, with no practical possibilities to access all the companies and people behind the documents for our study, we could not make an informed judgement about the intentions behind different requests. To this end, we suggest that future studies could evaluate our results (and the frequencies we uncovered) as well as device their own studies together with recruiters of design professionals to better account for the different language practices that are present in job advertisements.

Second, the different ways requirements are written up in job advertisements and policy documents surface questions about how to compare the content of the documents. The two documents gave us the advantage of working with data in its natural form and context. The diversity of the requests present in the advertisements resulted in a coding scheme comprising 35 different types of requests (codes). Applying a coding scheme with a higher number of codes proved to be a complex task. In accounting for this complexity, we pursued multiple rounds of coding and had multiple coders. We also asked experienced design educators to assist us in comparing the different types of requests in the advertisements with what was stated in the policy document. The comparison produced the re-grouping of our initial results in broader competence areas. The re-grouping holds research opportunities about how to effectively organize and present different types of requests in more open-ended studies on job advertisements. Further, in needing to re-group different types of requests, we also note that the high amount of codes initially posed a challenge for the educators in comparing the fit between what was written in the two types of documents. In short, the documents have different purposes and audiences which are not immediately comparable. While job

advertisements provide details about the skills and activities needed to apply for a position, the content of the policy document is formulated in such a way that it can be meaningfully translated into different undergraduate programmes and courses by design educators across the country over time. To this end, in recognizing the complexity that surfaced in comparing the documents, future studies could further explore how requests and requirements are formulated in different types of documents to acquire a richer understanding about (a) how educators are instructed to prepare their students (in e.g. programme and curricula descriptions) in relation to what is requested in job advertisements and (b) how to facilitate this comparison.

4.2 Job advertisements as a source of knowledge for design education and practice

Design educators in Brazil are in many ways tasked to shape how Brazilian society and industry perceive the role and responsibilities of designers. As for educators in other countries, the task is problematized by the fact that the scope of graphic designers' work is changing, making the specific skill set needed to work as a graphic designer a topic of debate among both educators and practitioners. The results of our study - and the process we followed – provides here an empirical reference point in potentially refining current perceptions about design in Brazil. In the short-term, design educators may for instance see our resulting coding scheme – and the frequency associated with different codes – as an overview in planning courses and programmes that better respond to the immediate needs of industry. Design graduates and students need to possess a large share of competencies, knowledge and skills and personal traits when applying for positions in industry, and our analysis of the advertisements could here provide guidance in considering about what to cater to in design education.

In thinking about the scope of design in Brazil and abroad, it is important to note that design education cannot only cover what is being requested by industry in the present. Design education need also to engage with the vision and perceptions of designers in the future. In specific, the requests made by companies in their job advertisements provide a short-term view on the profession, as the recruitment typically occurs in a few weeks/months after the position is advertised. However, with only a smaller subset of the advertisements referencing more strategic and managerial skills, design educators need also to consider the long-term skill development of both the individual and the profession in planning curricula. To this end, we reiterate the short-hand nature of the requested uncovered and encourage educators to strategically monitor, challenge and change such requests. Similarly, we hope that design practitioners may consider our results as a reference in both self-development and -promotion. The evolving nature of the design profession makes it a necessity for practitioners to continuously review and update their skill set and offerings to clients and, in doing so, our results provide an evidence on how the work of designers is described in Brazilian recruitments and how such discussions can be followed through job advertisements.

That said, to conclude, it is important for policy-makers, design educators and practitioners to remember that the labour market for designers is in many ways global and that designers seek for positions and clients not only in their home country but also abroad. To this end, we conclude that monitoring the interest of industry should not only take place on a local level but also in comparison to developments in other countries. Job advertisements provides here an accessible and efficient way for professionals, educators and policy-makers to engage with developments in different countries in terms of what skills and knowledge companies articulate for designers.

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About the Authors:

Paulo Roberto Nicoletti Dziobczenski is a doctoral candidate at the Department of Design, School of Arts, Design and Architecture, Aalto University. His research concerns the graphic design profession and education.

Oscar Person is an assistant professor at the Department of Design, School of Arts, Design and Architecture, Aalto University. His research concerns the strategic integration and management of design with a special interest in the expressive nature of design work.

Leandro Miletto Tonetto holds a PhD in Psychology and works in Design Research in Brazil. He is a Professor of Design for Experience at Universidade do Vale do Rio dos Sinos and co-founder at Zooma Inc. – Consumer Experience.

Roberta Rech Mandelli holds a master's degree in Design (Universidade do Vale do Rio dos Sinos, Brazil). Her research focuses on how the design of toys and play activities can help to stimulate the empathic experience of school age children.

Appendix

Description of the codes in our coding scheme

Design deliverables	Brand design	Deliver brand design outcomes such as logo design, visual identity manuals, etc.
	Digital design	Deliver digital design outcomes such as websites, newsletter, digital interfaces, social media materials, etc.
	Editorial design	Deliver (complex) editorial design outcomes such as books, newspapers,
	Packaging design	Deliver packaging outcomes.
	Print design	Deliver print design outcomes such as flyers, advertisings, posters, etc.
	Service design	Deliver service design projects/outcomes.
	Signage and POS design	Deliver signage, point of sale and environmental graphic design outcomes.
	Video and animation design	Deliver video, animation/motion design outcomes.
Knowledge and Skills	**Conceptual design skills**	
	Business	Knowledge in marketing and business strategy; knowledge about the market/industry of the company.
	Concept design	Knowledge in developing concepts, translate the requirements into a concept, etc.
	Design thinking	Knowledge and use of design thinking methodology.
	Problem solving	Ability to solve design problems.
	Research	Knowledge of user and trends research.
	UX	Knowledge of User Experience design.
	Content skills	
	Content creation	Create, selects and/or deliver text (copywriting) for advertising and other.
	Foreign language	Knowledge of and foreign (English, Spanish) language.
	Native language	Knowledge of native (Portuguese) language.
	Process management skills	
	Client relationship	Knowledge to work with and manage client relationships.
	Project management	Knowledge to manage projects; prioritise between and coordinate multiple projects; work independently.
	Teamwork	Ability to work and communicate in a multidisciplinary group of professionals within or outside the company (suppliers, freelancers, etc.).
	Software Skills	
	2D software	Knowledge of 2D software such as Illustrator and Photoshop.
	3D software	Knowledge of 3D software such as 3DStudio.
	Animation/video software	Knowledge of Animation software such as After Effects.
	Office software	Knowledge of Office software such as Microsoft Word and Excel.
	Web software	Knowledge of Web software such as Dreamweaver.
	Technical design skills	
	Coding	Knowledge of language programming such as HTML, JavaScript, etc.
	Design for web	Knowledge of design for web and interface design.
	Illustration	Knowledge of both hand and digital illustration.
	Layout	Knowledge of composition, grid, colours, typography, etc.

	Photography	Knowledge of photography and image retouching.
	Production	Knowledge about the technical/production step in the design process: dealing with printers, generating files, materials and print techniques.
Personal traits	Acumen	Personal characteristics that contribute to a superior performance as a designer.
	Aesthetic sense	Personal characteristics that contribute with (visual) work as a designer.
	Creativity	Personal characteristics such as creativity and innovation for the design process..
	Self-driven	Personal characteristics that demonstrate a willing to grow in the profession.

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Pedagogical Design Research for University Police Uniforms

BRANDEWIE Brooke[a*]; KIM Injoo[a]; KIM Myoung-Ok[a] ; ENGEL Robin[a] and KARPIAK Kevin[b]

[a] University of Cincinnati
[b] Eastern Michigan University
* Corresponding author e-mail: brandebc@ucmail.uc.edu
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This paper explores issues and opportunities for new university police officer uniform designs by utilizing a User-Centered Design Methods course as a qualitative pedagogical research approach. As a way of introducing problem-based learning, we brought the uniform redesign project to the junior level class in the School of Design. Since the design brief focused on university police, we viewed this as critical since students are key stakeholders of the uniforms. From the students' interviews with the officers, key themes were identified about the current uniform items (i.e. hats, shirts, vests, pants, hats, and accessories) among other uniform topics. Findings indicated that while the police uniform was inherently professional and recognizable because of the authority of the uniform, there were issues with the uniform, which largely related to fit, fabrics, functionality, and identity. The collaboration between the University of Cincinnati Police Department (UCPD), faculty, and students served as a platform to strategize and plan for next steps towards new police uniform designs and demonstrates a holistic interdisciplinary pedagogical approach for translational design research.

university police uniforms; user-centered design; interdisciplinary design pedagogy; problem-based learning

1 Introduction

User-Centered Design Methods is a required seminar course for fourth year level design students in the School of Design at the University of Cincinnati. This course provides an interdisciplinary pedagogy of the design philosophies and processes that place the user at the centre of design, while learning how to analyse and anticipate user behaviours to identify their needs. Since there are many positive effects with problem-based learning (PBL), the theoretical causal model of PBL (Van Berkel & Schmidt, 2000) was referenced to enhance the pedagogical framework for this course in order to encourage self-motivation and learning experiences. In the fall of 2016, the University of Cincinnati Police Department (UCPD) requested to collaborate with the Design faculty to redesign their police

uniforms. The integration of real-world interdisciplinary design research projects into the classroom is a cornerstone of PBL since students become active and responsible for their learning (Hmelo-Silver, 2004). This project was therefore introduced in the User-Centered Design Methods course to enrich learning competencies while empowering the students to practice their design research skills by investigating the design issues and opportunities related to the university police uniforms. The purpose of integrating this project into the class was an important part of generating preliminary data for the university police uniform redesign project.

1. Since we live in a complicated society involving increased crime and terrorism, the role of police officers is more significant than ever extending their job beyond protection into a more complex role of serving as a community ambassador of peace and safety as they are enforcing laws. It is obvious that the officers' performance while on duty is embodied through their police uniform since they exercise their authority and power when encountering citizens. Indeed, a uniform is distinctive clothing worn by members of the same organization and its meaning has been influenced by the wearers' occupational abilities and their performances in interacting with people, since clothing is a powerful cue in impression formation (Johnson, 2005). So the uniform, especially police uniforms, identifies the wearer as a part of a collective authoritative organization.
2. All garments have their own functions, ranging from aesthetic to physical. For the functionally oriented garment design, there are several requirements such as physiological, biomechanical, ergonomic, and psychological considerations. A functional garment values aspects such as fit, comfort, and mobility; expressive needs include status, role, and self-esteem; and aesthetic attributes related to design elements in the functional design process are based on the specific needs of the target consumer (Ahsan & Tullio-Pow, 2014). The police uniform, especially the university police uniform, needs to be an efficient tool to express the authority of law enforcement, yet it also needs to convey friendly and approachable qualities, as its "users" or stakeholders include students, faculty, and additional surrounding community members.
3. Considering the importance of the role of university police officers and therefore, how significant the uniform is, there is considerable body of literature acknowledging the power and legitimacy of police uniforms (Balkin & Houlden, 1983; Bell, 1982; Johnson, 2013; Singer & Singer, 1985). Specifically, previous research has focused on how the police officer uniform conveys authority, impressions of colour, interpersonal perceptions, influence and attitude (Bell, 1982; Johnson, 2013; Singer & Singer, 1985). However, less attention has been given to the police uniform, and especially to university police uniforms as a functional garment that requires a systematic approach to analyse and to apply the officers' needs, with consideration to the community's needs/preferences in the design process. The User-Centered Design Methods course is an effective educational vehicle for students and key stakeholders in the university campus community to participate and contribute to the collection of data in the research and discovery phase.
4. Through this paper, we will explore issues and opportunities for new university police uniform designs by utilizing the User-Centered Design Methods course as a qualitative pedagogical design research approach. Activities and outcomes from this class will address both physical and psychological aspects of the uniform to suggest a new uniform design, with the intent of making the university police officer feel more approachable and trustworthy, which can enhance the image of university campus police officers. This pedagogical interdisciplinary design effort is strongly suggested to produce successful design outcomes by integrating real-world research into the classroom. Ultimately it could serve as an effective curricular strategy for new approaches to design; stakeholders within a university system can collaborate to realize solutions that are value-driven (students' learning experience) and outcome-focused (new designs).

2 Background

2.1 General Social Function and Historical Context of the Police Uniform

Sociologists have remarked on the special social functions such uniforms perform, solving many of the problems associated with modernizing a workforce in an increasingly urban social milieu (Joseph & Alex, 1972): it designates group membership (both for in-group member and out-group observers) in the service of creating an occupational identity; in the service of group cohesion, it accentuates certain statuses (rank, occupational achievement, etc.) while concealing others (class, and other forms of social status); it serves as a symbol of legitimacy and marks the wearer as harbouring special skills and prerogatives; and it suppresses, or at least sublimates (Bhugra & Silva, 1996; Craik, 2003), individual idiosyncrasy. These processes serve as mechanisms of social placement which provides a framework for mutually negotiated forms of social interaction (Paperman, 2003), including self-formation (Matthews David, 2003; Streicher, 2012; Ugolini, 2010), transgression (Craik, 2005), and resistance (De Camargo, 2016).

It is within that sociological framework, and that historic context, that we should understand the development of the first police uniforms. It is most common to tie the police uniform as we know it today to the "bluecoat bobbies", Robert Peel's so-called "New Police" of 1829 (Miller, 1975). He formed the London Metropolitan Police Department, and placed officers in uniforms that were different than the military, but provided an identifiable presence, which were used to deter criminal activity in neighbourhoods where they patrolled. More recent historians have attempted to resist "Whiggish" histories, in which Anglo-American police are viewed as citizen-volunteers, by linking the creation of this force to Peel's preceding experience in the occupying armies of colonial Ireland (Brogden, 1987), while others have cautioned a direct analogy should not be over emphasized (Styles, 1987).

Either way, a tension lies at the heart of the police uniform (Sinclair, 2011). It was designed to be both reminiscent of the British military uniform—with its epaulettes, brass buttons and other traditional features—but also markedly different; the prevalent blue was chosen as a contrast to the imperial military's red coats, and thus to connote the distinct mission, prerogatives and limitations of the new Force. The task, negotiated through apparel as well as through administrative organization and armouries, was to forge an administrative branch that embodied the use of violent force, and its constraint, in the service of a newly emergent liberal order.

This latter issue, of the limits and restraint of just violence, served, especially initially, as one of the key markers between military and police forces in the 19th century (Foucault, 2007), and it remains integral to the political, social and symbolic stakes of police uniform design today. The police uniform has become the most readily identifiable aspect of modern policing, with significant changes in design over the last century. There has been a significant amount of research evaluating the degree to which even subtle differences in uniform design convey meanings to different populations, officers themselves included, while also shaping the outcomes of police-citizen encounters (Bushman, 1988; Johnson, 2005; Nickels, 2008; Paul & Birzer, 2004; Singer & Singer, 1985). This insight places the issue of uniform design at the core some of the fundamental issues in policing today: What is the role of police in a diverse, multicultural, liberal society (Chan, 1997)? What are the potential forms of relation between police, as a distinct body, and a general public and how can we organize police labour to move closer to our collective ideals (Karpiak, 2010; Mutsaers, Simpson, and Karpiak, 2015; Karpiak, 2016)?

2.2 University of Cincinnati Police Department

Relationships between communities and law enforcement in the United States are in current turmoil, as a number of recent highly controversial police encounters have exposed the rifts between the police and their communities. Controversial officer-involved shootings, in custody-deaths, and aggressive law enforcement practices have yielded a growing distrust amongst communities and police, evident in recent movements such as Black Lives Matter.

The city of Cincinnati in which the University is situated has experienced such a police-community relations crisis after a controversial police shooting in 2015 by a white University police officer of an unarmed African-American motorist in an area off-campus. Law enforcement services for the University are handled by the University of Cincinnati Police Division (UCPD). The UCPD maintains approximately 74 sworn officers and 26 non-sworn security officers; the UCPD sworn officers have full police authority. These officers have primary policing responsibilities on University-owned and operated property, and also patrol in the neighbourhoods surrounding the University. The shooting by a UCPD officer sparked national media coverage and community protests, as this incident occurred during a string of high profile controversial police-involved shootings in the United States (Ellis, Melvin, & Shortell, 2015). Ten days after the shooting incident, the officer was criminally indicted on charges of murder and voluntary manslaughter, yet two separate criminal trials both resulted in hung juries. Ultimately, this incident caused a crisis in public relations between the University and the local community. Immediately following the incident, University officials initiated a comprehensive voluntary police reform process that too, included comprehensive changes in policies, procedures, and training. The purpose of reform is to provide more effective, efficient, and equitable policing, while simultaneously rebuilding trust with university and community members (Public Safety, 2015). One important aspect of this reform effort was to reintroduce the UCPD through a redesign of their police uniforms since a significant amount of research has demonstrated that public trust is key to ensuring stable communities and allowing police to perform their duties to the best of their abilities. During a time when the public continues to challenge police authority and question their legitimacy, changing a uniform is more than just fashion; it can serve to reinforce the image of police officers as helpful public servants who are more approachable and protect the communities they serve.

3 Methodology

3.1 Course Project Brief

The police uniform redesign project was introduced to the User-Centered Design junior level class in the School of Design. The first 4 weeks of the course covered theory, principles and methods of user-centric design, for which then the project (including recruitment, interviewing, feedback and presentations) ran from week 5- week 14 in fall semester in 2016. Since the design brief focused on university campus police, we viewed this as critical since students are key stakeholders (users) of the uniforms. In addition, students are developmentally more mature as fourth year students, so it was feasible for them to assume a more autonomous role in the course, and already had a basic understanding of qualitative design research.

3.2 Strategy for Data Collection

The participants were recruited from the UCPD, which included 27 sworn police officers and 15 security police officers. In recruitment, faculty assured that the participating officers were from varying genders, ranks and levels of experience.

Forty-eight students were enrolled in the course. In advance, it was predetermined that the students' core research activity would be to conduct interviews and observational research during a ride along session with a police officer on duty during a shift. They were also given the option to shadow a safety officer, whose primary duty includes walking around campus or standing in one place, if they were not comfortable riding in the police car with the officer, though the majority of students were excited at the idea of it. Students signed up for one two-hour session during a first, second or third shift over a six-day period. Faculty assigned the students to individually develop a list of questions about policing and the police uniform, focusing on their wearing experiences (including fit, functionality, fabric, colour, identity, etc.) and satisfaction with the current uniforms. Faculty intentionally gave students the freedom to identify what they wanted to learn, in order to further encourage their own curiosity and motivation. Once the ride along activity was completed, students were given 24 hours to annotate and analyse their experience.

Faculty then randomly formed the class into 8 groups of 6 people to discuss their experiences together. In their new groups, they were asked to analyse their data collectively to identify common

themes across their research. In addition to the ride along sessions, students were also asked to conduct secondary research, for which they could also use to further support their group's findings (history of the uniforms, material developments, colour theory, etc.). Next, students re-joined their groups to discuss their experiences and examine their findings (organized as problems, needs, and wants/desires) for overarching themes.

3.3 Analysis: Project feedback and presentations

The groups then shared this information in a presentation to faculty. In doing this, faculty were able to identify gaps in their research and provide guidelines for further inquiry based on their self-prescribed focus area and findings. The faculty's role was especially important at this time, since the PBL facilitator must continually monitor the discussion, selecting and implementing appropriate strategies as needed (Hmelo-Silver & Barrows, 2006). Faculty helped students clarify any confusing information and missed insights, and also provided guidance on next steps for their research process. From this, they clarified their opportunity areas, for which they were asked to address emotional, physical/functional (what they need to perform their job) and aesthetic opportunities (as it related to their image).

The final deliverable was a research presentation with primary and secondary insights and opportunities to faculty, the UPD officers and administrative leadership. This interaction also allowed for the officers to validate and elaborate on the students' findings. By allowing the students to identify their own focus area, each group presentation had a unique angle to the project which yielded a broader range of insights as a result. In addition, commonalities across all of their findings were determined for aspects of the uniform including tops, bottoms, accessories, design details (pockets and fabric), and identity (as demonstrated in the Tables 1-3 below).

4 Results/ Findings

As a result of the students' interviews with the officers during the ride along sessions, the findings were organized into key themes for the current uniform clothing items and topics involving the uniform (i.e. identity). The results highlighted the issues and needs of police officers with regard to the uniform in order to enhance their performance.

4.1 The current police uniform (Shirt, Vest, and Pants)

1. Table 1 describes the officers' experiences with the current police uniform shirt, vest and pants. The current uniform shirt is a non-stretch, woven polyester blend with a centre front placket with buttons down the front, and consisting of two breast pockets and shoulder epaulettes. The officers consider the current uniform shirt to be "professional and familiar to the community". However, multiple issues resulted with the fabric/fit of the shirt. The officers' indicated that the fabric was slippery causing the shirt to "rise out of the pants because of how heavy the belt is weighing the pants down, which is very distracting". A part of this issue seemed to be due to the length of the shirt in comparison to body width and thereby interfering with the tactical vest. Other comments referred to the quality of the fabric, suggesting that the fabric "frays when it is rubbed by items on the belt" and that "pills badly". Since the fabric of the shirt was without stretch, it was considered to be "uncomfortable" and "not easy to move around in". The shirt was one of a few layers of that officers wear, including the undershirt, the bulletproof vest, in addition to 1-2 inner jackets and outer coats. Since these fabrics were not breathable, the officers became hot and can sweat excessively.
2. Regarding the vests, the results of the interview largely focus on aesthetics and its symbolic meaning. The police officers acknowledged that the vest was a "status symbol and is good for personal safety", yet also acknowledged that it was a symbol that can communicate "overexertion of power". Since it is something that the Special Weapons And Tactics (S.W.A.T) team wears, it was both familiar and identifiable. However, one officer

commented that it looks “incredibly militaristic and unapproachable like riot gear, which can intimidate citizens”.

3. The results for the pants of the current uniform suggest there were issues with the functionality and quality of the fabric. The current uniform pants had a tactical style with a fly-front zip and side cargo pockets. One officer stated, “the crotch depth was too long and hinders movement”. For female officers the pant style was “especially problematic when going to the bathroom”, because they had to remove their duty belt. An additional comment referred to the colour of the pants. The officer explained, “the black pants fade with each wash creating inconsistency”.

Table 1 Pros and Cons of the current police uniform (shirt, vest, and pant).

Shirt	
Pros	**Professional and Familiarity** - Looks professional and is familiar to the community
Cons	**Quality of Fit / Fabric** - Fabric is too slippery and it doesn’t stay tucked in; buttons also tend to fall off - Shirt rises out of pants because of how heavy the belt is weighing the pants down. It is very distracting - Fabric used for the shirts is not easy to move around in - Uniform layers are too hot and not breathable - The light blue imitation material pills badly - Length of shirt is too short with the torso being wide and interfering with the tactical vest
Vests	
Pros	**Symbolism** - Symbol of status and safety and can also be an overexertion of power
Cons	**Familiarity / Identifiable** - Familiar and identifiable
	Militaristic / Unapproachable - Incredibly militaristic and unapproachable like riot gear
Pants	
Pros	N/a
Cons	**Quality of Fit / Fabric** - Crotch depth is too long and hinders movement - The black pants fade with each wash creating inconsistency - Light blue colour of our uniforms also gets dirty easily
	Functionality - Going to the bathroom is a problem for female sworn officers

4.2 The current police uniform accessories and design details (Hat, Belt, Pockets, Fabric)

Table 2 describes the officers’ experiences with the current uniform accessories (hat, belt) and design details (pockets, fabric). The current hat worn by police officers was a hard shell “campaign hat”, broad-brimmed felt straw hat, with a high crown, pinched symmetrically at the four corners. The officers associated the hat with professionalism, as reflected by one statement that indicated, “the campaign hat has a professional, symbolic look for the police force and is meant to build trust”. In addition to the hat being symbolic, it was also “easily identifiable”. This was important especially during public events. One officer commented, “the significance of the hat was only necessary at events such as football games when we need to be easily spotted”. Another officer described, “the campaign hat makes civilians feel safe that they’re easily discernable”. In addition to serving as a

visual cue, another statement described that the campaign hat is “usually seen worn by state troopers”. While it is a recognizable part of the uniform, statements suggest that it inhibited approachability. An officer commented, “this hat gives the civilians the feeling that he or she should not approach the officer, as well as being too intimidating”. Additional statements focus on the wearing experience of the hat. One officer explained, “the hats are uncomfortable and hinder movement”. Another comment was, “the campaign hats eliminate my view and gives me a headache”. Furthermore, “when it rains, the water pours off the hat and down the coat and into the boots”. Additionally, an officer said, “it is an unnecessary distraction”.

The current belt that the police officers wear can be described as a belt that was “typically constructed of nylon or leather used by police and security officers to carry equipment easily, in a readily-accessible manner, while leaving the hands free to interact”. Although the belt was an important part of the uniform, there were no positive comments associated with it. Mainly, the officers’ remarks reflected how cumbersome the belt was especially in restriction movement and also in its heaviness and stiffness. One officer commented, “the leather is stiff, it doesn’t bend or move easily and it can break down when bent, and the equipment on the belt is very heavy”. Another stated, “the belt restricts movement at the waist and causes lower back and hip pain”. Furthermore, it “does not allow us to sit properly in the car or chair”. One officer also suggested “the belt does not look professional and wears easily”.

Regarding the design details of the current uniform, two main design details discussed by the officers focused on the uniform shirt pockets and the fabrics. There are two breast pockets on the front of the shirt, which were considered to be non-functional. One officer explained that “the pockets on the shirt do not hold much” and is “awkward”. Specifically, one officer explained that there is no place on the shirt to hold a pen, even though there is a patch stitched on the upper shirt pocket”. Another suggested that the aesthetic of the pockets “is very outdated”. The fabric garnered many comments, all relating to quality, performance and comfort. One officer explained, “the material was itchy, not stain resistant and generally uncomfortable”. Another stated that the collars are “very stiff and itchy”. One officer simply remarked, “the material is horrible”. An officer commented on the breathability of the fabric, explaining that it caused “excessive sweating in the winter months”.

Table 2 Pros and Cons of the current police uniform accessories and design details (hat, belt, pockets, fabric).

Hat	
Pros	**Function / Symbolism** - Only necessary at events such as football games when we need to be easily spotted which makes civilians feel safe - Professional and symbolic to build trust
Cons	**Approachability / Intimidating** - The sworn officer's hat is usually seen worn by state troopers. This hat gives the civilian the feeling that he or she should not approach the officer, as well as being too intimidating.
	Functionality / Purpose - When it rains, the water pours off of the hat and down the coat into the boots - An unnecessary distraction - Uncomfortable and hinder movement - Eliminates my view and give me a headache
Belt	
Pros	N/a
Cons	**Functionality** - The leather is stiff, it doesn't bend or move easily and it can break down when bent. - Very heavy and hard to clean. When it gets dirty, they have to throw it away and buy a new one.
	Professionalism - Does not look professional
	Movement Restriction - Restricts movement at waist and causes lower back and hip pain. It does not allow them to sit properly in the car or chair.
Pockets	
Pros	N/a
Cons	**Out-of-date Pockets / Importance** - The pocket look is very out-dated, but they are important.
	Functionality - The breast pocket is awkward and non-functional.
	Storage - The pockets on the shirt do not hold much. - No place on the shirt to hold a pen- a patch is stitched on top of the upper shirt pocket.
Fabric	
Pros	N/a
Cons	**Quality** - The material is itchy, not stain resistant, and generally uncomfortable. The collars are very stiff and itchy. The fabric is cheap/thin and rubs together. - There is lots of pilling, excessive sweating in warmer months. The fabrics itch and run on the body causing officers to be uncomfortable. - The material is horrible.

4.3 The identity of the current police uniform

Table 3 describes the officers' statements on the overall identity of their current police uniform. Many remarked about the current uniform colours with regard to recognition. Several officers noted that the uniform did not reflect the brand of the University. Two officers stated, "the current uniform has no connection to the University" and "the uniforms lack a distinct connection to the University". Comparably, one officer mentioned, "the uniform is not distinguishable from the City police". Interestingly, another officer described that the "current uniform colours for UPD are almost exactly like the State police with only minor detail differences". Other issues were noted that the uniform caused the public to view them in a negative way. One officer stated, "the overall uniform has a negative and intimidating view from the public". Furthermore, one explained, "it feels as if we're unable to properly serve the community due to appearing unapproachable". In addition, an officer remarked that the officers "feel like they are not receiving the recognition they desire".

Table 3 The identity of the current police uniform.

Identity	
Pros	N/a
Cons	**Uniform colours / Recognition** - The current uniform colours for UPD are almost exactly the same as the State police with only minor detail differences. - The UPD officers feel like they are not receiving the recognition they desire. When the State police are on campus for many events, the officers all merge together in colour.
	Branding - Lack a distinct connection to the University - Distinction from the City Police and more compatibility with the university is needed - The current uniform has no connection to the University
	Negative associations / Intimidating - The overall uniform has a negative and intimidating view from the public, especially with the recent trial. - It feels as if we're unable to properly serve the community due to appearing unapproachable.

5 Discussion/ Implications

5.1 Recommendations from Students' Interviews with Police Officers

Findings from the students' research indicated that although the police uniform was inherently professional and recognizable, there were issues with the uniform, which largely related to fit and functionality. Overall, the uniform shirt and the fabric were two aspects of the uniform that the officers wanted to be improved. Regarding the police uniform shirt, officers acknowledged that it is iconic and communicates professionalism, supporting the previous research (Bell, 1982; Bushman, 1988; Spindler, 2001) that the uniform has the authority and legitimacy when the officers are enforcing the law. However, the fit and fabric of the shirt were not satisfactory. The shirt was constantly coming untucked, due to the "fabric being slippery and due to the weight of the belt". To prevent this, one officer recommended adding snaps or buttons to connect the hem of the shirt to the top of the pant. Additionally, the fabric was not durable or comfortable, and did not allow for breathability. It was suggested performance alternatives such as "polo-style shirts that could function to keep the officers drier and cooler with moisture-wicking lightweight and breathable fabrics". Another officer mentioned about "durable, stretch (knit) fabrics similar to those used in performance wear to make it easier to move around in". Interestingly, suggestions focused on the importance of the colour of their under shirts. One officer described, "Officers feel safer avoiding a white/obvious undershirt since it indicates a weak point for attackers...criminals with the intention of shooting or stabbing an officer will aim for the white undershirt because they know it is the layer closest to the skin not protecting them". Furthermore, another officer described, "if special shirts were designed and provided for the officers they would need to be black, or matching the outer

colour of the uniform". Colour was also important to hide dirt and marks. An officer mentioned "switch to a darker grey or even red colour that does not show sweat or food stains".

Overall the officers acknowledged the value of wearing a vest, because it was a symbol of power and safety and was obviously good for their personal safety. Concurrently, the officers recognized that the vest was associated with negative connotations, like the overexertion of power and intimidation. If a vest could be a part of their university uniform, they recommended that it be "distinguishable from the S.W.A.T vest" and elaborated for it to be "more proper". The officers liked for the vest to offer "better weight distribution between the belt, pockets and vest", as well as "increased comfort and accessibility, with easier access to their radio". The results for the pants of the current uniform suggest there were opportunities to improve the functionality, especially for female officers who must remove their belt each time they use the restroom.

Regarding design details, the quality of the fabric was an area for improvement overall with the uniform top and bottoms. Additionally, the officers emphasized the importance of the pockets, yet their comments described them as "out-dated, awkward and non-functional", suggesting improvements with the aesthetics, placement and function.

The officers identified the current campaign hat to be necessary because it "allows for them to be easily recognized in a large crowd". They also associated the hat to be "a symbol of professionalism and trust". However, it was also viewed as intimidating to civilians and made them seem less approachable. Furthermore, it was not comfortable and hindered movement and visibility. An alternative suggestion that was requested by multiple officers was a baseball cap, since "it looks less intimidating". Since the officers would like for the uniform to connect better with the University branding, a baseball cap could further differentiate themselves from the city police while communicating an athletic appeal.

The duty belt was viewed as synonymous with the police uniform, yet was also one of the most restrictive items of the uniform. Although it was critical to the officer's role, it restricted their movement and inhibited their performance. It was heavy and stiff because it is made of leather, and the equipment on the belt caused it to weigh even more, resulting in some cases, increased lower back and hip pain. Suggestions were to use a light-weight material or re-imagine the functionality of the duty belt altogether.

There were several comments about the identity of the uniforms with regard to recognition yet distinction. The officers understood the importance of being identifiable by citizens in the community; however, their statements reflected their desire for a stronger visual connection to the University. By improving the uniform to reflect the branding of the University, the officers would be further differentiated from city and state police. In addition, "they acknowledged that improvements could also make the officers look approachable and less intimidating".

5.2 Students' Learning Experiences based on Problem-based Learning (PBL)

This course yielded several positive effects based on Problem-based Learning, which included self-directed learning and taking responsibility for their own learning, along with facilitated collaborative knowledge (Hmelo-Silver & Barrows, 2006). The ride along sessions with the officers proved to be a significant experience for the students; though some students were apprehensive prior, they were energized and motivated after their experiences. It was at that moment that students' developed greater empathy and compassion towards the police officers. Since they were able to spend this time with the officers during a shift, they cultivated a great appreciation of their responsibilities, for which they were surprised at how much of their job focused on assisting community members.

Another important aspect regarding class activities was balancing individual and group work in order to promote self-directed learning and collaboration. Students conducted their ride along sessions individually so that students had greater autonomy in developing their questionnaires, since intrinsic

motivation occurs when learners work on a task motivated by their own interests, challenges or sense of satisfaction (Hmelo-Silver, 2004).

Upon completion of their ride along sessions, students were placed into groups, which allowed them to discuss their experiences and practice synthesizing their findings. It was critical to involve the University police officers in the beginning of when the project was introduced, in order to acclimate the students to the officers and the project brief. It was effective for the officers to listen to the presentations towards the end, since at that time many of the findings were discussed and validated and/or expanded upon further. Both of these interactions reinforced the reality of the project, and reminded students that they were designing for users with specific needs. Overall, the students felt they were empowered while practicing their design research skills by investigating the design issues and opportunities related to the university police uniforms.

6 Conclusions

The collaboration between the University of Cincinnati Police Department, faculty, and students demonstrates a holistic interdisciplinary pedagogical approach for translational design research. The uniform is an important aspect of the reform process to provide more effective, efficient, and equitable policing, since it is integral to the image of the police department to the University community. The project was embedded in the User-Centered Design Methods course so that students could investigate and understand the challenges that the University police officers face with their uniforms, and therefore empowered them to do so in a self-directed manner, both individually and collaboratively, in order to encourage curiosity and foster critical thinking (Hmelo-Silver, 2004).

Integrating this design project into the class had a significant role in generating preliminary research data for the project. As students are key stakeholders in the community, when given the task of finding the problems, meaningful insights were generated for the uniform including the shirts, vests, and pants, in addition to accessories and design details. They spoke about problems and frustrations from the officers' point-of-view by highlighting officers' experiences with the uniform. They also communicated their findings in terms of importance to the officers, demonstrating empathic and user-centric orientation. Moreover, students articulated the causes and effects of problems, which illustrated critical thinking by examining "the why" behind many of these issues. Students were asked to consider opportunities from both functional (physical and emotional) as well as aesthetic perspectives, for which they distinguished "needs" versus "wants" with the uniforms. Their findings culminated into a presentation with a call to action or outline of design opportunities to be addressed, directed by and from a problem statement.

Officers were actively involved in the class activities (such as critiques and presentations), therefore students were consistently engaged with their clients. The UCPD administration was also proactively involved throughout the entire process, which prevented the project from merely being a classroom exercise; instead, it served as a practical platform to strategize and plan for next steps towards new police uniform designs. After the course was completed, all research findings were compiled and synthesized. In the Spring semester 2017, the UCPD, College of DAAP faculty and students, with support from a uniform manufacturing company, suggested several uniform concepts. From this preliminary research and design development, the aim is to leverage these insights to create a new identity, that of which represents the University branding, as well as the new policing principles of transparency, legitimacy, accountability, fairness, collaboration, and innovation.

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About the Authors

Brooke Brandewie is an Assistant Professor in the Fashion Design Program at the University of Cincinnati. Her research interests intersect the disciplines of fashion apparel design, anthropology, and wellbeing/healthcare. She is currently engaged in collaborative research that focuses on medical and police uniform design.

Injoo Kim is a Professor in the Fashion Design Program at the University of Cincinnati. Her research focuses on holistic design thinking through fashion design to improve the quality of life for users and their environments. Her current research includes apparel product development across genders and ages through size and fit studies.

Myoung-Ok Kim, Ph.D., is a visiting assistant professor at University of Cincinnati. Her research has focused on wearable technology including 2D & 3D clothing construction/fit as well as smart garments/devices. She has numerous publications for fashion design practices.

Kevin Karpiak, Ph.D. is an Associate Professor at Eastern Michigan University. His work focuses on policing as a nexus for exploring broader questions in the social sciences. He is co-editor of the Cornell University Press monograph series *Police/Worlds: Studies in Security, Crime and Governance*.

Robin S. Engel, Ph.D. is Vice President for Safety and Reform, and Professor of Criminal Justice at the University of Cincinnati. She serves as Director of the International Association of Chiefs of Police (IACP)/UC Center for Police Research and Policy.

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Whole-to-Part-to-Whole: Co-Evolutionary and Integrative Design Approach

CASAKIN, Hernan* and GINSBURG, Yoram

Ariel University
* Corresponding author e-mail: casakin@ariel.ac.il
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Forming designers in a fast-changing international scenario is a challenge for most schools and departments of architecture. It is in the design studio where students not only develop and apply analytical thinking skills, partly acquired in regular courses, but also abilities related to design synthesis and evaluation. However, a major question is how to effectively use knowledge and abilities in a manner that will lead to successful learning processes, and satisficing outcomes. To this aim, the Whole-to-Part-to-Whole Design is proposed in the architectural design studio as a catalysator of students' capabilities, and as an approach for processing and integrating knowledge in a co-evolutionary way. A case study of a dwelling project is analysed to illustrate how the design approach is implemented. The paper discusses how the approach, can help to bridge the existing educational gap between analytical abilities and design skills. Pedagogical implications are presented.

design studio, architecture, co-evolution, knowledge integration

1 Introduction

Architectural schools and departments in universities around the world are facing the challenge of teaching designers in a fast-changing scenario. Students are expected to graduate with a well-balanced body of knowledge in a wide spectrum of domains, such as history, theory, technology, and design. Part of this challenge resides in the difference between learning in regular courses and in the design studio, considered as the core of the architectural studies (Goldschmidt, 2002). It is in this educational environment where students not only develop and apply analytical thinking skills, partly acquired in the different courses, but also abilities related to design synthesis and evaluation (Caliksan, 2012). Students are expected to acquire and integrate theoretical and practical knowledge (Sancar, 1996), develop their expertise and competence, and form their own ideas and judgments (Chastain & Elliott, 2000).

While students receive feedback from their teachers, they are engaged in a learning-by-doing activity that implies gaining knowledge and developing skills in a practical manner (Hinson, 2007;

Schön, 1987). A major difficulty, however, is how to effectively apply the expertise acquired in previous courses to fit it into the architectural design studio agenda, in a way that it will lead to successful design learning processes and satisficing (to use Simon's notion) design outcomes (Goldschmidt, Casakin, Avidan, & Ronen, 2016) (See Simon, 1981, for further explanation about satisficing). In this sense, simply learning-by doing does not automatically warrants that students will know how to efficiently use prior knowledge in order to make a coherent interpretation of the problem, and to produce an acceptable solution that is explainable and justifiable (Goldschmidt, 2014). Thus, in order to support the learning-by-doing activity, suitable approaches are crucial for facing these design education challenges. It is in the second-year design studio in the School of Architecture at Ariel University, where students must deal for the first time with a brief and a site simulating a real project in professional practice. Therefore, a major goal is to harvest what they achieved in the first year with regard to the sensual and conceptual perceptions of architecture, and integrate these into real practice. To this aim, design tools from both the conceptual and the practical spheres should be delivered to students to allow them to advance their own agenda.

The Whole-to-Part-to-Whole: Integrative and Co-Evolutionary Design is an approach that seeks to relate and integrate the variety of layers of knowledge acquired by students both in the architectural courses, and in previous design studios in a systematic and creative way. The approach aims at helping students to enhance their analysis, synthesis, and evaluation capabilities (Eliouti, 2009) during the design process in a non-linear, iterative and developmental way. This approach was developed through the last five years, and implemented by the design of a mixed-use complex of dwelling units.

The design of residential units, representing approximately 75% of the urban fabric in the contemporary city, is considered as one of the most complex topics of architectural education. It is part of a triangular matrix of the following systemic interrelationships: i) the residential building, the street and the neighbourhood; ii) the residential unit and the other units; iii) the spaces and functions of each residential unit.

The paper describes the proposed educational approach its context, and major focus. Thereafter, it introduces the housing project carried out in the design studio, the intended aims, and the timeline for the different phases of the project. The final part illustrates and analyses the work of a student. This is followed by a final section discussing how the approach can help to bridge the existing educational gap between analytical abilities, and design thinking skills. The paper concludes with a focus on the aspects that went well, as well as what needs to be improved in the future.

2 The Integrative and Co-Evolutionary Design Approach

The Whole-to-Part-to-Whole: Integrative and Co-Evolutionary Design is an approach that seeks to integrate the different layers of knowledge acquired in previous courses in a systematic and creative way. An important feature is concerned with the zoom-in and zoom-out scaling strategy. Part of the complexity of the mixed-use project, consists in coherently designing non-repetitive dwelling units at the urban, architectural, and interior design scales. To this aim, the approach encourages students to combine divergent thinking with convergent thinking at the distinct phases of the design process. This is achieved by means of a series of analysis, synthesis, and evaluation cycles (Eliouti, 2009; Jones, 1980). While using divergent thinking, students are encouraged to explore, and analyse as many idea solutions as possible in terms of their suitability to the design goals. In the convergent thinking mode, they are requested to come up with a few alternatives, which leads to a final solution (Liu, Bligh, & Chakrabarti, 2003). Design decisions are evaluated against design requirements in a cyclical non-linear fashion. In this way, students can modify their solutions at any stage of the process by keeping consistency through the different design scales.

2.1 Design Approach: Focuses and Tasks

Whereas the design approach promotes the use of divergent and convergent thinking at any stage of the design process, it also focuses on the following key aspects:

2.1.1 Contextual analysis

People's culture and lifestyle is strongly linked to places. Certainly, the inseparableness of the human being and place is a central issue of debate in the design project. While the environment is being more and more degraded, architecture has an important function in contributing to identifying and strengthening the 'genius loci' and spirit of place (Norberg-Schulz, 1982). We expected that the analysis and understanding of the fundamental features of each site (Lynch, 1985), would be critical to produce radically unique design solutions in each selected site, even that all projects shared a same design brief.

2.1.2 Problem definition and conceptual thinking

A most important stage is to frame the design problem, which structure and inform the design task (Lawson & Loke, 1997; Newell and Simon, 1972). In contrast to site analysis that is concerned with a concrete and detailed reality, problem definition is mainly related to the understanding of critical aspects of the design situation. Accordingly, students were requested to reflect on their design intentions, define initial goals, and deploy conceptual thinking (Goel, 1995).

The generation of design concepts was supported by a series of design exercises to produce mental maps (Jeffery & Burgess, 2006). These are abstract two-dimensional subjective representations of the site (Lynch, 1960) that were used to put in relevance major spatial issues as perceived by the students. The emergent mental image contributed to structuring the design problem (Casakin, 2008; Konar & Chakraborty, 2005).

2.1.3 Problem solving skills, and idea generation

Designers usually work by jointly understanding and framing the problem, and generating solutions (Lawson & Loke, 2004). Thus, the next stage consisted in helping students to develop their problem-solving skills when producing alternative design ideas about their personal understanding of 'dwelling in the contemporary city' (Perttula & Sipila, 2007). To this aim, they first built conceptual mock-ups disregarding the scale of the physical site. Thereafter, they produced 1:250 mock-ups that helped test their ideas in the selected site.

2.1.4 Inspiration sources and idea generation

The generation of ideas was stimulated using within-domain and between domain images as metaphorical and analogical sources. Exposition to visual stimuli enhanced the chances to enhance the quality of the design solutions (Goldschmidt & Smolkov, 2006). A major challenge, however, was how to help students identify and retrieve relevant concepts from the images, and adapt them to the design project without becoming fixated (Cardoso & Badke-Schaub, 2011). To this end, students were trained to retrieve analogical and metaphorical principles from visual images, which also served as inspirational sources for their projects (Casakin, 2005; Gonçalves, Cardoso, & Badke-Schaub, 2014).

2.1.5 Precedents as inspirational sources

These tools are specific designs that are exemplary in some way, and thus it is possible to learn an important lesson from them (Akin, 2002; Clark & Pause, 1985; Lawson, 2004). Precedents are existing solutions generally produced by master designers in reference to specific design problems, which were used by students as examples of imitation, and as sources of inspiration for their own designs. The Whole-to-Part-to-Whole approach encouraged to continuously use precedents at every stage of the design process, and at different scales of the project (e.g., either a façade or a construction detail).

2.1.6 Speculations on design form - morphology and façade

The city's morphology, and specifically the immediate context where students intervened, is the outcome of cultural and socioeconomic dynamics. The context, architectural brief, and the personal beliefs and goals of the students were the three major determinants of the building form. The way that these elements interacted along the process affected the resulting morphology of the project, including the external volumes and the façades. The dialogue established between the housing project and its context, and the meaning of good city form (Lynch, 1984) was another concern. For example, whether the morphology and facades of a building should imitate or contrast with the genius loci of place (Norberg-Schulz, 1991) was a crucial question. In this regard, students used between-domain displays to analyse structural relationships established between external form, and interior space of an object (Ching, 2007). This enabled students to continue developing their abstraction and analytical skills, and to enhance the visual quality of their projects.

2.1.7 Speculations on function and organization

The role of functionalism in a building can be traced back to the Vitruvian triad, in which 'utilitas' (convenience or utility) stands alongside 'venustas' (beauty or aesthetics) and 'firmitas' (firmness or structure), known as one of three typical goals of architecture. The function or purpose of a building, dwelling units in this case, has always been a key issue affecting the external appearance and the organization of internal spaces (e.g., Cherulnik, 1991; Nasar, Stamps & Kazunori, 2005). An important aim of the learning process was to help students deal with a complex program consisting of non-repetitive units. Two complementary mechanisms were employed to this end. One that served as control, and determined the number of units, the maximum square meters allowed for the functions and for ground level occupation, and the maximum volume of the building. In contrast, the other mechanism was non-restrictive, and aimed at giving freedom to organize different dwelling units according to individual programmatic goals and needs. The aim was to discourage the design of repetitive units, and to promote the exploration of atypical dwelling units, for the sake of reformulating the notion of contemporary dwelling.

3 Method

3.1 Participants and set up

Twenty-six undergraduate students from architecture in their second year of studies were enrolled in the design studio. The students work individually, and were unaware of the goals of the study.

3.2 Task and procedure

The task called for the design of a mixed-use project consisting of 8 to 10 non-repetitive dwelling units, and a small public building located in a controversial urban area of Jerusalem city. Students were requested to visit, analyse, and select one of three sites located in different contexts of the city that included: a peripheral neighbourhood, an historical quarter, and a central business area.

It was specified that the design should account for several environmental and contextual aspects, such as the 'genius loci' and historical development of place, typology of existing buildings, morphological language, public spaces, orientation, topography, views, and bio-climatic conditions, materials and technology, cultural and spatial behaviour. Other aspects concerned with the building and its context included: interior vs. exterior; open vs. closed spaces; private vs. public spaces; function, structure, and shape; horizontal and vertical circulation schemes. It was expected that students would be able to define a new design language for the housing project alternative to the existing one. Table 1 shows the timeline assigned to students for the development of the project, and the phases of the design process, including intermediate reviews, and the final presentation.

Table 1 Timeline, design activities, and lectures presented during the development of the mixed-used project.

Meetings	Hours	Design activities
1 - 3	22	Introduction of the course + Visit to Jerusalem: analysis of three intervention sites + iconic dwelling buildings + Site selection + Mental map
4 -7	20	Development of project in 1:250 – conceptual and concrete models + site model
8-9	10	First intermediate presentation: urban design scale– 1:250
10-11	10	From urban to architectural scales - 1:250 to 1:100. Design brief analysis – dwelling types and users– the architectural envelope
12-16	20	Development of project in 1:100 – the internal functioning and organization of the dwellings and their relations with the exterior
17-18	10	Second intermediate presentation: architectural design– 1:100 and its influence on 1:250
19-20	10	From architectural to interior design scales - 1:100 to 1:50
21-23	15	Development of selected parts of the project in 1:50 – spatiality and interior design: furniture, materiality, technology
24	5	Third intermediate presentation: interior design– 1:50 and its influence on 1:100 and 1:250
25-26	10	Integration and development of the project in the three scales
27-28	12	Final presentation (two weeks after meeting 26)

4 Project outcome

In order to illustrate the outcomes produced in the design studio, we present and analyse the work of Avihad as a case study. Avihad worked in Kiryat Yovel, a densely populated neighbourhood in southwest Jerusalem area. Historically, the neighbourhood served as a shelter for those who had nowhere to go. In the 50s', a number of housing projects were rapidly built by the government in order to provide accommodation to the torrent of immigrants and refugees. These were characterized by small and repetitive dwelling units - about 40 to 60 square meters, and very basic facilities. With the years and the economic progress, many families left the place and moved to other better areas in the city. However, those who remained failed to develop roots, and till today they see the neighbourhood a temporary place. Partly for these reasons, Kiryat Yovel suffers from a lack of maintenance and attractiveness for potential new residents.

Thus, a major goal of the project was to reverse the situation by designing new residential units and public facilities that should be attractive for more well-off groups of families. The brief called for the design of a variety of typologies of varied sizes that should be suitable for a range of users. Eventually, when families would grow, they would be able to move to other units in the same building.

The analysis of the project is organized into the following stages of development: i) problem definition and concept generation; ii) approach to urban scale: the dwelling project and the neighbourhood; iii) approach to architectural scale: the housing project and the dwelling units, and iv) approach to interior design scale: the dwelling unit -spaces and functions.

In the problem definition and concept generation phase, Avihad analysed the physical and sociological context from objective data. Thereafter, he produced a mental map of the area, illustrating his personal and subjective interpretation of the site, that included a diagnosis of major conflicts and design intentions. The understanding and ideas that emerged from the mental map, were explored further by the use of abstract mock-ups. At this stage, the student was expected to elaborate and discuss his initial design ideas in 3D. An outcome of this was a mock-up representing an inter-play of vertical and horizontal elements that served as connectors between public spaces along the floors of the building (See Figures 1a and 1b). The proposed idea suggested alternative spaces to the existing housing project, and public meeting areas.

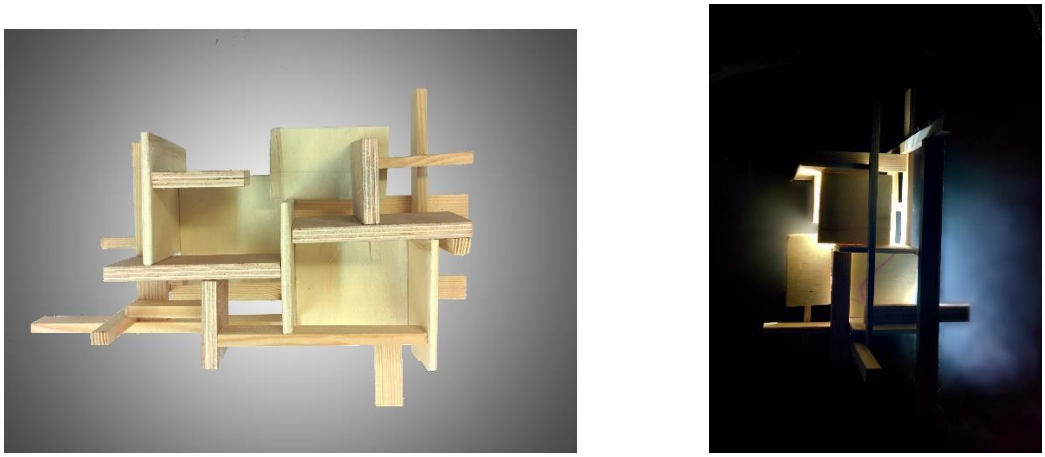
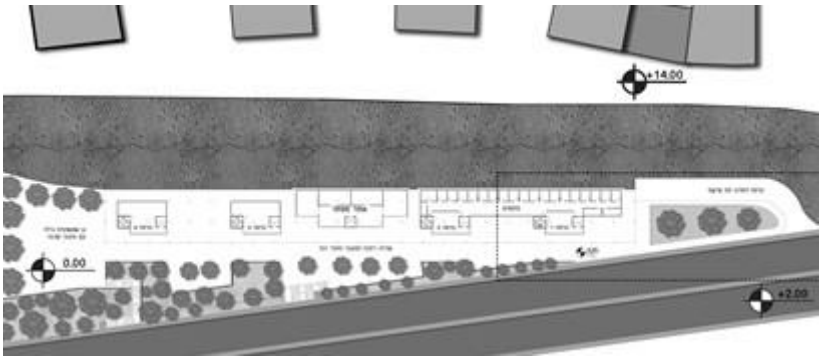


Figure 1: Conceptual model – composition of horizontal and vertical elements: plan and view. Source: Avihad Fried

In the next stage, the student continues redefining the problem and exploring his design ideas at an urban scale. To this end, he constructed a series of 1:250 mock-ups of the site to test alternative solutions. The urban scale was appropriate to elaborate further on his personal beliefs and goals, before dealing with the detailed brief of the project. Avihad's central design idea was to keep alive the collective memory of the place by integrating the new dwellings with the existing slab. He also proposed adding public functions to strengthen the interaction between the neighbours. To this aim, he designed a park, a small commercial centre, and a play area for kids (See Figure 2a). The use of historical precedents helped him to design a colonnade street, that served as a transition zone between the exterior and the interior of the building, and provided shadow to the entrances of the different units and the public zones (See Figures 2b).



(a)

(b)

Figure 2: The housing project and the physical environment a) ground floor plan in 1:250; b) colonnade street. Source: Avihad Fried.

Precedents and images about bridges served as inspiration sources for another design goal: due to the dramatic topography of the site, he decided to use the building as a connector between the lower and the unconnected higher levels of the neighbourhood. In this way, the metaphor 'a housing building as a bridge' led to the free transit of residents and visitors through the housing project (Figure 3).

Regarding the collective memory of the place, another design goal was to preserve the rhythm of the façade and the vertical circulation piers of the existing slab. This leads to another metaphor referring to the circulation piers as huge public lanterns. The figurative concept was implemented by illuminating the different floors by means of monumental skylights situated above the vertical shared public spaces. Moreover, in order to articulate the monolithic volume of the slab, and in analogy to a ship image, the building was divided into three major parts: the lower one corresponding to the larger dwellings, the higher one combining dwellings with offices in the last floors, and the central one was conceived for the commercial area, as illustrated in the working model in 1:250 (Figure 4).

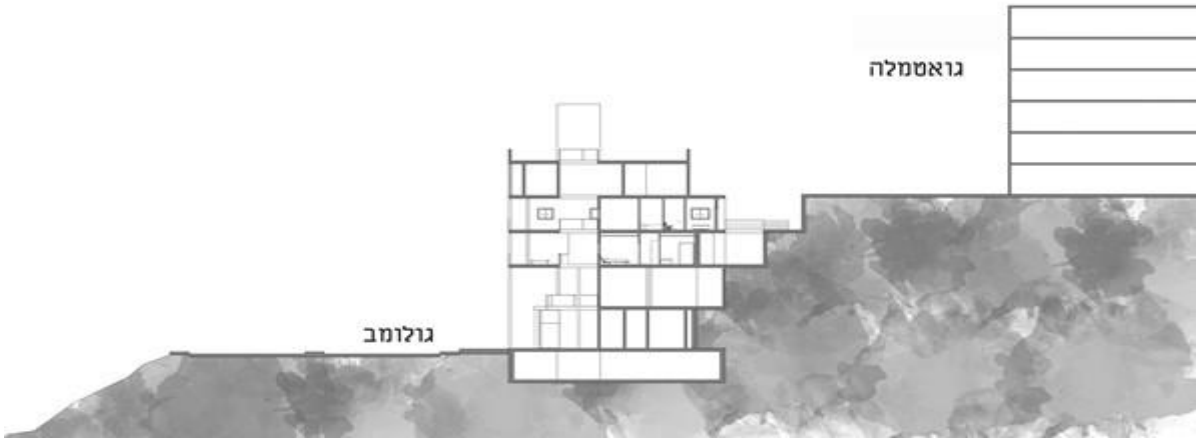


Figure 3: The housing project and the topography of the site. Section in 1:250. Source: Avihad Fried.

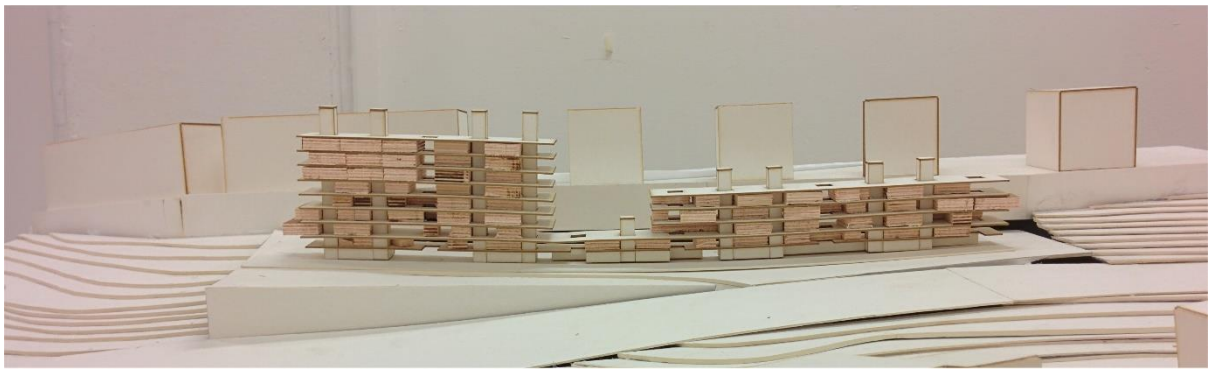


Figure 4: The housing project and its near environment. Working mock-up in 1:250. Source: Avihad Fried.

The next stage was a transition from the urban to the architectural scale. It focused on the relationship between the building and the dwelling units, and therefore the student worked at 1:100 scale. After learning the design brief, he analysed spatial and functional needs of the dwelling units. This was supported by external images that included housing typologies, which served as consultation sources to the design problem. In this stage, a major challenge was to deal with the design and organization of the units without disregarding the goals and ideas developed at the urban scale. The example of Le Corbusier´s semi-detached houses served as an inspiration for the design: whereas externally the image of the existing slab was preserved, internally the new dwelling units were designed as open-ended systems partially detached from the façade. Consequently, a double skin façade containing passages and public spaces was created along the building (See Figure 6c). The design strategy enabled the units to grow internally according to their present and future needs,

and converted the façade into a 3D 'latticework' filter that generated an inter-play of light and shadow (Figure 5).

Figure 5: Dwelling floor plan in 1:100. Source: Avihad Fried.

(a)

(b)

(c)

Figure 6: Façade of the building: a) front view; b) modularity, materiality, and depth of the façade; c) double skin façade containing circulation and semi-open public shared in 1:100. Source: Avihad Fried.

Variations in materiality was used as a concept to stress the rhythm of the façade. The combination of materials was used to differentiate the legibility of the dwelling units – mainly characterized by

wood and stone, from the public zones – i.e., entrances, commercial areas, and offices - characterized by glass curtain wall and concrete (See Figures 6a and 6b). New questions about the external image were raised at this stage of the process, which led to the redesign of the building at the urban and architectural scales (Figure 7).

Figures 8 and 9 depict the situation of the site, and how it was modified after the project intervention. In the photomontage it can be observed how a new layer of modernity was added, while the identity and collective memory of the existing building was preserved at some level of abstraction (Figure 9).

The stage that followed was a transition from the architectural scale to the interior design of selected dwelling units, where the student worked at 1:50. He explored the technology and materiality of the different spaces that also included furniture, texture, and colour. Figure 10 shows an example of the design of two dwellings: one is a duplex unit, and the other is a dwelling for a family with two kids, one of whom is handicapped. A major goal at this stage was to confer a unique identity to each unit, without disrupting the composition of the morphology and the façades.

Figure 7: The housing project. Mock-up in 1:250. Source: Avihad Fried.

Figure 8: Existing housing slab in Kiryat Yovel. Source: Avihad Fried

Figure 9: Photomontage showing the new housing project in Kiryat Yovel. Source: Avihad Fried.

(a)

(b) *(c)*

Figure 10: Interior design: a) floor plan of two dwellings; b) Internal view of the library in the right-side house; c) Internal view of the double space in the left side house. Source: Avihad Fried.

In sum, the proposed design approach aided to reflect about the project, bearing in mind the integration of solutions at different physical scales. The development of the design outcomes was achieved in an iterative and co-evolving way along the process, till a final solution was reached.

5 Reflections of what went well and what went wrong

The Whole-to-Part-to-Whole: Integrative and Co-Evolutionary Design approach was proposed as a catalysator of design student capabilities. The approach was intended to help students consolidate and enhance the knowledge acquired in the architectural courses, and in previous design studios. The method aimed to reduce the current educational gap between analytical abilities - generally taught in the courses, and design thinking skills acquired in the 2nd year design studio, mainly dealing with analysis, synthesis, and evaluation. While simulating the design activity as if carried out in real professional practice, the approach attempted to make another step forward to integrate theoretical with practical knowledge. Specifically, the approach facilitated the means to reflect about individual design intentions, and define design goals. Consequently, students managed to identify and structure the critical aspects of the dwelling design problem. The use of inspiration sources such as images and drawings, were essential to establish metaphors and analogies with the design problem. In this regard, the identification and transference of analogical and metaphorical principles was highly efficient for the production of creative design ideas and solutions. In addition, the employment of precedents and building typologies as sources of knowledge also contributed to deploy conceptual thinking along the design process. Existing solutions made by master and well known architects were used by students as examples of imitation and assessment of their own projects. Making abstractions of these and other sources like analogies and metaphors, and applying the retrieved design principles to the architectural design problems showed to be critical to bridge the gap between analysis, synthesis, and evaluation capabilities.

Moreover, the method supported the development of the design task at incremental levels of detail, through the different scales of the project. Working in a zoom-in and zoom-out modality, from the whole to the parts and vice-versa, aided to deal with the complexities of the design task and understand the intricate system of relationships established between and within the different scales of the project. Consequently, a major input of the approach was to systematically deal with a multifaceted design process in a relatively short period of time, enhance design expertise, forge individual judgment independently of the guidance provided by the tutors, and finally arrive at creative design outcomes.

Besides these important achievements, there is still room for improvement of the design approach in a number of aspects. One concern is how to effectively collect and apply to the project the information obtained from site analysis. Although this is an essential stage of the design process, a major difficult resides in identifying relevant data, and in operationalizing it to suit personal design intentions in practice. We realized that not all the information collected during the site analysis showed to be significant or useful for the design project. This can be attributed to the difficulty of filtering information, and shifting from divergent to convergent thinking. We suggest that in future projects, site analysis should be more informed by individual motivations and subjective interpretations of the data, than by an objective and rational analysis of data. This would help to guide divergent and convergent thinking in a more personalized and efficient way.

Another issue is concerned with time management and coordination of the different design activities carried out during the project. A conflict between the extended design agenda and the time limitations forced the teachers to move ahead fast in order to comply with the planned schedule, sometimes before completely achieving the goals set for a particular stage. A fine tuning of the agenda in coordination with the timetable will allow refining further the design approach, and establishing a clearer hierarchy between primary and secondary goals.

Whereas the design approach demanded from students integrating their solutions at the urban, architectural, and interior design scales, another major difficulty was how to develop and adjust the

project at each of these scales without altering original design goals and intentions. For example, a typical problem was how to coordinate design actions for organizing the non-repetitive and atypical dwelling units, while caring at the same time for the design of common vertical circulations, shared structure and ducts, and the legibility and aesthetic harmony of the building. Although useful and stimulating, adapting and transforming information from precedents and other visual sources to the design project showed to be another difficulty demanding a level of expertise that not all students always had. It is possible that in order to develop such design skills in the future, the approach should include a series of short exercises to learn how to map and adapt information from visual sources represented at different level of detail, to the problem at hand.

The method, which was applied to the design of a mixed-used housing project, will be implemented next semester in the design of a public building. Together with this, in a following study we plan to carry out a survey with the 2nd year architectural design students in order to gain further insight into their perceptions about the proposed design approach. In particular, we would like to learn more about the potential strengths, weaknesses, opportunities, and threads (SWOT) that the method could involve for enhancing education in the design studio.

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About the Authors:

Hernan CASAKIN had appointments as research fellow in Hamburg University, Tel Aviv University, and TUDelft, Delft University of Technology. He is a board member of several international journals. His research interests are in design thinking, expertise, design education, and creativity.

Yoram GINSBURG is an independent architect specialized in regional and urban planning, and in public and private building. He is a senior lecturer in urban planning and design studio courses. His research interests are in theory of place and locality in architectural and urban planning.

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Living Labs in Co-Creation and Sustainability as Strategies for Design Education

MOUCHREK Najla [a*] and KRUCKEN Lia[b]

[a] Virginia Tech
[b] Creative Change
* Corresponding author e-mail: najlamk@vt.edu
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Design schools have an important role in promoting innovation and sustainability in society. Didactic and research activities can be oriented to approach societal problems and develop solutions for specific contexts. 'Living laboratories' (living labs) offer significant opportunities to investigate everyday practice and collaboratively explore possibilities, by opening a space of encounter between researchers and users. This paper presents the initiative *Laboratory of Design, Co-creation, and Sustainability*, aimed at investigating design strategies to promote the culture of sustainability among youth. It included young design students from both university and technical secondary education. Methods involved participatory design-based analysis, context-mapping, and strategy generation. The results emphasize: a. the need to develop competencies in sustainability within design education, promoting critical thinking and ability to implement innovative solutions; b. the potential of co-creation to generate 'contexts for change'; c. the need for more open and flexible educational approaches, allowing common sharing, engagement, self-reflection, and flexible assessment.

design education, co-creation, living labs, design for sustainability

1 Introduction

Promoting the culture of sustainability among young people is a fundamental strategy to support the creation of contexts for change towards sustainable ways of living. The view on the central role of culture for development reinforces the need of allowing for full participation and empowerment of citizens and communities in the solutions for the future. It is especially concerning the new generations that the promotion of a transition towards healthier, sustainable and integrated lifestyles is fundamental. In this context, design principles and practices constitute a potential field for creative innovation and support for promising initiatives on sustainability, offering skills, abilities, methodologies and a unique viewpoint.

The aim of the present study is to investigate design strategies for enabling change and fostering the development of a culture of sustainability among design students. The focus is to develop and to apply participatory approaches, stimulating reflection, critical thinking and their ability to propose and implement innovative strategies for sustainability and social innovation.

This process aims to contribute to the training of design professionals able to act creatively and effectively, searching solutions to the complex contemporary issues through research, analysis and experimentation conducted and oriented by design approaches. First, we expose the theoretical framework and methodological procedures adopted. Following, we describe the initiative, some results and final considerations.

2 Theoretical Framework

2.1 Culture of Sustainability

Concerns about economic growth to the detriment of the environment have been prominent on the international agenda since the United Nations Conference on the Human Environment in 1972. In 1987, the United Nations produced the document Our Common Future, proposing the classic definition: "Sustainable development is one that meets the needs of the present without compromising the ability of future generations to meet their own needs" (Brundtland, 1987, p. 48). The dimensions of sustainability are often discussed based on the widespread Triple Bottom Line model (Elkington, 1994), which identifies the three pillars of sustainable development: ecological quality, economic prosperity and social justice.

The term 'social sustainability' often refers to a particular branch of sustainable development concerned with its social dimensions and implications (Vallance et al, 2011). McKenzie (2004, p.12) proposes a working definition: "social sustainability is a life-enhancing condition within communities and a process within communities that can achieve that condition". The author lists a series of indicators, which go from equity of access to key services to transmission of awareness of social sustainability between generations (McKenzie, 2004). In a broad sense, social sustainability concerns the ability of human beings of every generation to not merely survive, but to thrive (Magis & Shinn, 2009).

The transition towards sustainability constitutes a process of social learning (Manzini, 2008), reflecting the centrality of a cultural shift in how individuals and society address issues in these dimensions (Duxbury & Gillette, 2001). Hence the importance of considering the cultural dimension of sustainable development (Soini & Birkeland, 2014), fundamental due to the necessary major societal changes in perception and values in the transition to sustainability. Universities are an important player in the constitution of this field of knowledge and practice in the local contexts. Higher education should involve students and scholars in advancing research and knowledge in order to build more integrated and efficient frameworks for social and cultural sustainability, but also to model sustainable awareness and practice.

2.2 Role of Design facing societal challenges

Design is a dynamic process: the act of thinking, planning and devising courses of action with a particular purpose. It is possible to say that a designer is a "thinker whose job it is to move from thought to action" (Friedman, 2000, p. 10). Design can be approached in its various dimensions, among which are highlighted: (a) as a conscious effort of the individual to establish a significant order for things and objects that surround him (McCarthy & Grenville, 1997); (b) as a process and a set of projects and creative activities; (c) as an active agent for problem solving, through the planning and implementation of actions to change existing situations into preferred ones (Simon, 1982); (d) as an agent to create and recreate the sense of objects and experiences (Franzato, 2010); (e) as an agent of mediation between diverse actors, transversal by nature, which acts by facilitating and supporting the development of innovations (Krucken, 2008).

In the context of the transition towards a sustainable culture and lifestyle, the field of design offers a range of potentialities and interfaces for innovative action. The authors point out that design can be a powerful catalyst in this subject, proving to be an effective methodology of intervention (Manzini, 2008). Designers can contribute in many directions: proposing plural solutions and designing new scenarios (Krucken, 2008); establishing conditions for the creative context (Landry, 2000); developing tools, equipment and infrastructure to support promising practices (Malaguti, 2009); using their knowledge and specific tools to facilitate convergence towards the shared ideas and potential solutions (Manzini, 2008). In some cases, its role expands, with the application of concepts and principles of design permeating all phases of the project or intervention.

In the words of Manzini (2008, p.16), “creativity and design skills are elements effectively needed to move a social and technological innovation process of such magnitude as required by the transition towards sustainability.” Characteristics of design can contribute to solve the issues of our time: interpretative wealth and visionary ability (Krucken, 2008), as well as skills of thinking in a systemic manner and the inventiveness of language (Cardoso, 2012).

The focus of design is evolving toward a systemic perspective, increasing its field of action. “The transition to a sustainable society will require new ways of designing that are informed by a vision, a deep understand of the dynamics of change and a new mindset and posture” (Irwin, 2015). At this point, it is important that designers develop skills to be facilitators in process of innovation, promoting collaboration and active participation: to integrate, to activate dialogues, to create connections (Krucken, 2008). Multidisciplinary action networks take form, in which designers can contribute offering their specific competence and professional knowledge, interacting with other non-professional designers in a partnership model (Krucken, 2008).

It is up to designers to participate actively and positively in the development of sustainable solutions in various fields (Manzini, 2008). In the words of Margolin (2007, p.14): “faced with the growing complexity, designers have to think more profoundly about the future and their role in making it into the present.” More specifically, design schools can play an important role in the emerging scenario, generating original ideas and interacting with local communities (Manzini, 2011).

In this study, we explore the possibilities of differentiated intervention to generate solutions to contemporary issues, applying Design principles and practices. In this context, co-design practices and collective creation of strategies and tools emerge as promising modes of action.

2.3 Participatory Design approaches and Living Labs

Participatory processes are described in academic literature with various terminologies and from the perspective of several fields of knowledge. Participative research, action orientation and transdisciplinary approaches became prominent within academia in the 1970s and particularly in Scandinavia, England, The Netherlands and Germany. Some of its origins are related to conflict resolution (Lewin, 1946), democratisation and (re-)development of society (Reason, 2002), as well as collaborative work supported by labour unions (Nielsen & Nielsen, 2006). Within the social sciences, the search for perspectives on participatory approaches have been coined "action research" (Lewin, 1946). Nielsen & Nielsen (2006) argue that besides the original idea proposed by Lewin (1946) on how to approach practice and theory of action research, the field is also oriented to the development of "democratic forms of knowledge" as well as "critic of authoritarian structures and culture".

Participatory approaches in design are guided by the general idea of involving all stakeholders in the design process to help ensure the result meets their needs. Some authors defend the idea that design could lead the way to a cross-disciplinary framework on participation (Harder, Burford & Hoover, 2013). The current context offers opportunities for changes in participatory practices, including a surprising opening for experimentation and a shifting notion of design. New forms of participation arise, including open and user-driven innovation, living labs, fabrication labs, public participation and social innovation, among others (Bannon & Ehn, 2013).

Living labs emerged as a response to close innovation environments and become a major platform for innovation in Europe (Bannon & Ehn, 2013). The initiative presented in this paper is positioned among design school labs, a specific kind of living labs involving teachers, researchers and students. In the search for a definition for Living Lab, we would like to highlight the contribution of Bergvall-Kåreborn et al (2009). By means of an extensive investigation on definitions, approaches and experiences, the authors proposed this comprehensive statement:

> *A Living Lab is a user-centric innovation milieu built on every-day practice and research, with an approach that facilitates user influence in open and distributed innovation processes engaging all relevant partners in real-life contexts, aiming to create sustainable values. (Bergvall-Kåreborn et al., 2009, s.n.)*

In the field of design research, often Living labs are described as a design research method in the field. Dell'Era and Landoni (2014) define Living Labs as "a design research methodology aimed at co-creating innovation through the involvement of aware users in a real-life setting" (Dell'Era & Landoni, 2014, p. 139). Complementarily the authors situated it in the map of design research methodologies, proposed by Sanders (2006), as can be seen in Figure 1.

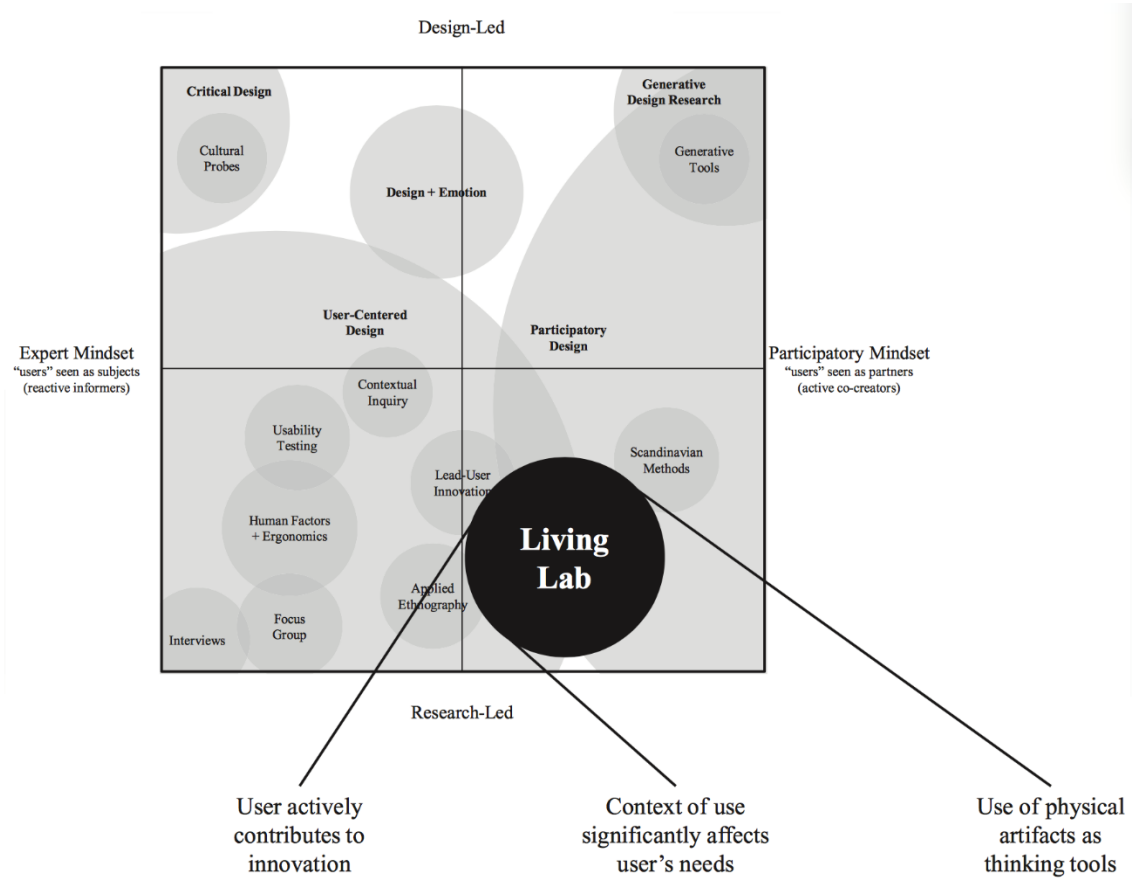

Fig.1. Living Lab in the map of design research methodologies: Source: Dell'Era & Landoni (2014, p. 149), based on Sanders (2006).

According to this analysis, a Living Lab is part of the 'research-led' group of tools that promotes a participatory context. The authors highlight some characteristics of Living Labs as: real-life experimentation environment; involvement of aware users in the co-creation; use of diverse interaction strategies with users and stakeholders; use of platform technologies to exploiting the potentialities provided by existing technologies or create value, by exploring the opportunities provided by new technologies (Dell'Era & Landoni, 2014).

We consider Living Labs either as a user-centric innovation milieu built on every-day practice, and as a design research method, which has potential to promote social innovation and sustainable values in society.

2.4 Student development and engagement in sustainability

Applying design Living Lab in undergraduate courses has also the potential to improve students' developmental outcomes and their engagement with sustainability. During the college years, students are navigating the complex transition from adolescence to adulthood. Emerging adulthood might be considered a key turning point in the life span (Schwartz, 2016), since the young person is undertaking a process of identity exploration; reflection and experimentation with values and principles; and search for meaning and purpose in professional and life choices. Empowerment is considered a fundamental factor for young people to guide themselves and constitute a future development plan, which has an impact not only at the personal level, but concerns the whole society (Mouchrek, 2017). *Capacity Development for the Transition to Adulthood* is one of the three axes of the Operational Strategy on Youth 2014-2021, proposed by the United Nations Educational, Scientific and Cultural Organization (Unesco, 2014). Learning experiences that include opportunities for reflection, experimentation, elaboration of possible futures and ethical choices are particularly suited to improve individual development trajectories, enrich and complement students' academic and professional formation.

In order to face the youth's contemporary and future challenges, it is essential to invest in creating new scenarios and lifestyles, strengthening critical thinking, autonomy, ability to make choices, stimulating new perspectives and practical ways (Mouchrek, 2015). Design-based participatory process are suited to support youth development and empowerment at the extent that they: (a) provide spaces for experimentation, inviting youth to reflect and enact choices in a non-serious, playful environment; (b) offer opportunities for peer interaction, equal participation with adults, exploration of diverse identities, and elaboration of possible futures; (c) improve youth's ability to understand and contribute to (trans)forming their life contexts, exercising skills for protagonism and positive intervention (Mouchrek, 2017).

Universities have also an important role in the process of transition towards sustainability, offering experiences for students to develop skills of integration, synthesis, systems-thinking, complex problem solving, and awareness of social responsibilities associated with professional practice, self-efficacy, and capacity for advocacy and interdisciplinary collaboration (Sibbel, 2009; Stephens et al. 2008). The changes required in the process of social learning in the transition to sustainability will be performed via active participation of competent citizens (Barth et al., 2007). Awareness and competences in sustainability are increasingly necessary in the constitution of citizenship and social engagement.

Key competences for sustainability to develop are as follows: foresighted thinking; interdisciplinary work; cosmopolitan perception, transcultural understanding; participatory skills; planning and implementation; empathy, compassion and solidarity; self-motivation and motivating others; distanced reflection on individual and cultural models (Barth et al. 2007). Design Labs for Sustainability are aligned with those objectives, fostering students to learn, constitute competences and engage in sustainability. This is particularly important in design education, considering the role of designers in facilitate change towards sustainable lifestyles and practices.

2.5 Living Labs for Design and Sustainability

Considering Living Labs for Design and Sustainability in educational contexts, some relevant initiatives can be pointed out:

- MIT Sustainable Living Lab[210] (USA). It is committed to transforming the campus into a living laboratory for sustainability innovation - a place where students, faculty, and staff work together to problem-solve through applied research and analysis.
- Cambridge Living Laboratory for Sustainability [211] (UK). The 'Living Lab' provides opportunities for Cambridge students to improve environmental sustainability on the University estate through projects, internships and research. It draws on the expertise and talent of students and staff at the University of Cambridge, encourages application of knowledge to the real-world context, enhances skills of those involved, and increases connections between people.
- Sustainable Summer School Designwalks[212] (Wuppertal Institute, Germany). The concept of Living Labs was the base for this project. In workshops, courses or seminars taking place at an innovation campus, students and professionals from general design and product design courses will create innovative and resource efficient Product Service Systems in an inter and trans-disciplinary fashion.
- POLIMI DESIS Lab (Italy)[213] - The POLIMI-DESIS Lab, based in the Department of Design of Politecnico di Milano, is composed of a group of researchers adopting a strategic and systemic approach to design, with a specific focus on design for services and design activism. It has a background in service and product-service-system design for sustainability and investigates the way design can support and trigger social innovation, combining creativity and visioning with the capability of engaging in co-design processes.

These initiatives illustrate the potential of universities and schools become living labs for sustainability worldwide and opening space for experimentation and communication for young people and community.

3 Procedures and Methods: Applied Approach of Co-creation in Design

The initiative presented is part of the project *Design and Transformation*, developed by the authors at the State University of Minas Gerais (Brazil) and the Human Centered Design program at Virginia Tech (United States). The project aimed at investigating the potential and applicability of design as an agent of change in the process of transition to sustainability, regarding students in the transition to adulthood.

Following a general trend of change of perspective in the field, we can currently find various types, paths and design research activities (Buchanan, 2001). In addition to the traditional methods, design research has been using increasingly new methods developed specifically from the thought and practice of design, many of them still in progress (Pizzocaro, 2011). In this context, we highlight the potential of design research to: (a) start research on issues not yet raised (Friedman, 2000); (b) enrich the skills of designer/student/researcher in design to produce a larger understanding and a conscious knowledge facing the issues that present themselves today (Pizzocaro, 2011).

The research methodology is aligned with Participatory Action Research, as it aims to include and empower the object of study (students) and configure participants as agents with voice, resources, and authorship (Brandt et al., 2013; Wright & McCarthy, 2015). The research will also adopt the concept of Design Space: a space for emerging potentials, which is built and co-designed by multiple actors in their interactions, integrating diverse tools, technologies, materials, processes and social arrangements.

[210] https://sustainability.mit.edu/living-lab
[211] http://www.environment.admin.cam.ac.uk/living-lab
[212] http://wupperinst.org/en/p/wi/p/s/pd/290/
[213] http://www.desisnetwork.org/courses/polimi-italy/

The nature of the present research is qualitative and multi-method, using a composite of procedures and tools. The methodology involved exploratory survey; analysis and understanding of context using design principles and practices; and proposal and implementation of innovative interaction strategies, based on processes of co-creation in design.

At the core of the participatory design approach, there is a range of activities of co-creation in design. The term co-creation came to describe a process that "involves the creativity of designers and people not trained in design, working together in the development process" (Sanders & Stappers, 2008, p. 1), allowing the participation of various actors in key decisions. Co-creation/codesign is a way of progressing through a problem or design scenario and is used as a means of, for example, attending to behavioural change (Kingsley, 2009). Bringing co-creation into design practice changes “how we design, what we design, and who designs. It will also affect the tools and methods that the new teams of co-designers will use.” (Sanders & Stappers, 2008, p. 12). Typical features of participatory design are the collective construction of knowledge, mutual learning, prototyping, iteration.

In conducting processes of co-creation, roles change and become more complex: the user/audience becomes co-designer of the process, the designers/researchers are also facilitators and designers take on new tasks, demanding new skills and competencies (Sanders & Stappers, 2008). Therefore, it is important to develop skills and provide opportunities for experimentation in co-creation approaches in design education. The initiative presented in the following item is oriented to these purposes.

3.1 Laboratory of Design, Co-creation, and Sustainability

Design schools have an important role in promoting innovation in society. Teaching and research activities can be oriented to approach societal problems and develop solutions that are suitable for specific contexts. In this sense, ‘living laboratories’ (living labs) offer significant opportunities to investigate everyday practice and collaborative explore possibilities of making, by opening a space of encounter between researchers and users.

The Laboratory of Design, Co-creation and Sustainability (Figure 2) was developed as an undergraduate course for Design students, elaborated and conducted by the authors at the State University of Minas Gerais (Brazil) in 2013-2014 (Mouchrek, 2014). It was conceived as a Design School Lab, defined as “a team of researchers, teachers and students who orient their didactic and research activities towards promoting sustainable changes” (Manzini, 2011), aiming to constitute a formative design research environment (Binder et al., 2011).

Figure 2 – Group discussion and image selection - Laboratory of Design, Co-creation and Sustainability.

The primary objective of the Laboratory was promoting experimentation of strategies of co-creation and sustainability tools, teaching students to identify and apply different possibilities to develop a design project. Following an experimental approach, the course aimed to extend the capability of active intervention of future designers in contexts of transition towards sustainability, encouraging

them to interact collaboratively to develop, facilitate and implement innovative solutions in this field.

The students were asked to develop an open project, in three phases: 1. Research; 2. Analysis; 3. Project development (Synthesis and Concretization). The steps in the design process are shown in Figure 3. The design focus was defined as promoting the culture of sustainability targeting young audience from 14 to 24 years old. The targeted audience could be either the students from a technical secondary school in design and visual arts or the students from their own university (undergraduate school in design). Since the design students were in the same age group (18-24 years old), in several cases they were at the same time users and designers of the proposed solutions. The evaluation criteria adopted in this course were qualitative and process-based, considering the result of the project, but also the whole development process and the possible innovation impact of the solutions. In this way, students were encouraged to register and document all phases of the process with pictures, images, graphics and comments. While on phase 1 (Research), the instructors used a more directive approach, including lectures and guided participatory activities, during phases 2 (Analysis) and 3 (Project), the instructors focused on guidance and monitoring.

Figure 3 - Phases of the design process in the Laboratory of Design, Co-creation and Sustainability: Research, Analysis, Synthesis, and Concretization.

The student groups had relative autonomy to decide what and how to do at every step of the way, bringing the issues and question to the teachers who offered references, proposed some discussion points, pointed out possible options and analysing consequences of their choices. Students have learned from real situations, seeking means of understanding and solving as issues arose. The main idea was providing an open space for students to actively participate since the beginning of the project, allowing them to define: what did they want to design (products, services, interfaces or communication strategies), why did they want to do that and which innovation impact they meant to achieve. They also were invited to bring their own references and bibliography, which resulted in a rich collective of shared resources.

3.1.1 Phase 1 – Research: Initial Surveys and theoretical basis (conceptual phase)

The purposes of the initial phase were: (a) opening the debate and introducing the themes to be explored in the course; (b) broadening and deepening design concepts; and (c) building a collaborative approach that would guide the subsequent phases. It consisted of ideation sessions and construction of collective visual maps about:

- Design conceptions, potentialities and limits
- Characterization of the target audience (*What means to young nowadays? What is the spirit of our time? What questions emerge? How design can speak to them?*)

The collective maps drawn up at the beginning of the process led to the emergence of various issues and fuelled an active debate among the students, who have shown interest, willingness to express their views and collaboratively built a complex profile of issues related to young people´s reality. Figure 4 shows the students working together to build the conceptual and visual maps.

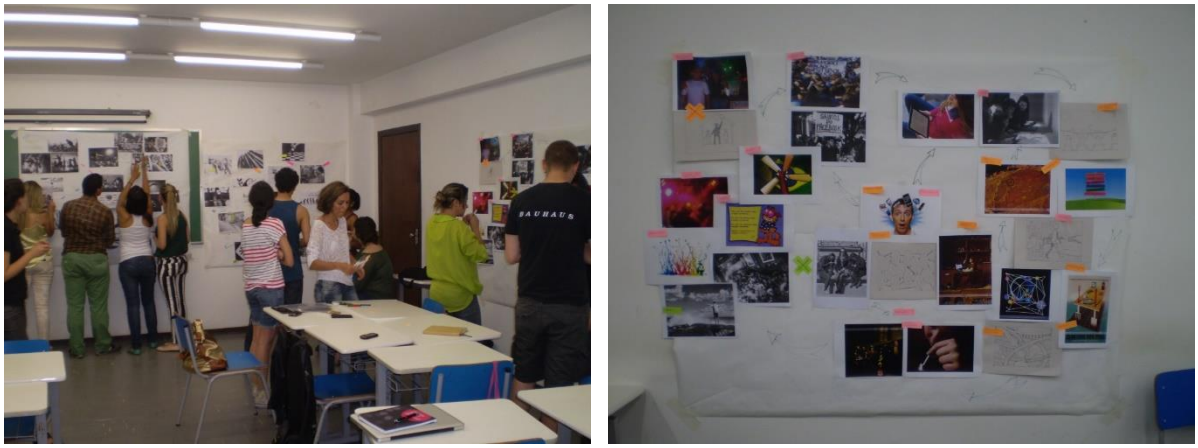

Figure 4 –Building collective visual maps - Laboratory of Design, Co-creation and Sustainability.

The first phase also included lectures and discussions about contemporary visions of design, sustainability approaches in design projects, approaches and tools of design research, case studies on systemic and strategic approaches in design and open innovation.

3.1.2 Phase 2 - Analysis

From the topics covered in the collaborative maps and analyses, students organized into groups and chose themes for elaborating their project. The themes for the projects sought to answer the questions "What are the perceived problems or opportunities?" and "How these questions are related to the dimensions of sustainability?", starting with intense ideation sessions. The sequence of actions in the research phase followed the outline presented in Figure 5.

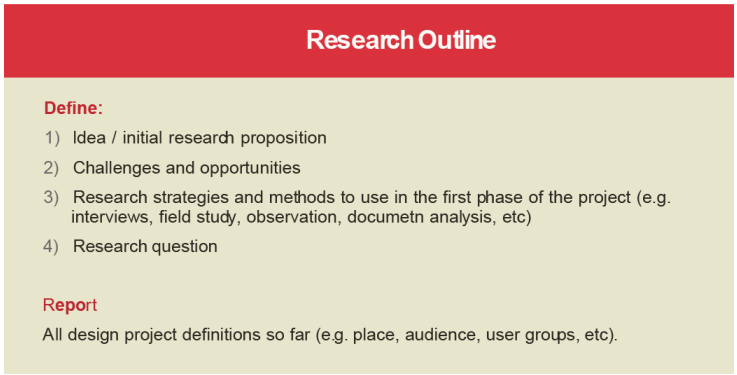

Figure 5 – Research Outline - Laboratory of Design, Co-creation and Sustainability. Source: Krucken & Boschi (2013).

With defined focus and context, the following four weeks were designated to research and analysis on the chosen topic, including to outline a script, to plan and to realize a field research with the participation of the target audience, and finally to present the results of the initial phase of project.

By presenting the synthesis of their in-progress project, students completed an important milestone in the Design Lab. The in-progress project presentation requires students to exercise skills such as: synthesis, visualization, project planning and management, organization, systemic view. It is also a great opportunity for students to receive feedback from the instructors and from peers – and eventually reframe, reorient or even pivot their project. The presentations are structured according to a template (Figure 6).

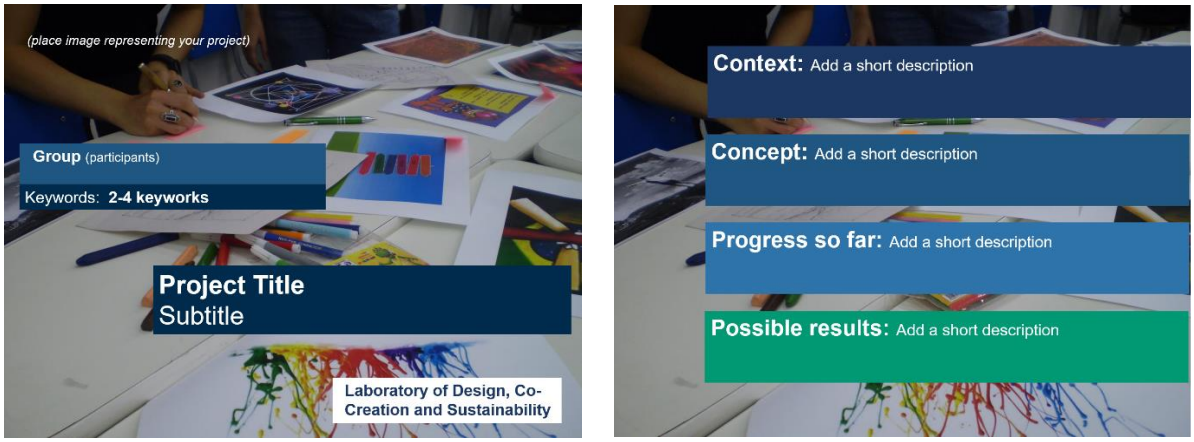

Figure 6 – Template for in-progress project presentation - Laboratory of Design, Co-creation and Sustainability. Source: Krucken & Mouchrek (2013)

3.1.3 Phase 3 – Project (synthesis and concretization)

After the in-progress presentation and the collective debate about the project and the progress of the work of each group, the students began the implementation phase. During the final four weeks to develop their projects, which should rely on some type of application, even a high-fidelity prototype and a preliminary test. As a final result, the groups made 15-minute presentations (Figure 7), in which they described the phases of the process, the product/pilot intervention developed and analysed the process as a whole. The presentations followed the script show in Figure 7.

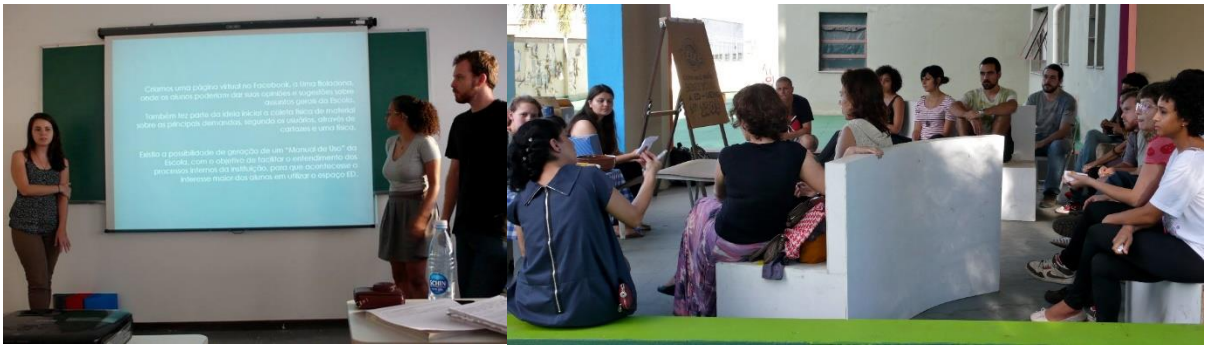

Figure 7 – Final presentations - Laboratory of Design, Co-creation and Sustainability.

The results of co-creation processes include: a) the development of microcredit funds that can support the solution of issues of collective interest of the students themselves, and b) the development of a communication platform for identification, discussion and collective solutions to

common issues among young people in particular contexts. In both kinds of solutions, the central role of communication strategies was observed. All projects aimed to generate common good, with real social impact for the concerned communities. A synthesis of projects developed by the students is presented in Figure 8.

Project 1 - C.A.F.E. Co-create, Appropriate, Fund, Experience public space

Theme: Public space | Incentivize collaborative community appropriation

Solution: Projects for the public space in the university campus, discussed with the community in an open event designed as a "Global Cafe". Students promoted crowdfunding and other alternative funding strategies to fund small projects in the local context.

Project 2 - URNA BOLADONA

Theme: Verticalization of the school causing distancing of people and difficulty of sharing information / low sense of community (physical barrier).

Solution: Horizontalize relationships through virtual and face-to-face collaboration. Creation of social networking page with on-going polls allowing students to express their opinions and suggestions on several issues in the school. Conducting surveys and analyzes (both virtual and in-person).

Project 3 - What do designers do? Building a sustainable professional future

Theme: Relationship of the young student of the technical courses of design with the professional future. Peer mentoring for career exploration and choices.

Solution: Generate reflection about professional future and explore possible design approaches in this context. Interviews and elaboration of shared video with the students.

Project 3 - Proposing a new occupation system in the school hall

Theme: Need for spaces for integration between the design majors in the school, in environments then underutilized (hall)

Solution: Research on knowledge of events and occupation of the hall. Proposition of exhibition of works of unified form, integrated in order to value the courses and to promote collective events of the university community.

Figure 8 – Synthesis of projects developed in the Laboratory of Design, Co-creation and Sustainability.

During the whole process, several competences were involved and stimulated. Design tools such as visual mapping, collaborative maps, ideation sessions, desktop research, visualization techniques,

questionnaires and surveys, virtual prototyping and immersion with user participation were applied. These tools and schemes for structuring, synthesis and presentation of project aimed to direct the concept definition and the development of the project, assuring consistency while maintaining the flexibility and room for innovation.

4 An open discussion

The Laboratory of Design, Co-creation and Sustainability promoted interesting results and proved to be a promising initiative toward the purposes of this research, insofar as it resulted in the production of concrete collective results, from the joint dynamics of diverse expertise and perspectives. The open approach led to the development of competencies as context analysis, proposal of *foci* for intervention, research and selection of information and forms of intervention, knowledge and selection of design tools, synthesis, visualization, familiarity with development and design stages and ability of organization and communication.

Some important aspects can be highlighted in relation to dynamics proposed by students, which include:

- active use of social networks and platforms as a tool for communication and interaction in an innovative way;
- the use of alternative references in search of content (e.g. videos, movies, other initiatives);
- the perception of the concept of sustainability related to the context in which young people live today and their interests;
- the intention to promote democratic processes for young people to express their aspirations and transform them into action with the support of design tools and methods.

Furthermore, in the context of the initiatives motivated and driven by design, we could notice that the participatory approaches, based on co-creation, offer excellent opportunities to promote the sustainability culture among young people (especially young design students), because they contribute to (Mouchrek, 2014):

- develop capacity of critical thinking and ability for analysing complex problems and find differentiated solutions;
- provide fields of experimentation in which the young person explores the possibility of creating solutions from their own resources and motivations of action;
- offer a range of tools and forms of intervention, that young people learn collaboratively to select and apply;
- create possibilities of developing concrete projects and geared to action;
- establish a dynamic system, where the impact of actions generates a mechanism of feedback and confirmation coming from their community of reference, which nourishes and stimulates new cycles of project and applied action.

Regarding the students' collective construction of knowledge during the Laboratory of Design, Co-creation and Sustainability, the visual maps and discussion in the initial phase led to particularly deep reflection and rich results. The diagram in figure 9 shows all the aspects raised by the group in response to the questions: "What is being young nowadays? What is the spirit of this time?". Students showed a profound understanding of the complex challenges and characteristics of contemporary youth cultures, in which they are embedded themselves. Additionally, when asked how the field of design can contribute to solve these issues, students came up with innovative strategies and potential leads for design projects, which inspired their exploration and project development throughout the Design Lab experience.

Figure 4 - Collective concept map - Laboratory of Design, Co-creation and Sustainability. Source: Mouchrek (2014).

The Lab was conceived and performed as an open experience, displaying the main features of co-design activities: aiming to fostering systems thinking; encouraging students to be active participants and suppliers of sustainable solutions (Fuad-Luke, 2010); allowing the emergence of new ways and possibilities of action; and promoting partnerships and collaborative construction of knowledge. Promoting self-reflection and the students' ability to design as a "reflexive dialogue" with reality (Schön, 1983) were also important aspects of this learning experience.

The experience also showed the potential of Living Labs for generating open and creative communication. Communication strategies in this field must, first and foremost, provide opportunities to hear what young people have to say. In a dynamic and open communication approach, it is possible to create contexts to transform perceptions, views, demands and desires of young people in practical factors of mobilization and expression. The communication created 'by the young' 'for the young' is a highly creative factor, given the impact that can generate in terms of stimulus, participation and representativeness.

The democratic and experiential forms of knowledge promoted by participatory practices are especially important for design research and education and have been investigating by many authors. The challenge of promoting the "learning by doing" is stressed by Penati (2012, p.57): "the didactic experiences aimed at the acquisition of design skills, or the transmission of capacities to operate heuristically, design exercises occupy a lot of space". This consideration reinforces the nature of design as an open discipline. Quoting Penati (ibid.) it "is perhaps destined to keep open the areas of research that regard its practices and, among these, the practice of teaching". Many designers and researchers have appointed the need of open practices of teaching and researching design, especially strongly in the last decade.

5 Final considerations

Several considerations raised in the theoretical framework have been confirmed in practice and new insights emerged. The results emphasize that the training of young professionals in design should include the development of competencies in sustainability, encouraging critical thinking and ability to implement innovative solutions.

About sustainability approaches, the findings suggest that: the issues related to sustainability that arouse interest and motivate actions are those linked to youth´s current reality; they respond positively when encounter contexts that facilitate the organization of ideas and resources and the conduction of project processes, allowing them to drive their aspirations and views towards the practical implementation. It is observed that a renewal of the discourse on sustainability has a very positive effect regarding the interest and impact of sustainable initiatives among young students.

The results also highlight the potential of co-creation in creating "contexts for change" and fostering sustainability culture, especially in design education. We highlight some important aspects raised in 'open spaces' teaching as developed in the

- Creation of contexts of action and interaction between young people;
- Develop and apply strategies of mediation to facilitate the understanding of the complex issues (as sustainability) and the search for solutions by the young people themselves;
- Foster innovative communication approaches, creating conditions for young people to create a speech from themselves.
- Learning to conduct research and develop projects (in addition to develop technical skills and capacity for analysis and application) promote autonomy and empowerment among students.

In this sense, the need of more open and flexible educational approaches is noted, in order to give more space for:

- common sharing – stimulating the participation of the students by including their contributions and own references (e.g. in the Course content definition);
- engagement – promoting the active involvement of users and stakeholders in the creative process;
- self-reflection – encouraging learning from experiencing and adopting the changes that the project may undergo during its own development as part of the process (learn from mistakes);
- flexible assessment – implementing alternative evaluation parameters for the results in terms of theoretical and practical learning.

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About the Authors:

Najla Mouchrek is a doctoral candidate in the Human Centered Design program at Virginia Tech. She holds a Master's degree (2014) in Design, Innovation and Sustainability. She studies interdisciplinary design-based strategies to support college student empowerment and engagement in sustainability.

Lia Krucken is a design researcher and professor in Brazil, Germany and Italy. She holds a PhD in Design with studies at Politecnico di Milano (2005), where she collaborates as guest professor. Currently she is a post-doctoral fellow at the Coimbra University.

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Using Design Competencies to Define Curricula and Support Learners

FASS John[a]; RUTGERS Job[b] and CHUI Mo-Ling[a]

[a] London College of Communication
[b] OCADU
* Corresponding author e-mail: j.fass@arts.ac.uk
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This paper presents findings from design research related to a Design Competency Framework (DCF). The DCF is a visually-oriented system for developing curricula in design and is an example of the application of design research to design education. The DCF is divided into a set of sixteen categories including core skills, such as visualisation, and meta competencies such as synthesis. These are presented in the form of a matrix. We see three distinct advantages of using such a system. Firstly the DCF is personalisable at various scales such as individuals, units, courses, and programs. Secondly it is student centred - while we do not assume that design students are passive consumers of their own curricula in non-competency based design education we make the case here for student access to curriculum design processes. The DCF allows students to participate in the design of their own education. Finally, the DCF is resistant to imposition from above and as such questions the modes and institutional dynamics through which design courses come into being.

design research, design competencies, design curricula, competency framework

1 Introduction

The current interest in design in both business (Kupp & Anderson, 2017; Kunitaki et al, 2016) and academia (Miller, 2017; Chamberlain and Mendoza, 2017) has produced many publications by academics, business leaders and design practitioners. In these books, papers and design thinking workshops the characteristics of design as a practice and as a way of thinking about the world is communicated to a mass audience with the aim of demonstrating how non-designers can acquire this strategic knowledge (Mootee, 2013; Manzini & Coad, 2015). While the values and characteristics of design are communicated to an ever increasing mass audience, these publications do not explore how design is learned in tertiary education (Rutgers et al, 2015). We are interested in asking how designers learn? and how should design education prepare people for their future practices in the many fields of design activity? What kinds of skills should they learn? and what should the overarching structure of a learning experience in design education look and feel like? The Design

Competency Framework (DCF) is intended to address some of these questions through the lens of an organised matrix of competencies (Rutgers, 2015). This paper aims to set out a rationale and some examples of how the DCF can be useful, but does not intend to definitively establish a model for universal design education. It assumes that all learning experiences are contingent: on personal circumstances, on institutional prerogatives, and on local conditions of delivery and access.

Design as a professional discipline, as a cultural form, as a research field, and as an area of tertiary education is in a period of convergence (Deutsch, 2017; Watson, 2017; Self & Baek, 2017). Previously discrete design domains are starting to teach the same skills across multiple programs. For example, at LCC illustration, graphic design, interface design and interaction design all teach the core competency of sketching, and the higher level competency of coding. While design schools still divide their students into specific study areas and year groups, the design and development of design curricula in universities could be described as a kind of dark magic; ungrounded in evidence (Strauss, 2014), fulfilling institutional or marketing opportunity (Healey et al, 2014) instead of student needs (Havergal, 2015), and having unclear or untraceable trajectories over the three or four year period of study. The increasing marketisation of education in the UK, shown by a steady rise in tuition fees and consequent increase in student debt, has put art and design education under pressure to define exactly what it will provide a prospective student. The DCF suggests a way for design educators to articulate their curricula in a consistent and responsive way. The design competency framework matrix is shown below (Figure 1)

Figure 1 Design competency framework matrix

2 Origins of the DCF

The DCF came about from a need within the Industrial Design program at OCADU in Toronto where the program leaders set out to clearly articulate what students would be learning while studying there, what learning methods would be used, and what new knowledge they could hope to graduate with. The program is arranged around the acquisition of design competencies that develop alongside the expanding focus of the curriculum and the development of the student body as a group, and as individuals. We see three main advantages of this approach. First, it affords the development of curricula in design that are responsive to need by specifying competencies at multiple levels. Second, it is a personalisable framework that enables distinct models for different courses, navigable and deliverable by technical staff, academic leaders and students. Third, it allows input from learners themselves. It is not fixed in time, discipline or institution and contains the possibility for students to design their own trajectories through a program, contribute to the development of what they are taught, and even to redesign the curriculum anew every year should they wish. In other words, we do not assume that design students are passive consumers of their own curricula.

In an international team across two world-leading design universities, we have implemented the DCF in multiple ways. We have run three workshops at international design conferences including Cumulus 2017, and AIGA 2017. The intention at Cumulus was to determine the degree of flexibility in the DCF by asking design educators from all over the world in varied disciplines to design their own competency frameworks. The results revealed convergence between design programs, and a need for higher level meta competencies that cut across disciplines. The intention at AIGA was to provoke discussion in a design centred workshop about the design competencies of the future and reflect on the level of future-proofing the DCF allows. Results show the educators are perhaps not well prepared for the design of curricula that transcend traditional design boundaries to include say, bioscience or political activism. Within our respective institutions we have run workshops with academics and outside partners. The aims were to test the limits of accessibility of the DCF at an institutional level and to develop new or recently re-validated curricula. Results show how the DCF can both galvanise and support institutional systems for program development. Finally, we have used the DCF in the studio to elicit from students what skills they wish to learn and to allow them to track their own progress.

3 Why competencies?

Ennis (2008) defines a competency as 'the capability of applying or using knowledge, skills abilities, behaviours, and personal characteristics to successfully perform critical work tasks' (2008: 5). This definition incorporates how we have understood competencies in the DCF as more than technical ability or mastery of domain knowledge. Personal characteristics for example include cognitive, social and emotional attributes (Dubois, 1993; Lucia and Lepsinger, 1999) deployed by designers in the production of their work. The DCF thus emphasises competencies beyond traditional studio design skills. Boyatzis (1982) goes further to include the environments and relationships featured in a particular context and the motivations and perceptions an individual may have of themselves and their abilities. The DCF responds to this through its self-assessment matrix that permits a developing picture of design competency to energy as a student progresses through a program. Another important aspect of Ennis' definition is its emphasis on the *application* of knowledge or ability. This is reflected in the DCF's insistence on design *practice* as the engine of learning and skills acquisition in design.

In medical education competencies are seen as a way to place the student at the centre of the learning process (Harris *et al*., 2010). Like the DCF, students are required to monitor their progress toward stated goals. This allows the student to identify gaps in their knowledge and seek out learning experiences to fill those gaps. This process, and the models that facilitate it, is characterised by flexibility and the importance of self-directed learning. An important aim of the DCF is to share

responsibility for learning outcomes more meaningfully with students and thus ultimately do away with year groups by providing selectives chosen by students from a menu of options.

4 Competency models

A competency model is defined as 'a descriptive tool that identifies the competencies need to operate in a specific role or industry' (Ennis, 2008: 5). Sandwith et al (1993) identify the ranking of competencies in a hierarchical model as integral to the concept of a competency framework, the DCF follows this pattern. The argument in favour of organising competencies in a framework or model structure is that it allows for adaptation and customisation of a program of study (McClelland, 1973; Spencer and Spencer, 1993).

Using a competency-based framework means working backwards from which competencies a program wishes to furnish its students with towards the levels of competency expected at what points on the program of study. Learning experiences and materials can then be devised to fulfil these needs at specific points in the learning journey. Describing competency based medical education Harris *et al*., (2010) show how 'using a competency-based framework… and working backward to build enabling competencies in the undergraduate curriculum may provide an authentic curriculum focused on the qualities and attributes required' (2010; 646). In addition, they identify a weakness of their curricula that also often applies to design. 'A clearly articulated framework of practical, real world objectives provides a rare opportunity for students to develop a clear pathway toward relevant competencies. Many previous curricula have relied on a layering of experiences that do not always build on one another', (2010: 647). Of course, medical education is not the same as design education and there may sometimes be a strong argument for the layering of learning experiences in design but the argument we would like to develop is that these experiences should be observably directed towards a set of definable goals that progress through the curriculum.

5 Competency models in design education

Competency models in art and design education have been a way to gain equal status with subjects already using competency models, such as literacy and mathematics (Haanstra, 2013). In a review of competency models in art and design (ENVIL, 2015) certain characteristics are evidenced, these are divided into *responding* and *making.* The former includes contextualising design work in relation to history and cultures, and students reflecting and assessing their own and others' work. Making includes applying media, techniques and processes, using knowledge of structures and functions, and selecting and evaluating a range of subjects, symbols and ideas. We can see that there are some competencies that may be distinctive in art and design, i.e. application of subject knowledge to material processes, higher level awareness of the social and political meanings of systems and structures, and positioning within the cultures and histories of creative practice.

Design education does not only happen in universities and arts schools. For example, Business Innovation Factory (BIF) a design agency specialising in business development has developed a competency model (BIF, 2017) of its own intended to guide its employees through a career in experience design. Their 'career competency framework' is organised around core competencies that correspond to individual, project, team, and organisation levels of work activity and thus scale through the company. The model specifies what advancement through the company implies in terms of competency for an experience designer and features many elements, such as visual communication and story telling or self-direction and evaluation that would be expected in a design program competency model.

6 Theoretical background

We use the term design competency to denote learning outcomes from the cognitive domain (thinking), the psychomotor domain (making), and the affective domain (feeling). Thus for us a design competency is defined as the knowledge (as it relates to thinking, cognition); the skills (doing,

making); and the behaviours (feelings, attitudes, motivations) students need to acquire. We seek to integrate these separate elements of Bloom's (1959) taxonomy and suggest that design is an area of human activity where the cognitive, the psychomotor and the affective domains are successfully combined (Qamar et al., 2016; Berk, 2016). An example is a student designing a system for a palliative care home. She tries to imagine what it is like to lie in a hospital bed by role playing, she reviews the available literature and practice relevant to the topic, and she makes design prototypes at increasing levels of resolution in order to develop and communicate her ideas. In this way she combines respectively her affective capability to empathise with people and situations, her cognitive ability to interpret and synthesise existing sources, and her psychomotor ability to make things and test them. Schön (1992) describes this as *reflection in action* it is 'a reflective conversation with the materials of a design situation in which designers interact with their immediate design representations' (Schön, 1992: 67). Traditionally in education these domains are treated separately. Cognitive abilities are acquired in universities through formal learning experiences such as reading, essay writing, lectures and seminars. Technical education by contrast focused on the psychomotor domain by teaching mastery of a technical skill such as machining or millinery. Training of a psychologist in turn would also focus on affective abilities in the context of communicating with patients. In design, we recognise that it is necessary to authentically combine all these ways of being, doing and acting and suggest that a competency framework is a good way of doing so because the overlaps are made explicit at every stage of the program.

The many ways of doing design include sketching, diagramming, body storming, visual storytelling and spatialisation and provide a rationale for the many types of learning experience in design education. These methods are also explicitly exposed as design competencies in the DCF matrix. Developing different types of intelligence is an essential part of training as a designer, this is reflected in how analytical thinking, visual thinking, spatial thinking, temporal thinking, and conceptual thinking are embedded in the DCF. This variation in thinking styles draws on and demonstrates Gardner's (1983) theory of multiple intelligences with include the visual-spatial, the bodily-kinesthetic, and the interpersonal. The DCF is thus an attempt to incorporate these different types of intelligence into design curricula in a way that can be clearly evaluated and communicated.

Designers know that solutions are rarely completely new or original: they are usually a recombining of existing ideas into new configurations. This implies that design consists of crafting new relationships between elements from a personal reserve of heuristic understandings. Martin (2007) calls this *integrative thinking*, which he calls 'a process of discipline and synthesis' (2007: 7) whereby the connections and relationships between two opposing models of a situation are combined into a third that features elements of the first two but is stronger, more valid, or more relevant to a given context. The competencies necessary to do this kind of synthesis in design involve adapting to different thinking typologies, developing contextual awareness and sensitivity to the demands of various materials.

In summary, the DCF seeks to integrate Bloom's taxonomic categories through reflective practice involving cycles of experimentation, iteration, and evaluation. These steps feature different ways of thinking through a design situation, such as visual or temporal, to arrive at a new synthesis of meaning and context. The following section will report on two case studies, the first focuses on the development of a new curriculum, the second on student trajectories through an undergraduate design program. Finally, we position a competency approach as being in sympathy with the aims of West et al (2017) with regard to how curriculum design involves refining materials and themes over time, and developing methods of evaluation. In addition, we acknowledge that there are many different approaches to curriculum design such as the standards-based ideas of Magee (2017) and the need to articulate relationships (including their limitations) between what Dalziel (2015) calls conceptual maps, frameworks, and practice in learning. We have found that a competency-based model is well suited to the experiential and embodied learning that takes place in design schools and

suggest it as way of implementing the concerns expressed by the Larnaca Declaration (Dalziel et al, 2013).

7 Design and business at OCADU

This section reports on the process of designing a competency-based curriculum in higher education in Toronto, Canada. We present the results of a faculty workshop that aimed to envision what a new BA program in design and business could look like at OCADU.

Fifteen participants were drawn from OCADU faculty, McMaster University, and external partners. Participants were consciously included to reflect the range of experience and opinion in the relevant departments, this is thus an example of purposive sampling since we interested in a specific group of faculty members. The methods used included visual annotation of the DCF matrix, group discussion, diagramming and card sorting. In the initial task three groups of faculty members were asked to identify competencies for three different student personas using card sorting and personas. Personas are considered to be aggregated individual profiles, derived from prior research. They are used in design as a way of representing different user types and have been extensively deployed in human centred design and interaction design (Getto & Amant, 2015; Kunur at el., 2016). Personas were divided into social entrepreneurs, business start ups, and design project managers (Figure 2). These were developed to reflect the range of applications, and the stated interests of potential applicants.

Figure 2 Personas

The next step involved brainstorming the potential competencies of the student personas. Participants started by first card sorting, then adding and rephrasing their own ideas prior to arranging them on a table visible to their particular persona group. Next it was necessary to categorise those competencies and map them to the DCF matrix. The matrix is limited to sixteen separate competencies, this number was chosen as we have consistently found it to enable sufficient detail in the curriculum without over-specifying a program of study. In this way at the end of the first phase of the workshop participants had created three detailed competency matrices, one each for the three personas (Figures 3, 4, & 5).

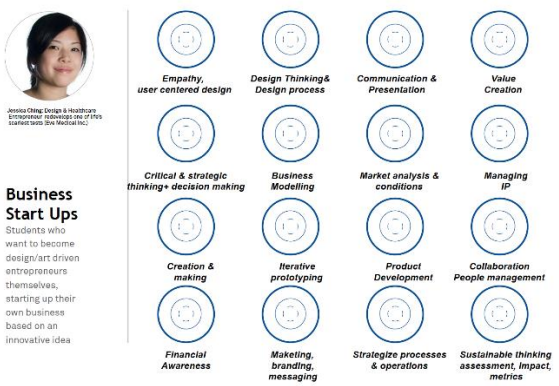

Figure 3 Persona 1 competency matrix

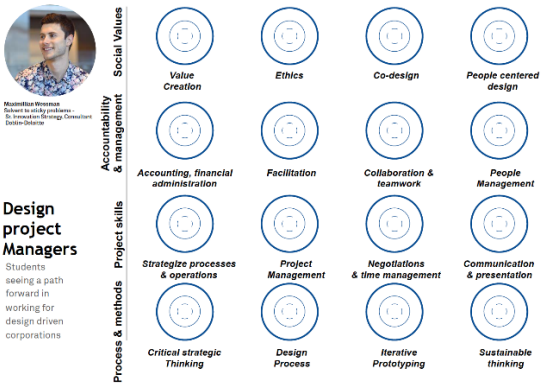

Figure 4 Persona 2 competency matrix

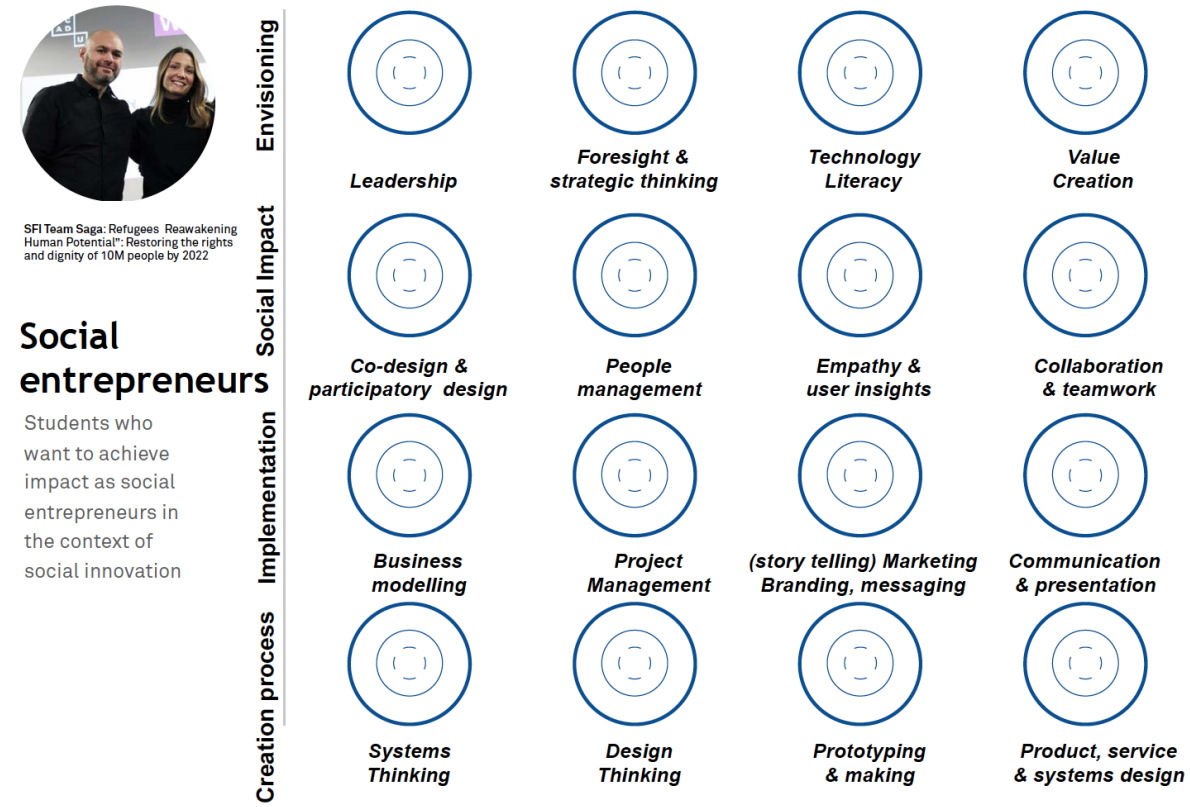

Figure 5 Persona 3 competency matrix

The next step in this phase was to integrate the three separate matrices that arose from the individual students' personas into a single competency matrix (Figure 6). This was done by identifying competencies common across the three matrices. The aim here was to derive a comprehensive set of competencies around which to build a curriculum.

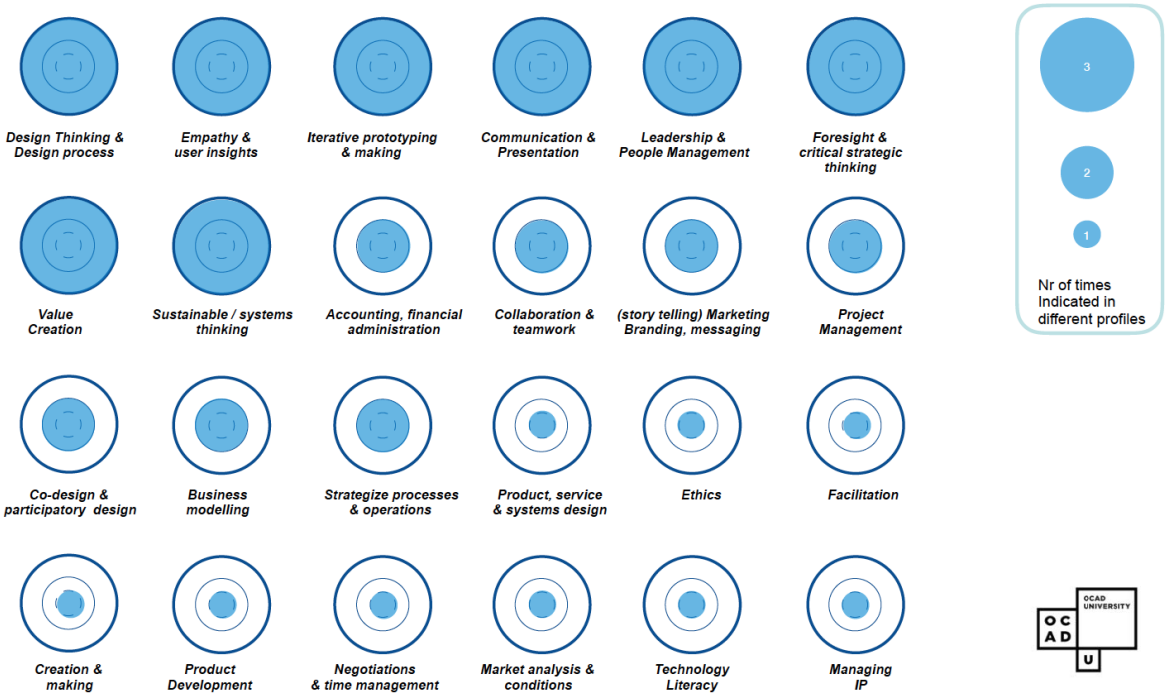

Figure 6 Aggregated competency matrix

Phase two of the workshop required participants to follow a similar exercise related to their respective personas but this time to focus on meta-competencies. Meta competencies (Figure 7) are defined as those that involve students learning at a higher level of abstraction. They are the most valuable, long lasting and future-proof competencies that students acquire, but also the hardest to measure and codify, and therefore difficult to implement at curriculum level. For the new design and business degree meta-competencies include; creative confidence, intrinsic motivation and managing complexity.

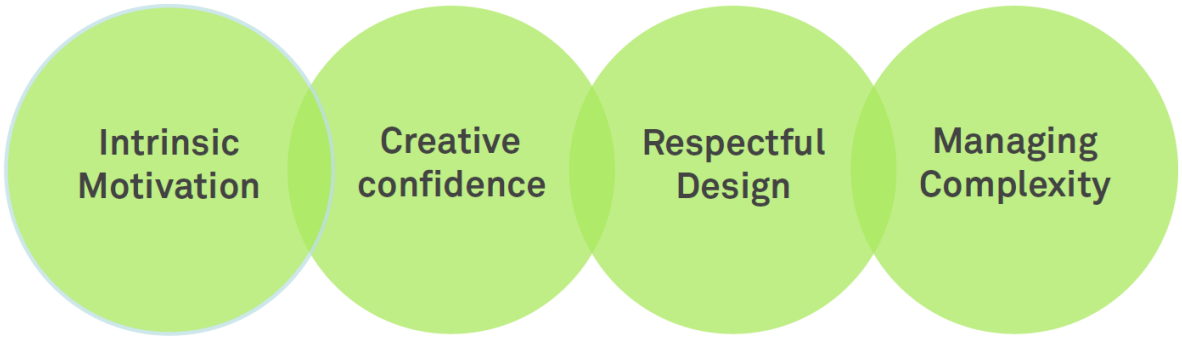

Figure 7 Meta competencies

The final phase of the workshop involved all participants working together to identify pedagogical assets across OCADU and beyond (Figure 8). This figure is included to demonstrate how the process of identifying assets involves rough sketching and unresolved collaborative diagramming familiar to designers from brainstorming and prototyping processes.

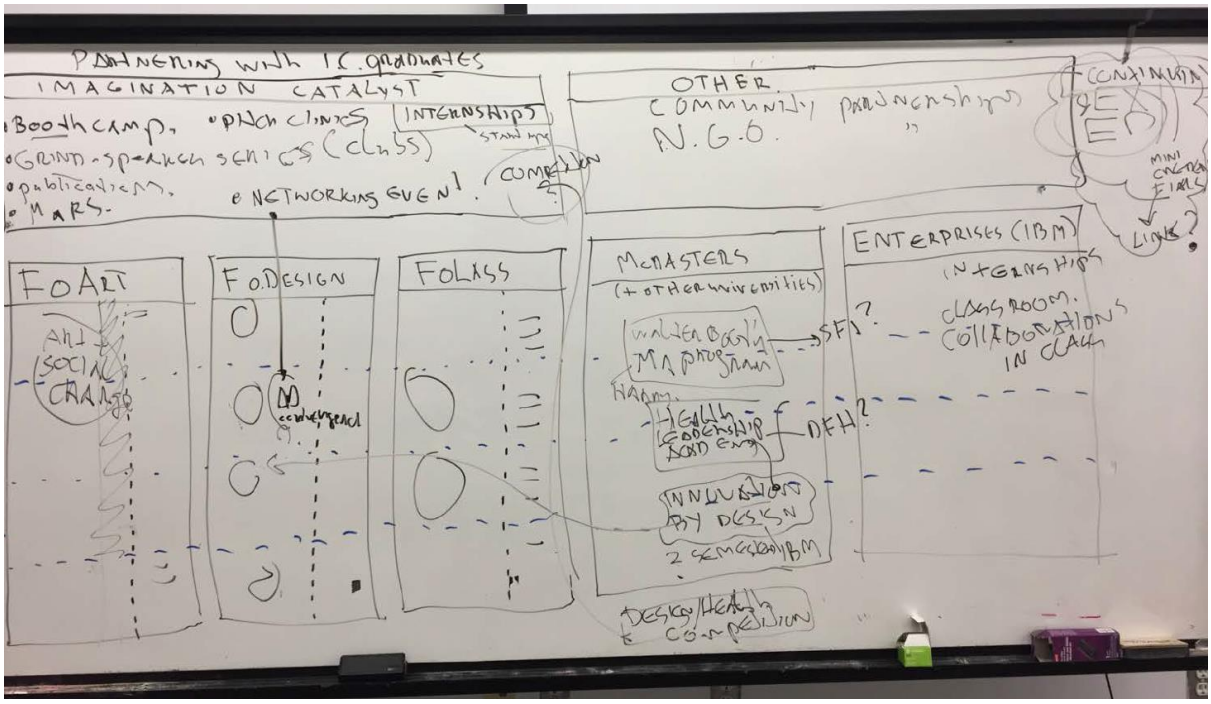

Figure 8 Planning with assets

This meant accounting for the complementary priorities of project partners and how they might unfold over time in the context of a series of learning encounters and varied learning experiences. An important finding here is that visual mapping enables points of overlap to emerge and corresponding opportunities for collaboration and specialisation to be mapped to overall aims of the university and the elicited student competencies.

Using the DCF for curriculum development revealed its effects as a design artefact in itself. These effects can be seen as enabling externalisation, categorisation, specification and planning.

7.1 Externalising

Participants in the workshop were chosen because of their involvement, experience and expertise in design and business education. Their knowledge in these areas is tacit, implicit knowledge, built up over years of teaching and practicing in their respective areas of activity. The DCF was seen to structure the externalisation of this knowledge by focusing thoughts in written form first on small cards so that they could be read by all members of a group and then transposed to the DCF matrix sheet.

7.2 Categorising

Transposing the results of the brainstorming step, where many ideas emerge in a relatively unstructured way, involves deriving categories from the resulting data. The DCF matrix, a paper sheet printed with a visual representation of the DCF as a series of circles arranged in a grid, affords data reduction. The associated need for categories is enforced by constraining the possible competencies to sixteen. Thus the DCF was seen to support the identification of categories as well as individual competencies.

7.3 Specifying

The resulting set of competencies, arranged according to four categories and allowing for different levels of expertise, were then used to specify the design and business BA program. The process of specifying what the students on a design program would be required to learn involves other institutional factors such as marketing, portfolio development, and departmental profile but in an initial workshop scenario the DCF showed how it can be used to specify the overarching logic for the curriculum of a design and business undergraduate degree.

7.4 Planning

The process of; externalising tacit knowledge into individual competencies, deriving categories from them, then specifying the content of a program according to where the competencies fall into categories allows for planning across a number of axes such as duration of study, learning spaces, and partner organisations. In the case of the OCADU proposed design and business program, planning involved integrating multiple stakeholders such as faculty members, a partner institution, and industry collaborators. The DCF allows this process by making it clear what students would be learning and when.

The way the DCF provides for externalising, categorising, specifying, and planning is through *visual mapping*, *synthesis*, and *collaborative sharing*. The advantages of visual representation of complex systems are well covered elsewhere (Larkin and Simon, 1987; McInerny et al., 2014) and the DCF was shown to support findings that demonstrate the ways visualisation helps in assigning categories of information, providing an overview of systems with multiple elements and how these might change over time. Finally, the DCF was shown to support collaborative working in groups from four members up to fifteen by scaling to different levels i.e. from a single competency card to a fully specified matrix. Working together and sharing the results of the group work was shown in the OCADU workshop to be enhanced by the way the DCF allowed participants to input their contributions, and how it allowed for plenary sharing.

8 Information and interface design interactive prototype

This case study reports on the design and development of a prototype online version of the DCF. The aims of the online digital prototype are to allow design students to track their own progress through a course of study, to enable self assessment, to provide detail about what constitutes a competency on IID, and to output a personal competency profile at any given stage of the program. The case study was conducted as part of an undergraduate degree in information and interface design (IID) at London College of Communication (LCC). Seventeen first year students were asked to complete a blank DCF matrix sheet, writing in the competencies they believed should be taught as part of the program (Figure 9). The intent was to explore the possibility that students could design their own degree, participate in program development, and challenge their position in academic management as compliant consumers of the curriculum.

The resulting contributions were aggregated using the same method as case study one to derive an overall competency matrix for the program (Figure 6). This is not seen as a fixed pattern, but is intended to be open to change and continuous input. Students are encouraged to fill out the aggregated program competency matrix after completing each unit of study as a means of evaluation. An end of academic year review would thus reveal what they felt they had learned and to what level. On graduation, their final sheet would provide a guide to their overall abilities and help position themselves and their competencies for a post university creative life.

Figure 9 Students decide program competencies

The digital version of the DCF reproduces the original matrix but enhances its possibilities for interaction by allowing students to select and save the competencies they input, whilst also contextualising the model, the program, and the particular unit students are working on. The resulting matrix reveals what competencies have been learned to what level of mastery, allowing for basic controls such as saving and editing.

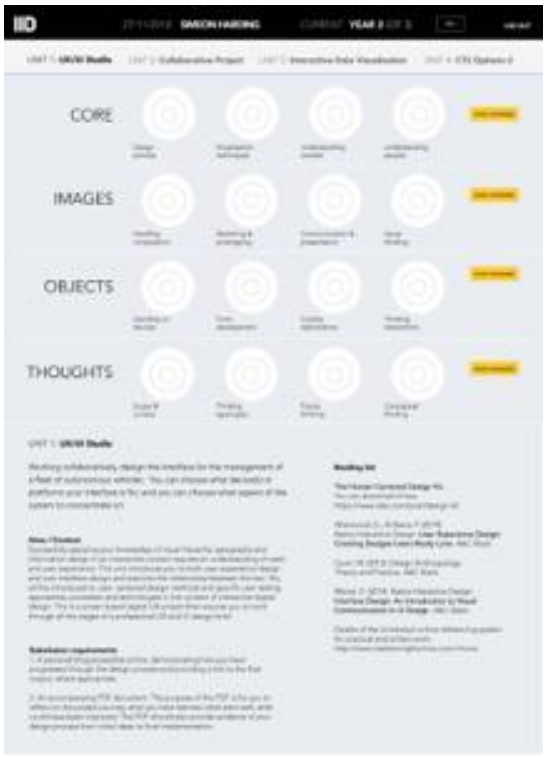

Figure 10 Interactive matrix

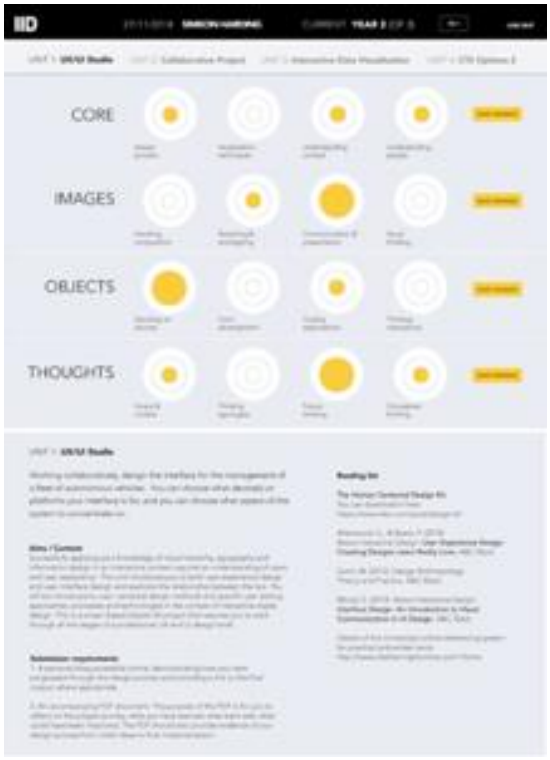

Figure 11 Completed interactive matrix

The system allows for an annual overview by collating the individual matrices from each unit over a year of the program. Students, tutors, lecturers, (and ultimately the university as a whole) are often assessed according to the levels of students attainment both between units, and over the academic year. Providing an annual overview (Figure 10) thus also provides a representation of individual achievement from a student-centred perspective, concentrating on the characteristics of student competency acquisition (Figure 11). During this phase of development of the prototype students expressed the wish for the possibility to grade themselves, but pointed out the necessity to see completed competency profiles from other students in order to give the correct weighting to their level of mastery. To answer this need, clicking on a competency label brings up an explanation of what it consists of (Figure 13). The next stage for this element would be to give an explanation of how the various levels of mastery are derived.

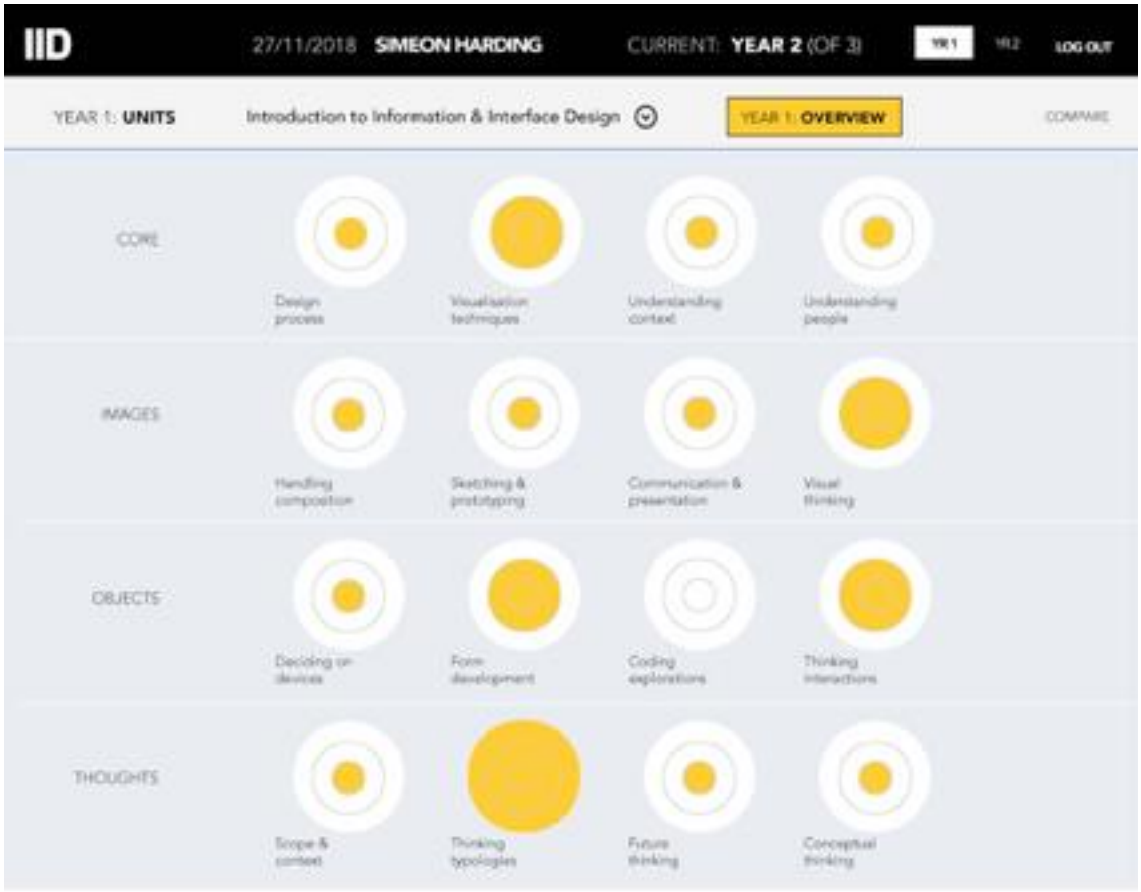

Figure 12 Annual overview matrix

While still in an early stage of development, student feedback suggests the online DCF system (Figure 12) has some advantages over the paper version, as a tool for autonomous learning management, i.e. by tracking progress through the program, by explaining the details of competencies and levels, and thus enabling self-assessment. The system also provides the opportunity for reflection and comparison via a visual gap analysis, and includes the possibility for outputting a shareable personal competency profile. The ways it does this include, visualisation, interaction, scaleability, and democratisation.

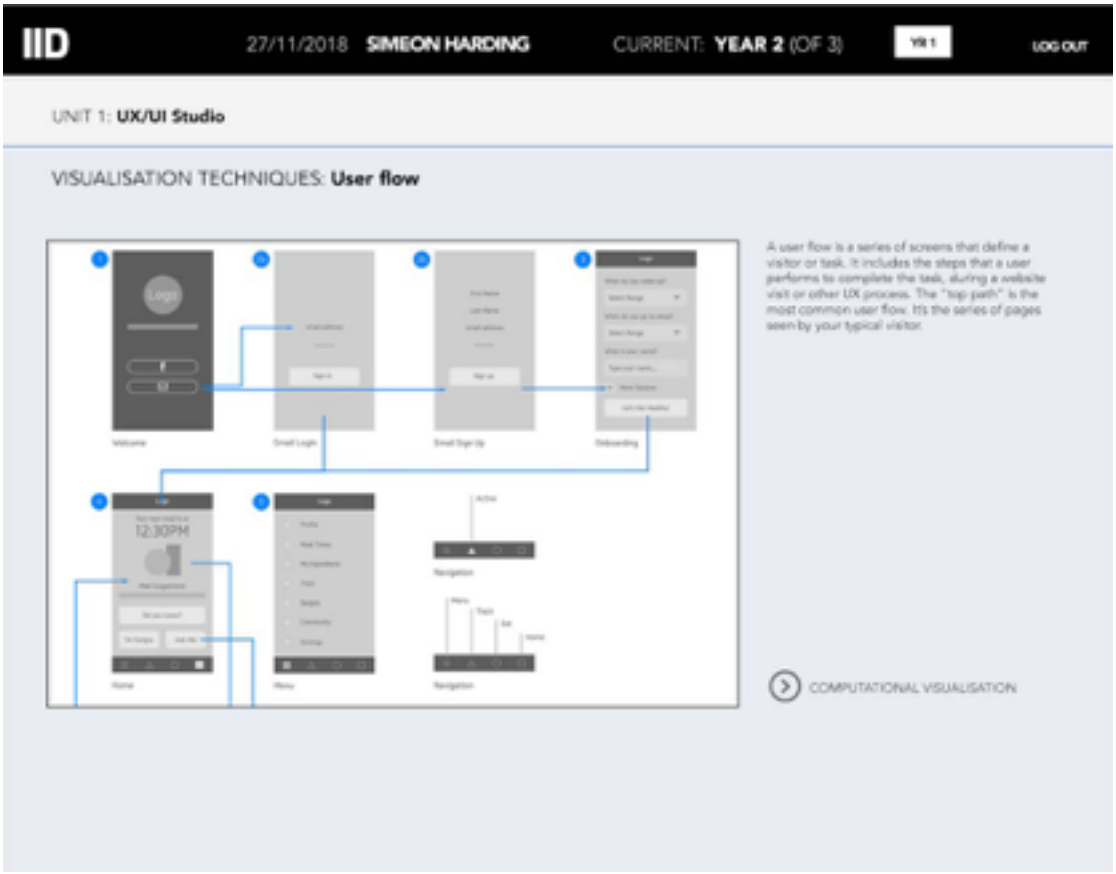

Figure 13 Annual overview matrix

progress through the program, by explaining the details of competencies and levels, and thus enabling self-assessment. The system also provides the opportunity for reflection and comparison via a visual gap analysis, and includes the possibility for outputting a shareable personal competency profile. The ways it does this include, visualisation, interaction, scaleability, and democratisation.

8.1 Visualisation

The online DCF prototype represents visually the way a student proceeds through the program, resulting in a trajectory signature. This is a visual record of what competencies they have achieved at what level of mastery at what point in the course. The value of this representation to teachers and students are that it allows the student to see how they have oriented themselves respective to the discipline and adds to their ability to position themselves on graduation for what they might wish to do next. Another valuable insight it affords is to teachers and academic managers about what competencies students are achieving and at what level, and therefore what gaps may exist in learning outcomes and experiences. Making attainment levels visually transparent between students and teachers also enables a flattening of the information hierarchy in the institution.

8.2 Interaction

Using the online DCF involves interacting with it by; selecting levels of mastery of separate competencies by clicking the concentric rings, saving the resulting profile, changing the level as a result of comparison with peers or through tutor feedback, then updating the profile. Interactions also allow for examination of competencies by accessing units, years, people, and the deeper explanations of competencies. Additional features could include sending a profile via email, zooming out to show comparison between all units of the program, and matching personal profiles to job competency profiles. Finally, the interactive version of the DCF make it tractable and navigable at multiple levels in a way not possible with paper sheets.

8.3 Scalability

Capturing and representing the micro level competency achievements of an individual student over a single ten week unit, and also allowing for a macro view of all students' competencies across all units of a three year degree means the online DCF has the potential to scale throughout the years of study and beyond as graduates pursue further study or professional training. It also means the program as a whole can be assessed according to how well its graduates have mastered the competencies it purports to teach. This ability to scale from personal to institutional level whilst maintaining a student-led structure has implications for how the DCF may be used to further democratisation and accessibility.

8.4 Democratisation

By consciously promoting self awareness of learning attainment, representing self management of progress through a degree program, and allowing for self assessment, the online DCF system hopes to promote student-inclusive curriculum design. Including students in the design of their own curriculum by eliciting the competencies and the broader categories they sit within we hope to lessen the distance between academic management bodies such as quality control officers, and departmental portfolio development. While we do not suggest that all curriculum design should be done by potential and current students, and that there are existing mechanisms such as student representation on course validation boards, we promote the values of inclusiveness inherent in a method and instrument that cedes some of the determining power of decision making to the people it will most effect in a way that involves reflection in the design studio itself, using a visual model.

9 Conclusion

In conclusion we suggest that the use of a Design Competency Framework can help at the start of a curriculum process. For example, when an institution wishes to devise a new design curriculum; academic management, course leaders, teachers and students can collaborate on what the program should teach, to what level, and at what point. The DCF provides a template and a process for how this could be done, not necessarily replacing existing systems but complementing them in a way that welcomes inclusiveness and involves the primary stakeholders. When a program is underway, the DCF is a means of making individual progress visually and interactively accessible to students and teachers through visual externalisation. The DCF also supports categorisation, which both permits specification of a curriculum and how to update it in response to identified needs. By encouraging and framing academic self-management the DCF supports learning autonomy and self awareness of skills and abilities. The integration of cognitive, psycho-motor and affective abilities in the pursuit of design making supported by the DCF holds the possibility for a high degree of flexibility and responsiveness necessary in a time of uncertainty and rapid change in design education. Well defined and rigorously derived competencies also have a longer shelf life (ten years or so) than the rapidly changing needs that emerge from short term institutional planning. Future work includes investigating the use of the framework through the duration of a degree program, evaluating its effectiveness as an instrument of academic self management, and exploring how it might adapt to varied cultures of institutional decision making.

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Tacit Synthesis: typography as research

COOREY Jillian* and MOONEY Aoife

[a] Kent State University
* Corresponding author e-mail: jcoorey@kent.edu
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The designer of today is solving complex problems. Among other skills, the literacy of other disciplines, the ability to be nimble in practice, engage in participatory design, and the capacity to interpret and synthesize research is imperative. For this study, we were intent on fostering a research-driven classroom, specifically in relation to typography. To expand student horizons, we've implemented the International Society of Typographic Designers briefs, providing a platform of research, innovation and conceptual thinking. Students typographically interpret a text, curating and authoring content. In implementing an inquiry-based learning methodology, research dictates form, rather than relying on typographic trends. Limiting the work to typography challenges students to demonstrate skill in constructing a personality and cohesive presence for audience engagement. The practice of typography transforms as a means of investigating content, dissecting and assessing. This level of initiative, and cultural understanding demonstrated, is critical. The projects foster an ability, difficult to teach yet invaluable to possess, separating a good designer from a great one. Emboldened by this synthesized knowledge, students are equipped with the skills and confidence to use typography as their instrument.

typographic research, typography, design education

1 Introduction: Typographic research as a means to inform and educate

In advocating for the literacy of other disciplines, designer Michael Bierut argues educators need to 'find a way to expose students to a meaningful range of culture' (Bierut 2007); otherwise graduates will speak in languages fellow designers understand, leaving designers talking amongst themselves. AIGA, the professional association of design in the United States, recently released the *Designer of 2025*, a document outlining the shifting paradigm of the design field. Based on data, trends among other disciplines and consultations with leaders in the field, the document lists seven 'trends and competencies' of learning outcomes appropriate for university programs to respond to this changing landscape. Among them, *complexity*. "Problems are increasingly situated within larger systems that are characterized by interdependent relationships among elements or activities. Relationships are physical, psychological, social, cultural, technological, and economic in their effects, requiring interdisciplinary expertise" (AIGA 2017). Students should be addressing design problems across

varying scales, identifying relationships between people, things, and activities within complex systems (Gosling 2017). As educators whose practice and research specialties lie within the realm of typography, we were interested in how we could incorporate cultural literacy and complexity into our classroom. Our goal was to change the way students perceived typography. Shifting the viewpoint from type as solely a vehicle of communicating content, to typography as a catalyst for research.

For this study, we were intent on fostering a research-driven classroom, specifically in relation to typography. Our curriculum mirrors many universities in regards to the instruction of typography, evolving from the trade-based history of the discipline. Typographic competencies are built through scaffolded assignments of ascending scale—from letter to word, paragraph to page, and lastly to document. Projects focus on hierarchy and the integration of type and image in the form of layouts and spreads. Research takes the form of gathering content, assessing typefaces—with the coursework primarily focused on the student's ability to set type and convey content. The study of typography is rarely linked to investigations of language or changing demands on readers (AIGA 2017).

Since 2014, we have been executing running the International Society of Typographic Designers (ISTD) Student Briefs in our Advanced Typography curriculum as a vehicle means to challenge how students work with typography. The ISTD, is a professional body run by and for typographers, graphic designers and educators. ISTD establishes, maintains and promotes typographic standards through a forum of debate and design practice. Through its highly acclaimed Assessment scheme, the ISTD engages with universities and institutions across the globe to raise the profile of typography in design education (ISTD 2017). The projects operate by prompting research-through-making, as the students respond to open-ended contexts. Gathering content, creating a narrative structure, and letting these lead the choice and means of utilizing medium, students make decisions based on a strategic communication goal. Content informs their approach in typographically authoring messages.

With the incorporation of inquiry-based learning, research becomes the focal point guiding the students work. In adopting a research-driven approach to typography, the practice of typography transforms as a means of investigating content, dissecting and assessing. This level of initiative, and cultural understanding demonstrated, is paramount. The projects foster an ability, difficult to teach, yet invaluable to possess, separating a good designer from a great one. Emboldened by this synthesized knowledge, students are equipped with the skills and confidence to use typography as their instrument.

2 Inquiry-based Learning

Various studies conclude a need for research and teaching to be linked in the classroom (Smith and Walker 2010, Stappenbelt 2013, Jenkins, Healy & Zetter, 2007). Figure 1 presents the connection between curriculum design and the teaching-research nexus (Healy & Jenkins 2007). Citing numerous learning benefits for students, Walker (2010) suggests a need for universities to place greater emphasis on pedagogies which fall in the top half of Figure 1. In relation to the design discipline, Salama (2007), reports that research and critical inquiry should be the backbone of design pedagogy.

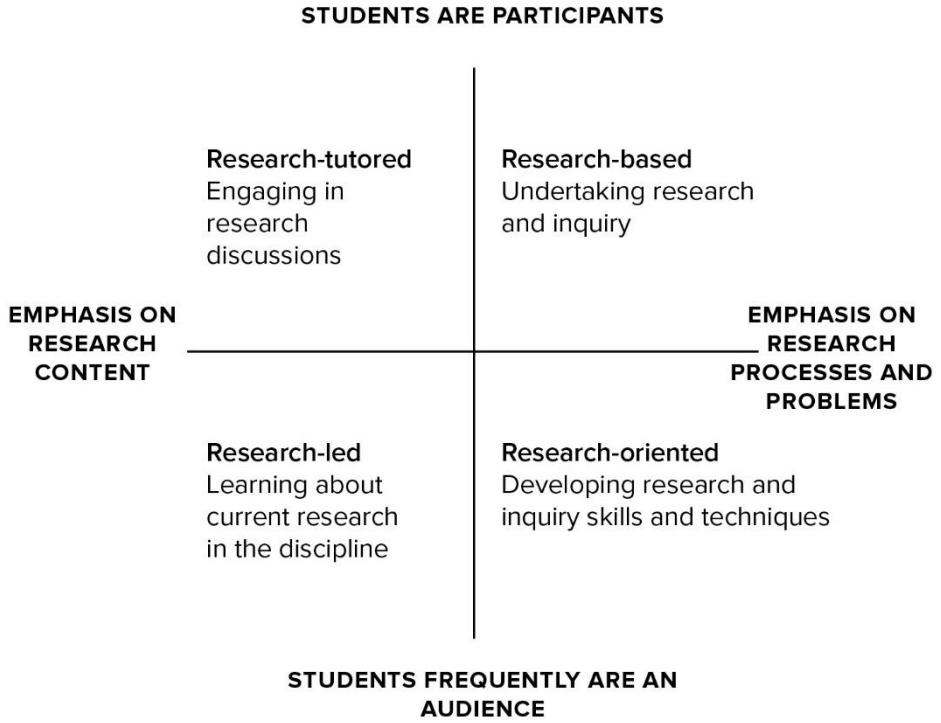

Figure 1 The relationship between curriculum and the research-teaching nexus. source: Healy and Jenkins 2009, p 7)

Inquiry-based learning is a teaching methodology centered around self-directed learning of the student as they take a research-based approach to education. When open-ended problems are utilized alongside inquiry-based learning, research is brought to the forefront as students pose questions and seek solutions. Studies have shown inquiry-based learning enhances student learning outcomes, specifically in regards to the development of higher order skills such as: analysis, evaluation, synthesis, and critical thinking. The role of the instructor shifts to one of a facilitator, teaching is coupled with research as both student and instructor become compatriots in the search for knowledge. Numerous researchers define the key fundamentals of inquiry-based learning as:

- learning that is stimulated by inquiry, i.e. driven by questions or problems;
- learning based on a process of constructing knowledge and new understanding;
- an 'active' approach to learning, involving learning by doing;
- a student-centered approach to teaching in which the role of the teacher is to act as a facilitator; and
- a move to self-directed learning with students taking increasing responsibility for their learning (Smith and Walker, 2010).

Inquiry-based learning can be organized into three categories according to how instructors utilize questioning. As its name implies, *structured inquiry,* is guided by the instructors as they provide a problem and outline for students. Through *guided inquiry*, the instructor provides questions to prompt investigation, yet students are self-directed in their exploration. Lastly, students take the lead using *open inquiry* as they pose questions and complete a full inquiry cycle. Smith and Walker analyzed these approaches and found that the teaching-research nexus is strongest when using open inquiry learning, allowing students to take the lead. Most importantly, they concluded if instructors are "co-learners in the inquiry, this helps facilitate an academic community of practice including both academics and students"(p 738).

As we aimed to integrate a higher-level of research in our classrooms, open inquiry was utilized. Students navigated various trajectories, defining their problem and posing questions. The subject matter of exploration was often beyond our expertise, shifting the teacher-student relationship to

one of equal stakeholders, a critical component of the inquiry-based learning experience. Tyler Galloway, associate professor at the Kansas City Art Institute, deduced how design educators should think: “Become a facilitator of dialogue, not a disseminator of ideas, but don’t withhold knowledge and experience” (Gosling 2017).

A key trend from the Designer of 2025 is the *Accountability for Predicting Outcomes of Design*, calling for research that informs practice. Research needs to be ongoing throughout a project’s duration, not merely at the start. Going beyond the ‘see what we found’, a designer’s research methodology must adapt methods from other disciplines to design problems and create practical applications (AIGA 2017). In using typography as both a catalyst and a method of research, we integrated several key student competencies outlined in this section, while building upon them, including acquiring the ability to:

- Interpret, summarize, and apply relevant research findings from a variety of fields in design investigations;
- Recognize, respond to, and employ different theoretical perspectives in the research writing of others in design process and outcomes;
- Synthesize research in written and visual form, addressing the designed artefact and supporting materials in light of three discrete contexts:
    - audience and medium for dissemination (embodied)
    - design outcomes as a contribution to a field of research (practice-based research)
    - dissemination of design concepts (strategy and specifications)
- Utilize typographic design as a means of speculative research in itself or ‘critical making’ through typography

3 The Role of Typography

As we approached a teaching-research nexus in our typography courses, it became imperative to understand the practice of typography and how it has evolved throughout history. To start, a basic definition of typography is, the visual attributes of written, notably printed, language. Typography is uniquely positioned as it crosses the lines between verbal and graphic communication, the writer and the reader, creative writing and the production of the print (Waller 1987). In communicating a message, designers are often tasked with achieving a balance between the visual and the verbal. *Verbal language*, referring to the literal meaning of words, and *visual language* referring to the character and connotations created by the typography. With the ability to be quiet, loud, hesitant, among a range of emotions—the visual aspect of type has the ability to command the verbal. “The role of the designer in establishing a tone that adds meaning to the verbal message is a matter of regular debate” (Knight 2012). Additionally, the term *visible language*, is synonymous with typography, referring to handwritten, drawn or mechanically constructed letters and orthographic forms (Swann 1991).

In the essay, *The Crystal Goblet* (1932), Beatrice Warde states that typography is simply the vessel to convey information, advocating for *transparent or invisible typography.* According to Warde, typography that hinders the message is bad typography. Historically, printers and typographers shared the view that typography should be in harmony with the genre of the text. Designer Jan Tschichold states the function of modern typography is to offer the reader additional support “modern man must read quickly and exactly. Every effort must be directed to transferring the words smoothly to the reader.” (Waller 1987, p. 46).

However, these stances belie their modern and modernist underpinnings respectively, representative of “the hegemony of invisibility” that permeated philosophies of typography at the time (Kinross 2004 p.78). Here, a scientific, universalist approach is applied to the needs of communication which ignores and subordinates the rhetorical aspects and potential of typographic form at both the macro and micro levels—ie. typographic behaviors *as well as* details of the appearance and combination of typefaces. It *is* important for students to engage with these concepts, which often align well with the teaching of foundations, where students utilize

typographic hierarchy to thematically organize content and guide an audience. However, too often this is where typographic education reaches a stopping point, neglecting the impactful value of typography as a tool for expanding and giving form to the expressive meaning of content.
In contradiction to Warde, designers and artists have long sought ways to investigate the communicative potential of typography. Stéphane Mallarmé's poem *A Throw of Dice Will Never Abolish Chance*, 1987, expressed the visual and semantic potential of typography and design. Mallarmé uses a variety of text sizes in carefully placed positions to add meaning to the poem. In these layouts, "space itself truly spoke, dreamed, and gave birth to temporal forms. Expectancy, doubt, concentration, all were visible things" (Andel, 24). Futurist artist Emilio Filippo Tommaso Marinetti coined the term "words-in-freedom" regarding free arrangements of words on a page. He saw space and meaning so intimately connected, as is expressed in his design for the cover of Zang tumb tumb, 1914. Marinetti called for "free orthography, which would freely deform and refresh words, cutting them short, stretching them out, reinforcing the center of the extremities, augmenting or diminishing the number of vowels or consonants" (Andel, 101). Other Futurists supported Marinetti's vision and demonstrated an obsession with speed and movement in their work. Through elaborate typographical compositions Futurists transformed the linear format of the printed page.

3.1 Typography as a Communication Tool

In our course, students focused on the potential of typography to establish a visual language, creating meaningful relationships between the components of the typographic system and narrative structures developed within the piece. As students collected primary and secondary research, they began to summarize their findings through a blend of verbal (writing) and visual (typography). Hartmart Skockl examines this relationship with writing as he articulates the relationship between typography and semiotics.

> *Writing can be called a connotative sign system as it uses content-form combinations of a primary sign system (language) as signifiers in a secondary system (typography). Typographic elements are complex signs which comprise various semiotic layers, each capable of independently conveying meaning (Stockl 2005, p 206).*

Stockl further discusses three ways in which the semiotic nature of typography demonstrates the capacity of typography to be flexible as a communication tool.

Typography serves to encode language

> *Typography and graphic elements display connotative meanings, "Typefaces may point to the nature of the document, carry emotional values or indicate the writers intended audience, and aspects of the layout may serve to reinforce the thematic structure of a given text and facilitate access to its information" (Stockl 2005, p. 206)*

Typography can take on pictorial qualities as letters form visual shapes depicting objects

3.2 Typography as a Catalyst for Research: Constructing identity and meaning through typography

Beyond a blend of the verbal and visual, we wanted our students to utilize typography in tandem with research. In the article, *Communication Theory and Typographic Research*, Harrison and Morris (1967) outline typographic research as: testing scientific hypotheses, artistic exploration, and in critical, historical, or analytic examination. As our students navigated the briefs they utilized one or a combination of those spheres of research as they defined their problem and developed artifacts.
In encouraging students to use typography as a means of investigating content, students become authors and producers as they push the boundaries of working with type. In the essay, *The Designer as Producer*, designer and educator Ellen Lupton advocates for the role of *designer as producer* as an alternative to *designer as author*.

> *Whereas the term 'author' like 'designer' suggests the cerebral workings of the mind, production privileges the activity of the body. Production is rooted in the material world. It values things over ideas, making over imagining, practice over theory. The producer must consider the physical life of the work, asking where will the work be read? Who will read it? How will it be manufactured? What other texts and pictures will surround it? (Lupton 1998).*

For these projects, students embody the dual roles of author and producer concurrently as they prepare their content while seizing the means of production, asking themselves the critical questions Lupton raises. In this approach, research dictates form, rather than relying on typographic trends. The subject matter and typographic treatments are linked, as they inform and enhance one another. Typography becomes a tool to tell stories, sharing the content in new and interesting ways—students learn to flex their typographic muscle, rather than finding it.

In order to set the scene for this approach to typography, and bridge the gap from the more prescriptive projects they may have become used to, in classes where they are learning the rules of typography and learning to integrate text and image within the constraints of an assigned artifact or context, we supplemented the self-directed learning reference material. The class curriculum builds to the ISTD briefs, and students are introduced to expressive typography and typography as a means of research incrementally from the start of the semester. They are given a brief historical context and design theory underpinnings and set to work on designing purely typographic posters, then a purely typographic identity system, and finally the ISTD prompts.

Open-ended briefs have allowed for students to pursue a myriad of topics. Subject matter has ranged from space exploration, to the Chernobyl disaster, mental health and the Iliad. When process and research dictate the end artifact, students tend to avoid developing rote solutions to format-specific goals. Instead, the outcomes are a natural outgrowth of the research, with formats and media chosen to best serve the communication goals, rather than as parameters within which the student is constrained. Unique results are achieved ranging from interactive experiences, exploratory books and cross-disciplinary collaborations. In shifting the focus away from the end artifact, open-ended problems encourage student initiative and ownership of the process. Students are free to explore a variety of trajectories as they define their field of study, posing unique queries, thus enhancing their research and working methodology. Students are less likely to default to a Google image search or Pinterest when designing due to the uniqueness of their topics. From a pedagogical perspective, this is immensely advantageous. When students pursue their interests and passions, integrating them into a problem, they are likely to be more motivated, thus increasing their creativity (Adams 2005).

At the start of the project, we explored critical making in relation to typography. Barness and McCarthy (2017) define critical making, a component of critical practice, as 'an approach undertaken in order to explain or understand a theory, phenomenon, or technology. Knowledge is formed through process and product.' Students completed visual research and typographic experiments as they adopted a critical practice (Figure 2). To initiate investigation and create a culture of making, various prompts were provided. Examples include encouraging students to: experiment with movement, experiment with shadow, investigate tactile explorations, work with collage, consult other disciplines, use geometric forms. Combined with their primary and secondary research, these visual investigations provided a starting point for students' projects and integrated research through making. "Merging intellectual inquiry with designed 'things' is the key component to forming a scholarly agenda through critical practice" (Barness and McCarthy 2017).

Figure 2 Examples of student visual research

4 Case Studies

The project briefs for this study were given to multiple student cohorts in our Advanced Typography course, totaling 35 students. The briefs consisted of five different projects, completed over the course of 7 weeks. The students were given free choice of which brief they wanted to pursue. The course investigates the communicative, structural and aesthetic aspects of typography. Projects build on students' previous experiences, enhancing skills for shaping verbal messages utilizing type. The groups were comprised of undergraduate juniors and seniors alongside graduate students. A majority of the students enrolled were local to our region, however, there were several international students which provided additional viewpoints during critiques. Throughout the project's duration students were required to keep a process book, which documented their research, ideation and refinements. The projects were assessed using the same categories as the ISTD student assessment which includes: research and development, strategy, typographic interpretation/skills, typographic detail, specifications and presentation (Appendix A).

Conclusions were drawn from the evaluation of the final artifacts, strategy and research. The ISTD rubric (Appendix A), used for the ISTD international student assessments, was used to determine student success. Projects were later submitted to the assessment. With the primary focus on typography, 60% of the rubric is devoted to typographic interpretation, skill and detail. Of secondary importance, research and development, which is displayed through process books, accounting for 20%.

4.1 Research & Development: Documented through Process Books

The ISTD assessment criteria require a strategy document and supporting research notebook. These '*process books'* are telling, containing insight to the student's research trajectory and showcasing the use of typography as a form of research in itself—a means to investigate in itself. Figure 3 shows a student beginning to pose questions (can cooking be craft? Art? Or both?), which led to additional research paths. As a pedagogical tool, we described and assigned the process book not just as documentation, but as part of an integrated, applied, typographic research approach. The books include, but are not limited to: contextual research, content generation and gathering, thumbnails, brainstorming lists, roughs, graphic experiments, notes and reflections and iterative refinements. Viewers of this document should be able to follow the students thought process from start to finish. Requiring a process book not only serves as an assessment tool for instructors, it also emphasizes the importance of process, ideation and revisions to students.

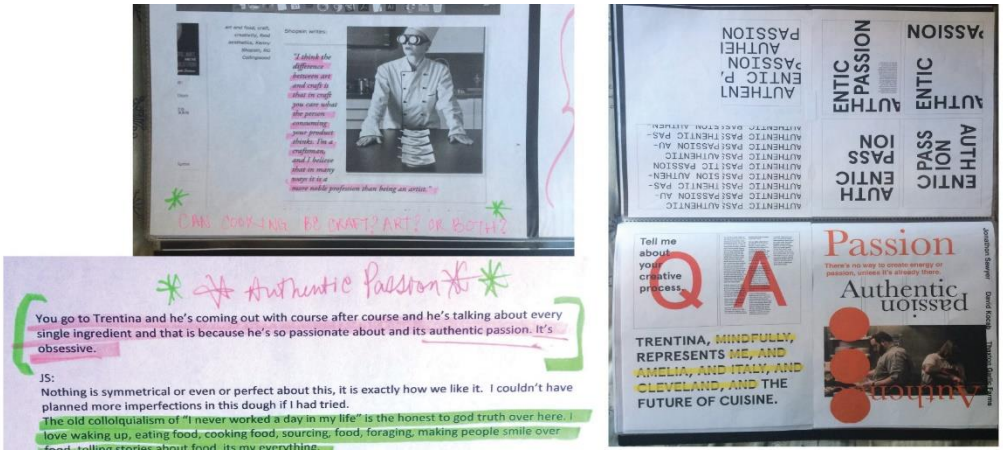

Figure 3 Example of student process book.

Figure 4 shows a detail from a student's process book in which the student typographically (and graphically) responds to complex concepts in philosophy. Engaging with the theory of another discipline not just as content to be styled, but as a means of approaching a design project the student explored and processed the concepts through word lists, mind maps, and the sketching of relationships—visualization tactics familiar to a designer. Having understood the source through this process, the student developed an integrated visual language and typographic artifact to articulate the abstract concepts of the source material for an intended audience. This process engaged the student in the definition of a purpose, audience, and form for this content and required a practice of translation, curation, distillation and explanation of content all through the medium of typography. In commenting on his work the student stated, "I don't think there's another single project in my whole time at Kent State University that taught me that research is important. I don't think I'll do a project the same way again; it changed my work ethic." This truly exemplifies the amount of research involved, so much so that it shifted the students frame of mind towards research.

The nature of the unframed design problem combined with the requirement for authorship of content and reflection on process embedded in the ISTD briefs creates a richer learning experience than traditional, artifact oriented briefs. For the student, they prompt a set of tasks and activities which culminate in a way that exemplifies educational philosopher John Dewey's definition of an experience as a consummation, rather than simply a cessation of activities. In this definition, separate experiences flow together and can be conceived of as a whole, labelled as a single act, and most importantly, constitute a pattern alternating between doing and undergoing (Dewey 1934). By using typography as a means of testing a communication strategy, and also as a means of investigating the content itself, the student acts and perceives in a cyclical and iterative fashion, immersing themselves in the content and moving through the project in a way that makes for a true culmination of endeavors, and an experience that can be labelled as having made a change in their way of thinking about research.

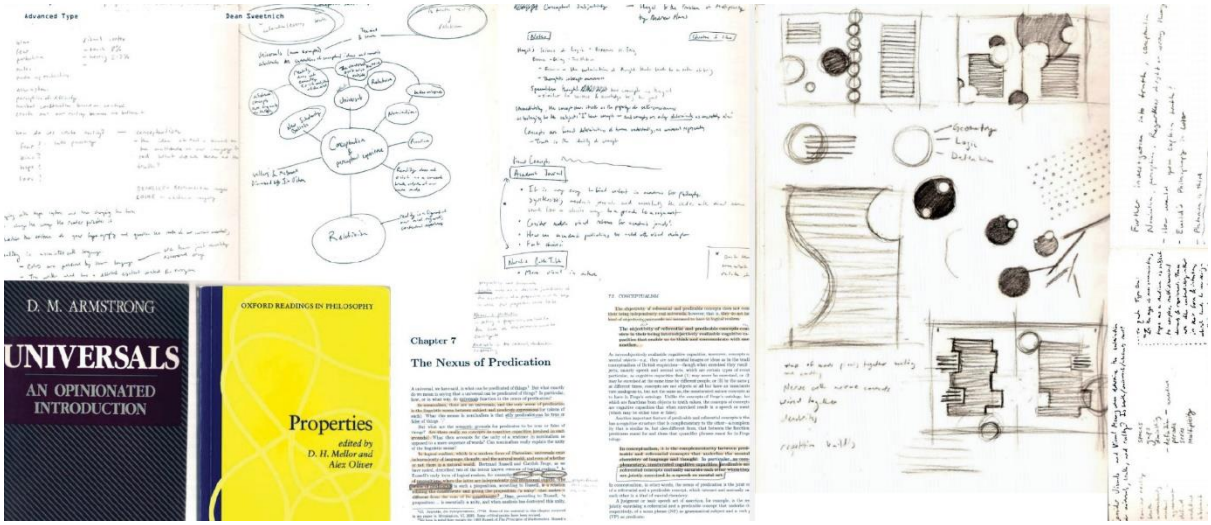

Figure 4 Detail of student research investigation.

The following final artifacts exhibit students' responses to the briefs, providing examples of how typography was utilized as a research tool.

4.1.1 ISTD Brief: Fickle Fads and Dedicated Followers of Fashion

> *A 'fad' or 'trend' or 'craze' is any form of collective behavior that develops within a culture, a generation or social group and which impulse is followed enthusiastically by a group of people for a finite period of time. Similar to habits or customs but less durable, fads often result from an activity or behavior being perceived as emotionally popular. You are asked to design a typographic work that explores the subject of 'fads'. (ISTD)*

Case Study 1: Student, Emily Thomas In, *Age of Anxiety* (Figure 5), Thomas responded to the brief with an exploration of McCarthyism. Gathering content from a range of sources, she organized the piece into a series of booklets, each typographically representing the creeping infiltration of fear fueled by this sociopolitical mechanism through a range of typographic techniques, binding styles, color choices, and paper stocks. After compiling everything into a pocket that demonstrated the lock-and-key nature of the concept, Thomas invited readers to tear open the 'book'.

Figure 5 McCarthyism, student project. Test is warped and interwoven at different scales to create a sense of interruption and discomfort which builds throughout the books.

Case Study 2: Student, Natalie Snodgrass As the briefs are open-ended, it is interesting to see two drastically different student responses to the same brief. It is a testament to the research process informing the final outcome. This piece (Figure 6), examines the fad of the Mid-Atlantic accent, an acquired accent popular in the early 20th century. Through the interpretation of this fad, the student began a deep investigation of language. The final book, *Learning to Speak*, takes us on a journey of the complex structure of how we form words and sounds. Typographic phrases are graphically coded providing the viewer with an education into the various components of speech.

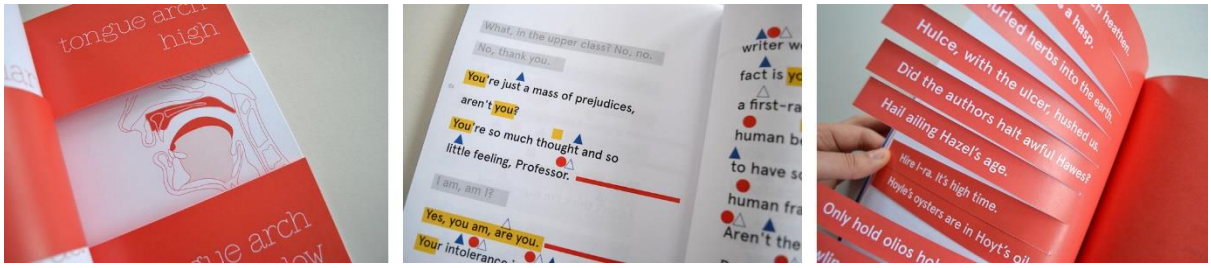

Figure 6 Learning to Speak, student project. Coded type provides insight into language and sentence structure.

4.1.2 ISTD Brief: Banned Books

> *Choose a chapter from a banned book and visually interpret it as a digitally dynamic book. The chapter should resonate with you for some reason or encapsulates what you believe to be its insightful nature. Consider how audiences of the book would have reacted to it when it was initially released. What was or is the aspect of censorship at play? Look to use the potential of the digital form to interpret your text: consider movement, interaction, reader behavior and experience. (ISTD)*

Case Study 3: Student, Alex Catanese Rather than selecting a banned book, this student decided to use the poem *We Real Cool*, written by African American poet, Gwendolyn Brooks in 1963. The interface (Figure 7) provides the viewer with multiple perspectives on the poem through the visual layering of content. Viewers can compare historical texts, images, videos and audio content as they navigate the site. The intentional disorganization of the frame is symbolic and represents the various interpretations of the poem itself, challenging the user's comfort level as the composition becomes more disorganized with each new. Historical footage is included to provide a raw look into the contextual climate of the ban. As one interacts with this site, a story is revealed in the same way a person might verbally tell one, providing loose connections, and multi-modal forms such as audio, motion, video, or text (Catanese 2016).

With specific regard to the typography, this student did an exemplary job of utilizing type to add meaning and enrich the narrative. The student provides a glimpse into his decisions in his strategy, stating,

> *The typography serves an expressive yet functional use, acting as various "voices" of different authors, while also subtly symbolizing opinions and interpretations that the user must consider and listen to. The type also plays on the linguistic aspects of the spoken word and poetry typesetting approaches. In addition, other visual forms designed to aid interpretation were researched, such as cross references, footnotes, bibliographies, poetic annotations, hyperlinks, pop-up windows, and transparency. Each typeface was chosen to reflect various aspects of the story around "We Real Cool," and also to provide distinctions between various voices involved. The humanistic aspects of speech are provided through Proza Libre; the historical character of typesetting in poetry publications is felt through Cormorant Garamond; the nature of raw typewritten source material, and the involvement of the government in the Kanawha County Textbook Trial is shown through Roboto Mono; and the historical posters and time period of the 1960s and 1970s are communicated through limited uses of Libre Franklin. (Catanese 2016, p 7)*

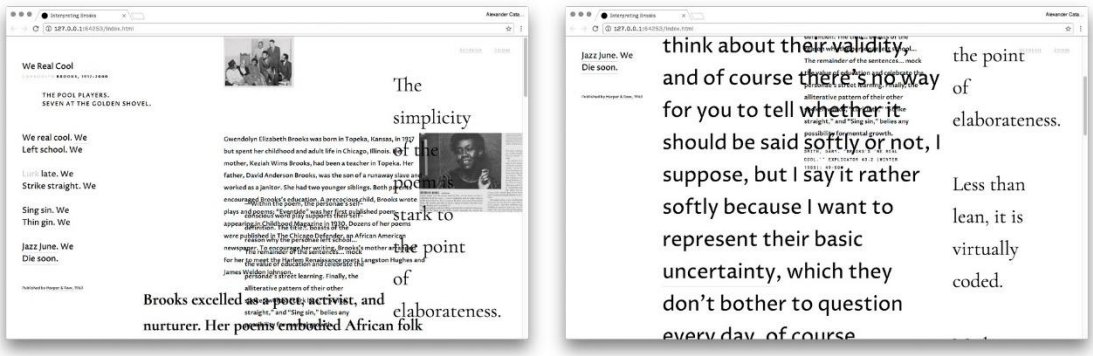

Figure 7 Interpreting Brooks, student project. The layering of the typography showcases multiple interpretations.

4.1.3 ISTD Brief: Manifesto

> *You are tasked with writing your own Typographic Manifesto that captures what you believe are the building blocks of typographic practice today. Consider both what you say, and how you say it. Your ideas need to communicate clearly – being mindful of your design-literate audience (professionals and students), but you also need to remain true to your own typographic beliefs. Typographic integrity and control should be central to your proposal, but don't try to second-guess what we are looking for. Most manifestos are intended to rattle a few cages, but the ones that have stood the test of time tend to be grounded in solid principles, insights & theory. Your submission should challenge and provoke, whilst being rooted in a clear understanding of our history. (ISTD)*

Case Study 4: Student, Anna Richard To respond to the prompt, this student chose to reflect on an existing manifesto, that of Eric Gill's *New Typography*, and examine it in light of a modern set of typographic contexts, constraints and challenges, in order to create her own manifesto. She focused on the application of the concepts involved on the web, and contrasted the didactic nature of the text with a reader-oriented experience. The audience is allowed to explode the book, which behaves as a series of pixel squares, that can be reordered and regrouped at will. Modern design critics and theorist's viewpoints on the original text were included as pull-outs or pop-ups and the student chose to translate the interactivity of screen to a printed piece through nested 'drop-down's. The hyper-text nature of typography on the web is explored through highlighted words, and the mutable nature of the book format. Finally, the reader is asked to assemble the author's own manifesto made from the previous text and its accompanying commentary. In this way, the book structure reflects not just a challenge to the text in the context of a new medium, but utilizes a traditional medium to convey the nature and features of a that digital medium in a way that sheds light on the principles espoused, helping us to critique them ourselves.

Figure 8 The New Typography: Commentary, student project. Eric Gill's seminal text is reinterpreted and deconstructed in light of the new context of screen

Case Study 5: Student, Brenan Stetzer In this response to the same brief, the student created a manifesto that reads in two directions, utilizing typography and format to convey the tension as he sees it, in the design discipline today. He harnesses historical stylistic precedents such as Dadaist chaos, and combines it with a strong grid system, to communicate the degradation of authority and perceived status quo. The layouts incrementally become more chaotic as the book progresses, and the structure of the binding allows the reader to see both a positive and negative view of the future of typography. The student researched manifestos such as the First Things First manifesto, the Futurist Manifesto, and others, to provide a context for the tone and style of language that would hark to the lineage of manifestos in design history, and crafted his own palindromic manifesto. In this sense, the typographic treatments were designed congruently with the writing of the content, and both emerged in synthesis.

Figure 9 This or That, student project. Palindromic manifesto reads in two directions, offering a two-sided interpretation of the future of typographic practice, and engaging the reader in the act of authorship

5 Discussion

The case studies shown display students' abilities in engaging with typography as research, as a means to investigate content, challenging the verbal and the visual while harnessing its potential as they crafted typographic artifacts. In this way, we consider open-ended typographic research as the next step in the evolutionary process of learning typography and utilizing it as a tool. Rather than discarding the concepts espoused by Warde and Tschichold, an opposition is highlighted and engaged with. Students consider the multifaceted capacities of typography to organize, separate and make clear *in tandem with and in relation to*, its ability to provide forms and layers of meaning which, to borrow from an information designer engages the 'active eye' of the viewer (Tufte 1990 p 33); where the designer may use a typographic palette and approach that aims to obfuscate or express and asks the audience to become a collaborator in co-authoring and reading the of the content.

For many, this was their first attempt in employing typography in this manner. Students struggled as they explored their topics while navigating how to work with type in constructing a narrative. Encouraging making and playful investigations, as displayed in their visual research (Figure 2), was helpful in shifting their perspective from using typography in the practice of typesetting content to typography as content generator.

In the case studies we can see the students engaging with content and theory from a variety of fields outside of design such as linguistics, philosophy, politics and literature. In this way, the briefs prompt the student to use typography in service of and in response to, broader cultural contexts. Also evidenced here is an engagement with the underpinning philosophies of design, particularly in

evidence in the projects resulting from the Manifesto brief, which show students engaging with critical design discourse, and authoring their own stance through and with typography.
In each of the projects, the students showcase the capacity of typography to explain and illustrate, alongside considerations of legibility and reading comfort, and consider how typographic descriptions might be a form of authorship in themselves, with the visual arrangement of content on the page constituting a research outcome in itself. In order to communicate with an audience, students consider not just an intended audience for their artifact, but also the typographic community as a field of practice. In the consideration of medium—wherein the designer becomes the producer—the students consider how format, binding style and methods of interaction become meaningful decisions, which in themselves communicate and disseminate design ideas with the audience. This consideration of the audience prompts the student to consider not just the context of reading, but also the concept of reading itself, as an interaction between two active participants, each contributing to the meaning of the artifact. In the requirement for students to produce a strategy and specifications document to accompany their ISTD submission, the projects also ask the student to disseminate design concepts for a design literate audience, explaining their approach much as a scientist would document her method for the good of the scientific community. In this sense, these design outcomes constitute a culmination of a holistic learning experience, in which the student considers their personal responsibility as a designer to their own voice, their profession, and their wider community.
As this was an initial study focusing on the integration of research alongside typography, case studies showcasing the final outcomes were provided. In future research, the authors intend to examine the notion of typographic process itself, as a process of answering research questions independent of the goal of creating a designed artifact.

6 Conclusion

The design field is evolving and as it does the need for designers to go beyond the role of 'form-givers' is critical. This paper advocates for the pairing of a research-driven practice with regards to typography. The integration of briefs challenged how students utilized typography as the act of making was fused with the act of thinking. Research informed the content of the projects, driving the form. Typography became the tool to tell stories as students explored a broad range of topics. Our goal is to produce culturally literate designers who ask questions, investigating topics beyond their expertise.

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About the Authors:

Jillian Coorey is an Associate Professor in the School of Visual Communication Design at Kent State University. Her research interests include creative process, typography and K-12 design education. She has presented, exhibited and published her work both nationally and internationally.

Aoife Mooney is an Assistant Professor in the School of Visual Communication Design at Kent State University. Her research focuses on typeface design and its methods and contexts. She has presented, exhibited and published her work both nationally and internationally.

Appendix A

Assessment Criteria

The criteria we use for assessment reflect what we require as elements for submission. We see these as an expression of appropriate practice for student designers and part of our support for typographic education.
All of the following criteria are used in the assessment of each project in both print and screen-based formats.

STRATEGY (10%)
- Each submission must be accompanied by a strategy of 250 – 500 words, succinctly describing the thought process underpinning your design proposals and how it implements typographic design to communicate with and influence the specified target market/audience.
- It should express what has driven your concept and its design development – not just a description of the various elements or a 'log' of what you did.
- While the strategy will be read by assessors, you should write it to be understood by a client.

RESEARCH AND DEVELOPMENT (20%)
- All submissions must be supported by relevant primary and secondary research.
- Your research and development work should show that a range of ideas have been explored before developing your selected concept. Ensure that you present this material in an order that allows us to follow your thought and design process.
- Design development on screen must be described through hard-copy evidence.
- The total amount of this aspect of your submission should not exceed the equivalent of one A3 layout pad. This may demand appropriate editing of your overall amount but is essential for our efficient appraisal of your process.
- You must cite fully your bibliographic/web sources and, where relevant, credit images.

TYPOGRAPHIC INTERPRETATION/SKILLS (50%)
- Typographic interpretation, creativity and control must be central to your proposals.
- Evidence of creative, strategic and innovative thinking in the outcomes is essential.
- Each project requires a sensitive use of type and, if appropriate, images. However, we suggest a subtle and sensitive approach to the inclusion of any illustrative content. Remember that your solution must be essentially typographic.
- The hierarchy of information in both print and screen formats must be clearly expressed through the inclusion and formatting of at least 500 words of text into your final submission.

TYPOGRAPHIC DETAIL
It is essential that you demonstrate rigorous attention to typographic detail across all elements of your submission – ensure that you check: spelling and hyphenation; punctuation; capitalisation; quote marks; widows/orphans; hyphens/dashes; rags; justification/rivers...
- Legibility, whether in print or on screen, must be considered – and resolved.
- Consideration should be given to the relationship between sound and movement in screen-based submissions.

SPECIFICATIONS (10%)
- Typographic, production/broadcast specifications, must be included and must reflect your detailed treatment of text matter.
- Using your layouts, present fully annotated typographic specifications and grid(s).
- Samples of paper stock and other materials used in print production should be attached.
- Refer to the Specifications Guides pages

PRESENTATION (10%)
- Presentation is important but no substitute for a weak idea.
- Ensure that screen-based submissions have been tested for use. Occasionally we cannot open files – these proposals sadly fail.
- All submissions must include a non-returnable flash drive with PDF(s) of images that reflect
  – concept origination
  – design development
  – form and usage
  – layout/grid system
  – media/material choices
  – typographic choice
  – typographic detailing
  – presentation images of the outcomes
- When submitting, complete the PDF form label, which will be available online closer to the submission date. Ensure that you indicate your project choice, by number, your media choice (screen or print) and fix the label firmly to your portfolio.
- Finally, check that all of the requirements of your chosen brief are included and clearly identified.
- Submit work in one robust, clearly labeled, portfolio – no larger than A2.

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Paradigm Shift in Design Education: An overview on issues and possibilities for change

ROCHA Hugo[ab*]; FERREIRA A. M. and JEFFERSON Manhães[b]

[a] UNIDCOM/IADE - Universidade Europeia
[b] IFF
* Corresponding author e-mail: hugorrocha@gmail.com
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The present paper intends to present an overview the *status quo* of design education, pointing out aspects from its creation and evolution over timed. It was made a short analysis that confronts the teaching model with the dynamics in which the world is today. It also points out the characteristics of a "new" designer, active in the creative economy, but not yet trained in educational institutions. Finally, it presents possible solutions for the remodeling of the teaching and learning process with focus on projects and real problems and points towards a new role of the teacher and the learning environment.

design; higher education; project-based learning; social change

1 Design education overview

There is now a vast discussion over how education, in general, must evolve (Assadourian, 2017; Bender, 2014; Furniss, 2015; Prior, Shen, & Karamanoglu, 2007). The world and its social and economic dynamics have changed, bringing a new level of complexity with it (Fry, 2008; Mau & Institute Without Boundaries, 2004). Given the cyclical dynamic of societies, as presented by Ferreira (2003; 2007), we understand the importance to rethink the educational practices for design to better respond to a new social structure and its challenges.

Along with some academic realities comes an inability to adapt quickly, which raises the question whether it is the ideal environment for creative people (Furniss, 2015). "Teaching is still very out of date, 50 years out of date" (Hunter as cited in Furniss, 2015, p. 31). This outdated format also shows it at Design Higher Education, which in some cases has changed little since its formal establishment. The school has become a social inadequate institution (Silveira, 2016). Design education history shows a tendency to replicate a model designed at the beginning of the twentieth century without critical thinking, adequacy of local issues, and incapable to evolve over time (Cardoso, 2012; Couto, 2008; Freitas, 1999).

The design sector has drifted apart from the limited skills taught by the design schools. Having to deal with professionals that come from clearly outdated school benches, the industry started to take the matter into action, to make available the designer that is needed for today's market. "Institutions are not producing the creative talent that is required, and is taking the situation into its own hands. It is recruiting from abroad and creating independent schools" (Furniss, 2015, p. 30).

1.1 Paradigm change in design

Design critics highlight the need for urgent change. Many authors (Assadourian, 2017; Dawson & Oliveira, 2017; Manzini, 2011; Silveira, 2016) point to the crucial skills of a designer that must be involved not in creating for today's world, but in assuming a position of helping to design the world in which we will all live tomorrow.

In order to understand that, we must acknowledge that we are under a paradigm shift as stated by Stebbing (2015, p. 24)

> *In the old paradigm design was characterized by: contributing to and promoting consumerism, obsolescence (Packard, 1967), commerce, wealth and waste; was environmentally blind; and a product's life was linear. If resources were considered at all they were perceived of as being limitless along with economic growth. Meanwhile, in the new paradigm, designers aspire to design for 'quality of being' rather than 'quantity of having' and with achieving a sustainable consumerism. This entails a circular use of finite resources due to environmental awareness and the aim of securing a sustainable future. I posit that this total contradiction between the old and the new design paradigms is the fundamental 'anomaly' which defines the paradigm shift in design activity.*

1.2 Design education as a gateway for change

Under this perspective of change, education must play a big role by understanding that "many new educational priorities must emerge: ecoliteracy [*sic*], moral education, systems thinking, and critical thinking, to name a few" (Assadourian, 2017, p. 30).

Training someone to be a designer implies providing students with tools and strategies to be able to question the current *status quo*, increasing their skills in critical thinking, and developing design proposals for a better world. Nowadays, designer already work on organizational structure and social problems, on interaction, processes, services, and human experiences. Many problems involve complex social and political issues. (Bernarda, Ferreira, Silva, & Queiroz, 2017a; Dawson & Oliveira, 2017; Manzini, 2011; Norman, 2010)

> *Education for designers (like nearly all education) is based on learning skills, nourishing talents, understanding the concepts and theories that inform the field, and, finally, acquiring a philosophy. It is unfortunate that our design schools proceed from wrong assumptions. The skills we teach are too often related to processes and working methods of an age that has ended. The philosophy is an equal mixture of self-indulgent and self-expressive bohemian individualism and a materialism transmitting this biased information is more than half a century out of date. (Papanek, 1984, p. 285)*

Design schools must bring to life professionals that are aware of its social role and impact, contribute to solutions for complex problems, and are powerful agents in the transition towards sustainability and social change (Bernarda, Ferreira, & Niemeyer, 2016; Bernarda, Ferreira, Silva, & Queiroz, 2017b; Manzini, 2011; Souleles, 2017). They cannot continuously seek the current path, training a large number of future professionals with the same market indication and mindset (Leite, 2006; Prior et al., 2007)

2 New skills for a new designer

There is a gap between what is being taught in the design schools and the needs of today's market. Design courses tend to focus on technical disciplines, ignoring fundamental aspects of our social dynamics that need to be (re)inserted into the academic curriculum.

Taking a closer look at the creative sector, it is clear that the market has evolved and can give some answers on the needed skills for a more complete designer who might be capable of adapting in a more complex and dynamic market compared to decades ago. **Figure 1** tries to represent graphically some the needed skills of this new designer which should add to all the others already embraced by the academia.

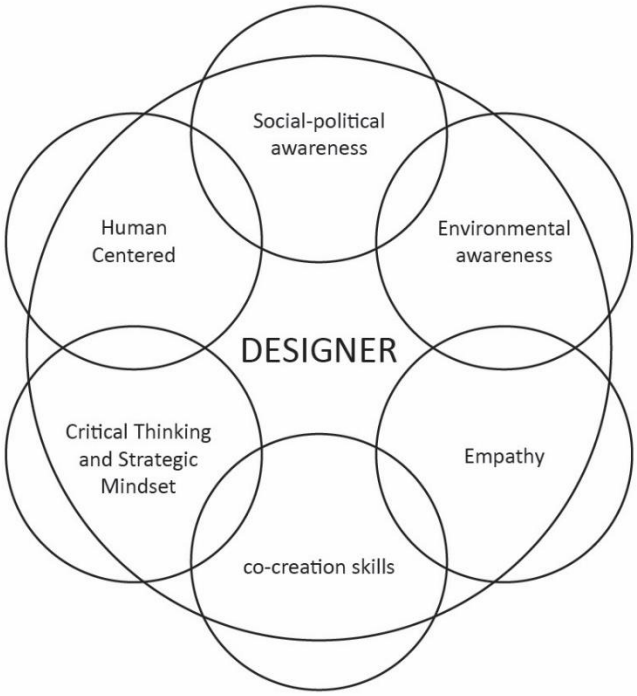

Figure 1 - New skills for the contemporary designer

2.1 Social-political awareness

One of the outcomes of complexity we see nowadays and that must to be understood by this new designer, is the non-conformity of today's world situation by the creative class (Bernarda et al., 2016). The massive crisis that took over the world in the last decade, affecting areas such as economy, politics and society, besides the security problems and tech revolution which brought into action – powered by the social and digital networks – an activist posture towards those issues, by many designers and design studios who consider themselves an important part of the change.

> *Designers are becoming increasingly engaged with social, environmental and political agendas. Some see themselves as social scientists, anthropologists, or community activists. [...] There has been a reactionary move from corporate to anti-corporate and profit is no longer the main driver. (Furniss, 2015, p. 13)*

2.2 Environmental awareness

The mindset for nowadays project development was established during the first industrial revolution where the design goals were limited to aid with the generation of profit, and as a consequence tended to be as practical as possible.

> *"Many industrialists, designers, and engineers did not see their design as part of a larger system, outside of an economic one. But they did share some general assumptions about the world. (McDonough & Braungart, 2002, p. 24)*
>
> *In the nineteenth century when these practices began, the subtle qualities of the environment were not a widespread concern. Resources seem immeasurably vast. Nature itself was perceived as a "mother earth" who, perpetually regenerative, would absorb all things and continue to grow. (McDonough & Braungart, 2002, p. 25)*

This way of thinking is still present in today's business logic, and that seem to be a wicked problem for designers. Designers work, in most parts, for external clients who set production costs and that seem to have not the required an open mind to dialog in a different direction. However, it is vital that the academic world leads this shift towards rethinking the creative sector in order to make an impact in the industry in a near future.

It is safe to say that the training of a new designer, a more critical one and aware of his project decisions, is required. This has little to do with training a designer only for social projects. Instead, it means that designers still need to produce for the industry and service sectors but knowing the impacts of each and every decision that is made during the course of the project.

> *We can, intentionally, design a more intelligent system, capable of creating innovation in order to develop regenerative production cycles, starting a new model where "residues are nutrients" and the products make a positive impact on people and the nature. (McDonough & Braungart, 2002, p. 8)*

Therefore, as has been presented, a mindset shift is mandatory. By participating in the creation of many services and products that will be used by a large amount of people, and consequently will consume natural resources, designers need to take into consideration materials and combinations of materials which not only are longer lasting products, but also that can be reused many times. This logic may be obvious for industrial designers, but it is necessary in many areas of design, like graphic, fashion, interior and even architecture.

> *This way of thinking generates a shallow creative attitude – a "cosmetic" design, as reported by property the finest modernist designer. The outcome of putting a good form in a bad product is that the user, once he figures out that has been tricked, will discard it faster. As the discard grows, the waste and the production of bad products also do so. This is the old equation established by the "scheduled obsolescence" as a way to the industrial growth. (Cardoso, 2012, p. 241)*

Projecting with the above mindset places design in the tail of the process, giving little or none power to interfere in a more strategic way, which generates – as defined by Cardoso (2012) – a shallow creative attitude. With this, comes a huge consequence to the field, according to (Furniss, 2015, p. 22)

> *Design is being devalued. It is now so quick to generate and so fast-changing that it is 'almost like fast food'. Sites like 'It's Nice That', whilst great visual resources, reinforce this issue by being more about the surface of design rather than actually about what underpins it and a way of thinking. Due to speed and a perceived need for change, design in some sectors has such a short life span that even the work itself is losing value. Design is also being devalued by the fact that there are too many designers and not enough jobs. Over-supply and less value afforded to certain design sectors is clearly evident in stagnant charge-out rates, and there is a lack of value attached to experience.*

The model that considers the use of a product as its final stage needs to the replaced. And, this new attitude needs to be practiced in the design schools as basic training for the development of design projects that have both social and environmental validation. We have the power to create products

inspired by nature, we can choose renewable energy sources and use a vast amount of solutions as strategies to overcome new challenges (McDonough & Braungart, 2002).

Designing products to be discarded, to be thrown in the garbage, is cruel to a world where there are finite and limited resources – despite of what it may seem. A packaging designer, for instance, needs to understand that the package itself is not the end but the means. The end product is what it protects, all the rest may be thrown out after all. Much of the needed value of a project is being put aside, taking only the economic value into consideration. Many designers today are still driven by this misleading behavior.

2.3 Articulation, macro vision and co-creation skills

Going against the super specialized training of today's design schools, the world's current scene requires a designer focused on "how to do it", instead of "what to do". Understanding the process and being capable of connecting to the right people and specialists that will help overcome a problem. This set of skills reinforces the co-creative ability necessary for a designer.

> *Design aims for the infinity – which means dialoguing, in some level, with almost all the other fields of knowledge. In its most ambitious sense, design must be conceived as a broad field that opens up to many other areas, some alike, others more distant. [...] The importance of design lays, today, precisely in its ability to build bridges and forge relationships in a world torn apart for the specialization and fragmentation of knowledge. (Cardoso, 2012, p. 234)*

Furniss supports this line of thought pointing that,

> *Through the formation of collectives and the process of collaboration designers are now working together and supporting each other in many different ways, dependent on each other and also on those outside the design sector. Collectives are enabling designers to share space, facilities and ideas, keeping individual autonomy while sitting under one banner. (Furniss, 2015, p. 13)*

And continues,

> *Design used to be about designing a product and then walking away. Now designers need to be more flexible and are reflecting this through fluid, emergent processes where solutions continually evolve. Designers are looking at issues, whether local or global, and then using design thinking to come up with alternative solutions. Sometimes these issues appear to be outside the normal realm of 'design' and do not have a traditional design output. (Furniss, 2015, p. 14)*

2.4 A new design attitude

"design processes have been re-invented" (Furniss, 2015, p. 13).

The evolution of the design process brought a significant change to the creative process and methodology. The reissue of the original model – totally put aside by the "cosmetic design" – which gains space again upon the complex needs of the world, placing, once again the human being as the focus of the workplace dynamics and the solutions for products and services. The Bauhaus school was founded by Walter Gropius, and he dreamed with the possibility of creating a new creative class, capable of designing "relevant things, adaptable, easy to use, and, why not, beautiful." (Alt & Pinheiro, 2011, p. 32).

Marketing, over the time, took the designer from a position of thinker, creative and innovator, to activities merely visual and aesthetics, generating little impact in the world and on people. But, as has been already stated, the reality has changed and the focus on Human Centered Design (HCD) has increased as an important project goal. All this indicates yet another area to be incorporated to the design skills which is the co-creative process in order to come up with more relevant outcomes for projects.

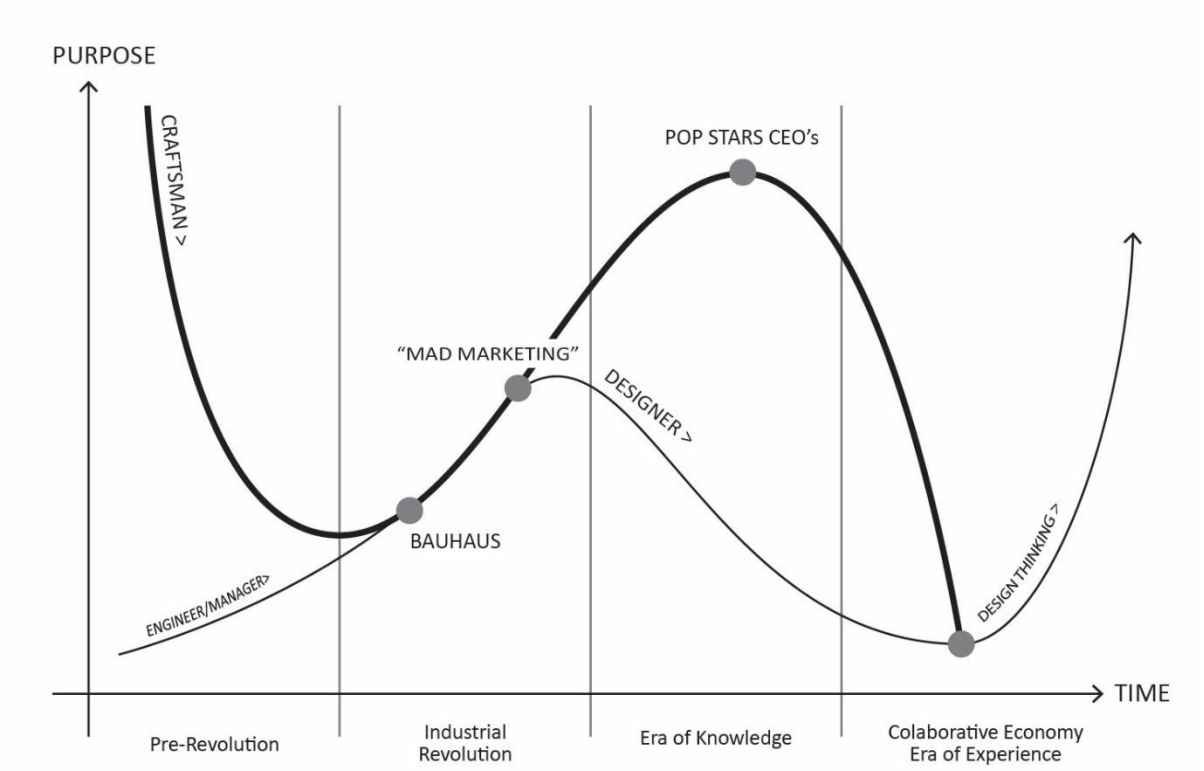

Figure 2 - The return of the design essence. Adapted from (Alt & Pinheiro, 2011).

This way of facing problems became worldwide known as Design Thinking and today is claimed by many design studios as being their approach to problem solving. One of the bright sides of Design Thinking is its HCD method.

> *Design Thinking is about people [...]. It's about understanding and focusing on the meaning of things for them, and designing better with this meaning in mind. It's about addressing wicked problems through the lens of those who face these issues on a daily basis. (Alt & Pinheiro, 2011, p. 41)*

3 Better integration with the design sector

Perhaps, by a basic survival instinct, the design studios as well as the creative sector in general need to be more agile than the academia, evolving quicker to remain competitive and active.

> *Economic pressures over the last ten years have affected the entire sector. Following the recession some larger, more established studios closed whilst others survived and became stronger. Many studios reduced their size, whilst offering a broader service. A Nesta report from 2008 highlighted that 'the recent economic slowdown is making generalism fashionable again, with many design consultancies attempting to enter their competitors' niche markets' (Miles, Green 2008). Hiring of full-time designers slowed dramatically after 2008, triggering the rise in freelancers.(Furniss, 2015, p. 17)*

Prior et al. (2007, p. 2) corroborates this idea, saying that "approximately 50% of the employees working as self-employed (freelance) (British Design Innovation, 2006; Labor Force Survey, 2006)". Even though the listed problems present themselves outside the academic world, it has become clear that they must understand this new employer and employee dynamic in order to work out the appropriate expectations of the market students about to embark after graduation.

Beyond absorbing and learning about the creative sector natural evolution – which is actually a passive behavior – Prior et al. (2007) defends that there must be a cooperative relationship and sharing from both parts.

> *Mutual linkages must exist between all elements of design education and the design sector; this will take the form of bilateral staff exchanges, live project briefs, student placements and most importantly employment of graduates. The role of the industry bodies is to lobby government on behalf of the sector, support and enhance linkages and promote best practice. The role of government departments should be to set industry targets in terms of sector performance; set student numbers studying design subjects at Schools, Further Education Colleges and Universities; monitor employment rates using statistical data from specific SIC and SOC codes; and finally provide sufficient funding to enable all of this to happen. (Prior et al., 2007, p. 11)*

On a survey taken in 2005 entitled 'The Business of Design', the Design Council reported some interesting and contradictory facts which may provide answers to those who believe that design educators and the design sector are not always on the same page.

> *Firstly, it is stated that 88% of design businesses think that all design students should complete extensive work experience, but only 54% of design businesses are willing to provide work experience for students. Secondly, 93% of designers think that business skills are either essential or useful in the design curriculum; however, only 54% of design colleges think that business skills are either essential or useful in the design curriculum. (Prior et al., 2007, p. 8)*

4 A Way out to design education: Project-based learning.

By nature, design is an activity that works with projects, some more complex than others. At the universities this dynamic is no different. Most of the chairs work with projects developed by the students, but education for the real world is short in two important aspects.

First of all, the majority design courses today are based on a pedagogical model which has been outdated for decades, defined by disciplines that do not communicate to each other. Looking through a practical perspective, it is easy to understand that different subjects do exist on a designer daily basis, but there are no borders. They flow through the projects according to the specific needs of each one of them. Breaking the learning process into modules of disciplines ignores the multidisciplinary characteristic of design.

> *Crossing disciplines has always occurred to some extent, but now it appears to be a necessity. Projects are increasingly issues-led rather than solutions-led and designers need to be more fluid in order to respond. (Furniss, 2015, p. 14)*

What Furniss (2015) defends not only shows the need of redesigning the academic approach, but also leads to a second issue with the way that projects are handled in higher education. The project proposals, presented as design briefs and handed out by the teachers, are usually shaped as fictional projects that tackle no real problem.

Taking both issues into account and adding what has been pointed out as new skills for the twentieth century designer, it is clear that the educational system needs to redesign its instructional practices. In that sense, a method seems to be adequate to provide the necessary approach to overcome those problems and guide the design schools back on track: The Project-Based Learning methodology (PBL).

> *PBL is a teaching method which is innovative and exciting, in which students select many of their tasks aspects and are motivated by real problems, that in many cases can and will, contribute to their community. (Bender, 2014, p. 15)*

This kind of contribution is fundamental, especially for designers, but also for the university. It has become a necessity to discuss design as a tool for social impact and not only as a consumption buster. Besides bringing social outcomes, real projects result in high levels of engagement and performance by the students (Bender, 2014, p. 16).

> *students relate and try to solve real problems that they think are important, besides designing many products (sometime called "artifacts") that may be used to show the acquired knowledge and communicate the solution to the other students.*

In that sense, the universities might be yet the perfect environment to include real projects that generate social impact and a place where the capital return is not pursued in a project (Margarida, Farinha, Pinheiro, Souleles, & Rocha, 2017; Souleles, 2017). That also contributes to the training of a better designer, more aware of the impacts of his decision in society, which has already been pointed as an important skill for today's professionals, which are social-political activists.

This kind of agenda allows students to understand "the PBL projects as being significant to them, driving them to achieve a higher level of engagement in the pursuit for solutions" (Bender, 2014, p. 23).

> *The PBL approach encourages students to participate in planning, researching, investigating and applying new knowledges in an attempt to come up with a solution to problems (Rule; Barbera, 2008). In that sense, the PBL is very similar to real life issues. (Bender, 2014, p. 25)*

Such characteristics are extremely salutary for the training of designers, since they are similar to the methodology used by design and that, in a way, should be a part of every design project ever done. PBL allows students to plan their actions in teams, testing, prototyping, and improving the results.

Bender (2014) point the following three criteria as being part of PBL, and which summarize its aspects, pointing to a fundamental difference to the types of projects usually developed in the design schools and giving some direction and hope for change.

> *1- A curriculum based around the problems and empathizing knowledge and cognitive skills.*
>
> *2- A student centered learning environment, small groups, and active learning with teachers acting as facilitators.*
>
> *3- Project results, focusing on developing students' skills, motivation and permanent passion for learning. (Bender, 2014, p. 25)*

Taking the item two into further analysis, which points towards changes in both the role of the teacher, and the need to redesign the learning environment in order to fit with this new reality, the following topics try to see ways for design in that sense.

4.1 The role of the teacher

The current ordinary classroom can be defined as students turned to a figure who supposedly has all the knowledge – the teacher. This reality is attached to an outdated, unsustainable model, full of unengaged students. It is safe to say that almost every student today is connected and is able to search for answers online. It is time to change the professor-student dynamic. In the PBL professors should not be in front of the students, but at their side. "Almost every description for PBL suggest that teachers, working along with students, develop a guiding, motivating question with which students may relate" (Bender, 2014, p. 23).

Bender (Bender, 2014, p. 42)continues, saying that "PBL means an important change in the learning possibility, where the teacher is not an information provider anymore". In this change of role, the teacher must act as a facilitator and an advisor. The understanding of this new positioning and the

propensity to change are fundamental for the success of this model where students, instead of mere information consumers, participate actively and became content and knowledge creators.

> *[...] modifying the role of the teacher. Instead of information providers [...], PBL requires professors who are truly educational advisors and tutors, as students move on with their projects. To some teacher this new role could be a real challenge. (Bender, 2014, p. 39)*

This quote highlights an important aspect that needs to be taken into consideration in the new educational dynamics. Technology is being integrated to educators and teachers need to perceive the digital platform as allies to the learning process.

> *On the other hand, they [professors] might be less fluent on most recent applications, like wikis, blogs, social networks, among other modern technological tools for teaching. But, these applications, are playing a growing part in the PBL projects (Cote, 2007). Indeed, it is hard to imagine an example of a modern PBL that does not apply activities based in technology. (Bender, 2014, p. 36)*

Nowadays, when digital media allows instant communication and there is limitless growing information available over the internet, rests a belief that to produce sense from the vast amount of virtual information is precisely the sort of skills that a student must have today to be able to build knowledge (Bender, 2014).

4.2 The learning environment

Another key factor in the learning process, which has been recurrently ignored and that remains unchanged along with the teacher's role, is the classroom. Though undervalued, the physical environment is equally important to the students' learning process and motivation.

> *Change does not come from the technology itself. It comes from the way in which we use it. The interior design of our schools can help unleash the creativity and the capacity for innovation that we will need to meet the challenges of the knowledge society.*

The modern learning spaces need to stimulate the creative skills of the students. Many workspaces are already changing its landscape, replacing the monotonous cubicles with the more collaborative open floors. "Monotonous work environments blur distinctions and impair creative thinking.", says Bosch (2012, p. 45). The architect is responsible for many projects that value the creative space inside different sectors and is the author of the innovative project for the Vittra School in Stockholm. At the design studios this posture has already been a reality for quite a while, but still remains as a lesson to be learned by the academy (Bosch, 2012).

In the experts' opinion, schools are still designed to have classrooms following the dynamic criticized in the previous topic of this paper.

> *The design of our schools is still patterned on an approach where the teacher spoke while the students listened. If we want to create better learning spaces, future schools should be designed with the goal of facilitating both learning and communication. We can use interior design to create new spaces that turn digital information flows into new knowledge. With new approaches we can create learning environments that are inspiring for students and teachers. (Bosch, 2012, p. 119)*

"The physical setting can challenge conventional thinking and provide new perspectives on daily tasks." (Bosch, 2012, p. 45). The learning environment needs to translate the proper needs of each activity, and not follow the same pattern for each and every one of them, limiting the learning possibilities and demotivating students and teachers. This aspect is even more critical when we talk about the creative industry that relies on non-conventional mindsets. To develop creative skills in a boring environment is a critical issue and has to be thought over, for those places can shape the way we learn and think (Bosch, 2012).

> *A thoughtful use of interiors and design can create learning environments that accommodate students' different and varying needs. The school of tomorrow offers places for focused concentration and reflection as well as rooms where students can debate and collaborate. With differentiated learning spaces we can exploit the full potential of the new media and educational approaches. (Bosch, 2012, p. 119)*

Image 3: Past and future - Learning environment

Another important aspect to take into consideration is the insertion of technology in the learning spaces, as presented by Souleles (2016). New technologies allow new ways of learning and students today may benefit from its use in the search of information and for work in a more collaborative way with their colleges, stimulating their skills towards a more cooperative sort of work.

> *The new technologies require a different spatial design approach than the traditional breakdown into uniform classrooms. Instead of desks and chairs, an optimal learning environment might require lounge furniture, large communal tables and secluded "caves". Instead of a traditional blackboard, the learning process might require rooms where groups of students can gather around a computer screen. (Bosch, 2012, p. 119)*

Tough the design field seems to be a safe environment for changes to be tested due to its dynamic nature and collaboration characteristics, open space classrooms, as established in this work, may present challenges to be discussed and argued.

Alterator & Deed (2013) point that the absence of walls, physically, may provoke a sense of dislocation and anxiety on teachers as they must change not only their role but also even deal with interactions with other teachers. "Teaching is a complex activity, and the complexity increases when the basis for making decisions about teaching and learning becomes uncertain." (Alterator & Deed, 2013, p. 326)

> *Taking advantage of the possibilities of flexible space may mean increased interactions as evident in team teaching. These practice changes may induce a feeling of a lack of privacy and a sense of exposure, disruptive noise, over-stimulation, impacting on task performance and individual stress (Davis et al., 2011).* (Alterator & Deed, 2013, p. 326)

A probable adaptive curve is to be expected from these changes of behavior and landscape, which may lead to adaptations concerning the nature of how design should be taught. The most significant barrier expected from the teacher's side is for him to be forced to be redirected from the established methods used until now.

5 The L3 Case Study

The project-based methodology was implemented as part of the L3 - *Lisbon Common Laboratory Learning* – consortium that involved students from three different Higher Education Institutions of Portugal and was funded by the Calouste Gulbenkian Foundation, Lisbon. The L3 Project received the "Here for Good 2017" award from Laureate International Universities (2017).

During the projects developed by the design students from IADE-UE, in collaboration with engineering students, from Instituto Superior Técnico, University of Lisbon, and students from NOVA School of Social Sciences and Humanities, from NOVA University of Lisbon, students had to deal with real problems, co-designing with critical stakeholders to solve issues at stake. "The L3 Project aimed scientific and civic education of students, through the application of innovative methods of active and collaborative learning in community settings" (Pinheiro, Farinha, & Ferreira, 2017, p. 99). The expected results were beyond design responses in a traditional sense (e.g., a product or a graphic layout) but also aiming at social impact and innovation.

> *According to each course programme they [the students] elaborated projects that included different areas, Urban & Interior design, Branding, Contemporary History, Experimental Methods of Energy and Environment, Photography and Events. Each project followed complementary stages of reflexion about the social problem to solve, the awareness of the existent needs, the strategy for design, a solution for the purpose, the elaboration of a project, the implementation and further improvement by the inputs and feedbacks (Serrano, 2008). All the projects suggested different types of vulnerabilities that have impact on their internal socioeconomic activities.* (Bernarda et al., 2017b, p. S910)

During the development of the projects, the students had worked on many skills as cited in item 2 of this paper, such as empathy, co-creation, and critical thinking. The role of the teacher also shifted from a knowledge provider position to a participant and mediator as it was his task to connect specialists and to help the students improve their skills providing guidance and tools during the role process.

Dealing with real problems allowed the students to empathize more and connect with important issues. That provided rich insights into the designed solutions giving context to the design process and a sense of belonging to the students. "This project developed with real situations was the best way to learn in a real context, and was very enriching in terms of social experience for the students" (Pinheiro et al., 2017, p. 99)

> *"The students had an intergenerational and intercultural experience, connecting and exchanging experiences and knowledges with people, a powerful experience of facing and listening to personal feelings.*
>
> *Their role was to awake awareness in individuals, expecting the promotion of their experience, amplifying new ways of behaviour in their closer circle generating or restoring relations and bridges of proximity by the development of tools to maintain the system diverse, productive and sustainable."* (Bernarda et al., 2017b, p. S910)

From what was seen during the process and pointed by Bernarda (2017b, p. S911) "an early awakening for a network construction can provide the formula for the construction of more assertive professionals in their projects and the communities will gain effective tools and training for their sustainability." In design higher education this case proved that a PBL could foster future designers qualified to deal with the paradigm-shifting world that has been pointed earlier in this work, allowing the students to develop the expected set of skills to deal with a more complex world.

6 Final considerations

The presented paper, aimed to demonstrate challenges to be faced in order to rethink the current status of design education, payed close attention to a new world status and its dynamics. The design

and creative market in general has evolved while some universities still have a lot of way to go to fully adapt their curricula to these new societal challenges. Straightening theses parties was pointed as a need for the system to evolve.

It must be reinforced that, even though the industry repeatedly aims for a student to act as an experienced professional, it should be made clear the ongoing training status of an undergraduate student. It is not up to the school to provide neither all the skills nor the experiences of a profession. Thinking otherwise is not only prejudicial to the alumni that feels constantly incapable, it also exempts the companies from its responsibilities, as pointed by Cardoso (2012, p. 232).

> *There is a disastrous trend in many areas – being design one of them – to consider a student, right after graduation, to be "formed professional". That is a distortion, responsible for generating a lot of unnecessary anxiety and frustration. Becoming a professional from any field is a long process of learning, of which the college is only a part.*

And he adds:

> *The first step, therefore, for the design student to situate himself in the world is to have the full conviction that he is still only a student. [...] With work experience, practice and internships, with readings and study and dedication, he can become a professional in any design segment he may choose. (Cardoso, 2012, p. 233)*

As presented by Pinheiro et al. (2017), educational experiences such as Project-Based Learning, here exemplified by the L3 project case study, are promising for starting a discussion towards the new teaching standards. We believe that PBL has in Design a fertile ground for a successful application to adapt and raise the level of training in design for social sensibility, self-esteem and civic behavior of future designers.

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About the Authors:

Hugo Rocha Graphic Designer, Design professor in Brazil at Instituto Federal Fluminense since 2005, Ph.D. Candidate at IADE-Universidade Europeia (Portugal), and Junior Researcher at UNIDCOM (IADE-UE). His research focuses on Design Higher Education for social impact and sustainable innovation.

Ana Margarida Ferreira is Industrial Designer and Assistant Professor at IADE-UE. She supervises Design PhD students, collaborates with Scientific and Editorial Committees of specialized journals and, as a senior researcher, is invited to make communications in areas as Creativity, Design, Social Innovation and Sustainability.

Jefferson Manhães Full Professor and Rector of the Fluminense Federal Institute. He holds a PhD in Systems and Computing Engineering, a Master's Degree in Computer Science and an Engineering degree in Systems and Computing. For 24 years he has been teaching at different levels of TVET. He has worked in the last 17 years as Coordinator, Pro-rector of Research and Postgraduate, General Vice-Director, General Director and Rector since April 2016.

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I-Wonder-How: A Method for Co-designing with Children in Design Education

UMULU Sıla* and KORKUT Fatma

Middle East Technical University
* Corresponding author e-mail: sila.umulu@metu.edu.tr
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This paper explores co-designing with children in the context of undergraduate industrial design education, and investigates the potential of performative and narrative-based design methods in co-designing with children. It addresses the early phases of design process and proposes a co-design method for supporting industrial design students' eliciting children's needs and preferences. The field study conducted involves a co-design session with 51 industrial design students and 24 third grade primary school children, and face to face semi-structured interviews with 24 design students who participated in the co-design session. The findings indicate that the proposed co-design method, I-Wonder-How, is supportive for industrial design students in their eliciting children's needs and preferences. Based on the challenges experienced by design students during the co-design session and the post-session design process, the study draws attention to the importance of the entire co-design experience including pre and post phases. While the pre-session phase entails preparedness of the parties involved, the post-session phase requires design students to focus on reinterpreting and reconstructing design insights.

co-design; co-designing with children; methods for co-designing with children; co-design in industrial design education

1 Introduction

Children as users and designers as adults who design products for children have distinct intellectual advancements as well as different ways of experiencing the world (Melanio & Gennari, 2013). Therefore, inviting children to the design process as partners is critical for developing an understanding about this special user group. Moreover, integrating children into the design process enables designers to broaden their perspective and introduces them into children's creative, imaginative and playful world (Saure Hagen, Mathillas Røsvik, Høiseth & Boks, 2012). Not only professional designers, but also industrial design students as novice designers can benefit from adopting this approach. Co-designing with children can enhance design students' grasp of the design

process, enable them to develop an understanding of children as users, and help them to overcome unique challenges of designing for children. However, the literature lacks specific methods or tools tuned for supporting design students' co-designing with children.

This study focuses on co-designing with children in the context of design education, and argues that developing a co-design method utilizing children's natural tendency for playfulness and role-playing can facilitate design students' getting into children's world, and help them better understand children's needs and preferences. The study aims at developing a co-design method for the early phases of design process to support industrial design students in their eliciting children's needs and preferences, and involves the development of a performative and narrative-based co-design method, its implementation as a co-design session with industrial design students and third grade primary school children, and face to face semi-structured interviews with design students who participated in the co-design session.

The paper consists of six parts. Part 1 introduces the research topic, the aim and scope of the study. Part 2 presents the key terms and the literature review. Part 3 covers the field study and explains the development and implementation of the co-design method in detail; this part concludes with the post-session interviews conducted with the design students who participated in the session. Part 4 presents the results of the analysis of the interviews. Part 5 discusses the conclusions of the study including the strengths and weaknesses of the method. And finally, in Part 6 recommendations are made for the ones who intend to utilize co-designing with children in the early phases of design education projects.

2 Related Literature

The literature review includes participatory design, co-creation and co-design, and the role of children in the design process and children as design partners. This section also covers a review of existing methods and techniques utilized in co-designing with children.

2.1 Participatory Design, Co-creation and Co-design

Participatory design has its roots in Scandinavia in the 70s and was motivated by the workplace democracy movement (Spinuzzi, 2005). This movement emerged as a response to the transformation of the workplaces as a result of the integration of computer systems into them, which caused a dramatic change in the work conditions of workers (Robertson and Simonsen, 2012). The aim of the movement was to give workers a voice in the design development process of those systems (Steen, Kuijt-evers & Klok, 2007). Many leading projects (e.g. Due project in Denmark, Demos project in Sweden, UTOPIA project in Norway) and conferences (e.g. Design Participation in England) conducted in line with this aim planted the seeds of participatory design (Bødker & Pekkola, 2010).

Along with the technological developments, the context of participatory design spread out of the work environment (Mazzone, 2012) and different design fields such as urban planning and architecture have adopted the participatory design approach. Moreover, over many years, participatory design field has developed an extensive collection of methods, tools and techniques, and made an impact on many other research areas as a mindset. From the 1970s up to now, participatory design, as a mindset, has argued that people (users) are "experts of their experiences" and allowed them to take an active role in the design development process (Sleeswijk Visser, Stappers, Van der Lugt & Sanders, 2005).

According to Sanders and Stappers (2012) in the area of participatory design co-creation and co-design have been growing with a motto arguing that "all people are creative." While co-creation refers to "any act of collective creativity", co-design, an instance of co-creation approach, indicates the collective creativity of designers and users working together in the design process (Sanders & Stappers, 2008). Co-design allows the user to take an active role in the design process and to contribute to the design as an equal stakeholder (Slesswijk Visser et al., 2005). Moreover, it allows

designers to access tacit and latent levels of user knowledge by inviting them directly into the design process (Sanders, 2002).

2.2 The Role of Children in the Design Process and Children as Design Partners

Druin (2002) states that children can be engaged in four different roles in the design process of technology: as a user, tester, informant and design partner (Figure 1). As users, children are observed, videotaped and tested while they are using an existing technology. In this role, children contribute researchers to gain an understanding of the impact of existing technologies on them and their future needs. In the role of tester, children test initial prototypes of new technologies while researchers observe and ask them for comments on their experiences. As informants, children can be involved in different stages depending on the information researchers need to gain from children. Children can be a user, the tester of initial prototypes or they are asked for input or feedback after the development of a product. Before the 90s, children were considered as passive subjects, as users and/or testers of already developed products. With the participatory mindset, children have taken an active role as partners in the design process.

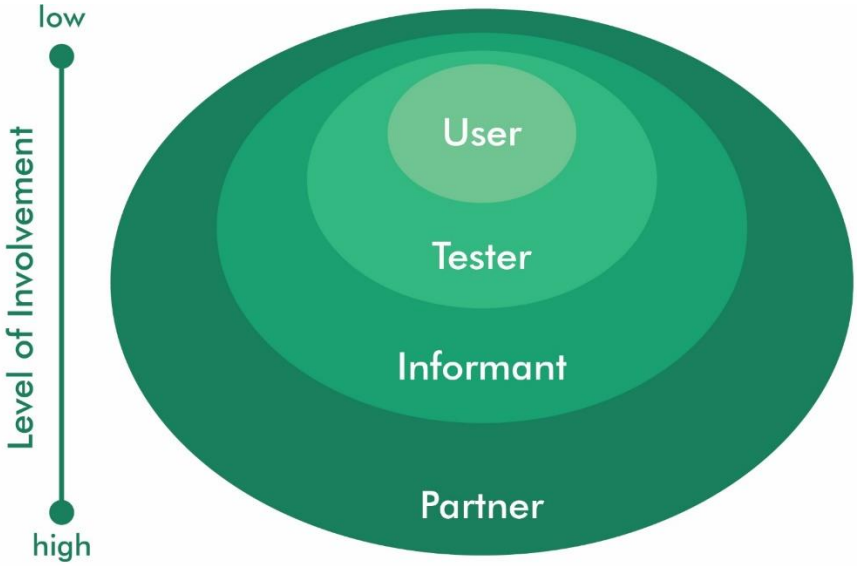

Figure 1 The role of children in the design process (Adapted from Druin, 2002)

2.3 Methods and Techniques for Co-designing with Children

Various methods and techniques have been developed for integrating children into the design process. Based on the ways in which researchers gain information from children, these methods and techniques can be grouped into five as observation-based methods, narrative-based methods, documentation-based methods, art-based methods, and game based methods (Nousiainen, 2008). Observation-based methods aim at gaining an understanding of users' actual work environment and their needs by observing and interviewing them while they are doing everyday activities. Contextual inquiry (Druin, 1999) is the most used and mentioned method in this group. The aim of narrative-based methods is to facilitate expression and verbalization of the views and ideas of children, and they include Embodied Narratives (Giaccardi, Paredes, Diaz & Alvarado, 2012) and Mission from Mars (Dindler et al., 2005). Documentation-based methods aim to discover different aspects of the topic area and to gain information about the context by utilizing documentation techniques, and they include Kid Reporter (Bekker, Beusmans, Keyson & Lloyd, 2003) and Networking News (Nørregaard et al., 2003). Art-based methods intend to enable children to materialize their ideas and generate solutions based on hands-on activities including mock-up and low-tech prototypes; this group includes Comicboarding (Morajevi, Li, Ding, O'Kelly & Woolf, 2007), Mixing Ideas (Guha et al.,

2004) and Layered Elaboration (Walsh et al., 2010) methods, each of which was derived from cooperative inquiry (Druin, 1999).

3 Field Study

The field study comprises two main stages. The first stage is about developing a co-design method for supporting design students' eliciting children's needs and preferences in the early phases of design process; this stage involves the literature review which leads to a matrix of existing methods, and the generation of a co-design method based on the matrix and the design studio project involved. The second stage is about implementing and evaluating the proposed method; this stage explores the theoretical and practical implications of the co-design method, and involves the co-design session, the post-session interviews with design students, and data analysis and findings.

3.1 I-Wonder-How: Developing a Performative and Narrative-based Co-design Method

The proposed co-design method, I-Wonder-How, was developed and conducted in the context of an undergraduate industrial design studio project with the participation of 51 junior year industrial design students and 24 primary school children. The expected outcome of the project was a product family including a washbasin and the accessories related to hand and oral hygiene for primary school bathrooms. The project addressed the primary school bathroom environment in reference to these product categories for building long-lasting hygiene habits, encouraging resource efficiency and product value, and enabling easy cleaning and maintenance. Co-design, in the context of the project, was considered as the most promising approach for eliciting users' needs, preferences and dreams as well as observing their hygiene habits and skills (washing hands and brushing teeth) in the school bathroom context. Therefore, a co-design session which utilized the I-Wonder-How method developed by the researcher was integrated into the fuzzy-front-end of the project with the aim of reframing and reinterpreting the project context by integrating the target users into the design process.

After investigating the existing methods and techniques utilized in co-designing with children, each method or technique was analysed in terms of its main purpose, the activities it included, the age of the participants, the skills required, the design field in which it was utilized, and its pros and cons. This analysis was documented as a matrix of methods. The matrix provided an important reference for developing the method, especially in selecting techniques and developing activities. I-Wonder-How method was developed in four stages: defining the objectives, specifying location and duration, selecting participants and developing activities.

3.1.1 Defining the objectives

In defining the objectives of the co-design method, the project context was taken into consideration. The method was planned to be implemented as a co-design session and was integrated into the project in the initial idea exploration phase with the aim of enabling students to gather user' needs, preferences and dreams. Therefore, the main goal of the method was to enable students to gain insights into the following aspects of the project context:

- The context of design, that is, the school bathroom
- The use of existing products in the school bathroom, that is, washbasin, tap, soap, tissue dispenser, etc.
- Personalization and customization of products of bathroom context and of personal hygiene
- Users' habits and skills concerning hand hygiene and oral hygiene
- Users' ideas about future school bathrooms

3.1.2 Developing activities and selecting techniques

Since the aim of the study included investigating the potential of narrative-based design methods in design students' eliciting children's needs and preferences, firstly, a narrative was generated

through the sessions in which studio tutors and the researcher participated. As a result of the discussions, a narrative inspired by the one used in Mission from Mars technique (Dindler et al., 2005) was decided to be utilized. The narrative was about the Martians who decided to construct a primary school on Mars for children visitors from Earth and contacted industrial design students to help them.

A shared narrative enables children to express their opinions and ideas about the issues which otherwise would be too self-evident to tell through ordinary interviews, and enables researchers to ask even the stupidest questions to children by utilizing a narrative about Martians who want to gain insights into the context of which they do not know anything. Personal hygiene activities, the main focus of the project, are also part of the daily routine and too self-evident. Besides the main aim of facilitating expression, the narrative also made children feel like part of the design team by assigning the children the role of researcher and/or designer consulted by the Martians. To maintain the consistency, all activities were designed considering this narrative.

In designing the activities, path of expression model which Sanders and Stappers mention in their book Convivial Toolbox (2012) was taken as a base. While selecting and staging the techniques, the path of expression enables a pathway.

The first step was concerned with observing the current practices in context; the design teams (children and design students) went to the school bathroom to perform two main hygiene activities, washing hands and brushing teeth. For this step contextual inquiry was selected as a method. Contextual inquiry combines two techniques, observation and interview, by focusing on observing actions performed by users while simultaneously discussing these activities with the user through the interview. Observing children in the field provides design students with insights into children's current practices. Besides, interviewing with them while they perform activities provides design students with the understanding of the reasons behind the way these activities are done. Based on the contextual inquiry, design teams' activities were specified as follows:

- Visiting the school bathroom together
- Children's performing two main hygiene activities
- Design students' conducting interviews with children about these activities

Concerning the documentation technique, both video recording and taking photographs were selected, and two students in each team were responsible for documentation. The children were also asked to take photographs of each other while carrying out activities to be later sent to the Martians. The reason behind giving them the role of the photographer was to make the step engaging for children as well as to make them feel like part of the design team.

The second step was concerned with recalling and reflecting on children's past experiences. This step aimed at enabling design students to gain insight into needs and preferences of children, and to prepare participants for the next generative session. To do this, interview technique was utilized together with question-driven cards generated by the researcher for this particular step. The first two cards included the first two questions asked by the Martians in which children draw and/or write down their actions performed during each hygiene activity step by step and specify products used to accomplish these actions. The third card includes the third question asked by the Martians. In the process of filling the third card, in order to gain further information about their needs and preferences, a discussion session was integrated into the step in which children reflect on these activities and express their way of making boring activities more engaging.

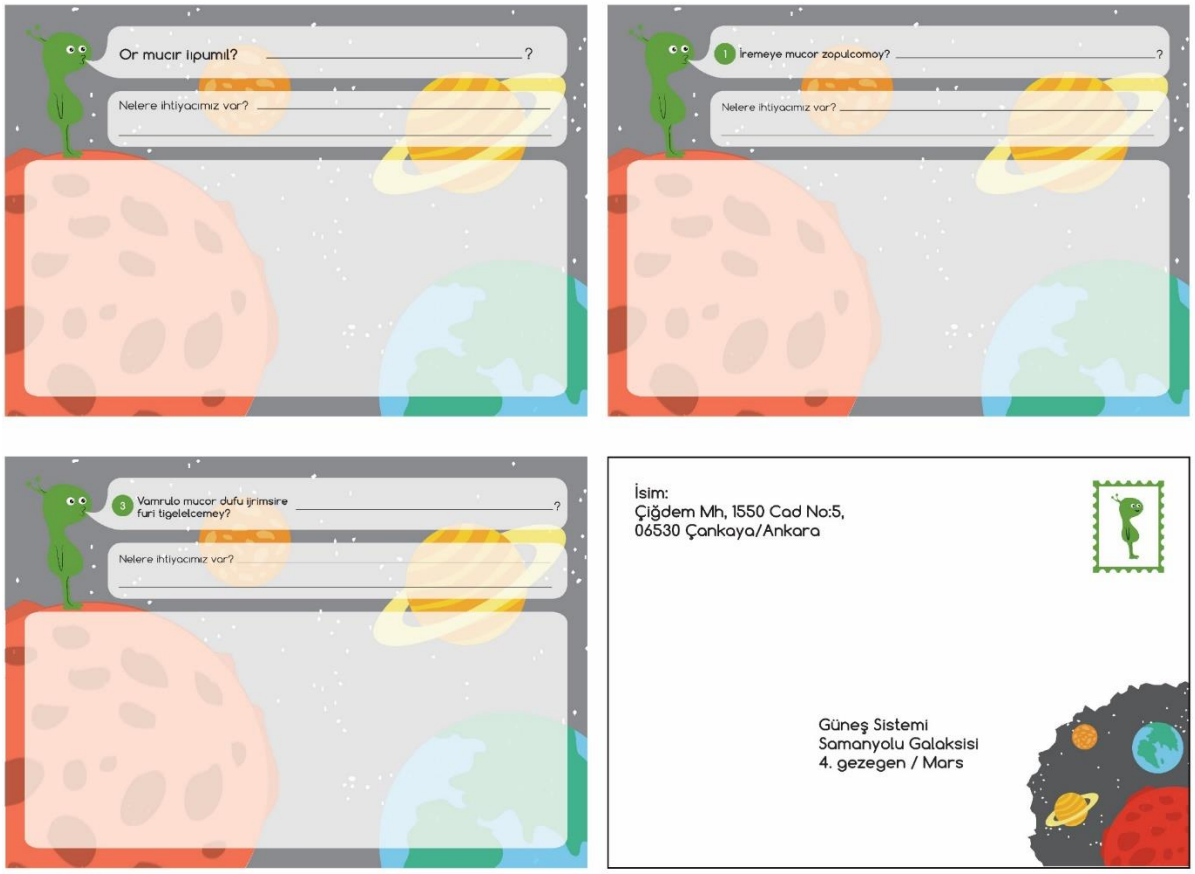

Figure 2 Question-driven cards. Buttom right: Envelope

The third step focused on exploring the future possibilities, in which participants created new ideas and concepts regarding the context. Brainstorming method was considered suitable for this step, as it has been traditionally utilized to generate ideas or requirements, finding solutions to problems and exploring new design spaces (Wilson, 2013). Moreover, using brainstorming method with children in generative sessions has been proved to enable children to generate novel and creative ideas (Thang et al., 2008). Design students are also accustomed to conducting brainstorming sessions in teams.

The fourth and final step involved embodying future ideas and concepts as physical artefacts. Low-tech prototyping technique was considered as the appropriate one for this step since this technique enables children to express their ideas which are difficult to communicate verbally (Druin, 1999), and to generate ideas or solutions which are more relevant and workable (Thang et. al., 2008). Tools and materials for low-tech prototyping included paper, pencils, crayons, glue, scissors, and play dough. In addition to these, design students were allowed to bring materials they considered useful in order to diversify the materials and the ways they expressed themselves (Druin, 1999). Moreover, the students were required to investigate design ideas underlying the artefacts children made because those artefacts could not express themselves (Thang et al., 2008).

3.2 The Co-design Session

3.2.1 Participants and the Spatial Context

As the co-design session was integrated into the third-year design studio project, all registered students, 51 in total, participated in the session. The students were divided into 12 groups, three groups of five and nine groups of three, for the project. The number of children participated in the co-design session was 24. All children were in the third grade (9 years old), and all of them were from the same class. Besides the researcher, the junior year studio team consisting of two studio tutors, three part-time instructors and one teaching assistant also participated in the session as co-

facilitators. The session was conducted in the library of the primary school which the children attended. The library was the main location for most of the activities; during the session children and design students visited the school bathrooms for acting-out and observation. The total duration of the session was two hours, from 2 pm till 4 pm.

3.2.2 Stages of the Co-design Session

Before the session, the design students in each team discussed and distributed the roles among the members; these roles included a photographer, cameraman, note-taker and partner. Each student in the design team also prepared a badge displaying the nickname associated with his/her role and the narrative in order to communicate their roles and facilitate children's engagement into the narrative. Each team also brought a laptop, cameras or smart phones to take videos and photos, and low-tech prototyping materials and tools (paper, pencils, crayons, glue, scissors, and play dough) for idea generation.

The co-design session consisted of five stages and included three missions to be accomplished:

1. Establishing the narrative
2. Mission one: Decoding signals from Martians
3. Mission two: Exploring the school bathroom
4. Mission three: Proposing a dream school bathroom
5. Presenting children with "Interplanetary Design Champion" badges

In the first stage, the narrative and the roles of the students and the children were introduced. The role of the children, as the members of the design team, was to help the Martians to find solutions to their problem. After they were presented the narrative, the design students introduced themselves as mediators and facilitators with specific roles and nicknames written on their badges. Duration of this stage was ten minutes and conducted in the library. After the introduction, the first mission was given.

In the second stage, the children were shown three videos including signals sent by the Martians in Mars language. Then, the design students wanted children to help them translate these signals into the local language individually. The signals addressed the three questions listed below:

1. How do you wash your hands?
2. How do you brush your teeth?
3. How do you make these activities enjoyable and fun?

In order to guide the translation process, each child was given a decoding sheet which included a table to match letters of Mars language with the local language. With the help of the table, each team went over the questions one by one, and briefly discussed alternative answers. After the decoding phase, the design students proposed the children to pay a visit to the school bathroom to make an exploration together.

Figure 3 Decoding session

The third stage was divided into two parts. In the first part, the children and design students made an exploration in the school bathroom. In the bathroom, the children performed two main hygiene activities which the Martians expected to learn about: washing hands and brushing teeth. Each child was given the role of taking the photos of the other child while s/he was carrying out these activities. Throughout the stage, the student teams made discussions with children regarding the two activities during children's performing, and they documented the session by photos, videos and notes. In the second part, the student teams returned back to the library and the children were given three cards. Each card addressed one of the three questions which the Martians asked through the signals. In the first two cards, children wrote down or drew the stages of each hygiene activity together with the materials and products utilized for these activities. In the third card, the children expressed the low points of the activities together with their reasons and described how they made them more engaging. After being filled in, the cards were put into a special envelope to be sent to the Martians by the design students. The total duration of the third stage was 45 minutes. After this stage, the children were given the third mission.

Figure 4 Exploring the school bathroom. Top: Children performing activities. Bottom: Children filling in the question-driven cards.

In the fourth stage, each team conducted a short brainstorming session with the children and then embodied their ideas into artefacts. In the brainstorming session, the children generated ideas regarding the future products utilized in hygiene activities by using sticky papers to write down and/or draw ideas. Then, the student team provided the children with low-tech prototyping materials so that they could describe, drew and/or model their ideas. When they were ready, each child took a photograph of his/her work to be sent to the Martians by the design students. The duration of this stage was 45 minutes. After the generative session ended, the children were given the artefacts they made. In the final stage, each child was given a "Interplanetary Design Champion " badge sent by the Martians to thank them for their help.

Figure 5 Low-tech prototyping session

3.3 Post-session Interviews

In order to understand the implications of the proposed method from the students' perspective, semi-structured interviews were conducted with the design students who participated in the session. At the beginning of each interview, the participant was given a consent form which informed the participant regarding the context of the study. The interviewer started by asking a general question about the topic of the study, and gradually continued with more specific questions. During the interviews, the order of the questions was changed, and some additional questions were asked according to the interviewees' answers without digressing from the topic. The interviews were conducted at the Industrial Design Department's graduate design studio. The interviews lasted between 10 to 30 minutes and were audio-recorded.

3.3.1 Participants

Out of 51, 24 industrial design students (15 female and 9 male students) participated in the post-session interviews individually. There were two students from each design team. The participants were selected based on their roles in the co-design session as there were an equal number of students in each role. The foreign students were excluded from the interviews; since the students communicated with children in the local language during the co-design session, foreign students were not able to provide detailed information concerning the session.

3.3.2 Interview Schedule

In order to structure the interview, an interview schedule including the questions and the possible probes was prepared. Before the questions took their final form, two pilot studies were conducted, and after each study, the questions were revisited and revised. In its final form, the interview schedule consisted of 17 questions and divided into five parts:

- Insights gained from the co-design session
- Comparison of the user observation phase with the co-design session
- Evaluation of the co-design session stages
- Evaluation of collaboration during the co-design session
- Suggestions

3.3.3 Analysis of Interviews

In the analysis of the interviews, thematic analysis method was adopted (Auerbach and Silverstein, 2003). Firstly, 24 audio-recorded interviews were transcribed verbatim into MS Word. Transcription process provided the researcher with the overview of, and familiarity with the data. After transcribing, the data was read all over again in detail. During the second reading, some initial themes started to emerge. Later, the transcribed interview data were studied in the light of initial themes. The raw data were divided into chunks, that is, relevant texts (Auerbach & Silverstein, 2003), and codes were assigned for each chunk considering the initial themes. Lastly, all data were

copied to MS Excel to easily arrange or cluster the data, and themes were divided into sub-themes and categories.

4 Results of the Analysis of the Post-session Interviews

4.1 Contribution of the Method to Co-designing with Children

There were several aspects of the co-design session which supported design students in co-designing with children. One of the most stated aspects was that the session was fun both for children and students, but especially for children. This feature facilitated children's creativity and their integration into the design process. Moreover, it made children express their ideas and collaborate with students willingly and in a fun way. Taking photos, prototyping, and the narrative itself were the activities stated by the design students as engaging.

In addition to being engaging and fun, each activity supported design students' co-designing with children in terms of various aspects. According to the design students, the shared narrative made children more comfortable and free to share their ideas and thoughts. It also created a common ground for children and students by making all members of the team a part of a shared mission. Activity of taking photos enabled the children who were shy to come out of their shell and to fully integrate into the design session. Low tech prototyping also empowered children to express the ideas which were difficult to communicate verbally; furthermore, it enabled children to create more concrete and detailed ideas as well as to create connections between the spatial context and the product.

4.2 Contribution of the Method to the Early Phases of Design Process

There were several aspects of the session which supported design students in the early phases of the design process. One of those aspects, and the most mentioned one, was that the session enabled design students to observe children in context. Exploring the school bathroom phase was considered as the most fruitful one among others in terms of data collection. Design students gained several insights in this stage in terms of user characteristics, hygiene habits, usability and resource efficiency and most of them integrated those insights into their final design solutions. For example, one group investigated the potential of washing hands together for developing sustainable hygiene habits by observing children's communication with each other while they were in the school bathroom together. Based on this insight they designed a station with three washbasins which enabled children to communicate with each other during performing hygiene activities. The second most mentioned aspect was that the design session enabled the design students to develop a deep understanding of the user group. According to the design students, this was facilitated by the brainstorming and prototyping phases during which the students gained insights into children's preferences and dreams.

In addition to the benefits of the session for the design process, the students also stated that the session contributed to their developing design research skills as a long-term benefit. It is important to note that the students who participated in the session did not have any previous experience in co-designing with children. Thanks to this session, the students gained experience in communicating and designing with children as design partners. Some students mentioned that the session altered their thoughts about children in a positive way.

4.3 Challenges Faced by the Students during the Session

There were some challenges faced by the students during the co-design session in terms of data collection, management, communication and location. Firstly, the challenges regarding data collection were experienced during the school bathroom exploration, reflection and evaluation, and brain storming phases. During the exploration phase, the children altered the way they performed the hygiene activities because the design students were observing them. This situation created doubts about the reliability of observations. Furthermore, some students mentioned that the children felt hesitated and embarrassed to brush their teeth in front of others. During the reflection

and evaluation phase, the children got confused about how to use the question-driven cards they were provided with, and they oscillated between drawing and writing. The cards remained insufficient in facilitating the children to think about activities in detail. According to the design students, this situation resulted from the fact that the paper size was too big and there were no guidelines or restrictions regarding the use of cards. This caused children's spending more time with deciding on what to do than completing the task itself. Furthermore, some students mentioned that the children competed against each other because there was one card for two children, so both wanted to be the one who wrote the most. During the brainstorming and prototyping phase, the students had difficulties in guiding the children because they digressed from the topic and generated extreme ideas which could not be utilized as design solutions. According to the students, besides children's nature, this situation might also result from the fact that the children perceived the prototyping phase as play because of the materials provided.

Secondly, one of the major problems the students experienced during the session was time management. Most of the students stated that the duration of the session was not enough to accomplish all the tasks and some of them failed to finish decoding and filling in the question-driven cards. Moreover, managing the flow of the session was also considered as challenging by some students; according to them, the reason behind this could be insufficient preparation.

Thirdly, communication with children was one of the important issues indicated by design students. The most stated challenge was that the children refrained from the students. According to the students, this might be caused by the inefficiency of the warm-up phase, children's being in the school environment, or the narrative. Due to the limited time allocated by the school, the warm-up session could not be done efficiently. This situation affected the whole process in some teams. Also, being in the school environment caused some children to perceive the design students as authority, and they hesitated to communicate with the students and/or to express their ideas.

Lastly, all teams being located in one room, the school library, caused some problems. According to the students, the space was crowded and noisy, which was distracting both for the children and the students.

5 Conclusion

This paper reported a study which aimed at investigating the potential of performative and narrative-based methods in co-designing with children in the context of undergraduate industrial design education. In order to fulfil the aim, firstly, a co-design method was developed and implemented as a co-design session in the context of a design studio project. Then semi-structured interviews were conducted with the design students who participated in the co-design session. The findings addressed the strengths and weaknesses of the method called I-Wonder-How. Moreover, the results drew attention to the issues which required further development.

The strengths of the method lie in its being performative and narrative-based as well as its involving hands-on techniques. The method combines exploratory and generative research techniques utilized in the early phases of the design process, and gathers and structures these different techniques under the roof of a shared narrative. The shared narrative about the Martians which spans the whole session creates a common ground for the children and the design students by assigning them all the role of a researcher. This helps design students' overcoming the challenges of integrating users into the design process as partners. Even if most of the children do not believe in the narrative, they consider the session as a game, embrace the process and go through the tasks willingly and joyfully. The narrative also enables design students to go beyond the boundaries of existing social and cultural context while designing for future experiences. The performative character of the narrative -which can be seen in the school bathroom exploration phase- facilitates the children's integration into the process as well as providing the design students with a rich source of data regarding the context and the users' habits and skills. The children's taking an active role in documenting the exploration phase makes them feel comfortable and integrated into the design

team. The whole process preceding the brainstorming and prototyping phase including the performing and reflecting on their current practices and past experiences raises children's awareness about the topic and helps them recall their experiences. This facilitates children's expressing their thoughts and ideas in the brainstorming and prototyping phase. Low-tech prototyping tools utilized in this phase also enable children's expressing their ideas and provide the students with a rich source of knowledge which can be transformed into design insights and ideas.

Besides the strengths there are weaknesses concerning the method and the entire co-design process. First of all, the method was implemented, and the session was conducted by novice designers with no previous experience in participating in or facilitating co-design sessions with children. Therefore, they did not know much about how to gather data during the co-design session with children, how to probe children, how to properly document a session, and how to communicate with children effectively. Moreover, as they did not have experience in generative sessions with children, the outcomes of the brainstorming and prototyping phase fell short of their expectations. The students expected a direct contribution from the children in the form of design ideas which can be applied to the problem area readily, rather than reinterpreting and reconstructing the ideas generated by the children as design insights. Therefore, most of the students considered brainstorming and prototyping phase unfruitful.

There were some other aspects which resulted in challenges during the session. One of them revealed itself in decoding, and reflecting and evaluating phases. The children had difficulties in understanding the intended use of the cards in these two sessions and thus, in fulfilling the tasks. Moreover, these activities caused some children's competing against each other regarding "who finishes first" and "who writes most". Another aspect was that the time for warm-up was too short. In some cases, this caused children's refraining from students and in some groups this situation affected the whole process and caused difficulties in gathering data.

6 Recommendations

The main insight gained through the study is that the co-design process should be taken as a whole and include the pre-session and post-session processes as well. In order to achieve the intended aim of the method and the co-design session, it is necessary to specify the roles and responsibilities of all the actors and stakeholders involved for all the phases. Therefore, the following sections discuss the recommendations for the ones who intend to utilize co-designing with children in the early phases of design education projects.

6.1 Pre-session Process

As mentioned above, as students did not have previous experience in generative sessions with children, they experienced challenges in terms of managing the process and collecting data during the session. In order to fulfill the aim of the co-design session and to minimize those challenges, the students should be informed prior to the session regarding the following issues:

- how to gather data during a co-design session with children, how to prop children, how to properly document a session, and how to communicate with children effectively
- the order and aim of the activities, and the ways of conducting these activities
- the expected and possible outcomes of the session

Another issue revealed by the field study was that the children had difficulties in terms of using the cards utilized in decoding, and reflection and evaluation phases. It would be beneficial to conduct pilot studies to test the effectiveness of such material, and to consult primary school teachers in terms of evaluating the suitability of the tasks for children's skills.

6.2 Post-session Process

According to the results of the study, most of the design students had difficulty in analysing the data gathered in the co-design session as well as integrating their insights into their design solutions. Providing the students with a guideline or directions for the post-session analysis would benefit the process. The students can also be provided with a platform or can be encouraged to conduct discussion sessions for sharing their insights and experiences with each other. Post-session discussions and presentation of analyses can provide diverse insights for design students.

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Section 25.

How Organisations Employ Design as Vehicle for Change

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Editorial: How Organisations Employ Design as Vehicle for Change

HAMMOND Chris[a]; YEE Joyce[b]; JUNGINGER Sabine[c], BROOKS Sarah B, SAYLOR Joni, and MICHLEWSKi Kamil

[a]IBM
[b]Northumbria University
[c]University of Applied Sciences and Arts

Today an unprecedented number of organisations are investing in design to deliver better and more sustainable outcomes. Design as a function of an organisation is not new – in 1973 at the University of Pennsylvania, Thomas J. Watson Jr stated, "Good design is good business." This mantra has become even more important in an increasingly challenging and volatile global environment. Life spans of organisations have significantly reduced, halving over four decades, and almost one-tenth of all public companies fail yearly, a fourfold increase since 1965 (Reeves and Püschel, 2015). The necessity for companies to constantly adapt their strategic approach to ever-changing conditions is greater than ever.

The turn to design is borne out of the need to sustain value, profitability and longevity. Enterprises need to innovate (Chesbrough, 2013; Eisdorfer and Hsu, 2011) and one approach to kick-start innovation is to use design (Kolko, 2015). The Design Value Index Study (Rae, 2016) demonstrates that organisations embracing design perform better. However, it remains unclear how organisations use design to generate competitive advantages. No one 'right' model exists. The common narratives around success stories tend to focus on changes that are externally tangible, i.e. they discuss new products and services. Little insight is provided into how an organisation is transformed in relation to its established process, structure and values. The culture of an organisation often gets overlooked in these conversations. Organisations big and small are investing in design to better compete and to create greater value for the people they serve. To maintain relevancy, one must create new forms of value. But how is this done?

This collection begins to help us understand how organisations are adopting design to create more value. It features examples in both the public and the private sector. This track initiates dialogue around and understanding of how design enables and supports culture change. As practitioners and researchers already engaged in this practice, we are extremely excited to facilitate this discussion at DRS 2018. We have curated a rich sample from a variety of organisations, ranging from medium-sized multinational technology companies, through small businesses in Brazil and Ireland, to public-sector departments in Europe and Canada. The papers surfaced a number of themes that can inspire more organisations to adopt design to continuously innovate. We highlight and discuss some of these themes in the following sections.

Valuing culture change over ideas

It's important to consider how sustainable design and innovation culture develops throughout an organisation. Jylkäs and Kuure's paper on '*Embodied design methods as a catalyst for industrial service design process' describes* embodied approaches to enable industrial service delivery teams to take a more human-centered approach. They discussed the potential for these approaches to yield improved outcomes and more respected positioning for the delivery team within the organisation. These two tactics can help catalyse the adoption of embodied approaches at the larger organisational scale. Additionally, the authors argue that embodied methods make the understanding of service context more experiential. This allows the project team and stakeholders to form a shared vision and goals for the service – crucial for culture change.

Using a design-driven innovation method impacts the way companies conceive, create, and capture value across the institution. It also changes the way people work and interact along with changing mindsets and culture. Transforming a company into a design thinking organisation is challenging, as pointed out by many of the authors in this track. Klitsie and colleagues in their paper *'Using dynamic capabilities in an actionable tool as a vehicle to initiate design-driven innovation'* focus on one difficult element in particular: innovation by design is both a strategic and a tactical capability. They suggest a theoretical framework to better understand this issue and to help organisations identify and leverage innovation capabilities.

Building design capability

Design capability is defined as an organisation's ability to apply design to strategically problem-solve, drive innovation, and create business success. This capability leads to better quality of life through innovative products, systems, services, and experiences (World Design Organisation, 2017). Many of the papers in this track share their approach to building and embedding design capability in organisations. These include using an innovation catalyst (Bastiaasen et al), flexible innovation frameworks (Stoimenova and De Lille), and process models (Iverson, Kunø and Vistisen).

Bastiaansen and colleagues' paper '*Design capability in a software SME: Report from an embedded design innovation catalyst'* addresses the challenge of integrating design capabilities into an engineering led organisation. They investigate the barriers to developing design capabilities and means of overcoming them. They present how design capability can be built quickly and become a catalyst for a software firm to move from a data-driven to a user-centered approach. Like other studies, they share barriers to adoption, such as an over-reliance on internal knowledge, low urgency to change, and the firm's existing low design capacity. A different approach to building an organisation's design capability is presented through Stoimenova and De Lille's paper *'Building the foundation for a design-led ambidexterity in a medium-sized tech company'*. It describes how small-to-medium enterprises (SME) can use design to improve their innovation outcomes. They present a new theoretical model tested with three SMEs – the Design-Led Ambidexterity (DLA). It creates decision making mechanisms and structures that enable a company to balance both types of innovation – incremental and radical. The paper highlights the interesting tension present in all design-led innovation initiatives: how to balance exploration and exploitation activities. Exploitation allows the firm to improve the efficiency of implementation and production of the existing capabilities of the firm. In contrast, exploration is characterized by search, experimentation, play, flexibility and investigation – and can result in new knowledge (Tabeau et al., 2016). Exploitation offers short-term success but exploitation is required to develop radically new solutions for longer-term success. Developing new solutions requires a guiding framework, methods and people; and a shared understanding of what needs to be achieved, conditions that Stoimenova and De Lille's framework attempts to address.

Iverson and Vistiesen's paper '*The role(s) of process models in design practice'* challenges our assumption regarding the use of design process models. They suggest that they are not merely used to guide and manage the design process, but also take on a more important communication role. Process models both create an internal design rationale and demystify design thinking to stakeholders. Developing flexible frameworks and models aids in the scalability of organisational design capability.

Design as a strategic tool

Botzepe highlights design's capacity to disrupt business as usual. This often means overcoming stiff resistance from the organisation (see Brown & Martin 2015). She raises the question that if this is the case, how does design get a seat at the table? Her paper addresses this issue by examining data from five design consulting firms (DCF) in Denmark which have strategy- or policy-level engagements with their clients. It examines the path to strategic work, and how DCFs have transformed to deal with the evolving nature of their businesses. Her findings support the value of design as a strategic tool. More importantly, they highlight the approach needed to convince organisations to invite external design firms to help inform their strategy. The paper proposes two main approaches. Firstly, repeated long-term client relationship building. Second, human-centered user research engagements to integrate design into the larger system. Similarly, Pandey's paper '*Entangling, oscilliating, frilux-ing: Branding the art of design*' explores the value of strategically framing and manifesting design as an approach to building design cultures. This case study illustrates the difficulties of building in-house design competencies for library staff. They observed how framing design activities with organisational language and values can drive adoption. The term 'friluxing' – derived from the Norwegian words meaning 'free playing' – is now used synonymously with designing in the organisation. Librarians have gained confidence using and teaching design methods to other colleagues. This change illustrates a shift in mindset and an increased understanding of design.

Gaynor and colleagues' paper *'How design thinking offers strategic value to micro-enterprises'* argues that design thinking can be a powerful instigator in re-invigorating the identity and purpose of a micro-enterprise that can often be diluted as the organisation grows. The paper explores the application of "Ecology Mapping" techniques to synthesize data from many perspectives to help focus an organisation's identity and actions. They argue that these understandings provide a platform that facilitates future strategies and actions. This engagement with design at a strategic level from the outset can enable cultural and behavioral change and support sustained adoption of a design-led approach.

Drivers and barriers

The final two papers focus on revealing different drivers and barriers to design adoption in different contexts. Braga and Zurlo's paper *'Introducing design-driven innovation into Brazilian MSMEs: Barriers and next challenges of design support'* provides a thorough and comprehensive account of design support systems in Brazil to foster a climate for sustainable economic growth. They particularly focus on challenges faced by various organisations attempting to integrate design at the project level. The authors recognized the limitation of a top-down approach to support design adoption and are keen to explore ways of supporting a bottom-up approach to design interventions through a process of collaboration. Lee and Person's paper, in contrast, looks at the barriers to the adoption of service design in a Finnish public sector context. Their paper *'Perspective: the gist of public tender for service design'* focuses on the important, yet often overlooked, subject of public procurement of creative services. They describe the challenges associated with procuring 'intangibles' such as service design consultancy. Case studies at different threshold points help reveal some of the challenges associated with poor transparency across the buyer and supplier relationship.

This paper track has been extremely popular as evidenced by its representation across two sessions. Our aim was to offer a portfolio of examples that show various ways organisations employ design to drive change. The range of papers illustrates the deepening interests in the field. It offers a platform for public and private sector organisations, researchers and practitioners. These themes only provide a glimpse into the range of varied research happening in this field. We hope that they act as prompts to help organisations adopt design to drive change and create more value.

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Building the Foundation for a Design-Led Ambidexterity in a Medium-Sized Tech Company

STOIMENOVA Niya* and DE LILLE Christine

Delft University of Technology
* Corresponding author e-mail: niya.stoimenova@gmail.com
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Approximately 75% of all Standard & Poor's 500 companies will be gone by 2027. The necessity for firms to swiftly adapt their strategic approach to the ever-changing conditions is greater than ever. To do so they need to ensure both short and long-term opportunities are fulfilled. A construct that can support them in doing that is called Design-Led Ambidexterity (DLA). A basis for DLA has been established in previous studies from a theoretical perspective based on two cases in large multinational companies. This study aims to further our understanding on the topic by investigating how an optimal foundation for DLA's implementation can be built in a multinational mid-sized tech company. As a result, we suggest a new version of DLA and its frameworks to accommodate the gained insights. We also designed and are currently training employees in a new way of working that supports DLA's implementation. Last but not least, our research provided new insights on the role design can play in achieving continuous stream of innovation.

design-led ambidexterity, ambidexterity, organizational design, design adoption

1 Introduction

Firms today have a one-in-three chance of failing within the next 5 years compared to one-in-twenty 50 years ago (Reeves & Püschel, 2015). In fact, according to a 2015 McKinsey study, the lifespan of an organization has decreased from 61 years in 1958 to only 18 years in 2011. Therefore, 75% of the stock market index Standard & Poor's companies will be gone by 2027 (Desmet et al., 2015).

The necessity for companies to swiftly adapt their strategic approach to the ever-changing conditions is greater than ever. As a result, many firms adopt an excessively short-term focus and neglect their longer-term horizons (Reeves & Püschel, 2015). For instance, while profit margins have significantly increased since 2010, investments in R&D and capital expenditures continue to be relatively low (Faeste, 2017). This notion is best reflected in the almost singular focus of many companies to become agile and adaptable leading to the rise of methods such as the Lean Startup (Ries, 2011) and Scrum (Schwaber & Beedle, 2002), as well as in the growing tendency to assess

leaders in terms of quarterly performance (Reeves & Püschel, 2015). Hence, to counteract these tendencies, a model has to be created that puts in place the decision mechanisms and structures which will manage to balance both sides of the innovation coin – incremental and radical innovation. Failure to do so will result in declining performance and the need to implement risky transformation programs (Faeste, 2017).

An increasingly popular construct for achieving long term firm survival and developing such dual focus inside firms is called organizational ambidexterity (Oehmichen et al., 2016). Defined as "the ability to simultaneously pursue both incremental and discontinuous innovation… hosting multiple contradictory structures, processes, and cultures within the same firm" (Tushman & O'Reilly, 1996), organizational ambidexterity allows companies to simultaneously manage current business demands and adapt to environmental changes (Mom et al., 2015). Due to its contradictory structures, however, its implementation continues to be challenging (Oehmichen et al., 2016).

Based on our previous work with two large multinational companies, we believe a way to overcome such challenges is to use a new type of ambidexterity – design-led (DLA) (Stoimenova & De Lille, 2017). We proposed a model that aims to further our understanding of the specific mechanisms through which the use of design might improve innovation outcomes (Stoimenova & De Lille, 2017). Currently relatively little is known on the topic (Liedtka, 2015) despite the fact that the popularity of design-based approaches such as Design Thinking (Brown, 2008) and Design Sprint (Knapp et al., 2016) continues to grow (Carlgren et al., 2016). Hence, the purpose of the paper is to advance our understanding on how to create a solid foundation for the implementation of DLA in organizations.

To do so, this paper presents the initial steps of DLA's implementation (the creation of a solid foundation for such) in a medium-sized multinational tech company we'll call X. Active in more than 90 countries with 3 300 employees worldwide, X is a B2B firm focused on the design and development of networked visualization products for the Entertainment, Enterprise and Healthcare markets. Built around its strong engineering culture, the company has no formal background in design, no design department and there are only a few employees with a formal education in design scattered around the organization. The process the company follows can be roughly divided in two parts: Product Definition and Product Development (a stage-gate-like process), primarily carried out in silos. Thus, the collaboration among different internal stakeholders can be difficult.

X presented an optimal case for the implementation of DLA for three main reasons. First, at the time of the research, a new CEO was appointed who emphasised the importance of shifting X's focus from being purely technology-driven to seeing technology as a service offering that delivers "bright outcomes" to their customers. This necessitates change in their organisational structure and processes with a strong focus on understanding when to kill of a project. Second, this new change in leadership initiated an executive desire and support to shift the company towards continuously delivering human-centred innovation in an optimal manner. Thus, initial interest was triggered to implement design (thinking) in their innovation efforts. Third, there is an influx of new employees who are still not fully integrated in the existing corporate culture. According to March's organizational learning theory (1991), this gives X the opportunity to create and execute new values and form new corporate culture.

This paper is structured as follows: first, the existing literature on different types of ambidexterity as well as the notion of DLA with its accompanying model and framework is reviewed. Then, the methodology of the research and the collected results are described. This is followed by a discussion of the results, concluded with a new iteration of the DLA model and framework. Last but not least, the article discusses possible implications for the role design can play in organizational structures and indications for future research.

2 Literature Review

As already mentioned, organisational ambidexterity has become one of the most heralded capabilities for long-term firm survival and development in the past few decades (Oehmichen et al.,

2016). Although different types of ambidexterity exist, they all have one thing in common: the construct is built upon two main elements – exploitation and exploration. The former allows the firm to improve the efficiency of implementation and production of the already existing capabilities and knowledge of the firm. As such it's associated with "refinement, choice, production, efficiency, selection, implementation and execution" (Tabeau et al., 2016). To achieve these, its processes and culture are defined by tight controls and carried out by units organized to be efficient (March, 1991). As a result, these activities improve present returns that are closely related to the firm's current actions (March, 1991) and thus, they are more likely to result in incremental innovation (O'Cass et al., 2014). All of these qualities make exploitation generally favoured by most companies due to its greater certainty of short-term success (O'Conor, 2008).

On the other hand, exploration is characterized by search, experimentation, play, flexibility and investigation, and can result in new knowledge (Tabeau et al., 2016). Such knowledge is essential for developing radically new solutions (Atuahene-Gima, 2005). To accommodate for these, exploration is usually associated with looser controls and structures, more flexible processes and search behaviours that are geared towards experimentation and improvisation (Duncan, 1976). Therefore, its results are often distant in time, uncertain and ambiguously connected to the current context (Stoimenova & De Lille, 2017).

O'Reilly and Tushman, (2013) and Chebbi et al. (2015) define three common types of organisational ambidexterity in regards to the interaction between exploration and exploitation. The first one, sequential, is a form of temporal separation, most useful in stable slow-moving environments. It's based on the notion that a company should regularly shift their focus from exploration to exploitation and vice versa. To do so firms need to develop processes and mechanisms that enable the seamless shift between the two (Wang & Rafiq, 2012). Thus, in order to be able to accommodate the changes of the environment they are in, the organisation regularly goes through periods of centralization (exploitation) to enhance cost efficiencies and decentralization (exploration) to emphasize innovation (Raisch, 2008).

Second is the structural or simultaneous ambidexterity. Unlike the first one, this is built upon two structurally separated and simultaneously operating units of exploration and exploitation. Each unit has its own processes, structures and cultures, managed in its unique way (Duncan, 1976). However, one of them, usually exploitation, is seen as the primary structure that's geared towards developing incremental innovation. Thus, it is often seen as the one that maintains stability. The other, usually exploration, is seen as the secondary structure and it's often carried out by project teams and networks focused on exploratory activities (Raisch & Birkinshaw, 2008). While such separation ensures each structure can achieve its goal (McDonough & Leifer, 1983), it also creates physical boundaries between the two (Benner & Tushman, 2003). Therefore, ensuring a smooth handover of ideas from one unit to another is particularly difficult (Stoimenova & De Lille, 2017).

The third type, contextual ambidexterity, attempts to solve the exploration-exploitation conundrum on an individual level (Gibson & Birkinshaw, 2004). It does so through "an interaction of stretch, discipline, and trust" and requires a "supportive organizational context" that "encourages individuals to make their own judgments". Unlike the other two types of ambidexterity, the contextual one emphasises the importance for an individual, not a unit, to be able to shift between exploration and exploitation while being part of a unit that is both aligned and adaptable. As a result, the organizational systems and processes are never concretely specified. According to O'Reilly & Tushman (2013), the most common example of such is workers being able to continuously optimise their jobs (exploration) and perform routine tasks (exploitation). This type, however, does not address the simultaneous and systematic conduct of exploration and exploitation on a company level (Kauppila, 2010).

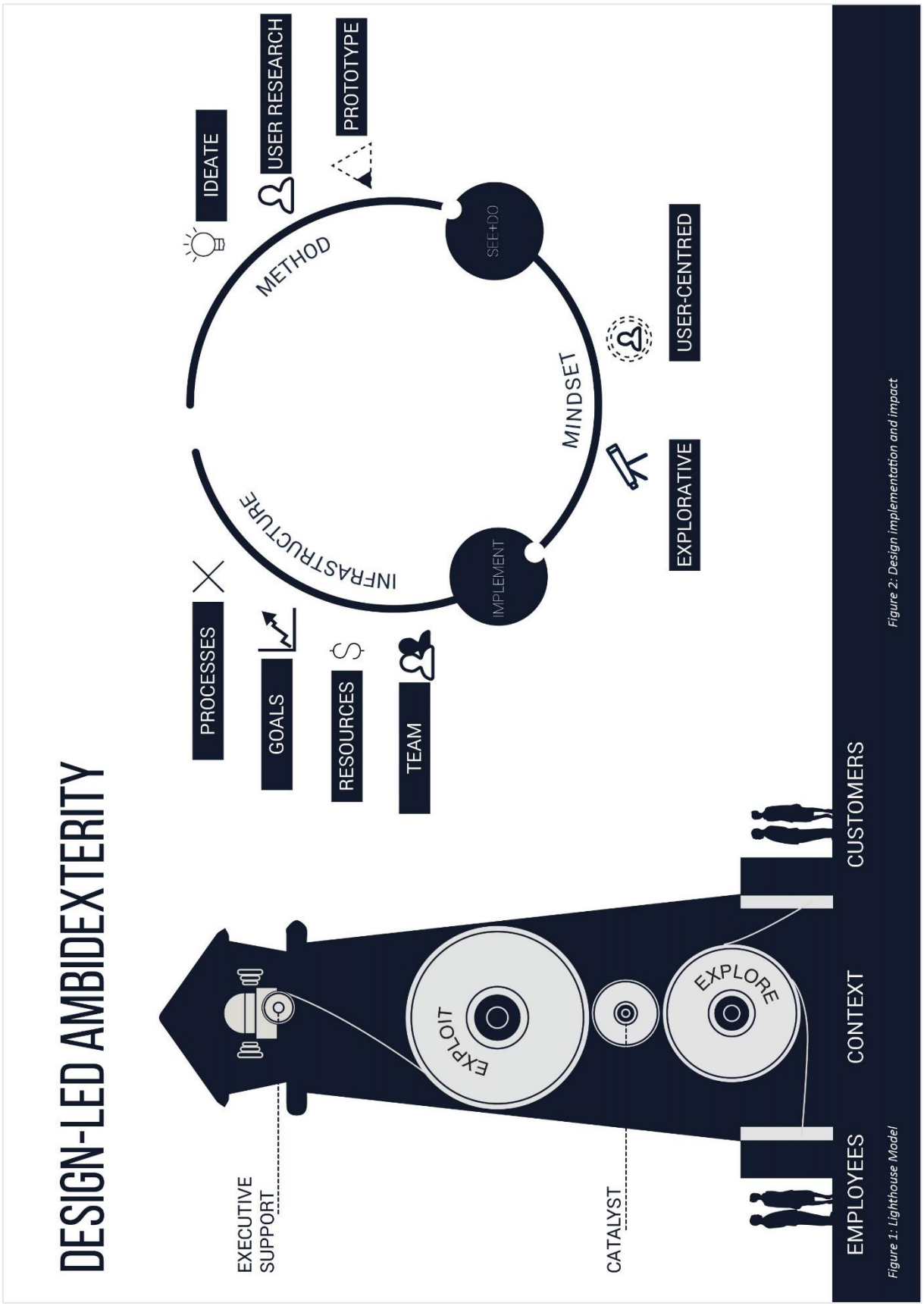

Figure 1 Lighthouse model

As already mentioned, however, a multitude of challenges exist when trying to achieve ambidexterity (Oehmichen et al., 2016) due to the distinct nature, roles and influence exploration and exploitation have on innovation outcomes (Tabeau et al., 2016). Thus, the tension between them should be managed well so balance can be achieved (March, 1991). Such balance is both feasible and beneficial to organisational performance (Jansen et al., 2009). The forth type of ambidexterity, DLA (Stoimenova & De Lille, 2017), is aimed at achieving just that. Firmly based on design methods, principles and values, DLA relies on five distinct elements to achieve a sustained innovation pace in companies. The elements are best represented in the Lighthouse model (LHM) (Figure 1). Like the other types of ambidexterity, DLA is based on Exploration and Exploitation represented as the two big wheels. However, unlike the others, it underscores the importance of the two wheels not only working simultaneously but also in cooperation. To ensure such, the element we called Catalyst was introduced. The Catalyst not only speeds up the collaboration between stakeholders but also ensures a smooth hand-over of projects from Exploration to Exploitation. Due to its nature, the Design Sprint (Knapp et al., 2016) and the Lean Startup (Ries, 2011) were identified as best methods to play the role of Catalyst. The three wheels are complemented by a strong Executive support and very good understanding of the Context, which also serves as the starting point for Exploration.

According to Stoimenova and De Lille (2017), a crucial part of DLA's implementation is the Design Adoption Framework (DAF) (Figure 2). The DAF claims that the adoption of design happens in three distinct stages, reflected in the model: methods, mindset and infrastructure. First, the gradual introduction of design methods to non-designers through both vicarious and hands-on learning should be initiated. This will lead to a change in the mindset of the team towards one that's favourable to design. Last but not least, by implementing the newly formed mindset in the day-to-day work of the firm, the authors posit that the infrastructure (processes, goals, team and resources) will change as well to reflect and accommodate the newly found mindset and methods.

As for the latter one, an action research was carried out together with one of the corporate start-ups (incubators) in X. The first researcher was involved in shaping their new way of working (WoW) by helping them set up, execute and analyse their user research and tests. This was complemented by participant observation during 6 creative sessions facilitated by an external design consultancy. The focus through all these was to understand how to embed design in the team's WoW and train a sufficient level of design capabilities in non-designers. To do so, we followed the already described DAF. The results of both stages were collected and analysed in accordance with the Grounded Theory Method (Charmaz, 2008). This type of ambidexterity is still under development and the implications of its implementation are not well-documented yet. Thus, we need to investigate further how to optimally create the foundation for such implementation and how this will affect the DLA construct itself. Last but not least, as already mentioned, undergoing such research will advance our understanding on the ways design improves innovation outcomes and more specifically, its role in creating ambidextrous organisational structures.

3 Methodology

To understand how to create a foundation for the initial stages of implementation of DLA, the first author was embedded in the company full-time for 5 months and guided the two distinct stages of our action research. First, we gauged the level of DLA in X by creating a clear overview on the current NPD process of the firm through the lenses of the LHM. Second, we tried to understand how to introduce and achieve a sufficient level of design capability in X using the DAF.

The former one was addressed with an extensive qualitative research of forty-eight 1-hour semi-structured interviews with forty-five employees from diverse functions, divisions and levels of seniority. An overview of the positions the interviewees hold within the firm can be found in Table 1.

Table 1: Interviewees overview

Position	Number of People Interviewed
CEO	1
Interim CTO/Senior VP	1
VP	13
Director	8
(Senior) Project Manager	6
Software developers	4
Business Development manager	2
HR	1
Quality Manager	1
Design Expert	1
Consultant (frequently works with X)	1
IP Manager	1
Program manager	1
Research Engineer	1
Other	3

4 Results

This section is dedicated to the description of the uncovered results in the sequence introduced in the Methodology section. Thus, first the existing NPD process will be explained through the lenses of the LHM (Figure 3). Second, the insights collected when implementing the DAF in the aforementioned incubator will be presented as well.

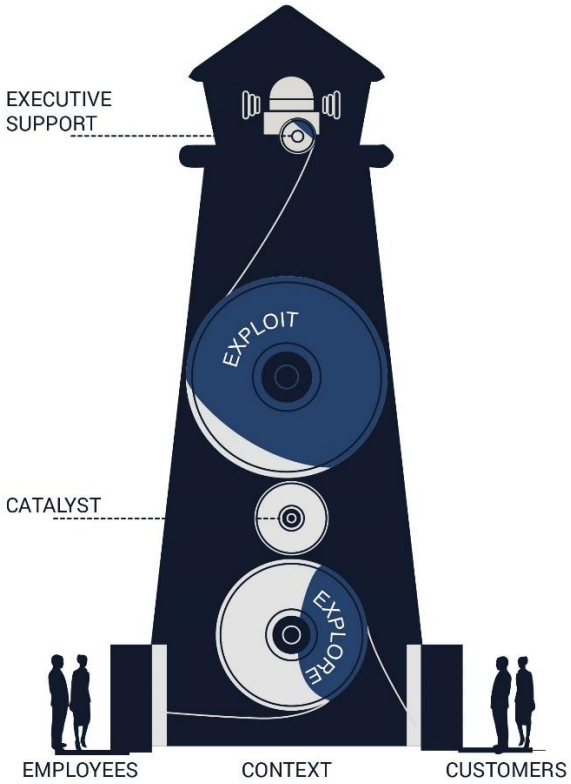

Figure 3: Existing DLA elements in X

4.1 NPD through the LHM lenses

Below you can find a summary of the firm's NPD process created by using the LHM as a lens (Figure 3). The explanation of each element is complemented by general challenges to innovation identified by the interviewees. However, the focus of this section will remain on the process since the challenges were used to explain the current NPD process of X and its structure and missing elements.

4.2 Context

The context is largely unaccounted for in X, as there's no formal way or common tools and methods to understand the competitive landscape and the users and customers' needs. Furthermore, the firm also lacks the capabilities to translate them to viable and desirable solutions. Some of the company's recently-established incubators, however, are dedicated to embed design in their way of working in order to overcome these difficulties. Yet, none (or very few) of their efforts to account for the context are well-organized, projects are generally advanced in a haphazard way and none of it is scaled across the organization.

4.3 Exploration

Some elements of Exploration (Product Definition), are present. For instance, a process for new technology derisking and introduction is currently being established on a corporate level and foundations are being laid to make it consistent across the organization. This, however addresses only the technological feasibility of an idea. The viability and desirability of ideas are not thoroughly (if ever) validated except in few small pockets across the organization. This is largely driven by the misconception of what constitutes a validated idea, complemented by the misalignment across internal stakeholders on how this should be done. There's neither a common WoW, nor tools, nor support, nor guidance on how to make informed choices early during this phase. In fact, the process of exploring new opportunities is largely based on a gut feeling and favouritism (either to an individual or an idea).

To combat that, several sporadic WoWs and initiatives were previously attempted by X with little lasting impact. The collected results support the notion that simply running ideation games and competitions cannot deliver on innovation practice or on the building of innovation skills, as they fail to have a lasting impact on how the company invests in and manages innovation. Without the right capabilities and a clear strategic direction, the majority of the generated ideas fell through the cracks, ultimately leading to sense of disempowerment among the employees.

4.3.1 Catalyst

The Catalyst element is currently not present in X. There's no official way or guidance on how different stakeholders (mainly internal, but also external) can come together and collaborate with each other. The gate review meetings during Product Development can be used for that, but this happens rather infrequently. Instead, only the R&D stakeholders are taken into account before and during the process. When it comes to the handover from Exploration (the new technology derisking process) to Exploitation, the company is experimenting with transferring people from one phase to the other. However, this has been done only in few cases and again, it stays exclusively within the realm of R&D, while other stakeholders are largely seen as an after-thought. Regardless, there's a good initial level of understanding in the company about the importance of multidisciplinary collaboration outside R&D.

4.3.2 Exploitation

As with most medium-sized/big companies, X has a very well-established Exploitation (Product Development) process. There's a strong supporting structure, the process is clear and communicated to every R&D employee through internal training programs on regular basis. There are also different communities and working groups within R&D that support it. Nevertheless, problems still exist when trying to seamlessly accommodate both software and hardware development. Furthermore, this is

complemented by the misalignment of actions among R&D and other divisions such as Services, Sales, Procurement and IT.

4.3.3 Executive Support

There's executive support to create desirable outcomes and work in a Lean Startup manner especially during Exploration as part of the CEO's new vision. However, every interviewee had their own rendition on what that entails and how it should be achieved. Furthermore, while many people especially in mid and high-level management mention the notion of design thinking as a way to talk to users and customers, understanding of its benefits is still rather shallow. Last but not least, these are paired with the notion circulating among middle and high-level management in X that Product Definition (Exploration) cannot and should not be put into a process.

4.4 Design Adoption Framework (DAF)

The second stage of our research dealt with the introduction of design capabilities to the team of non-designers in one of the corporate start-ups of X. As prescribed by DAF, we started by focusing on the introduction of design methods to the team with the initial help of another designer. The collected insights confirmed that once non-designers get the chance to both learn the methods vicariously and put them into practice, the desired changes in their mindsets, as defined and observed by Stoimenova and de Lille (2017) are present. This is true especially since the introduction of design methods to the team had been initiated by the second designer several months prior to the research.

However, despite the fact that the team had been using design methods for over half a year, they continued to struggle with the application of the methods and finding a way to implement the insights gained while using them, as they lacked the understanding how to adapt them to different instances and contexts. This notion was repeatedly pointed out during our informal talks with people from the team. Therefore, the presence of a favourable to design mindset (Stoimenova & De Lille, 2017) is important but it's not enough to achieve an organisational infrastructure in which design is deeply embedded.

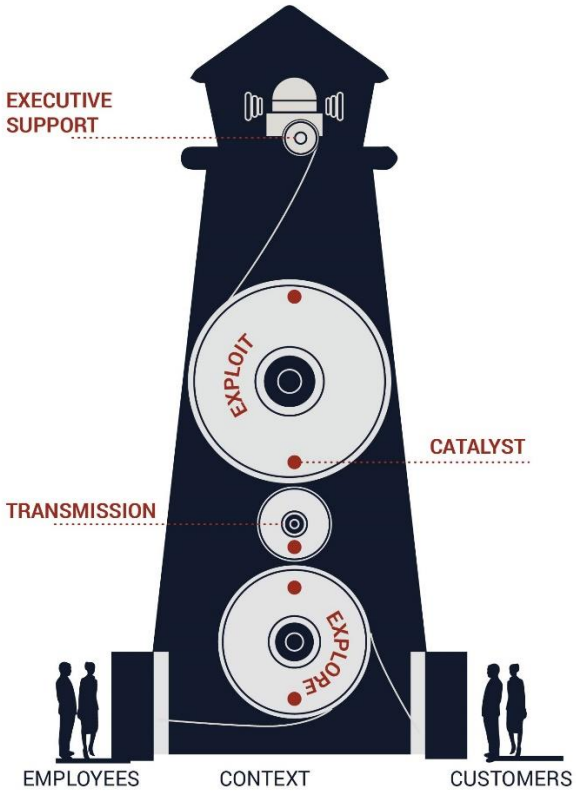

Figure 4: a new version of the LHM

To solve this challenge, the first author started not only introducing design methods to the team, but also explaining the different ways of applying them. This allowed her to explain the rationale behind them, hence incrementally giving the confidence to the team to work with them. Doing so proved to have positive results. However, due to time limitations and the fact that she wasn't embedded in the day-to-day operations of the team, the explanation remained on a rather abstract level. Regardless, this increased the team's level of understanding of the used methods and the initial steps in applying them to other contexts.

5 Discussion

The purpose of this paper was to advance our understanding on how to create a solid foundation for the implementation of DLA. The collected insights suggest that to do so, action needs to be taken in two complementary directions. First, a new WoW can be created that incorporates the missing elements of the LHM (Figure 6) by making the construct of DLA actionable. Second, the generated insights regarding the DAF have to be reflected into the framework Stoimenova & de Lille (2017) described in order to update it (Figure 7).

5.1 The Way of Working

Naturally, creating a new WoW will have its implications on the LHM. First, as already mentioned, the tension between Exploration and Exploitation should be resolved. We believe that although the Catalyst in its current form is instrumental to the quick alignment and connection among stakeholders, kick off and speed of projects, it cannot ensure a smooth hand-over between Exploration and Exploitation well enough. Therefore, a new function for the third wheel has to be introduced. A function that combines elements from both Exploration and Exploitation and allows them to work seamlessly together. In essence, such wheel would also be akin to the role Horizon 2 plays in the notion of the three strategic horizons (Moore, 2007). We call this new wheel Transmission and since it takes the former place of the Catalyst (Figure 4), the Catalyst as a function moves to support and enhance the three wheels of the LHM. While the original purpose of the third wheel Stoimenova and De Lille (2017) introduced is still intact, the newly-introduced notion of Transmission provides another layer of understanding on what the optimal relationship between Exploration and Exploitation could be. As such, it not only ensures the two other wheels don't counteract each other, but also transmits and adapts the signals from Exploration so the Exploitation can pick them up easily. Ultimately, the Transmission ensures both smooth transition and helps the engine (Exploration) to effectively and efficiently communicate to the wheels (Exploitation) in which direction they should turn. Thus, in essence, neither Exploration nor Exploitation, nor Transmission are ever truly missing from the project. Instead, at certain points of time, each one of them has a priority (Figure 5).

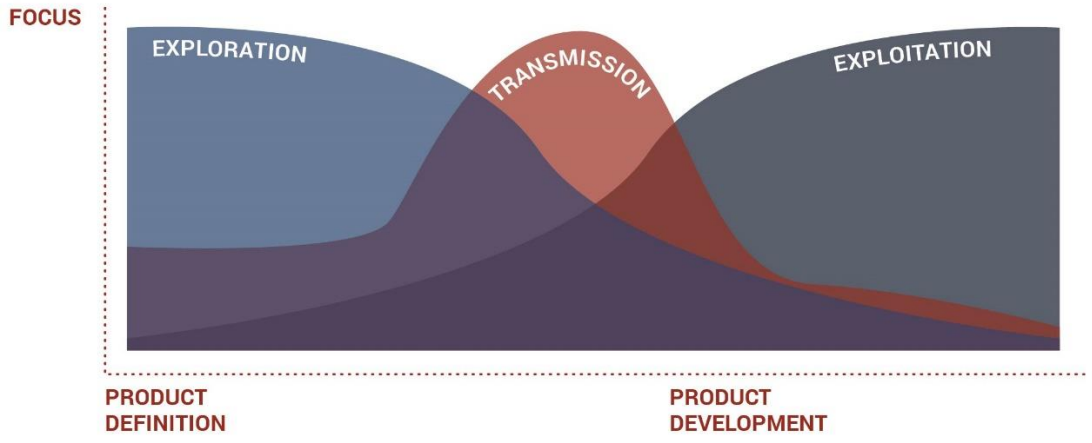

Figure 5: DLA's elements continuum

The collected results have implications for the role of design in DLA as well. Although the construct continues to be design-driven, we see the role of the designer as similar to the one of the lighthouse keeper. She is the person who makes sure the Exploration engine is powered effectively and efficiently and the whole mechanism works optimally. Last but not least, since she has the overview on what's working and what's not, she ensures that the lighthouse is human-centred throughout all of its actions and never forgets its purpose – to continuously create human-centred innovation.

Having these considerations in mind we created a new WoW called the Atom (Figure 6). The Atom is an amalgamation of design and traditional management methods best suited for use during Exploration and Transmission. However, since it's based on elements of Exploration and Exploitation, it allows and supports both to be carried out simultaneously and in collaboration. To achieve that, the Atom has three distinct levels: Understand, Create and Capture, complemented by methods, templates and tools tailored for each of its stages. It also revolves around a strong purpose informed by a continuous human-centred research. For each of the stages specific methods were selected to ensure the company's employees are capable of creating ideas that are viable, feasible and desirable.

To implement the Atom and ensure smooth adoption, according to the DAF, first employees' knowledge and understanding of the methods' rationale should be increased. Thus, we described each method step by step and created a method card and a template accompanying each one of them to ensure continuous reflection and clear purpose that drives the project. In addition, we designed a guideline book explaining how the elements of the Atom are connected and wrote several short blog posts, clarifying some of its elements. Finally, based on the structure of the LHM, we created three complementary versions of the Atom, as each one of them reflects the nature of the LHM element it represents: for Exploration, for Transmission and one that can make the Executive Support more tangible by creating a clearly communicated strategic intent. The versions were designed in such a way that they complement each other and the existing Exploitation process in X. Doing so supports the Atom's adoption, as the inability to unlearn old processes is one of the major barriers to successful adoption of change processes (Lorsch, 1986) and design (Assink, 2006).

Last but not least, to support the Atom's implementation we designed a new platform called Onami (Figure 7). It's an online (a website and a newsletter) and offline (lunch talks) platform, which supports a community of people who want to challenge the status quo and create meaningful innovations. As such, its role is to trigger and facilitate exchange of knowledge and support, ultimately enhancing the sense of empowerment, relatedness, recognition of achievements and participatory unit climate among X's employees. Simultaneously it will increase and sustain their intrinsic motivation to participate (Kerns, 2013). Furthermore, it's also used as a central place where information and concrete details and instructions on how the Atom and its methods and tools can be used are stored. Thus, it will be pivotal to the adoption of the WoW. Furthermore, unlike any other working group or a community in the firm, Onami is open to every employee regardless of their background or level in the organisational hierarchy. We believe that the combination of the Atom and Onami could provide us with a solid foundation for the implementation of the DLA notion in X. A visual representation of how the two will work together with the notion of DLA and the LHM can be found in Figure 8.

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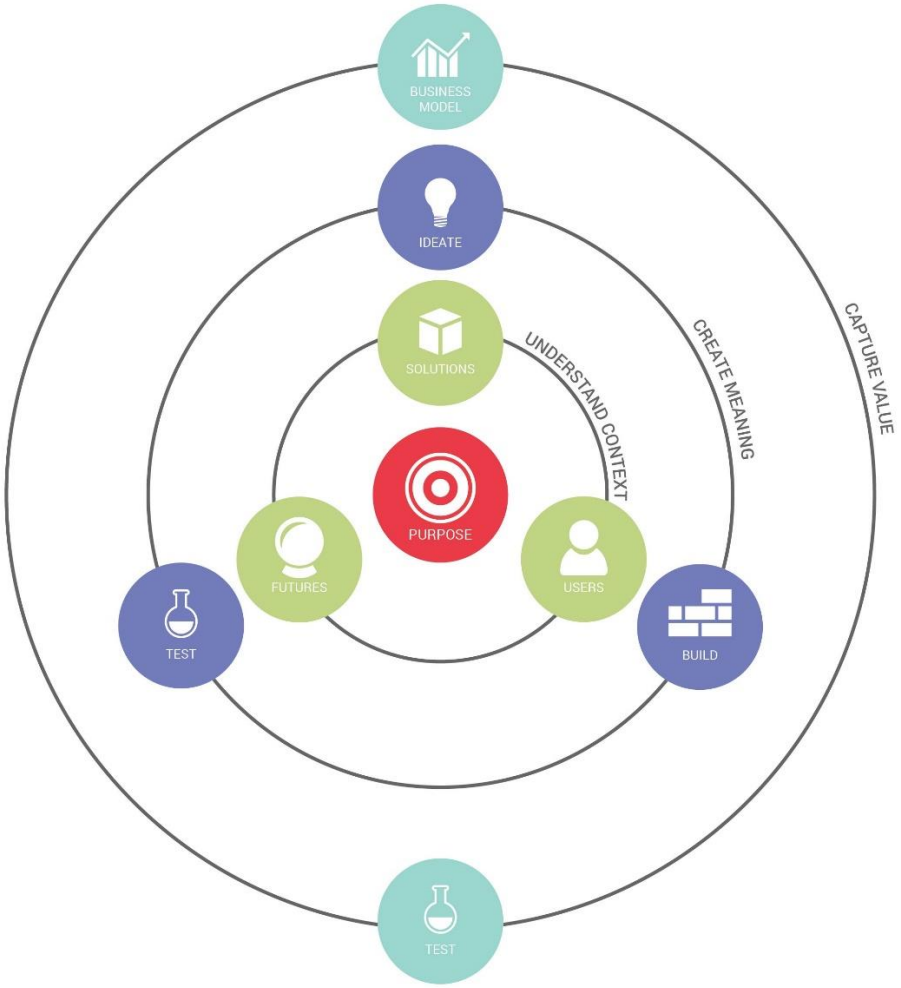

Figure 6: The Atom way of working model

Figure 7: a screen shot of the Method page on the Onami website

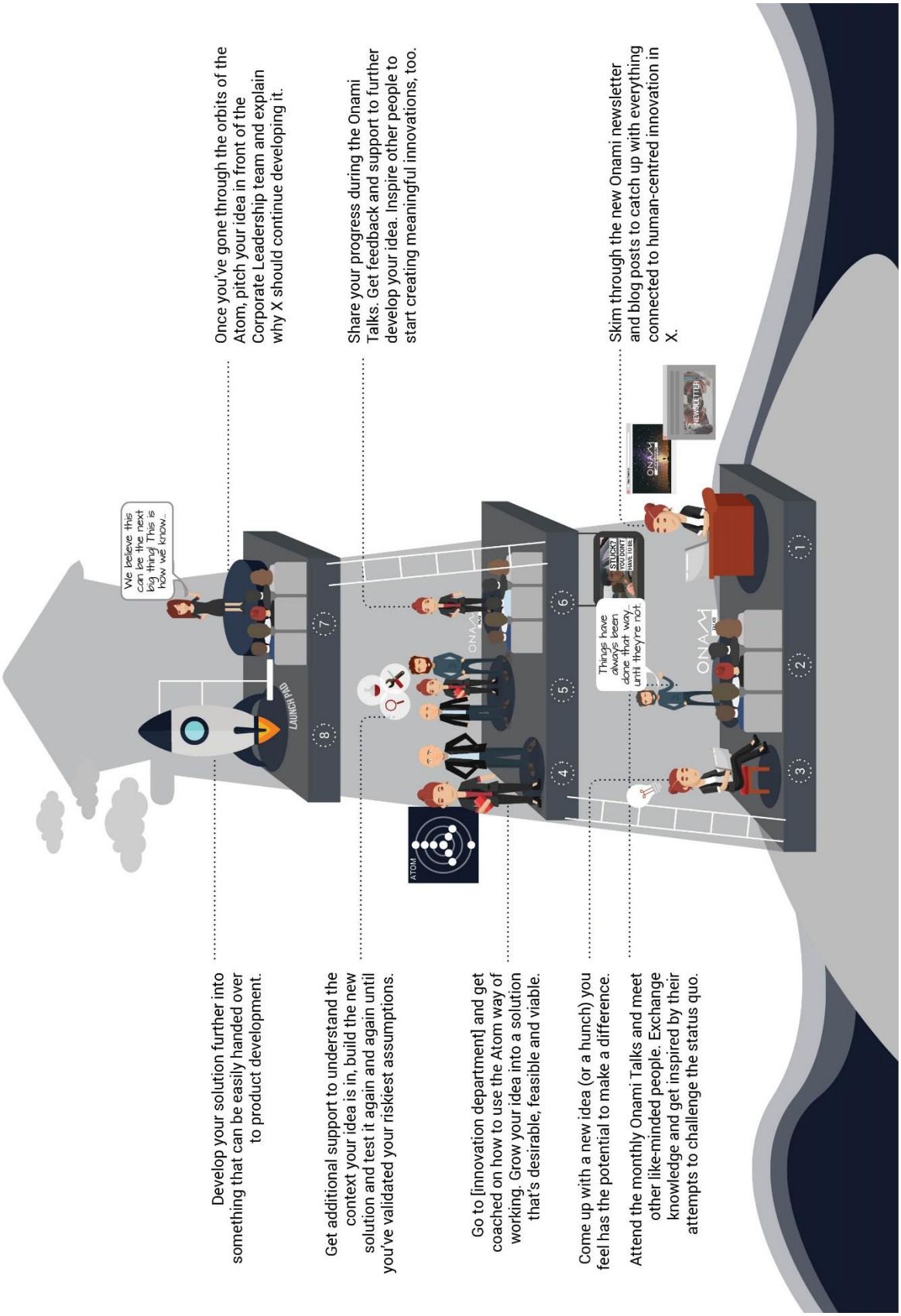

Figure 8: a visual representation on how the LHM, the Atom and Onami are brought together

5.2 Design Adoption Framework 2.0

Based on the aforementioned results, we propose a new iteration on the DAF (Figure 9).

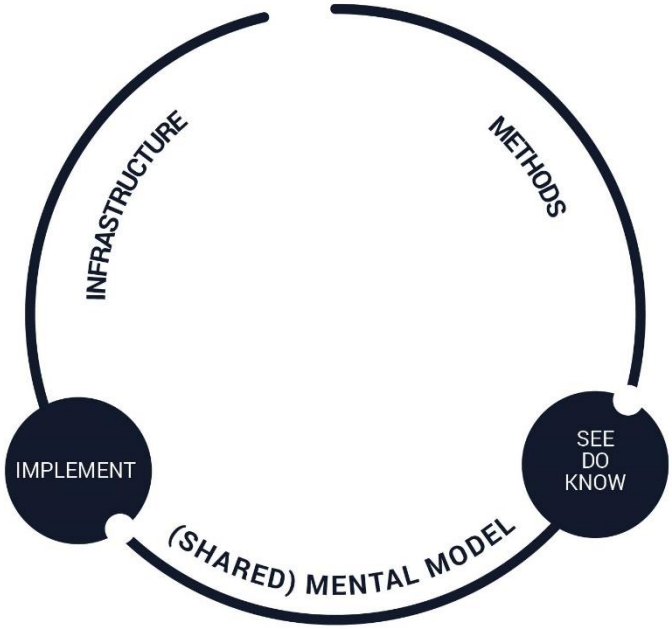

Figure 9: DAF 2.0

First, introduction of design methods should be initiated, supported by vicarious learning, carrying out the methods and expanding the knowledge base of the non-designers. As suggested by the collected insights, this should be complemented by creation of a shared understanding of the rationale behind each method. However, as the results show, the creation of a favourable mindset is a necessary condition, but it's not sufficient. A construct that addresses the uncovered gap is mental model. The role of "mental models is to provide a conceptual framework for describing, explaining, and predicting future system states" (Rouse & Morris, 1986). They allow individuals to understand phenomena, make inferences, and experience events by proxy (Johnson-Laird, 1983). Such mental models are crucial for both sensemaking and sensegiving (Gioia & Chittipeddi, 1991) and provide the means for individuals and organizations alike to create and share understanding of how things fit together (Lyles & Mitroff, 1980). Furthermore, according to Mumford et al., (2001), an important variable in shaping team performance, especially when it comes to reaching common understanding, is the availability of shared mental models. They help team members to anticipate each other's reactions, adjust their behaviour accordingly, and evaluate potential alternative courses of action (Klimoski & Mohammed, 1994). In fact, Mumford et al., (2001) argue that the need for shared mental models may be particularly important when groups are asked to work on creative problem-solving tasks. Their availability helps to generate relevant ideas and to evaluate them. This leads to the creation of an-ever evolving (shared) mental model that will guide team's decisions and help them adapt methods, add new ones and give sense to their project. As such, we believe the notion of mental model will create a better foundation for the implementation of an organisational infrastructure, as defined by Stoimenova and De Lille (2017) that supports design and subsequently DLA.

6 Conclusion

The challenges of implementing organisational ambidexterity are well-documented especially when dealing with the tension between Exploration and Exploitation. The theory of DLA (Stoimenova & De Lille, 2017) aims to resolve them by using principles and values of design. As a continuation of our previous work, in this paper we took the construct and tried to understand how to use it as a starting point of design's implementation in a mid-sized tech company. This helped us to gauge the DLA level

in X, understand their current processes and create a WoW and a platform that helped us in initiating the DLA's implementation in X. It also resulted in a new version of the LHM and DAF.

DLA and its LHM are still in their infancy. At their core they are still suggestive models devised based on existing literature and our work with three multinational firms. The present research proved that both could be valuable in achieving sustained pace of innovation and clarifying the role design could play. Yet, there's still a clear need to fully understand the benefits and challenges of their implementation. Thus, we propose a three-step approach to further research. First, investigate the constructs' implementation in different contexts (both existing companies and start-ups) and continuously reflect the newly-found insights into the models. Second, gauge the implications DLA has on the organizational structure and subsequently the innovation pace of a company. Third, clarify the strategic role design could play in building future-proof organisations and its implications on the quality of the produced innovations.

As already mentioned, our research within X continues as we're currently undergoing the initial stages of the company-wide implementation of the Atom. This will generate new insights for the model, the notion of DLA and the DAF, which combined will serve as a human-centred prism on organizational design. Last but not least, gaining more insights into this area can help us to establish the role of design as a driving force of innovation.

In conclusion, we are convinced the potential of the DLA notion is big as it can further inform our understanding of how to build future-proof companies. Such firms, in a time of great uncertainty and highly impactful technologies such as Artificial Intelligence and Blockchain, will not only be able to thrive but do that while putting society in the centre of everything they do. As such DLA can serve a twofold purpose. On the one hand, it can provide a structure and a framework that allows companies to approach the building of innovation capabilities. On the other, it provides us with a simple checklist of sorts that helps us understand which elements we should improve to achieve the coveted ambidexterity.

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About the Authors:

ir. Niya Stoimenova is a Research Assistant at the Faculty of Industrial Design Engineering, TU Delft. Her research focuses on the intersection between design-enabled Artificial Intelligence and organisational design.

dr. ir. Christine de Lille is Professor Innovation Networks at The Hague University of Applied Sciences, the Netherlands as well as Assistant Professor at Delft University of Technology. Her research interests lie in design material in systems, designing organisations and Research through Design.

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Embodied Design Methods as Catalyst for Industrial Service Design

JYLKÄS Titta* and KUURE Essi

University of Lapland
* Corresponding author e-mail: titta.jylkas@ulapland.fi
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All over the world manufacturing companies are moving towards service business. The service-dominated landscape of business is complex and the value of services is produced in networks combining products, services, different providers and actors. Services deeply influence the socio-economic systems we are living in, and, therefore, in the future all business will be service business one way or another. The article locates embodied design methods in the context of industrial service design processes and large-scale organisations. It connects embodied design to changing business landscape via industrial service design field where theatrical methods are used to understand, ideate and evaluate the impact of service concepts and to support transformation in an organisation. The article presents one design case done in SINCO service innovation laboratory with a large manufacturing company. Findings show that embodied design can speed up the industrial service design process by gaining a common understanding of the design challenge, by producing easily usable data and by earning the commitment of the stakeholders.

embodied design methods, industrial service design, design process, applied theatre

1 Introduction

Many companies worldwide are repositioning themselves strategically towards service business. For over a decade the fact has been that economies exchange more services than physical goods (Vargo & Lusch, 2004, 10), which has had an effect on companies' production, strategies and structures. The term 'servitization' has been introduced to conceptualize the idea of manufacturers becoming service providers (Lay, 2014). In addition, terms such as 'servitising' (Gray, 2013) are used to declare that inventing and adding services onto existing products will increase the value of any related intervention. Multiple organisations have continuously increased their revenues coming from the service business and have started to expand their business by offering product-related services (Lightfoot, Baines & Smart, 2013).

The transition to becoming successful in delivering services through product-service systems (PSS) (e.g. Guidat et al., 2014) is always unique for each company. Organisations need to change their business models, processes and procedures, relationships with the customer and the supplier as well as the mindset of employees to create value for their offerings (Roy & Baxter, 2009). Nevertheless, during this transition, as well as after it, new ways for understanding the design process, implementation and maintaining of the services are needed in different departments of the organisation. In a holistic and sustained service delivery process, all the involved teams should have an understanding of the provided result and its value for the end user and the organisation. In the environment where the focus of producing product-service offers is based on quantitative knowledge and information, the value of qualitative methods and data is often overlooked.

In the design of a PSS, cultural and social values, people and technology have the same relevance. Therefore, the designer is required to synthesize solutions emerging from the comparison of different points of view, different needs and socio-cultural models (Morelli, 2003). Several aspects of the development of PSSs are related to the discipline of design, namely, analysis of technological potentials, investigation of users' behaviour as well as contribution to the interpretation and translation of emerging cultural and social patterns into a set of requirements for the future PSS (Morelli, 2002). In this article, the focus is on embodied design methods as a way of understanding, ideating, developing and delivering services in an industrial context.

Even though the concept of services as performances and the use of theatre methods in service development are already recognized in several disciplines, such as marketing (e.g. Grönroos, 1985; Grove, Fisk & Dorsch, 1998) and design thinking (e.g. Weir, 2015), it still has novelty in industrial service design context. The article starts by making an overview of existing research and the connections between industrial service design and embodied methods. Next, the used research methods and data are presented briefly, before focusing on a Service Innovation Corner (SINCO) laboratory and a case study done in this surrounding. The research data generated through the presented use case and the outcomes of the analysis are described next. The article ends with conclusions discussing the findings of the research.

2 Service design and embodied theatre in an industrial context

The development topics of service design are often complex and abstract. This applies also to the industrial context, even though the services might be connected to a concrete product. Quantifying and tracking services that are experienced subjectively is challenging (e.g. Meyer & Schwager, 2007), and, therefore, methods that allow for understanding of user experiences in non-numeric ways can support the development and evaluation of the service offerings. To understand the possibilities of embodied methods in a multi-disciplinary industrial organisation, looking at services as performances unifies different perspectives.

In marketing literature, services themselves have been widely described as 'performances' (Berry, Zeithaml & Parasuraman, 1985; Grönroos, 1985), drawing a direct link to theatre. Service encounters can be thought to have theatrical components, such as a set, actors, audience and performance (Grove, Fisk & Dorsch, 1998). The performance is created when various drama elements of a service blend together over the duration of the service delivery. The customer experience is then based on how well an organisation can combine actor, audience, and setting to sustain a believable and enjoyable performance (Grove, Fisk & Bitner, 1992). Harris, Harris and Baron (2003) have demonstrated how the creation of a dramatic script within service organisations can help to define and clarify the 'experiential goal' or the intended effect of the performance.

In order to create change in services as well as in daily life of organisations service designers need to understand, think through and support interactions, which are not only verbal but also complex and embodied. 'Thinking with hands' is a regularly used metaphor in design thinking (Lin, 2000). This points to something fundamental for designers, namely that the lived body is the ground of human thinking. The way people understand the world is largely based on bodily experiences that come

from having a body with various sensor motor capacities (Lakoff & Johnson, 1980; 1999). The lived body (as in Poulsen & Thøgersen, 2011 by Merleau-Ponty, 1945) is actively engaged in the sense making process and functions as the foundation for interaction and thinking on several connected levels. Poulsen and Thøgersen's (2011) findings show that the design interaction finds its meaning and the shared references through situated embodied participation related to the pre-linguistic engaged perspective of the lived body. Hence, we must recognize the inherent connection between bodily engagement and design of solutions and arrange our activities to support the connection.

Service designers use different kind of theatrical methods to enhance embodiment during design process, such as experience prototyping (e.g. Buchenau & Fulton Suri, 2000), role-playing (e.g. Iacucci, Kuutti & Ranta, 2000), bodystorming (e.g. Oulasvirta et al., 2002), and service prototyping (e.g. Blomkvist, 2014, Rontti et al., 2012, Miettinen et al., 2012). For example, through acting out different scenarios it is possible to experience the pros and cons of a service and the proposed changes. This way decisions can be based on embodied experiences, rather than on the effects we imagine the changes would create. Embodied knowing has also been studied in organisational context from a practice-based viewpoint (e.g. Gärtner, 2013; Styhre, 2004).

Formerly embodied design methods might have been seen as quite radical in a production oriented industrial context. But increasingly more corporations are aiming to adapt service design to make their development processes more user-centric and agile as well as their results more innovative (Merholz et al., 2008). New cues are needed to trigger action and support the creation of new routines in organisations (Eyal, 2014) and that is where novel methods with change potential come into the picture. Penin and Tonkinwise (2009) argue that human-centred service design enables improvisation in service roles rather than scripting them non-negotiable. Improvisation and spontaneity can also be seen as communicative activities in ordinary conversation inside the organisations (Larsen & Friis, 2005). Also, the environment where service design is done can have a significant role on how the methods are and can be used (Rontti, 2016).

For this case study, we use SINCO service innovation laboratory as an environment and context of use for the embodied design methods. Embodied design methods are defined as methods that require bodily involvement of the workshop participants in the given tasks and activities. In the design case used in this article, embodied design methods include bodystorming, role-play and enactment with video prototyping.

3 Research methods and data

The article draws to the long-term collaboration experience of the authors and organisations in service development and utilizes a workshop design case to highlight the practical level of using embodied design methods. The case was done in SINCO laboratory and in collaboration with a large international corporation (later case company) that had originally core business in industrial production, but is currently going through a servitization and digitalization reform. Due to the change in the business, the case company is establishing and evolving their internal competence in service design and innovation. To support development of the new competences, a four-day workshop was organized with a twofold aim: (1) to find new solutions, process and strategy for an existing internal service in the case company, and (2) to act as an educational event about service design process and methods for the employees of the case company.

After every workshop day, a group interview with the workshop participants (n=10) was conducted. The group interviews (n=4) focused on the methods used as well as learnings and experiences of the participants during the day. The workshop participants consisted of the team leader, team members from project management backgrounds in engineering, design and business, and the project owners of the service being developed in the workshop. The research looks at the co-design workshop as a case study and utilizes the collected interview data as primary research data for the article. As a secondary data source, the facilitators of the workshop (n=4) were asked to write a field diary text after the workshop focusing on the embodied design methods used during the workshop. In

addition, the personal experience of the authors using embodied design methods as a part of service design processes, as well as from collaborating with the case company come through as tacit knowledge in the analysis and results.

The research data has been analysed through qualitative analysis methods. The interview and field diary data were first coded, then the initial codes and insights were positioned on a chronological order of the workshop (Figure 1). The workshop process gave the analysis a structured context, and the linear positioning of the codes to the workshop process enabled the reflection of the outcomes in connection to the used workshop methods as well as authors' expertise. After the chronological analysis, the second cycle of coding followed in order to find the overall themes that answer to the question of how embodied design methods can support an industrial service design process.

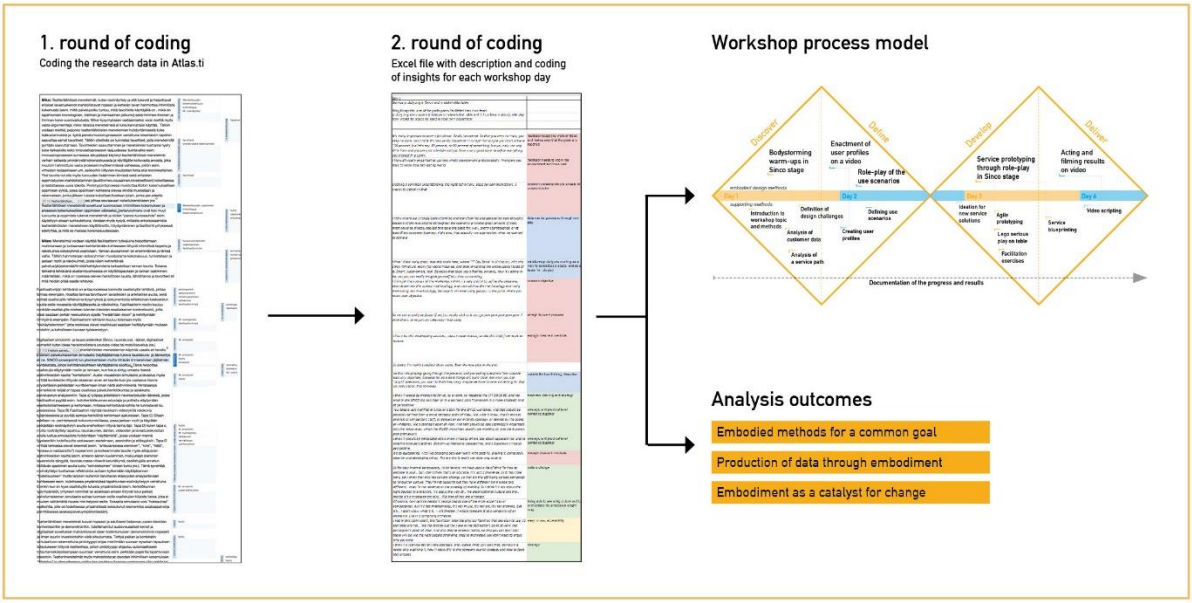

Figure 1: The analysis process from coding to research results.

4 SINCO lab as a workshop environment for embodied design methods

Studies indicate that the use of theatre in service designing is most common in relation to prototype testing (Penin & Tonkinwise, 2009). As designers are concerned about the quality of their designs, they want to test the use of the concepts in an appropriate setting, which might be a staged setting, such as a studio or laboratory. SINCO is a laboratory concept for service innovation, design and development. The laboratory has been developed at the University of Lapland and in collaboration with dozens of companies. The focus on embodied methods in SINCO has been mainly through service prototyping and laboratory approach.

Laboratory environment can be helpful in a number of circumstances, namely: (1) real life environments are in use or too far away from the development office, (2) service development has restricting confidentiality issues, and (3) when other settings that are 'too familiar' to service staff may blind them from issues that require attention (Rontti, 2016). As an environment, SINCO could be classified as a mini theatre where everyone can be an actor as well as a viewer. The laboratory aims to provide a rough but sufficient multi-sensual reference to the authentic environment where the service takes place. The workshop participants in SINCO can sense the service experience and bring out ideas and suggestions to improve the service, that otherwise might have been left uncovered (Miettinen et al., 2012).

A central part of understanding of a service experience is through acting out future scenarios. Role-playing has been recognized as a very powerful method for observing and discovering aspects and elements in the service prototype (Buchenau & Fulton Suri, 2000). There is a difference between empathizing with someone else's role and experience prototyping intuitively for oneself (Rontti et

al., 2012). Previous studies also show that it is beneficial to give a company representative a role in acting out the new service concept. This deepens their insight into the new idea and its user experience as well as gives them the means to evaluate the service experience from a user's point of view, rather than from an outsider's perspective (Miettinen et al., 2012; Rontti et al., 2012). The advantage of an environment such as SINCO has been recognized by local and global organisations. Even though SINCO is located quite remotely from the headquarters of big heavy industry companies, several of them have wanted to run their cases there. The advantages of a laboratory type of a setting are so significant.

4.1 A design case in SINCO lab

The article uses a four-day SINCO workshop with an international corporation as a design case for the analysis. The workshop followed a service design sprint process from discovery and definition to ideation and delivery (e.g. Design Council, 2007). Each workshop day had different focus and, therefore, also the utilized methods varied. The embodied design methods (Figure 2) were reinforced by other design methods such as service blueprinting and creating user profiles in order to support the workshop's twofold aim of developing a service and functioning as a service design training for the participants. In the analysis, the focus is solely on embodied design methods, but it needs to be recognized that they were used in combination and alongside other service design methods.

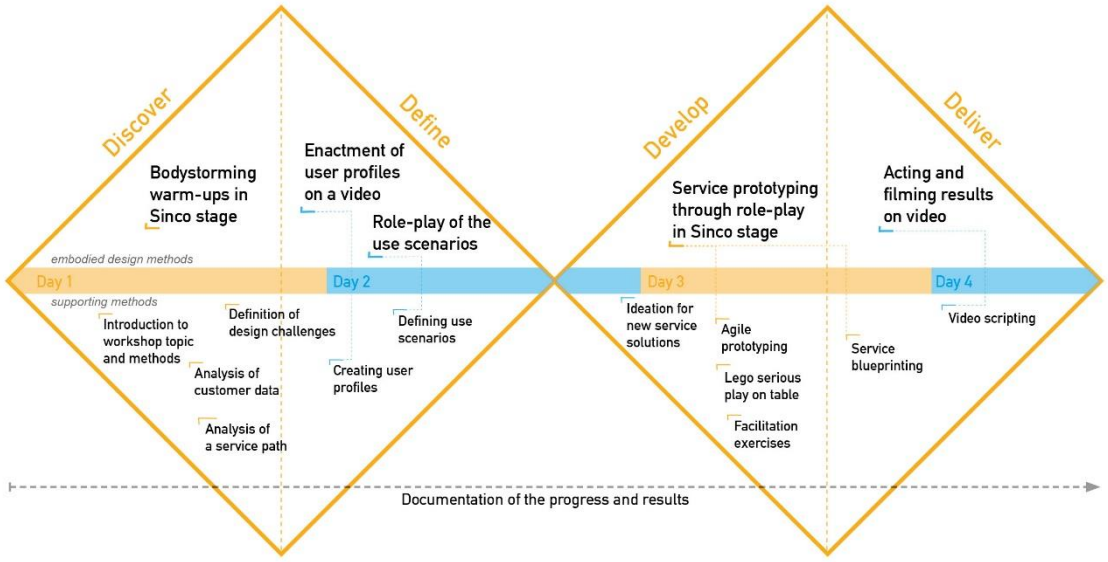

Figure 2: Embodied design methods and supporting service design methods used during the case workshop.

The first workshop day focused on forming of a shared understanding of the workshop goals, giving the participants information about service design and the service development case and analysing the pre-collected user insights as a reflection on the current state of the case service. The user insights had been collected in a form of a questionnaire from the current users of the case service, and the results were analysed through an affinity diagram on sticky notes and whiteboard. The user insights were then placed on a mapped service path of the current service. This exercise helped the participants to evaluate the status quo of the service, find the opportunity areas for improvements, and to set the goals for the service development.

On the second day, the participants focused on the user-centric view by creating user profiles that worked as a basis for user scenarios. The user profiles were based on the collected user insights and were created first on paper with persona-like profile description. User profiles were then

transformed into fast videos enacted by the participants in order to document and communicate the personalities and key features of the user profiles to other participants. User scenarios were then created around these user profiles and followed a service journey of the person. The scenarios were built first situation by situation on a paper. The developed scripts were then acted out by the participants through role-play in SINCO service stage (e.g. Rontti et al., 2012). Through role-playing, the insights and ideas were collected on a board as post-it notes where they were used as new data points to depict the current situation of the existing service through the eyes of the users (Figure 3).

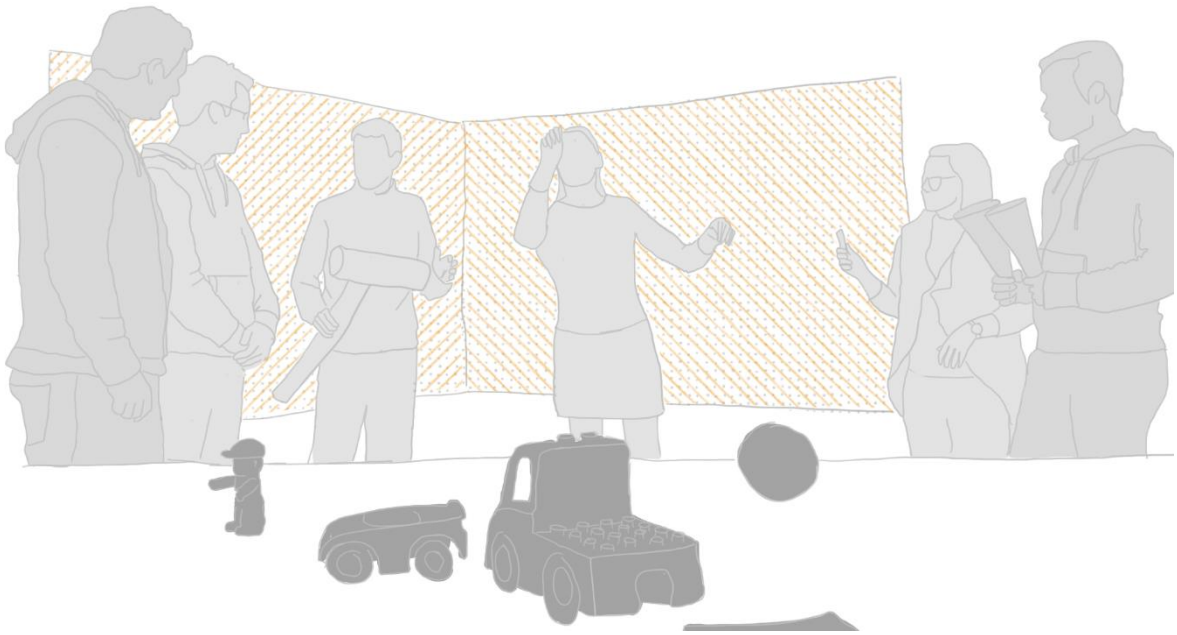

Figure 3: Role-play set-up for the service journey development.

The role-play continued on the third workshop day, but this time new service ideas were included in the enactment together with service prototyping with low-fidelity models. The prototypes were first ideated on a whiteboard table with Lego miniatures to easily demonstrate the interactions in the service situation. Prototyping was done in cycles between concretizing ideas on a table and continuing it as a role-play in the SINCO stage. During the role-play, the participants used any props available in the SINCO lab to fast prototype new solutions for the situations they noticed problematic or otherwise potential for new service solutions. Throughout the role-play each service situation was documented on a service blueprint by the team members observing the role-play. After going through all the service situations, the teams went through the service blueprints filled in during the role-play and completed the gaps that had been left out. During this exercise, the team members practiced facilitation of the teamwork by switching roles of facilitators one at a time.

On the last day of the workshop the core findings from the finished service blueprints were transformed into video storyboards. The storyboards were used to create short video stories about the core values of the new services solutions that were created during the workshop. In creating the videos, the participants took roles in filming, acting and editing the videos. They used smartphones and tablets as tools to shoot the videos, and iMovie as a tool to do fast editing of their video stories. The videos together with detailed service blueprints worked as the main deliverables from the workshop and supported the communication of the main results to the key stakeholders in their organisation.

5 Embodied design methods in industrial service design process

The analysis of the workshop data shows that there are different layers that can be identified when talking about the use of embodied design methods in an industrial context. The goals and purpose of the usage of embodied design methods can indicate what value and benefit the methods can provide for the service design sprint process. The following three sections focus on the opportunity areas of embodied design methods as a catalyst for an innovative industrial service design process in a large manufacturing organisation.

5.1 Embodied methods for a common goal

Embodied design methods may not be the most familiar methods in a rationally oriented industrial setting and, therefore, using such methods requires adjustment and pre-work. Some studies have been done in organisational context with professional actors (e.g. Larsen & Friis, 2005), but in the case of this article the organisation representatives wanted to test and learn embodied design methods themselves. The first day of the workshop was used to introduce the participants to the workshop topic and goals. According to the participant comments after the workshop day, it is important to have a common understanding and clear goals for the workshop. The methods used need to be in connection with the overall service design process and serve a purpose in each step where they are used. One of the participants concluded: *"we don't need a very detailed vision and mission, but we need a common goal, and a shared goal, what we want to reach--."*

When the participants know, what are the desired outcomes of the workshop it is easier to understand also why such methods as embodied design can help to achieve those goals. The workshop facilitators commented that in order to use theatre and drama successfully in an industrial service design context, it is mandatory to have shared goals for the methods, but also the commitment of the participants. In industrial setting the workshop organizer and facilitators are not necessarily the same people. The workshop organizer's role becomes important when the setting of the workshop is created through understanding of the process, used methods, shared goals, and through the involvement of required stakeholders. These factors create a stable ground for using the embodied methods successfully.

One of the challenges with creative methods is that it might require a lot of convincing at first to get the participants involved in using the methods. In this case, the familiarity of the embodied design methods varied between the participants due to their backgrounds, and therefore the clear argumentation of methods' benefits was needed during the workshop. According to the workshop facilitators, the used terminology might have a significant influence on how the methods are perceived. Instead of saying 'theatre', the methods might need to be explained as 'co-design' or 'design thinking' in order to find a suitable response from the participants.

In an industrial environment where engineering and business are the most familiar sources of argumentation, the soft qualities and strong human-centred view that embodied design methods support, may cause resistance as they are not seen as relevant as, for example, numeric data. When choosing the methods for an industrial service design process, different variables such as used time, resources and costs, need to be considered, as well as whether the method will bring the most value in the given situation. This also means that embodied design methods might not be the right choice for all of the situations in the industrial service design process.

In the case workshop, as well as through previous cases in SINCO, it has been noticed that even though the methods might have been unfamiliar for the participants, being involved in the process through one's own body creates a new kind of relationship to the topic. In the case workshop, this was sometimes realized as emotionally heated discussions, but also as moments of discoveries when topics were transformed from paper into action and experiences. Going through the addressed topics as bodily experiences made the participants take ownership of the project, which is important for the success of the next phases of the service development in the organisation.

5.2 Production of data through embodiment

Throughout the workshop several embodied design methods were used to reflect on and learn about the customer's point of view in connection to the developed service. In the interviews, the participants expressed that they felt getting a better understanding of the customer's needs, experiences and expectations through embodiment. Getting an embodied experience of the user's world helps the participants to create empathy towards the user (e.g. Rontti et al., 2012). According to one of the workshop facilitators: "*theatre methods are a naturally suitable tool for learning about the human experience and the experience of a process*."

Based on the participant comments after the workshop, embodied design methods made it possible to reflect on the pre-collected user data, but also to generate new insights during workshop elaborating on the existing customer data and analysis. During the idea generation and conceptualization phases the workshop focused on simulation and role-play at SINCO stage. Simultaneously, the participants documented the outcomes such as ideas, requirements and raised questions on a service blueprint. In this way, the results of the experiments became concrete rapidly. The used role-play methodology supported the embodied experience of the services, and when aided by documentation, it gave simultaneous results that could then be used immediately for the next workshop steps such as building a new service blueprint. One of the case company's team members concluded: *"I think we were strongly bodystorming and transforming and generating new thoughts, because of the role-playing throughout the scenarios provided great amount of data."*

The combination of role-play and the generation of data by observation and reflection were seen as a powerful way for producing qualitative data for the service development. In this method, the perspective of the customer is coming alive through the pre-gathered user insights taken into the role-play, and by combining it with the personal experiences and expert knowledge of the workshop participation, a wide selection of insights can be generated and documented. Experience through the case workshop shows that generating a large amount of qualitative data for instant use is one of the core values of embodied design methods. To be successful in it requires the availability of customer insights and the involvement of right stakeholders to bring in the knowledge and expertise needed to develop the service further.

5.3 Embodiment as a catalyst for change

In industrial service design cases, the stakeholders may be various and from different backgrounds. Therefore, the challenge for the project owners is to get all the stakeholders involved, but also in a right way, and in the right stages of the process. It may not give the best benefit to have all the stakeholders in a co-creation workshop, but rather allows to keep everybody in the communication loop giving the stakeholders a chance to feel part of the process and of having a relevance in it. One of the team members described the situation: *"-- we have a lot of stakeholders, which means also a political layer, which is also customer-centric, but lots of them have ideas and opinions and aspirations. And I think in these terms, service design might have the next level to be taken to, how to connect these ideas and concepts."*

In this case, it was important that the used methods also supported the internal communication after the workshop. It is essential that the outcomes from the embodied methods are concrete and shareable, for example, in a format of a video or a visual documentation, so that they can be communicated also inside the organisation and for people who have not participated in the design process. The internal visibility and commitment from the stakeholders are crucial for the success of an industrial service design process as it gives the project owners the power of advancing the process. Project owner said: *"we have to somehow find a way to explain it (results) to them (stakeholders), to make them feel being part of the change process, and see the good about it, and get the feeling, hey we are part of a good story--."*

In the workshop case, it was evident that embodied design methods can help concretizing the complexity of the case and therefore form a base for a shared understanding. In order to create

valuable services, it is important to understand the needs of the customer, but it is equally important to have an extensive understanding of the organisational landscape around the developed service. *"It is also about strategic positioning within the company, how do we position ourselves…",* said the team leader of the workshop case project. By having a clear vision of the project strategy and of the involved stakeholders and their needs, the project team is able to generate change that is needed to get the industrial services developed for the customers. Through a shared and embodied understanding, embodied design methods can support this change. The workshop participants saw that service design and embodied methods can help them to gain a more holistic understanding of the customers as well as stakeholders and to position themselves in the organisation strategically. Therefore, they have also been able to take the next steps and make decisions that are needed for the success of the planned service.

The workshop case was part of an industrial service design process in a large organisation, and due to the size of the organisation achieving change might be rigid and time consuming. One of the workshop goals was to provide new tools and ways of working by utilizing service design and embodied design methods inside the organisation. Giving perspectives for more human-centred view by emphasizing the embodied experiences, the learned methods in the workshop were showing change in communication within the team and in the models of collaboration. By focusing on action instead of discussions, the participants were able to get into a mode of teamwork that involves a lot of engagement and the exchange based on pre-collected user insights rather that personal opinions. Embodied design methods can help an industrial service design project teams to humanize the process with the strong customer focus and the utilization of so-called soft data that is produced through the embodied engagement in the design process.

6 Conclusions

Based on the experiences from the design case and previous SINCO cases, if embodied design methods are chosen as a part of industrial service design process, they need to be in a strong connection to the service design sprint process. The methods support shared understanding through embodied experiences, and therefore it was seen that a strategic positioning and the steering of change can be facilitated with these methods. Embodied design methods emphasize the human-centeredness in a process that in other parts might be heavily influenced by the industrial context and traditional views on quantitative evidencing for project decisions. The design case shows an example how embodied design methods can be utilized as catalysts for an industrial service design process by producing large amounts of qualitative data. This data can then be used in the service development, but also by getting key stakeholders emotionally engaged in the process and to promote the new way of working inside the organisation. A large and layered group of project stakeholders can be involved in the process by sharing the experiential insights and solutions, which can make the commitment of stakeholders stronger.

In industrial context, embodied design methods still play a role of a stranger, and convincing the project stakeholders to adapt those methods might need time and effort. The findings of this case are not radically new, but rather they describe the current situation in the manufacturing organisations and how embodied ways of working can be catalysed in them. It was shown, in the workshop and in the continuity of case project, that the embodied methods make the *understanding* of service context more experiential and therefore allow the project team and stakeholders to form a shared vision and goals for the service. The methods also support the *generation of qualitative and human-centric insights* that reflect the collected qualitative and/or quantitative user data. This way, the introduction of embodied methods also spark new ways of using existing data as well as new ways of working together. This means moving from meeting rooms to workshop environments. The methods help to embody 'second hand' user insights produced in the workshop and make them come alive through the enactment of the participants. By role-playing the user experiences, the workshop participants in the design case, took ownership of the presented topic, started

transforming the insights and built their own knowledge about the user. On top of that, the design case showed that embodied design methods can help the project team to *position themselves and the project strategically inside the organisation* by reflecting on the gained insights and understanding of the organisational context and culture. The strategic positioning can support the steering of change, and the ability to use the power in the organisational politics so that the project will proceed successfully.

The implementation of embodied theatre methods in an industrial context requires a setting of a solid ground. It starts by ensuring that the methods are replicable in the organisation and that there is sufficient facilitation knowhow as well as the required commitment for the use of the methods. It was evident during the case that an environment that provides support for creativity and embodiment, for example, in a form of a laboratory or a stage, can be helpful in the adaptation and utilization of the methods. An open attitude and the ability to see a big picture with a strategic vision, allow project teams to locate the embodied design methods in their design process. This way, it is possible to plan and develop meaningful steps of progress in order to bring the biggest value to the project. Finding the right way of integrating embodied design methods in and with the organisation may be constrained by the organisational bureaucracy, but concrete outcomes and real examples make the argumentation for the needed changes easier.

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About the Authors:

Titta Jylkäs is Service Designer and Doctoral Candidate at University of Lapland. She focuses her industry-based research in the human-centred view of industrial service design process and the utilization of technologies such as artificial intelligence in service design.

Essi Kuure is Researcher in the Service Design Research Team and PhD Candidate at the Culture-based Service Design Doctoral Programme of the University of Lapland. She focuses on creating new knowledge and methods of service design to industrial as well as social contexts.

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How Design Thinking Offers Strategic Value to Micro-Enterprises

GAYNOR Lee*; DEMPSEY Hilary and WHITE P.J.

Institute of Technology, Carlow
* Corresponding author e-mail: leegaynor1@hotmail.com
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Large organisations use design and design thinking to create value; however, there is a low awareness and practice of design and design thinking in smaller businesses. 69% of Irish businesses never use design, or use it only at a superficial level (DJEI, 2016). Previous research on the relationship between design and the wider-enterprise base in Ireland has focused on highly innovative and successful businesses that are already accustomed to design and have ten or more employees. The result of these studies has produced stories of how design creates value for each business, making it difficult to understand how it is applied in, and relates to, other businesses, particularly micro-enterprises without design competence. This paper aims to contribute to the academic field of design and wider-enterprise base in Ireland, in relation to design thinking and regional micro-enterprises who are not accustomed to design. It explores how design thinking offers strategic value to these businesses by building understanding of the identity and purpose of the business for the owner.
micro-enterprise; design thinking; business strategy; cultural change;

1 Introduction

Lindberg et al. (2010) discuss the evolution of design thinking into a meta-disciplinary activity. They believe that the explorative, integrative and holistic nature of design thinking, counters the restrictions of traditional, analytical and mono-disciplinary thinking. They assert design thinking to be collaborative in both problem and solution space, until a problem is adequately defined and expert knowledge can suitably be applied (Lindberg et al. 2010, p.35). This reflects the views of G.K. Van Patter and Elizabeth Pastor, co-founders of Humantific™ (an innovation consultancy based in New York), and the Next Design Leadership Institute (NextD). The framework; The Four Geographies of Design (Fig.1), developed by NextD (NextD, 2011), illustrates the evolution of design thinking in both practice and output. Design thinking now operates in complex areas of organisational and social contexts where in practice there is an emphasis on "sensemaking", and an increased need for human-centred research, co-creation, and an assumption free approach to challenges (Jones and Van Patter, 2009).

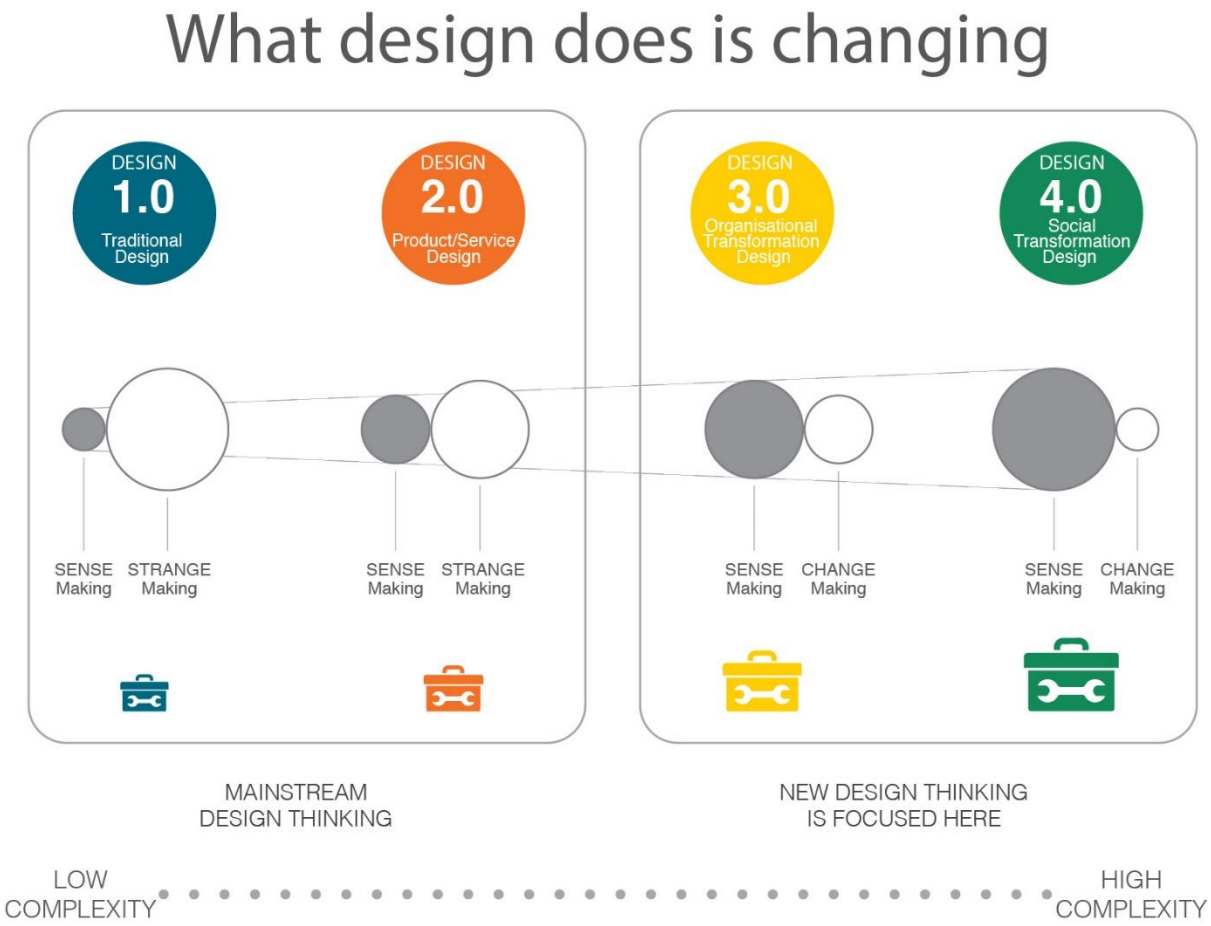

Figure 1 What design does is changing. source: NextD (2011)

"Sensemaking" has appeared in diverse research areas since the nineteen seventies, being introduced to organisational studies by Karl. E. Weick, and is further present in management science (Snowden), cognitive psychology (Hoffman, Klein, and Moon), education (Dervin) and human-computer interaction (Xerox PARC). While "sensemaking" theories range from being a finite process for individual problem solving, to a continuous process by the organisation as a whole, what is consistent among all theories, is the development of tangible and intangible models to represent and communicate information, and the process being highly dependant on the participants perspective and interpretation (Kolko, 2010). Humantific™ view "sensemaking" as a continuous, highly collaborative activity, to understand the present by making complex, ambiguous situations visual, clear and actionable (Humantific™, 2011). While the practice of design thinking is now weighted on "sensemaking", the output of design thinking has shifted from "strangemaking" to "changemaking", which acknowledges the now co-creative and transformative characteristics of design thinking, where the creative framing and re-framing of challenges plays a key role.

Owen highlights characteristics of design thinking that make it most effective as an integrator of diverse knowledge, including the ability to visualise and offer a holistic perspective, having a bias for adaptivity and multi-functionality, keeping a generalist and inventive view and making choice the last resort by exploring all alternatives (2007, p.24-25). Design thinking wants to diverge while expert knowledge wants to converge, the ability to be future orientated and remain in ambiguity is key to the relevance of design thinking. It is suggested throughout literature that design thinking offers a more adaptive, explorative and inclusive approach to business strategy and management (Golsby-Smith, 2007; Holloway, 2009; Liedtka et al., 2013). This is reflected in the Building Innovation Capability Framework (Fig. 2) that stems from the 2015 study of Design-led Innovation in SMEs in Ireland; Design Driven Innovation - Why it matters for SME Competitiveness (Lawlor et al. 2015).

Figure 2 Building Innovation Capability Framework. source: Lawlor et al. (2015)

This framework illustrates the requirements needed to develop an innovation capability within an organisation, consisting of four components of process, knowledge and competence, mindset and attitude, guided by the vision and strategy of the business. It highlights that design thinking can play a twin role in innovation capability building. By applying design thinking from the outset to understand the vision and strategy of the business through collaboration, visualisation, holistic and explorative thinking, it can be a transformational tool thats enables the cultural change of staff and future embedding of design (Bucolo, 2015, Lawlor et al. 2015).

The publication mentioned previously, and Ireland – the Design Island (DCCoI, 2017), a consultation paper towards a national design strategy, both feature case-studies highlighting the impact of design in Irish SMEs (Small - Medium sized Enterprises) across diverse industry categories, and offer a strong case for the adoption of design-led innovation in Irish SMEs. However, the biggest obstacle in successfully applying a design-driven approach in the majority of SMEs is the need to change mind-sets about what it means to *apply* design thinking principles to business development and innovation activities (Lawlor, et al 2015). Their remains a lack of applied studies investigating how design thinking can offer value to micro-enterprises, whom account for over 90% of SMEs in Ireland (CSO, 2014), and who predominantly do no engage with design. Micro-enterprises are businesses with less than 10 employees. Consequently, this research aims to discover how design thinking can offer strategic value to micro-enterprises in regional Ireland which are not design competent?

> *It is time for the Irish SMEs to become more dynamic and innovative across all levels of development. A greater awareness and adoption of a design-driven innovation approach and design thinking can impact positively on economic growth and job creation in Irish SMEs (Lawlor, et al 2015, p16)*

2 Methodology

2.1 Field Research

A qualitative research approach was undertaken within five diverse micro-enterprises located in a town in South-East Ireland. The objective was to gain an empathetic understanding of the culture and difficulties of these businesses, and explore their alignments with design. Design methods enabled the collection, analysis and synthesis of qualitative data from these case-studies to build theory which was context relevant.

Qualitative data generated in the pilot study was translated to a mind map (Tony Buzan) directly after the visit. Illustrating all information on a single page enables distillation of information, understanding of the area and in addition, provides a platform to develop relationships and insights. The mind map featured interpretations as to where design can create value, difficulties facing the business and owner, and information that builds understanding of the business activities. Categorisation of the mind map resulted in the emergence of four areas where design can offer value and in turn enabled the development of the business map. The business map used storytelling and different perspectives to develop a holistic understanding of the business on *one* page (Fig. 3).

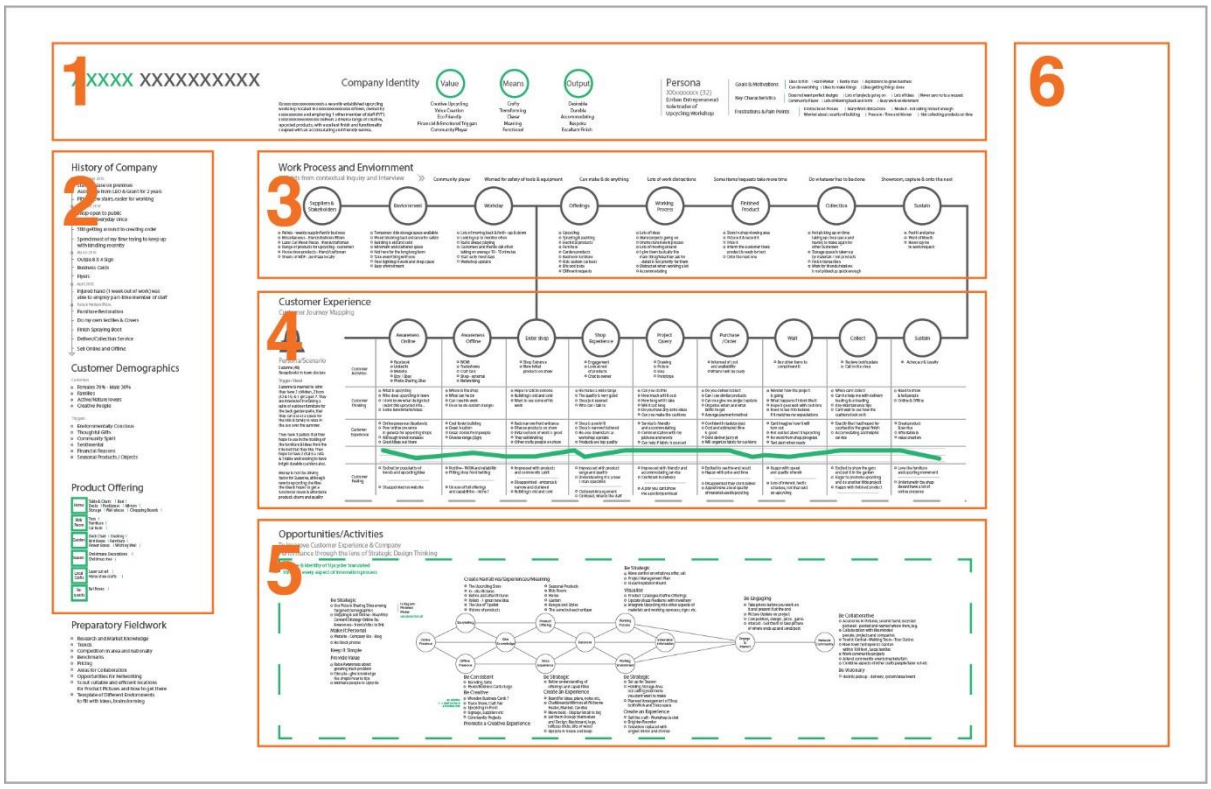

Figure 3 Final business map generated from the pilot study. source: Author (2017)

The business map was divided into six sections;

- Section one builds understanding of the culture of the business and the owner. It details value, means and output to develop understanding of the business. Working characteristics, goals and motivations, and frustrations and pain points, aim to build understanding of the owner
- Section two builds understanding of the past and possible future of the business. A timeline is created with future desires of the owner incorporated. Customer demographics are explored and product offerings are categorised
- Section three explores the working process and environment. It details a journey of the owner from finding materials, through the working process, to sustaining of business
- Section four describes a persona and customer journey map. A customer journey map is a technique that maps the customer's journey and their perspective, experience and emotions throughout. Multiple customer perspectives are considered through the customer journey map
- Section five explores and demonstrates where and how design can add value to the business. It parallels the stages of the customer journey and business owner's journey which offers structure in developing ideas

- Section six illustrates pictures from the field visit which aim to enhance insight creation and storytelling

Iterations of the business map enabled the development and refinement of section five. Further analysis of section five resulted in the emergence of categories which encompassed the areas of difficulty facing the business and where design can create value. These categories were illustrated on a single page in a book format, which combined with the business map template, facilitated the participation, collection and synthesis of future case-studies. The final business framework developed from the synthesis of five case-studies, described the micro-enterprises, in regards to their areas of difficulty and where design can create value (Fig. 4).

2.2 Ecology Mapping

The method "Ecology Mapping" stemmed from the final business framework. The objective was to use design thinking to facilitate the business owner in building understanding of their business identity and purpose. This knowledge intended to build a strong foundation of the business for the owner, which facilitates future strategies and actions. It was titled "Ecology Mapping" to emphasise the living and integrated nature of the business, and the visual and iterative nature of the method. Design thinking directly complimented the overall objectives of the project in building understanding of the identity and purpose of the business, based on the values of the owner and expressing a strong story through visualisation.

The planning for the "Ecology mapping" was explorative and consisted of two phases including:

- Design of the "Ecology Mapping"
- Design of the Final Visualisation

2.3 Design of the Ecology Mapping

The design of the "Ecology Mapping" was initiated by experience gained from the collection of data from field studies. This experience enabled the creation of a hypothetical sequence of the process. Within each stage, intent, documents and methods that may facilitate knowledge transfer were collected. The rationale for developing this process is twofold. Firstly, it allows the collection of methodologies and visuals that may facilitate the primary objective of developing understanding of the businesses identity and purpose for the owner. Secondly, it improves understanding of the process for the team of designers located in designCORE. "The best practice in design research is to integrate people from different backgrounds into a design research team" (Lojacono & Zaccai, 2004).

The "Ecology Mapping" was conducted in designCORE at The Dargan Research, Development and Innovation centre located at Institute of Technology Carlow. designCORE works with SMEs on research-led projects. designCORE provided the opportunity to interact with a business owner and offered a space that enhanced the application of the process. A mixture of stakeholders from designCORE offered expert knowledge from areas including Design Management, Design Engineering, Graphic, Web and Policy Design. A workshop based on the emerging process enabled the team to engage with the development of the process and improve understanding of its objectives.

While the duration of the "Ecology Mapping" was unknown, the result intended to deliver a clear and compelling story which enabled understanding of the business identity and purpose for the owner. This is achieved by the iterative generation and refinement of words, graphs and visuals during workshops, constant refinement of information between workshops, and reflection promoted throughout. Information was given to the business owner after each workshop to enhance knowledge transfer, and a final package was delivered on completion of the project.

2.4 Design of the Final Visualisation

The objective of the final visualisation was to depict the business and its environment. Concept visuals were developed to see the possibility of visualising this information and what the information may be. This was commenced by:

- Selecting a business from field studies
- Creating an adaptation of the Offering - Activity - Culture Map (Kumar, 2012). This adaption placed a description of the business in the centre circle. The values and offerings of the business are then explored in the next circle. The third circle explores activities that are related to the values and offerings of the business. The broader cultural factors which are relevant to these activities are explored in the outer circle
- Another map created concurrently investigates the internal and external stakeholders of the business
- Both maps are combined to build relationships and stories
- This information is translated to a single page visual. The structure of this visual illustrates the business, the business values and offerings, then strategies/channels to the external world. Here, the different stakeholders, customer segments and relevant cultural factors are explored (Fig.5)
- Iterations of this visual are developed until the outcome is satisfactory in demonstrating a compelling story of the business, and being replicated with other businesses

3 Results

Micro-enterprise business owners are experts in their area and highly passionate about their work, but predominantly lack the necessary management, marketing, and innovation skills to optimise and sustain their business.

Categories developed from synthesising field research were grouped into three areas consisting of the Brain, Mouth and Heart, which collectively encapsulate the businesses (Fig. 4). The grouping of the categories in this manner aims to build understanding of a business, targeted at demographics that do not have expert knowledge in business and management practice. The Brain of the business denotes the management and operational side of the business. The Heart is the business offerings in products and services and the people it engages with. The Mouth of the business is the external voice and perspective of the business, including branding, communications and online activity.

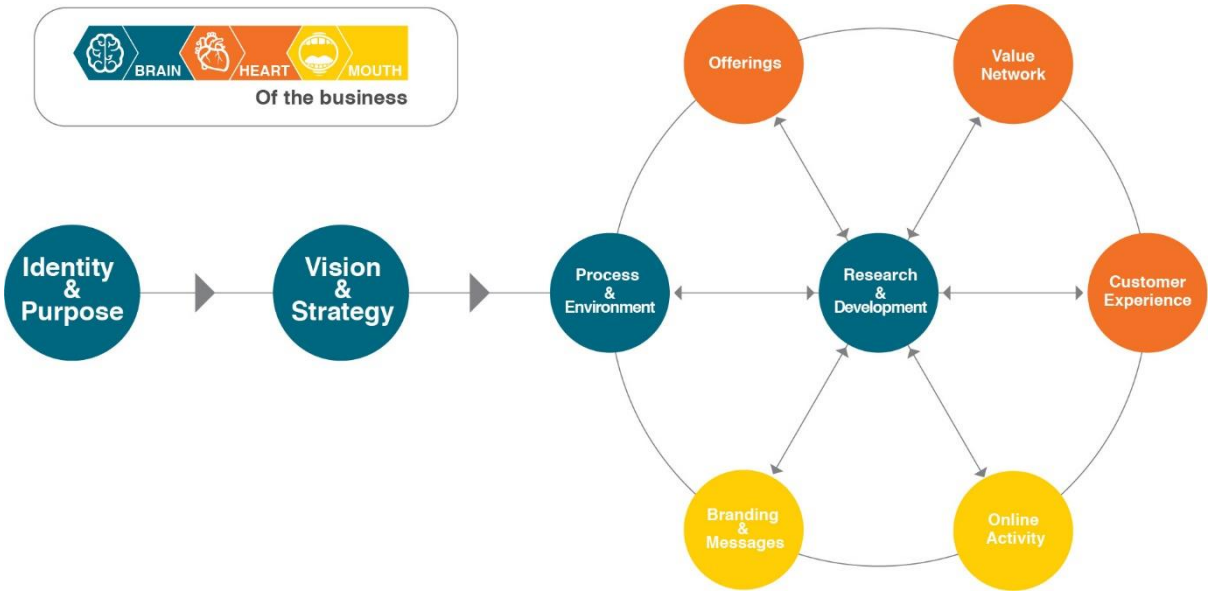

Figure 4 Framework showing areas of difficulty and where Design can add value. Source: Author (2017)

While these businesses were diverse in their offerings, common difficulties and themes were discovered. In the Brain of the business difficulties faced include the in-ability to visualise and externalise information, which contributes to difficulties in idea generation, project management and communicating with staff and customers. Additionally, all owners are under considerable time and money constraints and hence are focused on the day to day running and operation of the business. Consequently, they have difficulty in strategic thinking and adapting to changing conditions. All businesses aim to grow awareness of their offerings and change perceptions of the industry, however, they suffer in both the Heart and Mouth of the business by lacking continuity in offerings, messages and branding, and not identifying customer touch-points and engaging with their network.

3.1 Purpose and Identity

These findings are summarised in the core theme from field research; the difficulty for each business owner to articulate the identity and purpose of the business.

- The identity of a business is who the business is. It is directly related to the values of the owner
- The purpose of a business is why the business exists; the actual goal of the business

The lack of a clear identity and compelling purpose contributes to difficulties in the internal working process (Brain) and external perspective (Heart & Mouth) of the business. Design thinking offers opportunity to reduce difficulties throughout. By building understanding and articulating the identity and purpose of the business based on the values of the owner, shared understanding and direction can be developed. This can streamline and clarify internal operations, and influence and add continuity to messages presented to the external environment, through offerings, engagement, storytelling and relevant activities.

3.2 Ecology Mapping

The "Ecology Mapping" consisted of a series of four workshops with Business A. The owner of Business A came to designCORE with the intention of developing a new product; however, it was clear to the team in designCORE through early discussions that the owner was unsure of what he wanted to do. Consequently, it was explained that the method "Ecology Mapping" could offer value to the business by exploring the businesses environment, personal motivations of the owner, and facilitating the owner to articulate a reinvigorated purpose and identity for the business.

Business A is a family business established after finding a niche market opportunity. Their original core product ceased production in recent years due to a number of factors. The business has tried to build on other offerings since. However, this shift has resulted in the business now offering a diverse range of products and as a result there has been a subsequent loss of company purpose, identity and affection. Early conversation and secondary research highlights the business has difficulties in engaging with customers online and offline, the business engages in minimal marketing, networking and lack any online presence with the exception of their website.

Workshop One intended to broaden the owners' perspective of the potential and relevance of the business. This was achieved by mapping the broader values of the business and then relating a diverse scope of possible context areas where the business could offer value. Cultural factors that align with these contexts were then explored. The past pain points and future motivations of the owner were also discussed and a broad value offering of the enterprise was generated;

Social activities in private and public spaces

Workshop Two builds on the values of the business discovered in workshop one. The wide scope of context areas which emerged are categorised from rigid (institutional) settings to open (public) settings, within this categorisation, needs to be met shift from being a needed

educational/therapeutic tool to a desired fun/social activity. Focusing more on open contexts brought a fresh and invigorated perspective of the business to the owner. The workshop established that the owner desired to develop something that enhances and engages the community and provides broader social value. This is reflected in the working mission statement:

Enabling social inclusion, fun and expression in Irish regional communities

Workshop Three focused on developing understanding of different communities and the different stakeholders of a local community. Different community settings were segmented including; a local business, a public space and multinational company, to highlight the different buyers and users, their different needs and motivations, the revenue potential, and suitability and alignment of each segment with the business offerings and values. A SWOT analysis was generated with the owner, enabling him to see how his capabilities align with his emerging desired future. A user-journey map enabled the owner to see the other aspects of his business that may need attention. Examples of the business website and logo were shared to discuss alignment with the emerging understanding of the business.

Workshop Four refines the story for the owner. The values of the business and the personal attachment of the owner are discussed. It is highlighted that understanding of the business has transformed from being a business that offers educational games and resources to an enabler of engagement and inclusion in social spaces. These values are then aligned with cultural trends and factors to depict the relevance of the business purpose. Different contexts are explored which highlight increased opportunities in larger contexts. The customer journey is elaborated on to see the different touch points and means to engage with the customer. The last activity is to return to the SWOT analysis. It became clear that collaboration and bringing value into public spaces are core factors for the owners desired future reflected in the final mission statement:

Enhancing communities through games and spaces that support engagement and inclusion

The owner is excited about the possibility of co-creating with communities and other businesses in developing these spaces. He has an area in mind for a pilot project and will look to put a focus group from his community together over the coming months to discuss strategies and ideas for this space.

It was discussed that gaining funding and acceptance into public spaces and buildings would require metrics to highlight benefits to potential buyers. While the benefits of the business offerings are predominantly soft values, ideas for recording hard metrics should be considered, such as footfall, experience - before and after, exposure and activity - online and offline, surrounding business trade, etc. A contact was also given to the owner who has experience in creating community spaces and gaining funding to do so.

The final package generated from the ecology mapping was a six-page document that included all pertinent information created throughout the process in order to build understanding of the identity and purpose of the business for the owner. The structure of the final visualisation from workshop four, which captured all information created throughout can be seen in Figure 5.

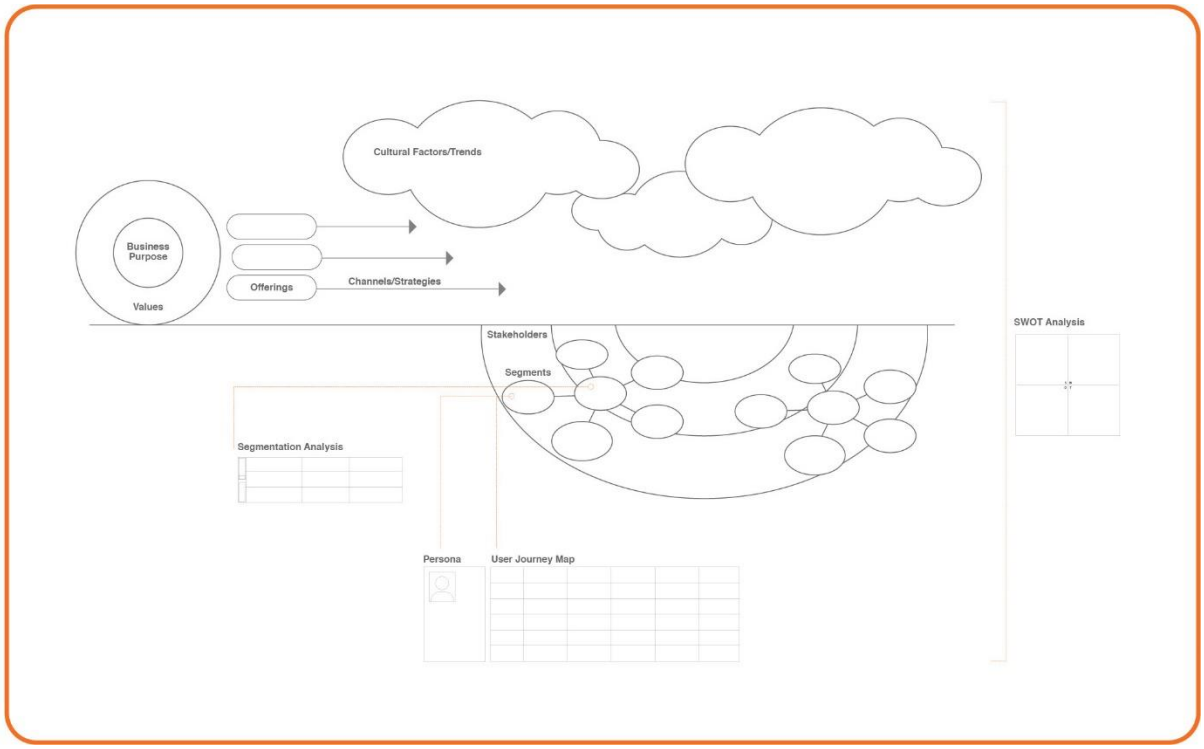

Figure 5 Structure of final visualisation (workshop four). Source: Author (2017)

The owner explained that he has been "re-invigorated through the process as to what the future could potentially hold for the business". He now anticipates that the future will be focused on creating social spaces and is excited by the possibility of collaborating and co-creating to build these spaces “I wasn't expecting to be feeling extremely positive about the future". Furthermore, he describes the business in regards to a platform and service, in contrast to the limited creator of products.

The owner admits that he has “gotten lost a few times or perhaps "overwhelmed" by the speed of the process and the terminology used. “It's only because I wouldn't be used to such environments and thought processes. I also found the report a bit deep for me at times" The owner of business A returned to designCORE after months upon the "Ecology Mapping" being completed. In this case, the business owner and members from designCORE developed on findings from the "Ecology Mapping" in a project that focuses on co-creating a community space. Additionally, while the owner was apprehensive about the need to increase his online activity, as he felt he did not have the necessary skills and resources to do so. He has been pro-active in building these skills in a programme in the local enterprise centre. These factors suggest that the owner aims to continue to engage with a design-led approach to his business.

4 Discussion

"Ecology Mapping" and Purpose and Identity

Design thinking offers an alternative to traditional business approach of strategy development (Hobday et al. 2012). This paper developed the method “Ecology Mapping”, where design thinking was practiced to facilitate the business owner in making sense of their world, articulating the identity and purpose of the business, and creating a solid foundation for future activities.

The focus of this research, being the identity and purpose of the business, aligns with existing theory found in literature on innovation capability building. While Lawlor et al. do not include identity or purpose in their framework, they assert "the glue that maintains this innovation system is the culture and values of the firm" (2015). This reflects the views of Sisney who highlights the

importance of being a values-based organisation and the need for a simple system that defines, reinforces and defends these values (2014). Similarly, Neumeier states that in a complex adaptive system the purpose not only sets the direction, but suggests rules for behaviour and produces communities of action (2008). The "Ecology Mapping" process resulted in;

- a mission statement and set of values (identity)
- a changed perspective as to the purpose of the business
- a rejuvenated understanding of the business by the owner
- a broader understanding of the relevance of the business
- a broader understanding of the business activities

The process shifted the owner's perspective of the business purpose to something he is invested and excited about and something that offers broader social value. While these factors are difficult to measure through traditional metrics, and may take time to show rewards, they suggest a more sustainable future for the business, and remove the owner's negativity in regards to struggling with, and thinking about the business. Moreover, the process combined with the final document provide a foundation that inspires and facilitates micro-enterprises in engaging with a design-led approach, growing awareness of their business, sharing messages and aligning future activities.

The Building Innovation Capability Framework (Fig. 2) demonstrates the task in sustaining innovation capability in an organisation. Findings from this research suggest the need to articulate the identity and purpose of micro-enterprises before exploring vision and strategies (Fig.6). The informality of micro-enterprises suggests the increased need to understand who they are in the present, in order to target and offer their most relevant value in the future. Importantly, the process of developing understanding through design thinking can enable cultural change and further embedding of design in both the development of purpose and identity, and strategy and vision.

Figure 6 Adaption of the building Innovation Capability framework (Lawlor et al., 2015) for micro-enterprises. source: Author (2017)

Developing understanding of identity and purpose, and vision and strategy of businesses aligns with the emphasis on entrepreneurial activity and attempts to expand existing businesses in the recent Action Plan for Jobs (A.P.J., 2017). In these instances design thinking can be used as a strategic tool at the inception of a business or challenge, or the agent of change in rejuvenating existing businesses. Here, design thinking differentiates itself from traditional business consultancies and models by taking a human and environment centred, co-creative and holistic approach, actively seeking new ideas, and broader value creation.

With these factors in mind, design thinking and methods like "Ecology Mapping" can link with existing industry support bodies such as IDA (Industrial Development Authority), LEOs (Local Enterprise Offices) and EI (Enterprise Ireland) and be integrated with programmes such as the S.Y.O.B (Start Your Own Business) programme. In these contexts, design thinking can mitigate risk, optimise understanding, make connections and build relevance for businesses of any size, providing a shared basis for future activities.

Design thinking is multi-disciplinary and integrative and thus offers value to any networking, collaboration and knowledge sharing activities. Here, design thinking can integrate diverse information and expert knowledge, offer a holistic perspective, make connections and provide visual models and shared visions. In line with the nature of design thinking, this paper highlights the broader value creation that can be achieved through design thinking in regard to business to business collaboration, social enterprises, co-creation, and community and regional development as described in the A.P.J. (A.P.J., 2017).

4.1 Design Thinking Facilitator

Design thinking in the new contexts of social and organisational transformation is an emerging practice, and encompasses the continuous development of new knowledge. As described by Humantific™ there is now an emphasis on “Sensemaking”, representing significant different skills and methodologies over traditional design. Consequently, the importance of the design thinking facilitator in the new multi-disciplinary contexts where design thinking operates cannot be over-stated. In these contexts the facilitator must create an environment that facilitates and empowers performance and thinking behaviours of diverse people and groups, be able to transform multiple perspectives and diverse knowledge into shared insights, and continuously motivate and delve into the unknown with a team.

Thus being non-judgemental, sensitive, perceptive, and empathetic with people, and being curious, comfortable with ambiguity, optimistic and determined in the pursuit of progression can all be seen as core attributes of design thinking facilitators (Vossoughi as cited in Rotman, 2013; Owen, 2009).

4.2 Potential Weaknesses

This paper offers an example of design thinking in the context of micro-enterprises in regional Ireland who are not competent with design. However, as evident in Figure 6, much more is needed to sustain a design-led approach within these businesses. Liedtka et al. note that often first changes that become visible when implementing design thinking are aspects such as perception, behavioural change and conversation etc. (2013). Consequently, business owners need to be persistent and creative in seeking and measuring intangible activities before traditional metrics. Significantly, the limited capabilities and informal character of micro-enterprises makes it more difficult to adopt design, as they lack design knowledge, competence and guidance, to successfully integrate and sustain it even if desired (Wolf, 2008).

While design thinking may be practiced on a project-to-project basis and enable the desire to adopt design, it needs to be culturally embedded to offer most value. Design leadership, design management and skill building are fundamental to the sustained practice of design thinking in micro-enterprises.

As businesses have their own cultures and ways of working, the process of implementation and content generated is heavily context-dependent and personal. In the case of smaller businesses there is increased necessity for good cooperation between the business owner and designer. Firstly, the owner must actually want to see some change in their business which asserts design thinking to be a top-down approach (Bucolo, 2015). Secondly, the Designer needs to understand the personal motivations and share the same values as the business owner (Best, 2011).

The "Ecology Mapping" was time consuming; while it consisted of four workshops, a significant amount of planning and reflection was needed throughout. In the "Ecology Mapping" it is

highlighted that formalising the reflection process for the owner may enhance the transfer of knowledge. Additionally, while the method and delivery aimed to be visual and compelling, this was difficult to achieve due to the intensive and novel nature of the process for the author. It is expected that through practice and future development, the overall process and final output can be enhanced by the increased inclusion of imagery, and reduction of terminology.

5 Conclusion

Findings highlight that micro-enterprise owners have difficulties in articulating their identity and purpose, which is reflected throughout the businesses. This study indicates that design thinking can be a powerful instigator in re-invigorating understanding of the identity and purpose of a micro-enterprise based on the values of the owner, developed in this paper through "Ecology Mapping". Developing these understandings provides a platform that facilitates future strategies and actions. Additionally, this engagement with design at a strategic level from the outset can enable cultural and behavioural change, reflected in the sustained desire to adopt a design-led approach. Design thinking and methods like "Ecology Mapping" can integrate with, and contribute to, existing business consultancies and industry development bodies. In these contexts design thinking can optimise understanding of the present and possible future of businesses of any nature and any scale. The application of design thinking and “Ecology Mapping” in the context of business development is being explored further by the author. Stemming directly from this research, the objective is to further develop “Ecology Mapping” and continue to integrate design-led thinking with micro-enterprises in regional Ireland.

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Introducing Design-Driven Innovation into Brazilian MSMEs: barriers and next challenges of design support

FONSECA BRAGA Mariana[ab*] and ZURLO Francesco[a]

[a] Politecnico di Milano
[b] National Council for Scientific and Technological Development (CNPq, Brazil)
* Corresponding author e-mail: mfbraga@gmail.com
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What are the barriers to introducing design-driven innovation into micro, small and medium sized enterprises (MSMEs) in mature industries through design support? What are the next challenges? This paper aims at answering these issues, proposing recommendations to overcome the barriers and exploring what is next. The research strategy was based on the analysis of two exploratory cases of design support in Brazil, taking the key stakeholders' perspectives into account. The approach is qualitative and inductive; we analyse empirical evidence using a literature review on barriers to design-driven innovation. New constraints in the inquired contexts and the ones which were found in other studies are identified and framed at three levels: individual (actors), organisational (micro), and ecosystem. Challenges are pointed out applying the HMW framework to the most promising scenario (which considered critical variables) to design-driven innovation in Brazilian MSMEs. In addition, recommendations on more immediate constraints are suggested.

design-driven innovation; MSMEs; barriers; design support challenges

1 Introduction

This paper focuses on the Brazilian context, but the problematic which is addressed can be considered of global concern, being a relevant issue in emerging and mature economies (see for instance Arquilla, Maffei, Mortati, Villari, 2015; Raulik-Murphy, 2010; Schneider, Gibet, Colomb, Orazem, Loesch, Kasparyan, Salminen, 2015). MSMEs are important sources of employment and contribute to decreasing the impact of an economic crisis (Airaksinen, Luomaranta, Alajääskö & Roodhuijzen, 2015; Bell, 2015; Cawood, 1997; Madeuf & Estimé, 2000; Organisation for Economic Co-operation and Development [OECD], 2016, Raulik-Murphy & Cawood, 2009). The need for innovation ranging from businesses to regions and nations has been fully recognised (OECD, 2014, ECLAC, 2015, European Comission, 2015, Galinari, Teixeira Junior, & Morgado, 2013; Raulik-Murphy, 2010; Schnaider et al., 2014; Silveira da Rosa, Correa, Lemos, & Barroso, 2007). Design as a way that leads innovation and humanizes technologies, keeping people at the core throughout its process,

constitutes one path to promote change at diverse levels: from micro (organizations, businesses) to macro (policies, territories, industries, nations, ecosystems). The designer "… is concerned with how things *ought* to be in order to *attain goals*, and to *function*" (Simon, 1996, p. 4), this definition is still appropriate nowadays with the expansion of the design field.

1.1 Methodology

This research uses an inductive reasoning, starting from empirical cases to identify the integration of design's problematic in the context of design support[1] when beneficiaries generally are MSMEs and have little or no design experience.

Two research strategies were combined: case study (Eisenhardt, 1989; Stake, 2000; Yin, 1994) and grounded theory (Glaser and Strauss, 1967). The case study is indicated when a contemporary phenomenon is inquired in a real context where the boundaries between the context and the phenomenon are not clearly defined (Yin, 1994). It allows diverse research phases interaction throughout the research process, which enables a better update of the research design according to the discoveries about the phenomenon and the needs found out throughout the research process (Eisenhardt, 1989). The grounded theory approach enables to evidence the meanings from empirical data (Glaser and Strauss, 1967).

Methods' triangulation was used, including semi-structured interviews (addressed to key stakeholders' representatives who take part in the design policy-making processes and implementation such as policy makers, advocates, designers and other consultants, and beneficiaries), in-depth interviews (to get insights on specific topics emerged from the semi-structured interviews), desk research (data collection and analysis from brochures, projects' documents, websites of projects, institutions and companies).

The design support cases inquired were selected in collaboration with a non-profit private entity which aims at promoting the sustainable and competitive development of the Brazilian small businesses. Polar types (Eisenhardt, 1989; Glaser and Strauss, 1967) were considered in order to favour theory extension and to contribute to fill in theoretical gaps. One project in a design-intensive industry[2] and another in a non-design intensive industry were selected. Table 1 shows the projects' characteristics.

Table 1 Projects' characteristics.

Project and context	Description	Activities	Purposes and Funding
P1 *Canastra region* 800 cheese producers 40 certified (Marzano, 2015) *Cheese from Canastra* 200 y. tradition Made of raw milk 2008 - Productive practices were considered as part of the	Industry: food and agriculture Location: Serra da Canastra (Minas Gerais Federation, Brazil) MSMEs (beneficiaries): This design support initiative counted on 30 to 45 beneficiaries from 2013 to 2016. This inquiry focused on 19 beneficiaries of design interventions that included a	Cultural heritage identification and registration (verbal language, community behaviour, territory features, institutional videos) Brand, tags and package design (for a consortium of 6 businesses that shared the same brand, and for other individual businesses).	To develop the territorial brand as well as individual producers brands. To support making products suitable for quality and compulsory certifications regulations, promoting a better communication of product origin and values.

[1] "Design support programmes are a policy instrument for improving the use of design and can comprise of one-to-one mentoring ranging from light-touch to more specialised interventions as well as subsidies, tax credits and export schemes." (Whicher, Swiatek, Cawood, p. 14, 2015) In the Brazilian case, design support is defined, developed and managed mainly by non-profit private entities. These entities are funded through a Brazilian Government's tax paid by formal companies (private firms).

[2] Industries in which design plays an essential role to develop outstanding products and services, considering the definition used by Verganti (2003, p. 35) who includes furniture, lighting, kitchenware, small appliance as examples of this typology of industry.

Project and context	Description	Activities	Purposes and Funding
Brazilian cultural and immaterial heritage by the Instituto do Patrimônio Histórico e Artístico Nacional (IPHAN) 2015 - *2nd ranking Mondial du Fromage et des Produits Laitières* (Tours, France)	major range of activities proposed. Projects studied were carried out from 2013 to 2016	Research of best practices in loco.	The non-profit entity funds from 60% to 80% of the design interventions, and the beneficiaries pay (refund the institution) from 40% to 20% of the total economic value.
P2 3rd Brazilian Lingerie Cluster 160 manufacturers Focus on wholesale B2B (Guedes, 2014)	Industry: fashion Location: Juruaia (Minas Gerais Federation, Brazil) MSMEs (beneficiaries): This project started with 25 beneficiaries but 15 left the project before its conclusion because of the own (from the entrepreneurs) investment required to open their store. Projects studied were carried out from 2010 to 2014	Technical drawing lingerie modeling workshop. Research of best practices in loco. Mentoring, coaching. Development of brand identities, tags, packages design, and other communication materials. Store design for the consortium of firms (same store and brand shared by a group of entrepreneurs). Lingerie collection design	To enlarge the beneficiaries market share introducing the products into the B2C market through a new retail store, to improve the quality and update the industry trends. The non-profit entity funds from 70% to 80% of the design interventions, and the beneficiaries pay (refund the institution) from 30% to 20% of the total economic value.

All interviews were done in the first language of the interviewee. They were recorded and transcribed. Fragments of the interviewees' speech referring to barriers, clearly connected to the research issues, were translated. Statements that appeared to have personal nature were excluded. A report including the subjects of interest for this research was elaborated and sent to the interviewees in order to validate the information.

Seven representatives of key stakeholders were interviewed (policy makers and project managers, designers and other consultants, and beneficiaries). The interviews were carried out between October 2016 and May 2017. The duration ranged from forty minutes to one hour and thirty minutes.

The analysis of the interviews proceeded in convergence with grounded theory reasoning principle of elicitation, first attributing codes to the texts fragments selected from interviews, summarizing them in short phrases or themes. Second, these themes were clustered according to the similarity between them through cross-reference. Finally, they were confronted with the existing literature enabling to distinguish between the new barriers and the ones that were already identified in prior research (Tables 3, 4, 5).

Three levels of analysis of drivers and barriers were settled as follows:

- The actors level: policy makers, designers and consultants, and beneficiaries as individuals;
- The organisational level: the micro level regarding organisational structure, culture and design process in the firm;
- The ecosystem level: the industry, economic, political and educational environment.

The introduction or integration of design-driven innovation into MSMEs is also studied in the literature with other terminologies such as: to absorb design management capabilities, to learn to use design, to adopt design, to innovate by design, to bring design into business strategy. The main

fields that deal with the issue identified in this research were: Design management, Strategic design, Product innovation, Design capabilities, Knowledge management, Design thinking, Creativity, Innovation and Organisational studies. The barriers to design-driven innovation found in the literature came from these fields at the actors and at the organisational level. In the ecosystem level, they were additionally recognised in the Industrial policy, Innovation policy, Design policy, Economics, and Finance field.

Future challenges were elaborated through the identification of critical variables in each level analysed, envisioning a preferred scenario to design-driven innovation, and by applying the 'How May We' (HMW) question framework from design thinking approach (Ideo.org, n.d.).

1.2 Design and MSMEs: a potential relationship towards change, innovation, productivity and economic growth

Micro, small and medium-sized enterprises (MSMEs) are considered important sources of economic growth, job creation and social cohesion in advanced and emerging economies (Cawood, 1997; Bell, 2015; Madeuf & Estimé, 2000; OECD, 2016, Raulik-Murphy & Cawood, 2009).

There is not a universal definition of MSMEs. MSMEs are, generally, non-subsidiary firms and the criteria used to define MSMEs are based on the number of employees, turnover and financial assets (OECD, 2006, 2016). These numbers vary across countries (OECD, 2006, 2016) as well as the definition and rules applied to employees in each country (European Commission, 2015b). In Brazil, the Brazilian National Confederation of Industry (Confederação Nacional das Indústrias [CNI]) considers as MSMEs firms in industry sectors that have fewer than 250 employees (CNI, n.d.c). the Brazilian Micro and Small Business Support Service (Serviço Brasileiro de Apoio às Micro e Pequenas Empresas [SEBRAE]) sets the limit at 99 employees for firms in the trade and services sectors (SEBRAE, 2014). Table 2 shows the values considered according to these institutions in Brazil (CNI, n.d.c; SEBRAE, 2014, n.d.a) and according to the European Commission in Europe (European Commission, 2015b).

Table 2. MSMEs criteria adopted by diverse institutions.

According to	Enterprize category	Headcount Annual Work Unit (AWU)	Annual turnover		Annual balance sheet
European Comission (2015b)	Medium-sized	<250	≤ €50 million	or	≤ €43 million
	Small	<50	≤ €10 million	or	≤ €10 million
	Micro	<10	≤ €2 million	or	≤ €2 million
CNI (Brazil) Industry	Medium-sized	<250	–		–
	Small	<50	≤ 3.6 million BRL		–
	Micro	<10	≤ 360 thousand BRL		–
SEBRAE (Brazil) Trade and services	Medium-sized	<100	–		–
	Small	<50	≤ 3.6 million BRL		–
	Micro	<10	≤ 360 thousand BRL		–

MSMEs generate four out of five new positions of formal jobs in emerging economies (Bell, 2015). They contribute to 45 percent of formal employments and 33 percent of national income (Gross Domestic Product [GDP]) (Bell, 2015). The World Bank estimates that there are between 365-445 million micro, small and medium enterprises (MSMEs) in emerging economies: 25-30 million are formal MSMEs; 55-70 million are formal micro-enterprises; and 285-345 million are informal enterprises (Bell, 2015). 600 million jobs will be needed before 2030 to absorb the global growing workforce (Bell, 2015), which reinforces the need for innovation in MSMEs towards a more sustainable scenario for these businesses, considering their potential contribution to creating jobs.

In the European Union (EU), 99 percent of companies are MSMEs. They contributed with 57 percent of value added in 2012 (Airaksinen, Luomaranta, Alajääskö, & Roodhuijzen, 2015). Gross value added (GVA) and employment are the two main measures that have been used to describe the MSMEs contribution to economies. The first makes economies wealthier, and the latter keeps the unemployment rate low (Airaksinen, et al, 2015).

In Brazil, 99 percent of businesses are MSEs, generating 52 percent of formal jobs (excluding the agriculture sector) in 2013 (Serviço Brasileiro de Apoio às Micro e Pequenas Empresas [SEBRAE] & Departamento Intersindical de Estatística e Estudos Socioeconômicos [DIEESE], 2015) and contributed to 27 percent of the Brazilian GVA in 2011 (SEBRAE, 2014).

The need to reduce inequalities related to MSMEs' productivity between mature and emerging economies through innovation, education and skills deployment is pointed out in order to consolidate the economic growth in developing countries (OECD, 2014; Economic Commission for Latin America and the Caribbean [ECLAC], 2015; European Commission, 2015a).

Despite the absence of a commonly agreed design definition (see for instance Arquilla, Maffei, Mortati, & Villari, 2015; Fonseca Braga, 2016; Swann, 2010), design as:

- a way to transform a current situation into a preferred one (Simon, 1996);
- a tool that drives innovation, competitiveness and national economic growth (European Commission, 2016; Thomson & Koskinen, 2012);
- a way to shape creativity towards innovation (Cox, 2005);
- a lever of non-technological innovations (D'Ippolito, 2014; Thomson & Koskinen, 2012; Verganti, 2008);
- a way to humanise technologies (Heskett, 2009);

is a potential instrument to drive change, innovation, productivity and economic growth at the micro and macro levels (from organisations to nations) as evidenced in several reports (Danish Design Centre [DDC], 2003; Design Council, 2007; Design Council, 2015; European Commission, 2016; Rae, 2013, 2014; Thomson & Koskinen, 2012).

1.3 A brief history and context of design in Brazil

> *… we could begin to trace the history of design in Brazil before the arrival of the Portuguese. In this case, we would mention the capacity of indigenous Brazilians to objects - networks, screens, baskets and banks - in perfect harmony with nature and with an inherent artistic expression. (Borges, 2009, p. 57)*

The influence of architects, such as Oscar Niemeyer, Lucio Costa, and Sergio Rodrigues, as well as Joaquim Tenreiro's and Zanine Caldas's furniture design, marked the basis of modern design and architecture in Brazil since the 1940's (Borges, 2009). In 1964, the Industrial Design College (Escola Superior de Desenho Industrial [ESDI]) was founded in Rio de Janeiro, and held the first higher education design course in South America; the educational programme followed the Ulm School in Germany, having some professors from there (Borges, 2009; Moraes, 2006; Moraes Junior, 2002). The professors' backgrounds were in architecture and engineering (Borges, 2009).

The economic model adopted as well as the late and forced industrialization process since 1964, when the military junta took power, led to the Brazilian identity crisis (Borges, 2009, 2011; Moraes Junior, 2002). Multinational enterprises, mainly from the United States, Europe and Japan, arrived in Brazil, influencing habits, culture and society. This process is known as modern colonization (Moraes Junior, 2002). These educational, political and industrial contexts contributed to the Brazilian rupture with its cultural roots (Borges, 2009, 2011).

After the end of the dictatorship period, in the 1990's the market openness to international competitors brought consequences to the Brazilian businesses:

> *Foreign products proved fatal for many companies accustomed to merely copying, since there was always a time-lapse between the original and the copy. At first a number of these companies went under, but in time the survivors grew stronger by absorbing design as a component in their manufacturing strategy. (Borges, 2009, p. 58)*

In 1994, the Brazilian Design Programme was the first noteworthy government initiative in the field of design policies promoted by the Ministry of Industry and Commerce (Ministério da Indústria, Comércio Exterior e Serviços [MDIC]), recognising the need for a 'Brazil Brand' and for investing in distinctive design characteristics for Brazilian products. From this time, it is noticed the emergence of Brazilian designers in the international scenario, working for renowned brands such as Motorola, Nike, Bentley, Volkswagen, GM, Disney; doing signed design for foreign companies (e.g. Sergio Rodrigues, Campana Brothers); and having excellent performance in international design awards (e.g. iF- Design Awards and Red Dot Design Award) (Borges, 2009; CBD, Apex-Brasil, MDIC, 2014; Kraichete, 2015; primary data collection). In addition, Brazilian brands start emphasising original features and multinationals with branches in Brazil settled design departments in Brazil, having Brazilian designers also in charge of products development to North America, Europe, China and India (Borges, 2009).

Despite the aspects aforementioned and the diversified industrial sector, Brazilian sectors such as furniture and automotive are still inward focused, being concerned with local content and domestic-market, and the industry is heavily protected from foreign competition (Araújo, 2016; Arnold, 2016; Bradesco, 2017; Galinari, Teixeira Junior, & Morgado, 2013; Moraes Junior, 2002; Organisation for Economic Co-operation and Development [OECD], 2014). Moreover, productivity growth in Brazil is associated with low value added sectors such as agriculture and mining, whereas manufacturing and services correspond to 20% of the Brazilian productivity growth, concentrating over 80% of value added and employment (OECD, 2013). The potential of manufacturing and services to contribute to the productivity growth is underexplored despite the value added and employment rates related to these sectors.

Economic reviews (Araújo, 2016; Arnold, 2016) have suggested the need to open the market to international competitors in order to strengthen the national industries. However, this initiative isolated could lead many firms to go under, especially MSMEs, because of the lack of resources and skills to lead innovation, increasing the unemployment rates. Then, combined initiatives that strengthen education, innovation, design and management skills, or, a learning process to integrate the Brazilian trade into the global one and into exports, providing appropriate support and competences to face this 'openness' process, are required for current and future generations.

1.4 The Brazilian Design Innovation Ecosystem

The Figure 1 uses a framework adapted from Whicher and Walters (2014)[3] to bring a picture of the Brazilian design innovation ecosystem based on

[3] This framework is the same adopted in the European context in the Design Policy Monitor (Whicher, Swiatek & Cawood, 2015).

- The Diagnostic Review of Design in Brazil (Centro Brasil Design [CBD], Agência Brasileira de Promoção de Exportações e Investimentos [Apex-Brasil], Ministério da Indústria, Comércio Exterior e Serviços [MDIC], 2014) – this study is an initial effort to measure the Brazilian design capability using as the main reference the Design Staircase Model (Koostra, 2009) and the International Design Scoreboard (Moultrie and Livesey, 2009).The difficulties related to the lack of available data are clearly evidenced, not enabling to compare Brazil to other European contexts;
- Caloête and Westin (2014) – this publication from SEBRAE lists the Brazilian institutions, programmes, courses, university laboratories, events and fairs;
- Borges (2009) and Kraichete (2015) – this research has been carried out in partnership with the Dutch Culture Centre for International Cooperation and started to map the Brazilian design scenario, its actors and initiatives related to cultural, promotion and funding assets;
- The National Institute for Educational Studies and Research "Anísio Teixeira" (Instituto Nacional de Estudos e Pesquisas Educacionais Anísio Teixeira ([INEP], 2017);
- And, information sourced at institutional websites of actors that play a relevant role in design and innovation programmes across Brazil, such as: the Brazilian Micro and Small Business Support Service (Serviço Brasileiro de Apoio às Micro e Pequenas Empresas [SEBRAE]) (SEBRAE, n.d.b), the Brazilian National Confederation of Industry (Confederação Nacional das Indústrias [CNI]) and the National Service of Industrial Training (Serviço Nacional de Aprendizagem Industrial [SENAI]) (CNI, n.d.a, n.d.b).

This scheme does not include all initiatives and entities that compose the Brazilian Design Innovation Ecosystem, but provides examples which have national relevance and sources where to find additional available data.

The Brazilian design policies are fragmented and short-term focused (Raulik-Murphy, Cawood, Larsen, & Lewis, 2009). Design and innovation policies publications regarding the Brazilian context have emphasised the need (a) for long run innovation strategies (Mazzucato & Penna, 2015; Raulik-Murphy, Cawood, Larsen, & Lewis, 2009), (b) to combine diversified design policy initiatives (Raulik-Murphy, 2010) and (c) to connect innovation systems that are quite fragmented across the country (Mazzucato & Penna, 2015; Raulik-Murphy, Cawood, Larsen, & Lewis, 2009) that is heterogeneous in terms of culture, education, innovation and design. The geography of design referred to design events (Kraichete, 2015), design jobs and firms (CBD, Apex-Brasil, MDIC, 2014) evidence these contrasting contexts across the country.

The concentration of design firms and jobs is mainly identified in the southeast and southern regions in Brazil (CBD, Apex-Brasil, MDIC, 2014). São Paulo, Rio de Janeiro, and Bento Gonçalves stand out regarding promotion initiatives. São Paulo and Rio held most design events, Bento Gonçalves held the largest furniture fair in Latin America with the Salão Design (Design Hall) Award. The first Brazilian Design Centre (Centro Brasil Design [CBD]) was founded in 1999 in Curitiba city where design concern has been evidenced also though design management studies focused on Paraná Federation companies (Murphy & Raulik Murphy, 2015).

The design and innovation policy-making processes follow essentially a top-down approach where political influence plays a definitive role in strategies, goals and investment decisions. In contrast, experts have emphasised the importance of participatory, collaborative and bottom-up process for policy-making (Maffei, Mortati & Villari, 2014; Whicher & Walters, 2014).

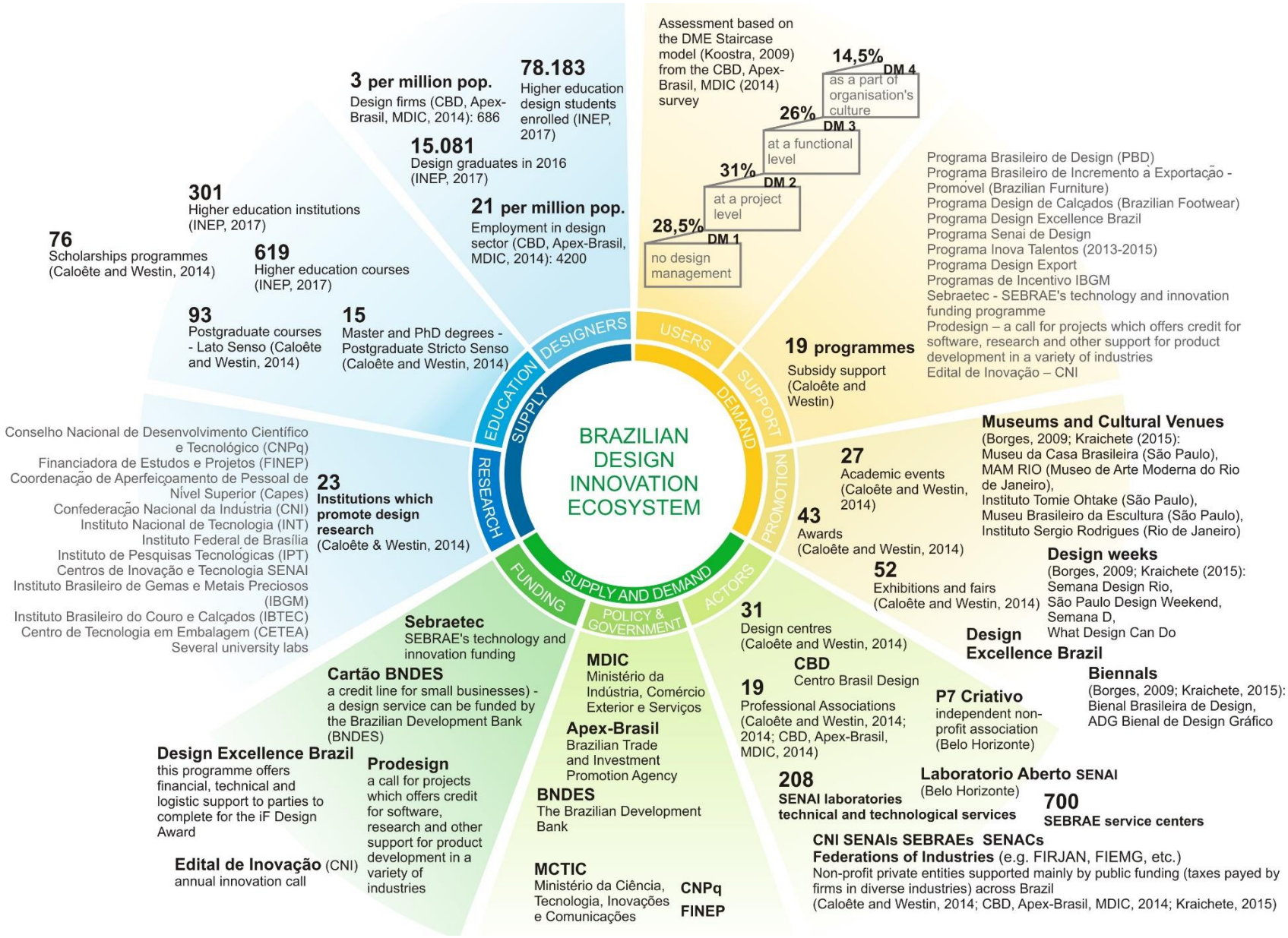

Figure 1 The Brazilian Design Innovation Ecosystem.

The Diagnostic Review of Design in Brazil (CBD, Apex-Brasil, MDIC, 2014) is an initial attempt, considering that the sizes of companies that answered the survey do not represent the Brazilian reality (where 99 percent of businesses are micro and small) as well as its industry sectors. Moreover, other limitations were pointed out as follows:

> *… the absolute design capability indicators in Brazil are often higher in comparison with other countries. However, this can be misleading because when the numbers are placed within the national context according to the size of the population, Brazil's design resources are classified at the lowest end of the table for all indicators. It should also be considered that there is a lack of data on the indicators for public investment in design and the contribution of the design sector towards GDP. (CBD, Apex-Brasil, MDIC, 2014, p. 49)*

The lack of design management studies and data on design across Latin America complicates a comparison with foreign regions (CBD, Apex-Brasil, MDIC, 2014) as well as an analysis of the state of the art of design in the country.

7 Barriers to introducing design-driven innovation into MSMEs

Tables 3, 4 and 5 show the barriers to design-driven innovation found in the literature review, and others spontaneously[4] cited by the respondents during the interviews. These barriers were framed at three levels: actors (Table 3), organisational (Table 4), and ecosystem (Table 5). Most barriers quoted were identified in prior research, others that were highlighted were not quoted before related to design innovation in MSMEs.

[4] The interviewees did not have access to the barriers found in literature nor before neither during the interview.

Table 3 Barriers to design-driven innovation at the actors level

Level		R	Barrier	Prior research
ACTORS	Beneficiaries		Reluctance to delegate authority or decision-making to others	Dyer and Handler (1994) cited in Massa and Testa (2008)
		🔵	Over-involvement in operational-level decisions and activities	Bruce, Cooper and Vazquez (1999) Nunes (2014) Raulik-Murphy and Cawood (2009)
		🔵	Not knowing where to turn for specialised help	Arquilla, Maffei, Mortati and Villari (2015) Cox (2005)
		🔵	Risk aversion	Cox (2005) Sternberg (2006, 2012)
		🟡	Passive attitude towards design with lack of cooperation / engagement with designers throughout projects	Fonseca Braga (2017)
			Lack of long-term strategy vision	Cawood (1997)
		🔵	Conventional thinking	Sternberg (2006, 2012)
		🟡🔵	Lack of experience	Arquilla et al. (2015) Bruce et al. (1999) Cox (2005) Schneider, Gibet, Colomb, Orazem, Loesch, Kasparyan and Salminen (2015)
		🟣🟡	Lack of design awareness	Cox (2005) Filson and Lewis (2000) Millward and Lewis (2005)
		🟣🔵	Difficulty in trusting motivated by regional culture, tradition*	None
		🟡	Delay in delivering needed activities (e.g. putting off prototype tests) - not related to availability of economic resources	None
		🟣🟣🟡	To 'follow the crowd' attitude (join actions because others are joining)	Sternberg (2006, 2012)
		🟡🟡🔵	Little understanding of product development/design	Arquilla et al. (2015) Filson and Lewis (2000) Millward and Lewis (2005)
			Not knowing product development and manufacturing costs	Filson and Lewis (2000)
	Designers Consultants	🟣	Lack of experience, practice-based know-how	D'Ippolito (2014)
		🟣	Lack of ability to communicate design knowledge to company members	Brown (2009)
	Policy makers	🟡	Lack of background in design management	Cox (2005) Maffei, Bianchini and Mortati (2014)

R Respondents
🔵 Beneficiaries
🟡 Designers and consultants
🟣 Policy makers

*Although there are studies emphasising the role of trust in some innovation ecosystems, research pointing out the lack of trust (motivated by regional culture) as an obstacle to design innovation was not found.

The difficulty in trusting and the delay in delivering required activities that would be carried out by the company in order to accomplish a design process phase were pointed out by respondents and identified as new barriers. The difficulty in trusting means that projects beneficiaries show reluctance to engage with consultants or to contribute to them mainly at first attempts of the project when they do not meet each other before. The delay in deliveries impacts design implementation and results (e.g. when tests cannot be carried out, problems are identified later, impacting time to market, and adding design activities to correct them).

Most barriers at the actors level were recognised by interviewees that collaborate with each other, having face-to-face contact throughout projects.

Table 4 Barriers to design-driven innovation at the organisational level

Level		R	Barrier	Prior research
ORGANISATIONAL	Structure	●●●	Limited resources	Acklin (2013) Larsen and Lewis (2007)
		●●●	Limited in-house capabilities for conducting innovation processes	Acklin (2013) Bruce, Cooper and Vazquez (1999) Cox (2005) Filson and Lewis (2000)
		●●●	Underdeveloped education and training	Larsen and Lewis (2007)
			Lack of management skills	Larsen and Lewis (2007) Altenburg and Meyer-Stamer (1999)
			Lack of manufacturing skills	Larsen and Lewis (2007)
	Culture		Use design support to address immediate needs during a crisis	Cawood (1997)
			Cost-driven approach	Millward and Lewis (2005)
		●	Lack of top management support	Cawood (1997) Filson and Lewis (2000) Larsen and Lewis (2007) Schneider et al. (2015)
			Lack of long-term strategy vision	Cawood (1997) Filson and Lewis (2000)
			Weak external contacts	Srinivasan, Lilian, and Rangaswamy (2002) cited in Massa and Testa (2008)
			Influence of a dominant owner/manager	Bruce et al. (1999) Millward and Lewis (2005)
		●	Lack of trust to build up partnerships	Larsen and Lewis (2007)
	Design process		No clear new product development / design strategy	Filson and Lewis (2000)
			Lack of competitors and suppliers knowledge	Larsen and Lewis (2007)
			Domestic market orientation	
			Lack of market launch plan and resource with stage gates	
			Lack of early superior/differentiated product definition	
			Lack of customers / users orientation	

R Respondents
● Beneficiaries
● Designers and consultants
● Policy makers

Few organisational barriers were cited by participants during the interview. Policy makers identify the lack of economic resources and the lack of trust among entrepreneurs, this second one hinders collaboration among them. Designers and beneficiary recognise the need to have in-house capabilities, education and training. The lack of top management (generally the owner in MSMEs) support to collaborate towards design support projects is pointed out by a designer.

The barriers quoted by respondents can be understood as the ones that they perceive as having a clear impact on design introduction through design support initiatives.

Even though the other barriers have an important influence on the introduction of design into MSMEs, they were not spontaneously remembered. A possible reason for this can be the usual focus of projects that do not include a prior design audit or a strategic assessment before defining design support strategies and projects goals. Hence, generally, designers and consultants have the role of developing and implementing specific new products and communication elements that were previously established in the design support programme or project by policy makers.

Table 5 Barriers to design-driven innovation at the ecosystem level

Level		R	Barrier	Prior research
ECOSYSTEM	Industry	🟣	Lack of cooperation between businesses**	None
		🔵	Illegality in the market (non certified products/firms)	None
			Difficulty in finding appropriate support with respect to design	Arquilla et al. (2015) Cox (2005)
			Imitation strategy context	Altenburg and Meyer-Stamer (1999)
			Inward focused (dedicated to domestic market and local content)	Araújo (2016) Arnold (2016)
			Few design firms considering the size of the national population	CBD, Apex-Brasil, MDIC (2014)
	Policy	🟣🟣	Bureaucracy limitations to select/contract consultants	None
			Bureaucracies related to intellectual property procedures	Larsen and Lewis (2007) Massa and Testa (2008)
		🟡🔵🟣	Bureaucracies related to local authorities / regulatory issues	Acklin (2013) Cox (2005)
		🟡	No clear strategy to attend to a businesses / design cluster demand / need - HOW	Maffei, Bianchini and Mortati (2014)
			Fragmented design innovation ecosystem	Maffei, Bianchini and Mortati (2014) Raulik-Murphy and Cawood (2009)
		🟡	One shot projects without follow-ups or long run strategies	Mazzucato and Penna, (2015) Raulik-Murphy, Cawood, Larsen and Lewis (2009)
	Economy		Lack of credit availability	Bell (2015) Larsen and Lewis (2007)
			Low exposure to foreign competition	Araújo (2016) Arnold (2016)
			Industry heavly protected from international competition	Araújo (2016) Arnold (2016)
			Unemployment	Altenburg and Meyer-Stamer (1999)
			Few jobs in the design sector	CBD, Apex-Brasil, MDIC (2014)
	Education		Lack of skills, education to move towards innovation	Altenburg and Meyer-Stamer (1999) OECD (2014)
			Few design graduates considering the national population size	CBD, Apex-Brasil, MDIC (2014)
		🔵	Lack of end-users education to recognise design value	Swann (2010)

R Respondents
🔵 Beneficiaries
🟡 Designers and consultants
🟣 Policy makers

**Although the cooperation between businesses is a recognised driver (Cantù, 2013; Rullani, 2011; Symbola & Unioncamere, 2016; Wenger, 2011), research pointing out the lack of cooperation as an obstacle to design innovation in the context of design support was not found.

The lack of cooperation between businesses and the illegality in the market were the new barriers recognised in the industry.

The lack of cooperation is when beneficiaries see the other beneficiaries as competitors that can 'steal their ideas or know-how' more than allies to achieve a goal. In the case of the studied design support projects, the cooperation is not characterized by interdependence and mutual influence[5] among firms in the same industry, since access to external resources such as a design consultancy is assured when the businesses formally join the project, which means that one company will access the competences proposed in the project regardless of other companies' attitudes, conditions and commitment. This cannot be seen as a network because the motivation to join other businesses is mainly based on sharing the investment costs and on the voucher scheme to exploit a resource, not requiring trust (among businesses), commitment or skills from beneficiaries.

Thus, the kind of collaboration identified means 'to help one another' or to learn in a collective process without prior relationships fostered by a bottom-up approach to business needs and to strategies formulation (to exploit resources). In this sense, the way the design support projects are

[5] i.e. Cantù (2013) explains that these two factors are present in different types of network, including interpersonal ones.

generally designed (top-down process) as well as how businesses join projects do not favour cooperation.

The illegality in the market (shadow economy products) represents the fact that some producers sell their products without quality requirements and compulsory certifications in the market as if they were made in a region where they were not, communicating this misleading information to customers through package and brand. These products are generally cheaper than original and quality-certified products, thereby affecting the competition in the retail market as the customer is not able to distinguish them.

The top-down approach to policy-making leads to the identification of another new barrier: the extensive regulations to contract consultants makes the process slower compared to hiring the designer or consultant in the market situation. Furthermore, the consultant has to fit in several requirements that are not related to their design background, reputation or competence to attain the projects' goals. Another issue is that some of these regulations' requirements counteract the idea of the design policy role (including design support) to balance or stimulate design supply and demand, making the conditions of private studios not suitable to hire them regardless of their competences and reputation.

Most ecosystem barriers were not cited by respondents. Some possible reasons can be that people get used to the national conditions just adapting to them, seeing things within the national boundaries context, another can be the top-down policy approach that discourages taking actions and trying to change a system that lacks meritocracy. The lack of education and skills towards innovation can also lead to hide the weaknesses at the ecosystem level (how can one recognise something in which one has no background or experience?). An additional evidence is the time required to formally recognise by law the designer profession in Brazil, an attempt that comes from 1980 (CBD, Apex-Brasil, MDIC, 2014) and is still being carried out with limited content being discussed regarding the global expansion and importance of design at organisational and national level.

8 Implications and recommendations on design support

All in all, design is not a priority throughout the policy programmes and projects. It is used in practice to achieve other priorities related to, for example, regulations, adequacies to technology and market requirements characterized by short-term strategies, immediate perspectives towards which benefits can be achieved, being more 'pushed' interventions than 'pulled' ones.

Hence, design as a connector, a functional integrator; an enabler of product-service systems (PSS) that fosters innovation to users; as a strategic driver; a way to boost economic growth; to envision futures, collaborating and co-creating them together with citizens, users or beneficiaries of policies, is not observed in project practices, policy priorities and approaches.

In addition, looking at the design support and policy frameworks, and at most research and supportive institutions that relate to design, leads to the interpretation that design is seen as an addition, being usually included in other policy priority such as technology or quality requirements to attain compulsory regulations. There are exceptions regarding this design understanding considering the aforementioned diversity, heterogeneity of design in Brazil. However, analysing the picture of the Brazilian Design Innovation Ecosystem and how it works we may state that generally the potential of design has a very limited understanding. This is evidenced by organisational, institutional and political practices as well as by current Brazilian design management research (e.g. CBD, Apex-Brasil, MDIC, 2014; Murphy, & Raulik Murphy, 2015) that also evidences the lack of data at national level, including public investment in design (CBD, Apex-Brasil, MDIC, 2014).

The difficulty in identifying public investment can be due to the inclusion of design as additional asset in other branches of policies programmes or to the lack of specific policies, institutions and agencies concerned with design. Furthermore, the fragmentation of the design innovation

ecosystem and the way annual accountability reports were done do not facilitate (a) the communication to a general public (citizens) and (b) to distinguish which part was specifically destined to design as well as measurable evidence of benefits directly related to the design interventions.

The suggested recommendations in order to start improving design support in Brazil are mainly related to the policy maker role, considering the current top-down approach to design support programmes. They are:

- To increase designers, consultants and beneficiaries participation in the policy-making process, so they can take part in the definitions of projects' goals and strategies. This kind of earlier beneficiaries' involvement tends to make them strongly committed to the project once they participate in its decisions. Designers and other experts can support prior assessments to design appropriate policy projects according to beneficiaries needs and conditions. The collaboration with experts in earlier phases can avoid misleading decisions regarding the lack of background in design;
- To set clear goals and strategy during the earlier collaborative phase. For instance, what is to be achieved, the competences required, how the programme/project will be carried out, who will be in charge of what and how, communicating this information to all key stakeholders;
- To revise best practices in their field across the world, several aspects related to MSMEs conditions to absorb design-driven innovation through design support programmes are not particular of a context but found in other situations too;
- To look for tools that can support design programmes and projects as well as experts' collaboration in order to strengthen their design capabilities towards future projects;
- To be updated and informed about the regional, national and global content and data related to design support programmes/projects as well as design in the world and in Brazil (collecting also current and comparable data in time), building on reasoning that evidences the impact on the Brazilian society and economy in order to negotiate required changes (e.g. to decrease bureaucracy and better consider meritocracy) to better accomplish their role in the supply and demand of design in Brazil as well as to define budget destinations;
- To move the focus of the work from inside the institution (e.g. fulfilling demanding forms and reports) to outside, including visits to beneficiaries with specific purpose of understanding their needs and conditions, listening to their expectations and what they need from the institution;
- To be immersed in the design world. To cultivate an environment that includes the design industry professionals as well as beneficiaries, promoting when possible events and meetings where people can have the opportunity to meet each other, share knowledge, propose solutions to common problems or discuss businesses' topics that interest both. To be present in design sector events and fairs (not just related to the institution).

9 Challenges of introducing design-driven innovation: What is next?

The next challenges come from the preferred scenario where critical variables were identified in each level:

1. the design support programmes/projects have an important social and economic impact;
2. the processes of policy-making are participatory;
3. the programmes/projects are evaluated[6] and monitored regarding short and long-term benefits/impacts;
4. the organisations are international market focused, human-centred and future-oriented;
5. the actors are design aware and build on appropriate education and skills to lead design-innovation.

In order to propose strategies to achieve this scenario, the How May We (HMW) questions (Ideo.org, n.d.) are proposed to be answered in collaboration with key stakeholders' representatives through a co-creation workshop using design thinking methods. The HMW questions elaborated are:

1. the design support programmes/projects have an important social and economic impact;
    - How may design support programmes/projects propose goals that have an important social and economic impact?
    - How may we communicate design support impacts to the general public and to potential partners?
2. the processes of policy-making are participatory;
    - How may policy makers elaborate new ways of crafting design support programmes/projects in collaboration with experts and beneficiaries?
3. the programmes/projects are evaluated and monitored regarding short and long-term benefits/impacts;
    - How may we evaluate short and long-run benefits/impacts of design support programmes/projects?
    - How may we monitor short and long-run benefits/impacts of design support programmes/projects?
4. the organisations are international market focused, human-centred and future-oriented
    - How may design support programmes/projects prepare companies/beneficiaries to become internationally competitive?
    - How may design support programmes/projects make the firms be dedicated to their users' needs?
    - How may design support programmes/projects make the firms be future-oriented?
5. the actors are design aware and build on appropriate education and skills to lead design-innovation;
    - How may we make policy makers and beneficiaries aware of design?
    - How may we improve policy makers and beneficiaries conditions of education and skills towards design-driven innovation?

[6] Evaluation framework has been discussed in Europe (Maffei, Arquilla, Mortati, Villari, Evans, Chisholm, & Londoni, 2014) and the assessment of design has been matter of discussion at micro (Fonseca Braga, 2016) and macro Schneider et al., 2015) levels. We need to consider local conditions and actors' perspectives, understanding current frameworks in order to analyse and generate alternatives for the Brazilian case.

10 Limitations and future research

Research in the design policy field is acknowledged as a new phenomenon despite the long tradition of design policy practice, remaining the lack of conceptual and theoretical foundations (Hobday, Boddington and Grantham, 2012; Raulik-Murphy, 2010). Moreover, the diversity of design policy programmes, the lack of common terminology, definitions, comparable data and indicators across countries, policies and projects also evidence this aspect (Raulik-Murphy, 2010). In addition, there is the lack of studies and data related to design in the Brazilian context (CBD, Apex-Brasil, MDIC, 2014). The literature used to support the cases analysis is fragmented coming from several fields as a consequence of the holistic view required to inquiry the issues proposed.

Design support programmes and projects *per se* do not assure the design acknowledgement and potential design use within companies and countries. The need for diverse interventions that can be combined with design support is recognised (Cox, 2005; Raulik-Murphy, 2010; Swann, 2010). Hence, this is one of this research limitations. This study looks at design support and its recommendations focus on that.

The next steps of this research aim at (1) pointing out the drivers to introducing design-driven innovation that have also been analysed but were not discussed in this paper, and (2) generating answers to the challenges in collaboration with key stakeholders through a co-creation workshop using design thinking methods. It can be seen as an experimentation for a bottom-up approach to start crafting future design support interventions, and their possible strategies.

A further step towards the implementation of collaborative strategies that can be adopted by policy makers is to apply a survey in order to validate and improve strategies considering a representative population.

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About the Authors:

Mariana Fonseca Braga is a designer with a master's degree in Industrial Engineering, and a background in design innovation management, product and service design. She is a PhD candidate in Design at Politecnico di Milano. Her research interests are: strategic design, design management and policies.

Francesco Zurlo is PhD in industrial design and Full Professor of Industrial Design at Politecnico di Milano, in the courses of Integrated Product Design and Management Engineering. He's Deputy Dean of the Design School and Head of the Course in Product Design (BA+MAs) among other positions held. He is author of numerous international publications about strategic design.

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Using Dynamic Capabilities in an Actionable Tool as a Vehicle to Initiate Design-Driven Innovation

KLITSIE Barend[a*]; PRICE Rebecca[a] and DE LILLE Christine[a,b]

[a] Delft University of Technology
[b] Haagsche Hogeschool
* Corresponding author e-mail: j.b.klitsie@tudelft.nl
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In order to become more innovative, corporations are increasingly turning to design-driven innovation capabilities. These capabilities are dynamic: they influence the way companies run their business and how companies create, capture and deliver value. Building design capabilities has proven difficult, given the tacit nature of design practice and the conflicting reasoning style of abduction that allows for the creative leap. However, if these enterprises don't improve, they are in danger of losing their ability to add value to the market. This may result in loss of market-share, which may lead to job destruction and the loss of valuable knowledge as communities of practice fall apart. This paper describes an iterative design process in which a tool was developed to determine which design-driven innovation capabilities a company is lacking. The tool started as a theoretical framework and was subsequently developed by prototyping with innovation managers from several large corporates. This paper contributes a new 'dynamic capabilities view' on design and innovation and a practical approach to implementing design in large firms.

dynamic capabilities; tool development; design; innovation

1 Introduction

It is increasingly difficult for firms to stay relevant. In fact, according to an article in Forbes "Half a century ago, the life expectancy of a firm in the Fortune 500 was around 75 years. Now it's less than 15 years and declining even further" (Denning, 2011). Some argue that large companies are simply not fit to survive, because they lose their ability to explore new opportunities as they mature and focus on exploiting their current products. In other words, they have trouble, "continuously reconfiguring their structures and processes, sustain stability through replication and optimization, ensure steady performances, and, at the same time, generate innovations in order to meet or create future demands" (Martini, Laugen, Gastaldi, & Corso, 2013, p. 2). Other authors even argue that 'creative destruction' is needed, were old companies are replaced by new ones as the economic, political and/or technical landscape changes (Schlesinger & Doyle, 2014).

To sustain profitability, enterprises will need to innovate (Chesbrough, 2013; Eisdorfer and Hsu, 2011). Not only do they need to innovate, they need to innovate efficiently and effectively as our world becomes more digital and more globalized (Carlsson, 2006). This leads to product/service development cycles that are becoming increasingly demanding upon organizations as customers get used to frequent product/service launches to market.

1.1 The Value of Design for Innovation

One approach to kick-start innovation in large companies that is increasingly popular is using design (Kolko, 2015). Design has been associated with, amongst others, using empathy (or deep customer insights), visual communication, brainstorming (or divergent thinking), abductive thinking and iterative and cross-departmental problem solving (e.g. using prototypes). It has been described amongst others as a way of reasoning, a method, a way-of-working and a mindset.

The greater value of design however, lies not only in how it aids to develop better products, but in how it can reshape companies (Yee, Jefferies, & Michlewski, 2017). Design can influence the way a company performs its day-to-day business by inquiring into the organization (Junginger & Sangiorgi, 2009). Dynamic capabilities are those capabilities that change how a company operates (Helfat et al., 2009). This paper thus proposes that design can be considered a dynamic capability. However, before a company can implement design, a transformation needs to take place (Deserti & Rizzo, 2014).

This transformation touches many facets of the company: the organizational culture (Brown, 2009; Deserti & Rizzo, 2014), the mindset of how innovation should be managed (Martin, 2009) and the systems that support innovation and business operation in general (Tushman, Smith, Wood, Westerman, & O'Reilly, 2010). For example, according to designers, innovations should stem from observations and customers (latent) needs, rather than traditional marketing research (Martin, 2007; Yee et al., 2017).

1.2 Literature on Design-driven Innovation

The body of literature associated with 'design-driven', 'design-led' or 'design-intensive' organizations and –innovation is growing[1]. Some of this research focusses on determining where a company is on a scale from the absence of design to high engagement in design. Examples of this are the Design Capacity model (Storvang, Jensen, & Christensen, 2015), the Design Value Index (Rae, 2016), the Danish Design Ladder (Ramlau, 2004) and the Australian extension of this model (Doherty, Wrigley, Matthews, & Bucolo, 2014). Other studies focus on determining what a design intensive organization is or what characterizes a 'designerly' company. Many portray success stories of companies that have realized a competitive advantage due to this transformation (Yoo & Kim, 2015).

However, not much of the reported research has resulted in actionable tools for managers, consultants or other (design) practitioners. Now that our knowledge of 'what design is' has progressed, it is time to focus on the question of how managers can implement design practices. What is required is a method to determine whether a company is ready to innovate in a designerly manner. More importantly, there is a need to determine how (not if) to make a company more design-driven and guide the transformation toward becoming more so. When the inhibiting factors to design-driven innovation within an organization are understood, then the steps to determine a transformation toward design can be planned.

2 Research Goal

This paper aims to develop a tool for an innovation management consultant (which is described in the section 'context'). This tool can be used to determine a client company's current state in the

[1] The aim of this paper is not to set-apart the differences between these approaches and will thus refer to the generic classification of 'design-driven' organizations.

context of transformation toward design. Following the use of this tool, the consultant can more effectively help the client formulate a strategy to innovate in a more design-driven manner.

To develop the tool, first a theoretical framework based on the dynamic capabilities view is introduced. Subsequently the design of a tool to make this framework actionable is considered. The process of developing this tool is in turn expected to improve the understanding of the concept of 'design-driven' organizations. Hence, the research questions are:

1. What are design-driven innovation capabilities of a company?
2. How can we best identify and leverage these capabilities?

2.1 Context

As mentioned, this research was performed in the context of an assignment by Innovation Booster (IB). IB aims to make companies more innovative by introducing a design methodology and a supporting corporate structure. This chapter briefly describes this consultant and its methodology to understand how this tool is employed and how it helps to implement design.

Large corporates who want to either increase their revenue through innovative product introductions or decrease their costs through innovative operations improvement can hire IB. These companies have often experienced growth through becoming experts at exploiting their operations. However, they've gradually unlearned how to explore and uncover new business opportunities. Consequently, more importantly than receiving insights for new products or processes, the clients of IB want to learn how to become innovative again.

The process by which this is done is visualized in figure 1. In short, IB's employees facilitate a client's own employees to tackle projects with the use of design. This is done in an iterative manner, starting with a small project and only a few employees (working part-time on the project). Once this project is finished and the client is satisfied, a follow-up project will often try to tackle more challenges. More employees will be engaged, the same methodology will be used, but a more robust and elaborate structure will be introduced. Ideally, a succession of these projects would end in a fully functional design-led internal incubator.

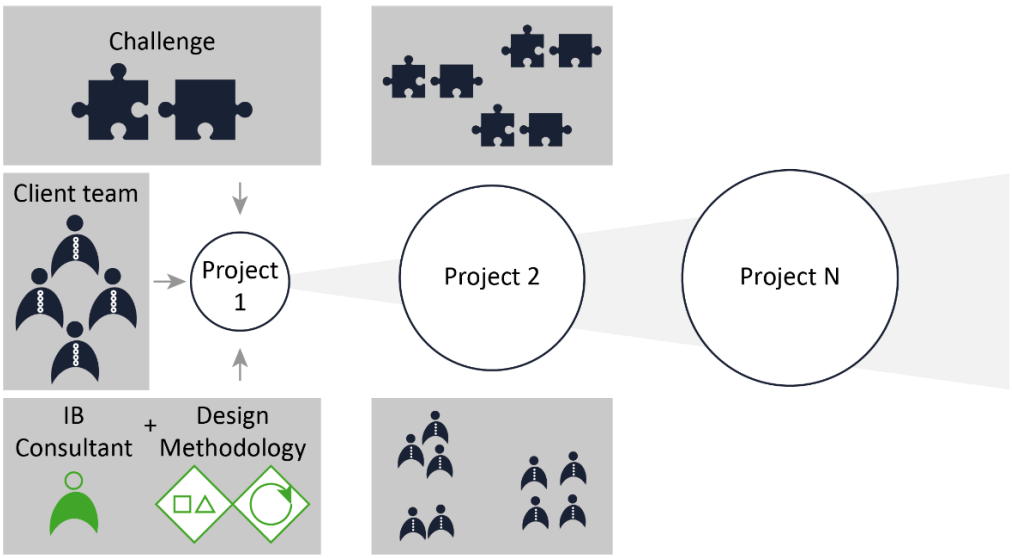

Figure 1: The Innovation Booster process starts by solving a small project with the use of design and expands with more teams and challenges

The challenge that led IB to instigate this research is that they were struggling to tailor their approach to their clients. The use of a generic approach leads to inefficiencies and a lower client satisfaction. The reason a tailored approach wasn't possible, is that IB had no standard approach of

measuring the 'baseline' of a client's design aptitude. IB was therefore looking for a tool to measure design-driven innovation capabilities.

3 Developing a Theoretical Framework

Two different theory streams were used to create a framework that describes 12 'Design-driven Innovation Capabilities'. First, the theory of innovation strategy (Pisano, 2015) provides a holistic perspective on the different aspects that a company can innovate on. As mentioned before, a dynamic capabilities (Pavlou & Sawy, 2011; Teece, 2007) view was added to emphasize the effect of design as a transformative power.

3.1 The Perspective: Innovation Strategy

According to Pisano (2015), an innovation strategy answers three important questions:

1. How will innovations create value for the customer?
2. How will the company capture a share of the value its innovations generate?
3. What types of innovations will allow the company to create and capture value?" Or in other words: how will the company deliver value?

The answer to the first question describes the need of a specific customer segment that is targeted and the proposition that is used to do so. Or as Amit & Zott (2001, p. 513) note, "the strategically important ties are those which would contribute in some way to satisfy the customer's needs". The way in which a company captures value describes the revenue streams, cost structures and potentially the partners that will be included in the model. The last question, how a company delivers value, covers elements such as customer relationships, key activities, channels and resources.

The act of innovation entails finding new answers to these three questions. Innovation might focus on the way a company creates value (i.e. a new need to be serviced). An example of these kind of innovations are Googles steps from a search engine to a mobile phone manufacturer, operating system developer and security camera producer. Other innovations such as business model innovation speak to the way value is captured (Berman, 2012). One of the most obvious ways this is done, is by introducing subscription models into industries that were previously based on one-off purchases (such as headphones, laundry machines and computer games). Last, new answers to the third question are innovations that use for example new technologies to service the same need (such as a new model iPhone that services the same needs, only more effectively).

This theory isn't specifically positioned as a design related theory. However, it stretches the importance of empathy, describes reframing and encourages creative problem solving. It can therefore be seen as a theory that matches a design-driven approach. It is important to note that the desired transformation is not about changing the way a company creates, captures and delivers value once. A transformed company has the capability to make changes within the three elements of the innovation strategy continuously. The question remains: how to develop the three innovation strategy elements?

3.2 Making It Actionable: Dynamic Capabilities

A firm needs dynamic capabilities to change its operational capabilities (Winter, 2003). Dynamic capabilities are a collection of routines that are defined by (personal) traits, processes and interactions (Teece, 2007). Through these capabilities, a firm senses market changes, learns how to deal with those, integrates the knowledge that it gathers and coordinates a change in the way it performs its daily business. According to Felin et al. (2012, p. 2) "An explanation of these collective phenomena requires consideration of lower-level entities, such as individuals or processes in organizations, and their interactions". These lower-level entities are also named micro-foundations. Pavlou and Sawy (2011) propose a framework that has four grouped micro-foundations:

- Sensing, or “the ability to spot, interpret, and pursue opportunities in the environment”;
- Learning, or “engage in learning to find new solutions, create new knowledge, and reconfigure existing operational NPD capabilities to develop new products”;
- Integrating, or “to combine individual knowledge into the unit’s new operational capabilities”, and;
- Coordinating, or “to orchestrate and deploy tasks, resources, and activities in the new operational capabilities.”

Dynamic capabilities are rarely explicitly mentioned in the same literature as design (thinking), Although Eisenhardt & Martin (2000) do mention “build new thinking” (p.1108) and the brokering of knowledge (which can be done through prototypes and visualizations) as dynamic capabilities. More explicitly, each of the micro-foundations can be linked to the features previously described as ‘design’. Sensing is linked to empathy, learning is linked to creative problem solving and integrating is performed through prototyping and visualization. Coordinating is supported by visualization and prototyping but is less inherently a design activity.

3.3 The Theoretical Framework

There are three questions that an innovation strategy is concerned with: how a company creates value, how it captures value and how it delivers this value. These three elements consider operational capabilities. There are four capabilities that a company needs to change its operational capabilities. If transformation is about building dynamic capabilities, then that means that a transformed company should have all four capabilities with regards to the three questions of an innovation strategy. This means that a total of 12 ‘Innovation Capabilities’ become apparent. These are all the capabilities that a company can develop to ensure a lasting fit with the marketplace. This theoretical framework is visualized in figure 2.

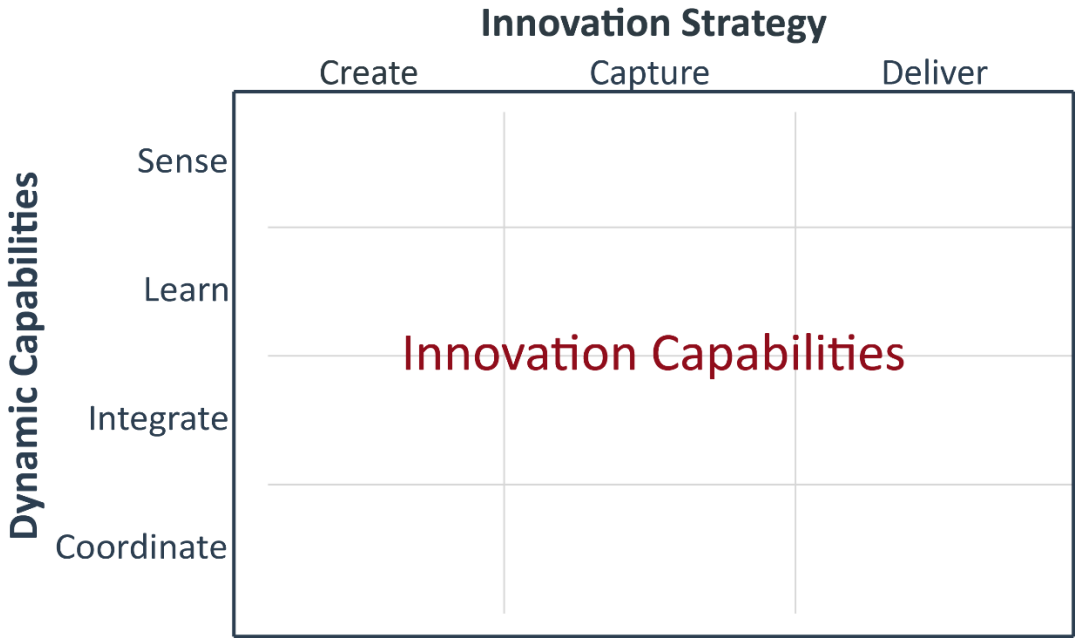

Figure 2: The proposed theoretical framework as a combination of Innovation Strategy and dynamic capabilities

4 The Development of an Actionable Tool

Now that the framework has been established, a tool can be designed. This tool was designed by testing prototypes with innovation managers. In total 9 innovation managers from 7 different companies and 3 design consultants provided input during 6 design cycles. These companies had a large office (frequently headquarters) in the Netherlands and operated in different industries. All but one of the companies can be considered large companies (>250 employees (Eurostat, 2017)). The functions of the managers and the type of companies are presented in more detail in table 1.

Table 1: The various iterations that led to the final design of the tool

# of company	Company Industry	Company Size (# employees in NL)	Functions of Participants
1	Healthcare	~4,000	Manager Innovation Lab
2	Pharmaceuticals	>100,000	Digital Specialist
3	Logistics	~50,000	Division Head, Managing Director, Manager Design
4	Commodities	~700	Innovation Manager
5	Bank	~50,000	Innovation Portfolio Manager
6	Financial Services	~3,500	Innovation Manager
7	Government	~50	Project Manager

The simultaneous development of a product and theory building that was applied during this research is a form of research-through-design (Stappers & Giaccardi, 2017). During the 'experiments', the researcher observed the reactions of innovation managers to the prototype and asked questions regarding its' usefulness and understandability. Following this, each experiment was evaluated and conclusions were drawn regarding the reactions of the innovation managers. Finally, these conclusions were used to improve the prototype and generate knowledge regarding the theoretical framework itself.

Because of the relationship between the researcher and IB, the tool was also designed to match the desires of IB. By introducing this element, the researcher constantly needed to balance three elements:

- Technical/theoretical feasibility, which in this case also included: does the tool do what it needs to do?
- Business viability, or: can the client design a business model around the tool?
- Human desirability, or: do users want to use this tool? Is it understandable?

Table 2 describes which factor influenced each decision during the iterations. The balance between those three factors is characteristic of design projects (Brown, 2009; Buckley, Beames, Bucolo, & Wrigley, 2012; Jones & Samalionis, 2008). Through a sequence of iterations, the tool developed from a canvas to a process including the use of a chatbot to perform inquiries. Figure 3 visually summarizes the development of the tool throughout the study.

Table 2: The various iterations that led to the final design of the tool

Iteration	Artefact	Participant (# as referenced in table 1)	# participants	Major Change driver	Key Learning
1	Framework	Fellow Consultants at Design co.	3		- The framework makes sense to this group - Add examples
2	Framework	Small Firm (#7)	1	Desirability	- Framework is overwhelming - General concept provides interesting framework
3	Framework & explanation slides	3 Large firms (#1, 2 & 3)	3	Desirability	- Improved understanding of framework - Difficult to gauge own organization
4	Framework & questions	3 Large firms (#4, 5 & 3)	3	Feasibility & Viability	- More 'objective' scoring - Opportunity spotted: let colleagues score (to increase objectivity & political support)
5	Framework & survey	1 Large firm (#3)	2	Viability	- Need for qualitative sense-making session - Surveys result in low engagement
6	Framework & chatbot	2 Large firms (#3 & #6)	4	Viability, Desirability	- Tool sparks engagement - Chatbot needs to be humanized

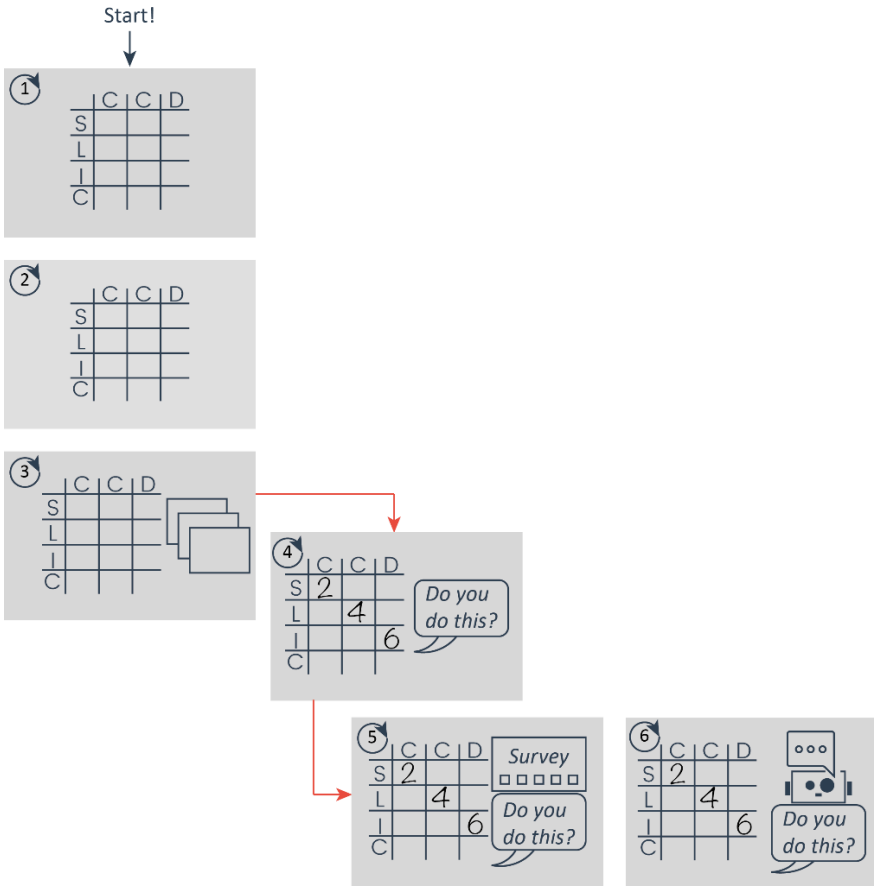

Figure 3: The development of the tool with two major pivotal moments

5 Evaluation

As the final form of the tool itself is not the focus of this paper, it will not be elaborated upon here. However, it is insightful to elaborate on two specific pivotal moments in this development process. This portrays the sort of data that was gathered during the iteration cycles and how these led to certain decisions. The first pivotal moment appears during the third cycle. During this experiment, participants noted that they understood the framework. However, they found it challenging to reflect upon their own organization and projects with the use of this framework. For example, the participant from company #1 noted: "I understand what you just explained…however, I'm having trouble coupling it to what I see happening"[2]. It was therefore clear that the tool needed an improvement in desirability. During the evaluation of this cycle, the researcher realized that instead of explaining the framework before-hand, it might be more useful to use questions to guide the participants through the framework. The result was that in iteration 4, only the titles of the different capabilities were mentioned and participants were asked to reflect on specific sensitizing questions. Afterwards, the answers to these questions were used to clarify the framework. This resulted in a much more fluent interaction.

A second interesting pivot appeared during the fourth cycle. Participants in this cycle independently from each-other mentioned that they doubted whether their vision accurately represented the reality of the entire organization. For example, the participant from company 4 mentioned;

> *I am obviously colored in my judgement. I'm always busy with the future because I'm tasked with innovation while 99% of the company isn't thinking about that. Should I try to think like the average employee?*

This indicated that participants, rightfully so, doubted whether the tool would lead to the valid insights that were being targeted. The judgement from one innovation manager is probably not generalizable for the rest of the organization. This insight, combined with a previous insight that innovation managers had a need for a tool that provided them with support during internal politics, led to an important pivot. The interview-style question guide (as portrayed in figure 4) was replaced with a survey that could be distributed to many participants within the same organization.

To illustrate, in order to gauge how clients interacted with their customers (and were thus able to 'sense' new opportunities to create value for them), staff were asked to rate their company on the following statements:

- *We get in contact with customers to uncover their needs and wishes*
- *We use qualitative insights from customers to develop concepts*
- *Whenever possible, quantitative data from customers is used to inform decisions*
- *Our mindset can be characterized as customer-centric*

This change would not only increase the validity of the information and thus improve the feasibility of the tool. Also, the information that was gathered from other stakeholders throughout the company was valuable to the innovation managers. Indeed, they expressed that they would be willing to pay for this information (and thus, viability was improved).

[2] Quotations are translated from Dutch by the first and third author

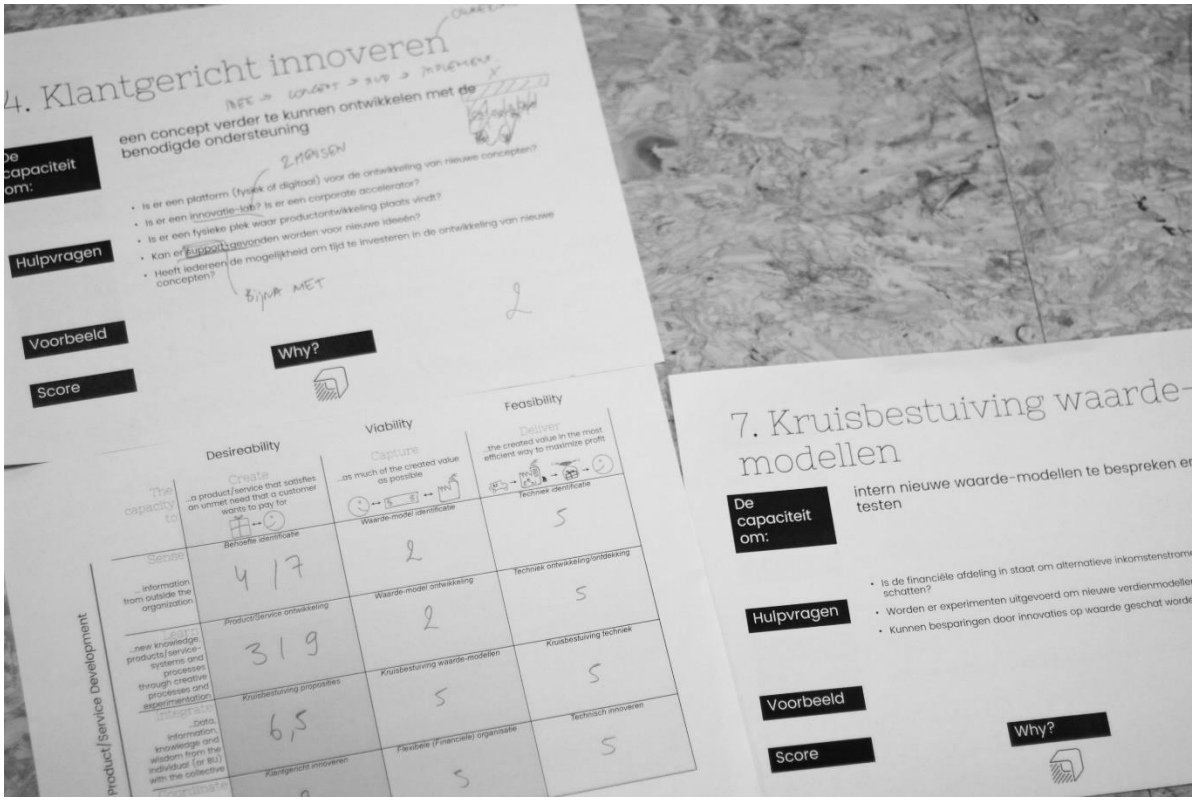

Figure 4: The sensitizing questions used in experiment cycle 4 and the resulting framework scores.

A last interesting finding, which substantiated the need for this tool, is that all but one of the innovation managers didn't have an innovation strategy. Some of them had an 'innovation agenda', describing for example which technologies they wanted to experiment with. Additionally, some companies did have a process in place which described their innovation process. However, as these agendas only focus on technologies, they tend to focus only on 'how value is delivered' and process descriptions focus on how new product initiatives are judged for example. As mentioned before, these documents lack direction on what value is created and how a company can monetize this value. The innovation managers explained the lack of an innovation strategy by indicating that they had too little time and knowledge to craft such a strategy.

As stated, through progressive insight, the tool developed into a process or proposition. This proposition is visualized in figure 5. In short, the 'tool' developed into a process where:

1. Employees of a company are inquired by a chatbot to provide data concerning design-driven innovation capabilities;
2. This data is analyzed and visualized using the theoretical framework;
3. This visualization is then discussed in a session with a consultant from IB and its' client. The goal of this session is to make sense of the data that is uncovered and to provide an opportunity for qualitative feedback, and finally;
4. The results of the data analysis and the qualitative feedback are combined in a report. This report includes an advice on how to improve certain capabilities.

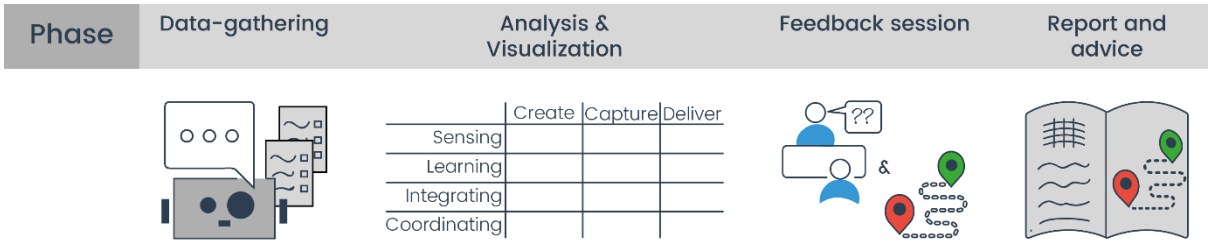

Figure 5: The final proposition includes a chatbot, a data-analysis phase, a qualitative feedback session and a formulated advice.

The qualitative feedback session was added to have an opportunity to explore why certain scores resulted from the chatbot. This session is explained in more detail in the end of the concluding chapter. It is important to note that this proposition, even though it is the 'final proposition' of this project, has not been finalized. Multiple iterations will still need to be performed by the client of this project to make the proposition market-ready.

6 Conclusion

This research set out to answer two questions: (1) what are design-driven innovation capabilities of a company? And (2) how can we best identify and leverage these capabilities? This research resulted in a definition of capabilities by combining the theory of innovation strategy and dynamic capabilities. Additionally, this research showed that almost without exception, companies do not currently operate with an innovation strategy.

During this project, a (and specifically not 'the') proposition to measure design-driven innovation capabilities is developed to answer the second research question. The development of this proposition was heavily influenced by context factors and is therefore not presented here as a scientific conclusion. However, during this practice, two observations were made that are believed to be fundamental to measuring innovation capabilities and are therefore described in more detail.

6.1 What are Design-driven Innovation Capabilities?

Design-driven innovation capabilities are needed to answer three strategic questions related to innovation as championed by Pisano (2015). It is important for a company to consider all of these three questions to "promote alignment among diverse groups within an organization, clarify objectives and priorities, and help focus efforts around them" (Pisano, 2015, p. 4).

What became apparent in experiment 2 and 3, is that each company seems to have trouble with specific elements of the innovation strategy. For example, one company indicated that they had no problem developing the way in which they delivered value. However, they were having trouble finding new ways to create value. On the other hand, another participant indicated that they had more trouble finding new ways to deliver value. To formulate answers to these three questions, dynamic capabilities need to be developed. These capabilities change the way a firm operates and is organized. If a company aims to realize design-driven innovation, it will need to foster these 'second-order' (Winter, 2003) capabilities regarding the before-mentioned innovation strategy subjects.

6.2 How to Identify and Leverage Innovation Capabilities?

The Innovation Managers that participated in this research often did not have a (complete) articulated innovation strategy. A uniform external method to identify these capabilities as proposed thus seems useful. Due to a perceived barrier regarding the use of surveys, a novel way of inquiring into capabilities was explored, which was positively evaluated. Most importantly, what became apparent during this research is that an assessment of these capabilities should include a qualitative session.

The definition of innovation capabilities in this article is based on the theory of dynamic capabilities and innovation strategy. These theories describe processes, systems and sometimes even mindsets.

To make it more complicated, there are interdependencies between elements such as processes and mindsets. It is therefore almost impossible to 'decompose' these capabilities into elements which can be tested without losing all validity.
To resolve this problem, a qualitative feedback session was added to the tool. During this session, sensemaking takes place regarding the data that is produced by the chatbot. This session adds depth to the data and offers an opportunity for strategy making. This session is performed by the innovation manager (who is experienced in the organization) and an experienced design consultant (who has experience with different innovation challenges). During this session, both parties discuss the results of the chatbot and explore why certain scores are given. The session results in agreed-upon statements that are grounded in the data from the chatbot but are also sufficiently high-level to be actionable. In the current iteration, no dominant format for this session was developed yet. A last interesting finding in this research is that a chatbot can be an effective way to gather input from employees on innovation capabilities. Using a chatbot has numerous advantages over using traditional surveys such as the possibility to provide contextual information and a more engaging experience for the respondent.

7 Further Research

The framework and the tool that were developed during this framework are a way of operationalizing dynamic capabilities, which has been pointed out to be one of the challenging facets of this theory (Barreto, 2010; Easterby-Smith & Prieto, 2008; Pavlou & Sawy, 2011). It is a novel way of combining theories that needs refinement and is empirically untested. As per the goal of this research, the results primarily indicate that the framework can indeed be used to inquire into a company. This study also indicates that the results can be used as a vantage point wherefrom a strategy regarding innovation can be made.
However, the framework itself is in its infancy and has not been validated. This research did not aim to test whether the defined capabilities accurately reflect the innovative capability of a company. Also, no longitudinal study has yet been performed to determine whether improvement on the scores of this grid result in better company performance. Follow-up research on the framework that was created is therefore needed. An initially interesting research would be to use the tool prior and after an intervention by a design consultant, alongside other validated measurements of innovativeness and financial parameters. Eventually, a quantitative study could be performed to see whether interventions lead to higher scores on the capabilities framework and whether this in turn results in better company performance.
This research also introduced the use of a chatbot to gather data. It is currently unknown what the effect of using a chatbot on the gathered data is. As alternatives to surveys are growing in popularity (especially in the realm of design research), research into the effect of using these methods on results and on the way that it can be used as (scientific) data gathering tool would be interesting.
In addition, it is interesting to uncover how the tool and framework that was developed can be leveraged in a variety of contexts. Even though it was originally intended as a conversation starter to determine an innovation strategy based on insights. One of the respondents also mentioned that it could be used to analyze how innovation projects progress or how teams within companies perform.
Besides research on the framework and the tool itself, it might be interesting to analyze the data that is produced from the assessment. First, it will be interesting to see which 'hurdles' Innovation Mangers mention during the qualitative feedback session. One could imagine that these hurdles describe absent micro-foundations. Gathering and analyzing the hurdles that are mentioned frequently and comparing them with the capabilities that they are linked to might create a holistic framework of micro-foundations that underlie design-driven innovation capabilities.
A second interesting research would be to determine whether typologies can be recognized in the results of the chatbot. For example, after analyzing the answers of many different respondents across different companies, certain 'profiles' may become apparent. Perhaps companies typically have problems with only one of the innovation strategy elements (the columns) or with one of the

dynamic capability elements (the rows). The definition of these typologies might help consultants and managers to determine best practices of solving innovation problems within certain typologies.

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About the Authors:

Ir. Barend Klitsie is a PhD Candidate at Delft University of Technology. His research focusses on how design can aid large companies to develop and implement innovations. His research is closely tied to practice and includes Action Research and Research through Design.

Dr. Rebecca Price is a Post-Doctoral Research Fellow at Delft University of Technology, Netherlands. Her research explores the implementation of strategic design with emphasis on digital subject matter. Price is also part of the EU commissioned Horizon 2020 research project, 'PASSME'

Dr.Ir. Christine De Lille is Professor Innovation Networks at The Hague University of Applied Sciences, the Netherlands as well as Assistant Professor at Delft University of Technology. Her research interests lie in design material in systems, designing organizations and Research through Design.

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Design Capability in a Software SME: report from an embedded design innovation catalyst

BASTIAANSEN Sjoerd J.B.M.[a*]; PRICE Rebecca Anne[a], GOVERS Pascalle C.M.[a] and MACHIELSEN Tjeerd M.[b]

[a] Delft University of Technology
[b] CM, Breda
* Corresponding author e-mail: Sjoerd.bastiaansen@gmail.com
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Recent studies on the added value that design provides to firms has led to widespread interest amongst the business community to develop design. However, knowledge of how organizations of varying industry types actually make use of design to generate competitive advantages remains limited. This study investigates a small- to medium-sized enterprise (SME) software firm that had recently taken steps to develop design capability[1]. The Dutch firm, titled *CM,* identified a need to increase design capability as a source of added competitiveness. During a six-month period, a design innovation catalyst (DIC) was embedded in the firm to build and integrate design capability across the firm. During the study's duration, the catalyst found the barriers to design capability to be a prevailing data-driven approach to value creation, reliance on self-referential knowledge rather than hypothesis testing with customers and users and a general low urgency to embrace design. The manner in which CM now leverages design as a value creation mechanism is shaped by addressing the opposing barriers to change that were encountered within the firm. This paper contributes practical knowledge on how design can be built quickly over six months and become a vehicle for a software firm to move from data-driven to user-centred solutions.

design catalyst; user centred design; organizational learning; software

1 Introduction

Attempts to capture the added value of design capabilities have been made in the recent past, by listing the categories on which design practices add value to the business (Lockwood, 2007), or by comparing stock price performance between design-centric firms and the S&P500 index (Rae, 2016). On the specific topic of design's value for SMEs the UK Design Council (2012) writes that for every £1

[1] Design capability is defined as an organization's ability to apply design to strategic problem-solve, drive innovation, builds business success that leads to better quality of life through innovative products, systems, services, and experiences (World Design Organization, 2017).

invested in design capabilities, firms can expect increased revenues of up to £20. Despite the growing evidence of added value and attention by policy making institutions (European Commission, 2009), SMEs are often hesitant to invest in design capabilities for a number of reasons, including difficulty in understanding the full potential of design practices (Brown & Martin, 2015; European Commission, 2009), difficulties in understanding a design professional's capabilities (Gulari, Fairburn, & Malins, 2013), and designers' potential difficulty in communicating with business managers (European Commission, 2009; Lockwood, 2007).

In building design capability, an encounter with the existing status quo of an organization occurs. In fundamental social theory a clash occurs first followed by a resolution in which both new idea (being design in this case) and existing status quo are reconfigured to achieve a beneficial outcome (Mueller, 1958). This theory is pertinent as investing in design capabilities can yield significant returns for a firm, as long as the difficulties of adoption are overcome and design practices are embedded into an organization in such a way that is contextually relevant. Without overcoming such barriers, design as a source of innovation within organizations risks being resigned to a perspective or mind-set, rather than a set of an evidence based practices (Dong, 2015). Therefore, contextually specific accounts of how smaller organizations make use of design in relation to barriers to implementation are also required to promote evidenced based practices that represent the broader business community – not just the success stories of large multinational corporations (Muratovski, 2015).

The aim of this paper is to describe and understand how a software SME built and now uses design capabilities within the organization for a six-month period. To do so, the paper first provides account of the existing barriers to CM's use of design. The design innovation catalyst (DIC) actions to overcome such barriers in order to build design capability are then presented. The inquiry is structured through the following three research questions:

RQ[1]: What barriers to the development of design capabilities exist in a software firm?

RQ[2]: How can a design innovation catalyst overcome identified barriers to design, in order to build design capability within a software firm?

RQ[3]: How does a software SME make use of design?

This study adds to an increasing body of knowledge regarding the development and use of design capabilities by embedding a DIC in various organizations. At the base of the DICs work lies their ability not only to bridge the gap between research and practice, but also to move between a learning and teaching position (Wrigley, 2016). This forces the DIC to continuously digest and reflect upon findings in the organization and academia, to inspire his output both in academia and in organization learnings. Recent scholars (Pozzey, 2012; Doherty, 2014; Stevenson, 2016; Nusem, Wrigley, & Matthews, 2017; Price, Wrigley, Matthews & Dreiling, 2015), have focussed on the development of these capabilities in a broad range of industries. This work expands that knowledge by adding a software SME to the collection of industries covered. Furthermore, this study investigates a company operating in the Netherlands experiencing growth, whereas previous studies have been carried out in Australian firms experiencing relative economic challenges.

2 Software Development and the need for Design Capability

Beyond the profitability of software firms and the economic implications of thriving industries, the rationale guiding this research is the identification that in a digital era the design of software that fundamentally shape society's form and function must be *good design*[2]. While poor software design (both in UX quality and system architecture) in the past resigned a launched product or service to failure or irrelevance, in the age of artificial intelligence, poor software design will have lasting ethical consequences for human – computer interactions. It must be a priority to ensure software

[2] Dieter Rams' ten principles of good design.

firms and other technology developers translate the potential of technology into value that benefits all users. To do so, these firms must be capable of making use of design. Although Bruun et al. (2014) found that software development professionals can develop design proposals, integrating UX design into agile development methods remains difficult (Plonka, Sharp, Gregory, & Taylor, 2014). Many agile-driven development methods are suited to software development professionals, without considering input from external sources – such as the use case approach (Lárusdóttir, Cajander, Erlingsdottir, Lind, & Gulliksen, 2016). Use case approaches begin from the viewpoint that a system is built first and foremost for the user (Lee & Nien-Lin, 1999). However, at closer inspection of this viewpoint, weaknesses appear.

One of the flaws of the use case is that while the approach focuses on how a technology can solve a user's goal, the way in which a user is framed is easily underpinned by a set of assumptions (Jacobson, Spence & Kerr, 2016; Lorenz, 1993). The user is an actor within the system and often represented through a set of generic set of requirements. Comparatively, design encourages much deeper consideration of the user's desires and emotions in context – well beyond user requirements. Methods of the design discipline are specifically shaped to achieve such an understanding.

Further, many agile software development methods often do not explicitly discuss user experience at all (Bordin & De Angelini, 2016). This leads to differences of perspective within new product development processes (Plonka et al., 2014). Another challenge identified in literature is that software projects often become development-led once the development team was running well, making team members involved in user research feel less relevant (Muñoz, Helander, de Gooijer, & Ralph, 2016). Muñoz at al. (2016) found that design professionals rebrand their activities to be deemed relevant by developers. This indicates the urge to involve users is low for many product development teams and as a result, the user's needs may be overlooked. This practice is also visible in larger software firms that market themselves as having a good user-experience, where 'surprisingly few have adopted usability methods and successfully incorporated these into development practices' (Lárusdóttir et al., 2016). This is a relevant challenge, especially in business-to-business firms, where the customer paying for the system isn't necessarily the product's end-user.

Bringing user-centred design approaches into the realm of software development will be a necessity to complex technologies more human-centred, and therefore easier to understand by users. This creates competitive advantage for an organization in a particularly volatile market. Understanding how software firms adopt and make use of design is therefore of importance.

3 Research Design and Methodology

3.1 Organizational Context

The SME that is part of this study was founded in 1999 and provided the service of sending text messages for marketing purposes for the hospitality and entertainment industry. Over time the company has expanded to a firm with offices in 7 countries in Europe and the Asia-Pacific region, employing over 250 people. The expansion the firm is experiencing has led the firm to undertake a rigorous exercise to define the firms brand identity. This exercise supports the firm's ambition to move from a company selling technical products to a brand that is internationally recognized amongst the world's most 'human' high-tech firms.

3.2 Design Innovation Catalyst Actions and Data Collection

Over a period of six months, the DIC (primary author) was active in the participating company, CM. In this period, the catalyst investigated the company's existing design capabilities as well as supported the organization in further developing design capabilities by actively engaging the employees in design exercises (Wrigley, 2016; 2017). Table 1 below shows an overview of this

research design. The following sections will discuss the methods used in the first and second rounds of investigation.

Table 1 Project timeline

Week	DIC Action	Method/s	Foci
1-8	First round data collection	Semi-structured interview (17), Survey (77)	Understanding the existing state of design capability in the SME
9-17	Engaging employees in design	Generative workshops, management engagements, usability evaluations	Developing design capability within the SME
18-26	Second round data collection	Participant Observation, Survey (79), Semi-structured interview (11)	Understanding the new state of design capability in the SME

3.3 First Round of Data Collection

The first round of data collection used a mixed method, consisting of a quantitative survey and a set of unstructured interviews. In total 77 employees from different departments filled out the survey, which was determined to be sufficient based on Barlett, Kotrlik, & Higgins (2001). The survey used was based on Storvang, Jensen, & Christensen's Design Capacity Model, displayed in Figure 1 (2014). The model is an adaptation of the design ladder (Kretzschmar, 2003), allowing the researcher to understand the state of design capabilities in the organization through 5 measures (awareness of design's value, application in the organization, user engagement, innovation drivers, and employment of designers). The survey data was collected on paper and processed using SPSS version 22. The total means were calculated as well as an analysis of variances between departments. The result of this survey can be accessed in Appendix A.

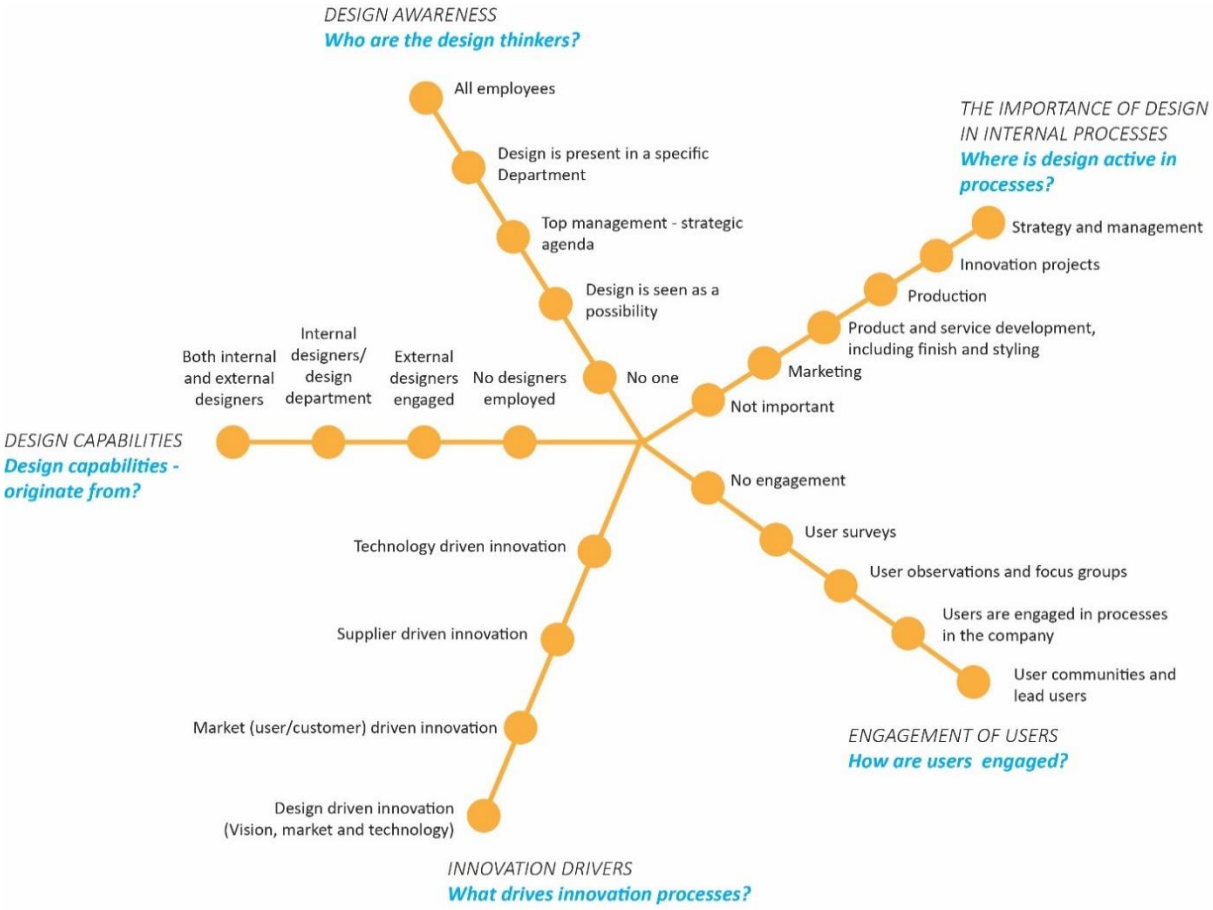

Figure 1 Design Capacity Model (Storvang et al., 2014)

A total of 17 semi-structured interviews were held, all interviewees held different levels of seniority in the company. The topics discussed were the employee's attitudes to design, the methods applied for gathering and processing user insights, New Product Development (NPD) methods used by the company, and the interviewees' attitudes to user engagement in the NPD process. The interviews were carried out in the first weeks of the catalyst's presence in the company. All interviews took place in the company's main office in the Netherlands. The interview data gathered through interview notes that were processed through thematic analysis described by Braun & Clarke (2006)

3.4 Engaging Employees in Design: Catalyst Actions to Build Design Capabilities

The catalyst's actions in the firm served two purposes. The first was hands-on cooperation with individuals and project teams to work with design tools. These actions were mostly carried out in the form of workshops. These workshops were combined with individual engagements between the Catalyst and internal stakeholders. Figure 2 shows an overview of all catalyst activities over the 26-week presence in the company. Further, Table 2 presents these activities in greater detail.

3.5 Design workshops

As noted, during design workshops, the catalyst worked hands-on with a product team or individuals to apply design tools to their products. The emphasis of these workshops was placed on engaging or empathizing with users. For this, the catalyst used tools for usability evaluations, the value proposition canvas, and scenario building.

3.6 Stakeholder engagements

Stakeholder engagements were intended to involve employees with a higher level of seniority in the firm in the catalyst's actions, as Pozzey (2012) notes that involvement and approval from higher level individuals strongly contributes to the chances of success. Meetings included conversations with the CEO, the managing director, and the CTO where design was advocated by the DIC.

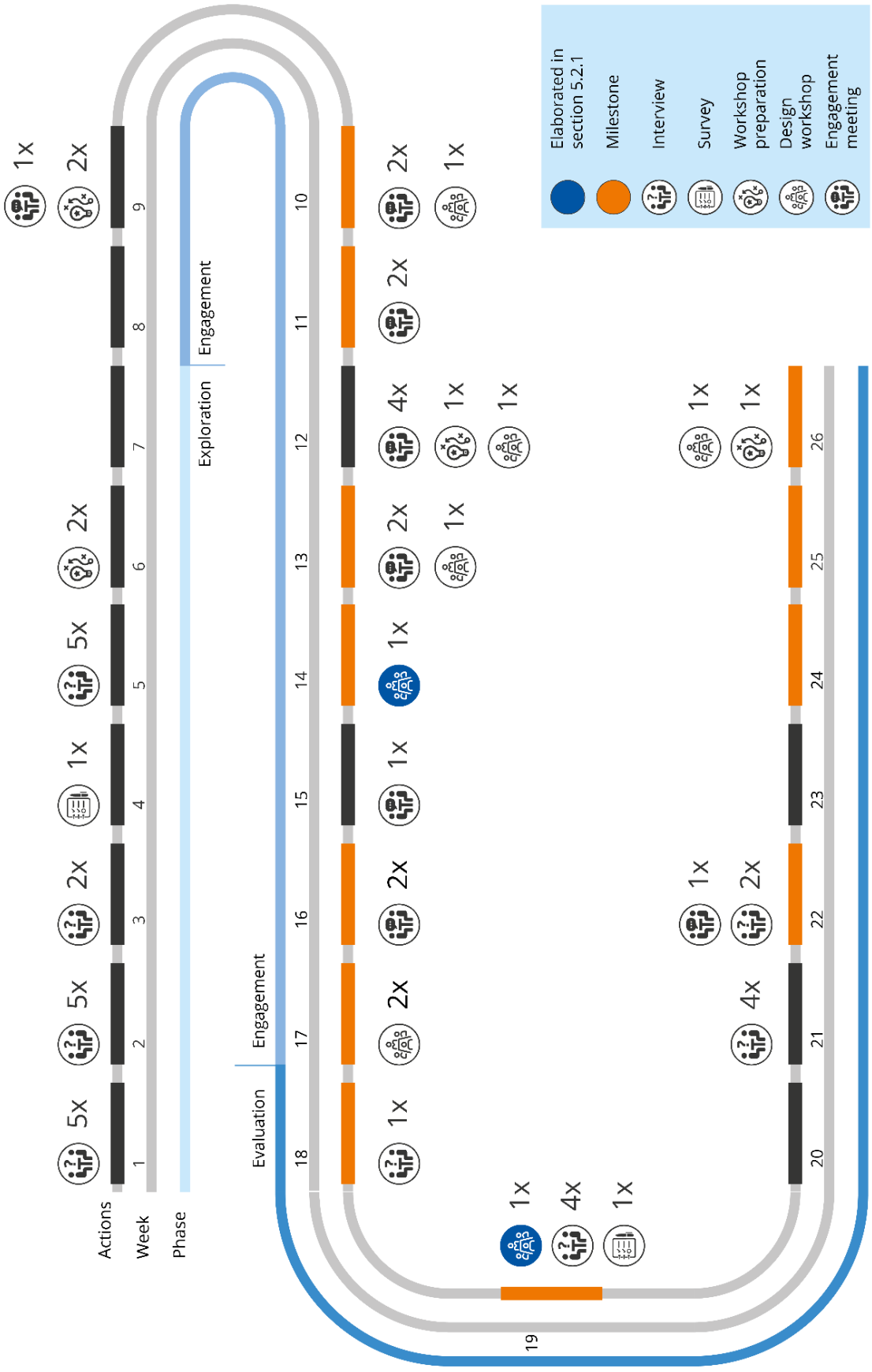

Figure 2 Timeline of design innovation catalyst's activities over 26 weeks

Table 2 Details regarding the activities of the design innovation catalyst over 26 weeks

Week	Activities	Description	Focus
1	Interviews (5x)	Interviews to explore the company's culture and approach to product development. (Average length ~1 hour)	Explore the company culture, understand barriers to adoption of design practices.
2	Interviews (5x)	Interviews to explore the company's culture and approach to product development. (Average length ~1 hour)	Explore the company culture, understand barriers to adoption of design practices.
3	Interviews (2x)	Interviews to explore the company's culture and approach to product development. (Average length ~1 hour)	Explore the company culture, understand barriers to adoption of design practices.
4	Survey (1x)	Distributed the first round of the survey. 77 responses were collected.	Explore the way CM perceived its own design capabilities
	Customer visit	The catalyst joined one of the designers to visit a customer that experienced problems in using CM's products (~1 hour).	Discovering the customer's problems and understanding how CM could mitigate these.
5	Interviews (5x)	Interviews to explore the company's culture and approach to product development. (Average length ~1 hour)	Explore the way CM perceived its own design capabilities
6	Workshop preparations (2x)	Together with 2 product managers the catalyst discussed how his work could benefit them (~30 minutes each)	Both focussed on how the team could engage with users to improve usability.
7	Data analysis	Analysing the interview and survey data	Understanding the barriers to adopt design practices that existed in the firm
8			
9	Workshop preparations (2x)	Engagements with a product manager and marketer	Understand how the company could build a more in-context understanding of the product portfolio
	Engagement meeting	Discussed the findings of the data analysis with an employee in the finance department (~30 minutes each).	Find out if he recognized some of the findings done by the catalyst
10	Engagement meeting (2x)	Met with the CMO and a product manager (~30 minutes each)	discuss progress and findings
	Design workshop	Workshop with a product team (1 hour)	Explain benefits of user involvement
11	Engagement meeting (2x)	Presentation to the Marketing team (30 minutes)	Update on progress and findings
		Meeting with product manager (30 minutes)	Build in-context understanding of product portfolio
12	Engagement meeting (4x)	Engagements with 2 marketers, somebody in HR and a product manager (~30 minutes each)	Update on findings. 1 person was asked for feedback on the report
	Workshop preparation	Prepared a workshop with a product manager (1 hour)	Go over the script for the workshop in week 13
	Design workshop	Workshop with a product team (2 hour)	Explain benefits of user involvement
13	Engagement meeting (2x)	Met with product manager (30 minutes) and a financial analyst (1 hour)	Discussed intermediate report with financial analyst, discussed findings with product manager
	Design workshop	Workshop with a product team (2 hours)	Start redesign for the registration of an App
14	Design workshop	Workshop with a project team (2 hours)	Fill out a value proposition canvas
15	Engagement meeting	Met with CM's CTO (~30 minutes)	Find out if he recognized some of the findings done by the catalyst
16	Engagement meeting	Individual meeting with head of software development (30 minutes)	Update on progress and next steps.

		Presented progress in weekly meeting of the marketing team (30 minutes, including questions)	
17	Design workshop (2x)	Workshop with 2 project teams (1 hour each)	Kick-off for DIY usability evaluations
18	Reflective interview	Interview with CM's CMO (30 minutes).	Interview as part of the reflection.
19	Design workshop	Workshop with a project team (1 hour)	Discussed insights from usability tests
	Survey	Distributed the first round of the survey. 79 responses were collected. (full day)	
	Reflective interview (4x)	Interview with 4 employees, average length ~30 minutes	Interview as part of the reflection.
20	N.a	The catalyst had a brief rest to regenerate energy for the remaining weeks	N.a.
21	Reflective interview (4x)	Interview with 4 employees, average length ~30 minutes	Interview as part of the reflection.
22	Reflective interview (2x)	Interview with 4 employees, average length ~30 minutes	Interview as part of the reflection.
	Engagement meeting	Met with a senior sales representative (~30 minutes)	Discussed possibilities for Sales – Development meetups for information exchange
23	Data analysis	Processing interview results	Discover changes in attitudes for individuals
24 25	Reporting	Report on the research findings	Make a final draft for proof-readers
26	Workshop preparation	Met with a product manager and a product marketer (~30 minutes)	Prepared workshop for a product redesign
	Design workshop	Workshop with a project team (~1 hour)	Find directions for a product redesign

3.7 Second Round of Data Collection

The second round of data collection also used mixed methods to collect data. A quantitative survey and a set of semi-structured interviews were completed. In total 79 employees filled out the survey, which was also calculated to be sufficient according to Barlett et al. (2001). Storvang et al's Design Capacity Model (2014) was again used to make the quantitative assessment, this allowed the catalyst to visualize differences in attitude over the course of the catalyst's presence. A question was added asking participants to list their involvement with the catalyst's work. The survey was distributed as it was done in the first round of data collection. The survey data was collected and processed using SPSS version 22, the results were compared to the data gathered in the first round. The result of this survey can be accessed in Appendix A.

Qualitative interviews were conducted with 11 participants, all of which were also interviewed in the first round. The participants in the second round of interviews were selected for their above-average involvement in the catalysts work. The semi-structured interviews followed an interview guide consisting of three topics, exploring three measures of the design capacity model; the attitude to user engagement in the firm, the organization's awareness of design's added value, and the application of design practices in the organization. The interviews were conducted over a period of 4 weeks in the company's main office in the Netherlands. All interviews except one were recorded. The audio recording was transcribed and combined with interview notes. These were coded through thematic analysis.

4 Findings

This section introduces the combined findings of the study. The results can be discussed in three main themes reflecting the research questions that structure this inquiry. These findings are; the barriers to adoption of design, how these barriers were overcome to build design capability, and how the company now makes use of design to protect its competitive advantage.

4.1 Adoption Barriers to Design

Throughout the first period of the catalyst's embedding in the organization, the catalyst found a number of barriers (visualised in Appendix B) to the adaptation of design practices, the most notable of these include:

- The firm's self-referential approach to product development where internal knowledge was considered valid;
- A low urgency to change given the healthy growth of the firm, and;
- The firm's existing low design capacity with limited designers hired.

The firm's self-referential attitude becomes clear through a lot of interviewees that noted they felt it not yet necessary to engage with users as long as the firm could identify improvements themselves, 'There still is more than enough to do to get all of our 38 products on a decent level' (Marketing). Other reasons why user involvement was not a high priority for the firm included that the firm preferred standardization over customization. 'We must prevent ourselves from doing too much tailor-making for clients' (Software development).

The low urgency to develop design capabilities in the firm was caused by the firm's current growth. The firm's revenue was still growing steadily, and a change might be interpreted that current processes are not effective or valued by the management. The firm's low design capacity meant that designers often had a very fragmented set of tasks and developers had to do a lot of the detailing themselves. 'We now have people for usability; but people are constantly approaching them with requests' (Marketing) and, 'When details are missing from the design, I often fill these out myself' (Software development). Taken together, these results indicate that CM initially had mixed ideas about the added value of user involvement and the role the design professional should play in the organization. Furthermore, the interviews also suggest that there was a growing awareness that the design capacity was insufficient.

4.2 Overcoming Adoption Barriers to build Design Capability

The actions that the DIC undertook to overcome the described barriers involved a set of actions that involved both bottom-up engagement with customers, users and developers, and top down engagement with executives and managers. These activities are described in greater depth in relation to each of major barriers identified and include:

- In product development cycles, internal knowledge and creativity was considered valid and sufficient for improvements or new product features. → The DIC demonstrated through workshops that sourcing external knowledge such as customer and user insight can enrich the design and development of software. This involved a bottom-up approach, working with customers, users and developers.
- A low urgency to change given the healthy growth of the firm → the DIC brought to the attention of management, some of the oncoming competitive market forces that were to be expected in the next five years. While the firm was growing now, building design capability was communicated as one way to protect current growth and explore future opportunities that could be the source of the next competitive advantage. This set of actions involved a top-down approach, working with managers and the executive level.
- The firm's existing low design capacity with limited designers hired → the DIC was able to persuade, with the support of direct supervisor, that the company's growth was a great opportunity to change the composition of the organization by hiring more designers.

Further, these designers would have formalised into their Key Performance Indicators, a set of actions to build design capability across the organization by for example, conducting workshops and skills training with other employees. In effect, new designers recruited to the company would continue the DICs role. The DIC would remain involved with the company over this period of transition.

Observations combined with interview data and questionnaire responses show that as a result of engagement with the DIC changed on the level of project teams and individuals. The survey that was conducted and processed did not show any significant effect after 26 weeks of involvement. However, the observed changes in behaviour and attitude was substantial. The changes observed included the mandatory training for all new employees to participate in a usability tests with users and customers. A product manager notes of the effect of these tests, 'Every time I do such a test, I find something new, and I think your presence helped me realize how strong the tunnel vision is when you work on a product' (Product manager). The front-end developer involved in that same project team also acknowledged the DIC's influence on the team's ability to look outside for input on product development. After a workshop on the value proposition canvas, they noted, 'It really helped us what you did in that last workshop, that really helped us get out of the tunnel vision' (Senior front-end developer).

The interview data also show changes in perception with regard to the three interview topics. Especially the attitude towards user engagement in the firm changed strongly. Whereas many argued user involvement to be unnecessary as employees could think of enough improvements by themselves when the catalyst started, interview results from the second round showed changing attitudes and behaviours. *'You see for example in the development of [product] they are involving housing corporations'* (Financial analyst), and*, 'I cannot rely on my gut feeling and say, 'I think this is beautiful and appealing to the customer'. I need a second pair of eyes'* (Product manager). It can also be seen that an increasing number of employees in the firm see design as a tool to improve product usability, rather than a downstream styling tool. *'I think design is thinking about thinking and planning what you are going to do, before actually doing it'* (Product manager).

Following the shift in the definition of design that could be observed amongst those interviewed, the interviewees also saw the role of the design professionals in the organization no longer as merely that of making aesthetically pleasing products, but also of having a responsibility to evaluate usability and develop new value propositions based on customer insights. For example, a product manager notes, *'[they] should ask the right questions I suppose to get the tangibles about what the customer actually means'* (Product manager), and from marketing, *'That also means interviewing users. If they are internal users or really clients of the company'* (Product marketer). These shifts in perception are arguably the result of the catalyst's efforts. They suggest that, as a result of the interactions with the catalyst, people had become more aware of the added value of design to the organization and how user involvement could support product development efforts.

4.3 How A Software Firm Makes use of Design

The way in which design is made use of is shaped by the barriers to design identified within the firm. The changed perception was reflected in product teams' behaviours observed by the DIC. The changes in behaviour were reflected along two major lines; managerial behaviours and product team behaviours.

4.4 Managerial initiatives to support product development teams

Based on the awareness created by the DIC's interactions, managers took up initiatives to support the product teams in their processes through actions aimed at increasing design capabilities within product development teams. These actions included; hiring three additional design professionals and to build ties with design consultancy firms to serve as coaches for the designers in the organization and to help create tools that support an in-context understanding of the products, such as customer journeys and personas.

Additionally, the firm's management announced 2018 to be 'the year of design', signalling additional investments in design capacity as well as increased attention to design capabilities over the full breadth of the organization.

4.5 Group and personal initiatives to embed design in the product development process

Product development teams that had been involved in workshops led by the DIC now made design actions a vital part of their development process. Each product team however employed different tools for different purposes.

One product team purchased usability evaluations from an internet-based supplier in order to quickly evaluate the effects of improvements made in development cycles. Another team also employed usability evaluations in order to understand effects of improvements, this team used the steady stream of new employees created by the firm's healthy growth to participate in these evaluations. A third product team with which the catalyst had worked together now used design sprint-like one-day workshops in order to develop prototypes.

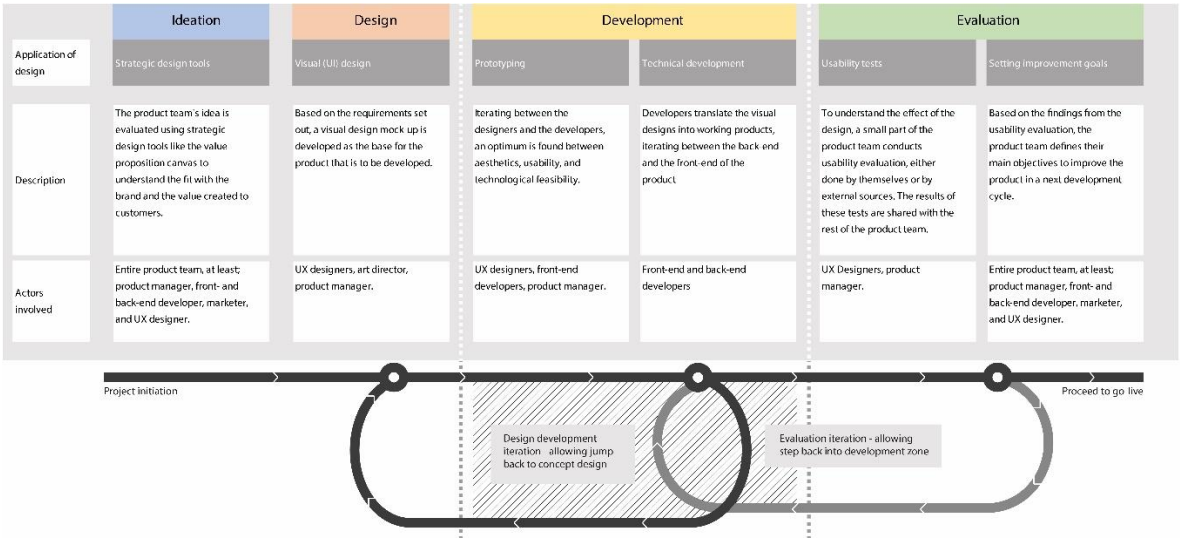

Figure 3: Application of design in the product development process

The way CM now implements design into the product development process can be seen in figure 3 above. A larger version of this visual can be found in appendix C. It shows that the design professionals are involved in all of the stages of the design process, whereas previously they were only involved in an early ideation phase. There are two loops of possible iterations afforded by CM's use of design capability. First, the ability to shift back into a concept phase of design after engaging in software development. Second, the shift back into development after evaluating a design with clients and customers. In both cases, these iterations encourage a software firm to depart from development driven mentality that can be dominant in the development zone (Muñoz at al. 2016). Further, Figure 3 shows how other players in the product team are involved in more designerly actions such as usability testing meaning that design capabilities are not just isolated to 'designers'.

5 Discussion

The exploration of the firm's design practices indicated substantial differences in the attitudes to design practices between types of people in the organization, where a large part had strong a technology-push view of product development (Verganti, 2008) and a minority of mostly designers and marketers approached product development from a user-centred perspective (Sanders & Stappers, 2008). By the end of the DIC's tenure at CM, it was found that the first group was shrinking as a result of catalyst actions to raise awareness and build design capabilities, whereas the latter was growing.

In order to overcome the barriers discovered in the exploration phase and build design capabilities, the catalyst engaged with both product teams and managerial stakeholders. A number of aspects were crucial to the success of the DIC's actions. The first was a continuous dialogue with the organization's management as managers may have difficulty understanding the details of a catalyst's work but they are likely interested in the catalyst's work. Next to that, an endorsement by managerial stakeholders helps employees to feel supported in their efforts to experiment with new ways of working. Second, it is important for DICs to engage with employees outside the research scope. The work of a design innovation catalyst also happens outside of workshops and formal engagements through knowledge sharing in breaks. This creates goodwill amongst employees to participate in workshops.

In the case of CM, non-design professionals have taken roles in design actions in order to strengthen the product development process, making all employees a part of the design process. At the same time, the role of the design professionals has been expanded as the perceived value of their work increased over the course of the project. The management's expression to further invest in the organization's design capability and depart from a development driven mindset provides a strong basis for a further integration of design into the business strategy.

7.2. The applicability of a DIC in organizations

As developing design capabilities requires habit formation, employees should be engaged with regularly over a longer period of time. The fact that a DIC is embedded in the organization over a longer period supports this. However, in larger organizations, a DIC can't engage with all employees, making achievement of critical mass in the organization more difficult. A DIC is therefore especially applicable in smaller organizations. To larger organizations hiring professional services firms for training and education on multiple moments over a longer time span may be more economical. This hypothesis is an avenue for future research. Another important weakness of the DIC-approach to building design capabilities is that it is reliant on the human dynamics between the DIC and the company's employees. Future DICs should therefore invest in a positive personal relation with employees in the organization, as this will increase the chances employees will be open to the catalyst's proposal rather than opposing them.

6 Conclusion and Future Research

Design capabilities in organizations can be built if an organization manages to provide substantial freedom to employees to experiment with new ways to approach product development. DICs should combine hands on activities to build capabilities with employees whilst at the same time engaging with managerial stakeholders. Future research could investigate the long-term effects of a DIC to understand what happens after a DIC's presence at the company. This should be based on longitudinal observations of firm and individual actions to embed and employ design capabilities. Furthermore, an overview of barriers to the adoption of design capabilities could be developed. This will help future DICs to understand if the barriers they have found are unique to their organization and find approaches that have proven effective in the past. A final proposal for future research is an investigation of the organizational infrastructure needed to facilitate a lasting implementation of design capabilities to make that design capabilities exist in the entire organization, rather than only in individuals. Existing studies generally pay attention to the professional skills a DIC should poses. But, as the success of a DIC is also reliant a DICs ability to engage employees in the organizations journey to becoming more design-centred future studies could also investigate a DICs personal qualities.

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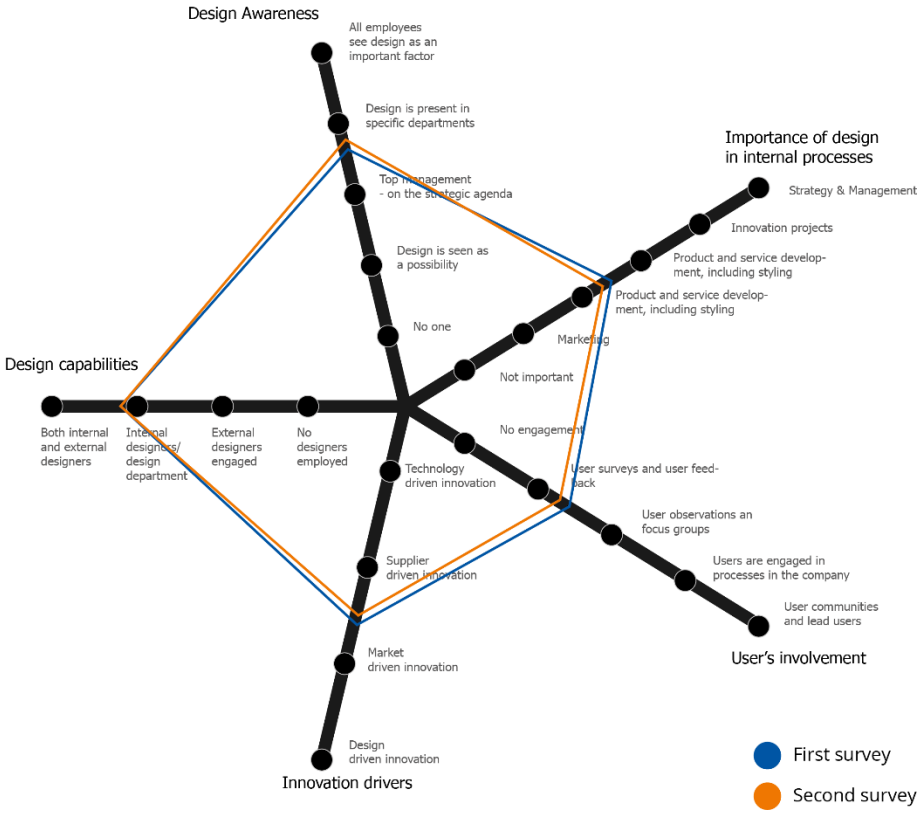
Appendix A

Appendix A: Means for individual departments for the first and second round of the survey

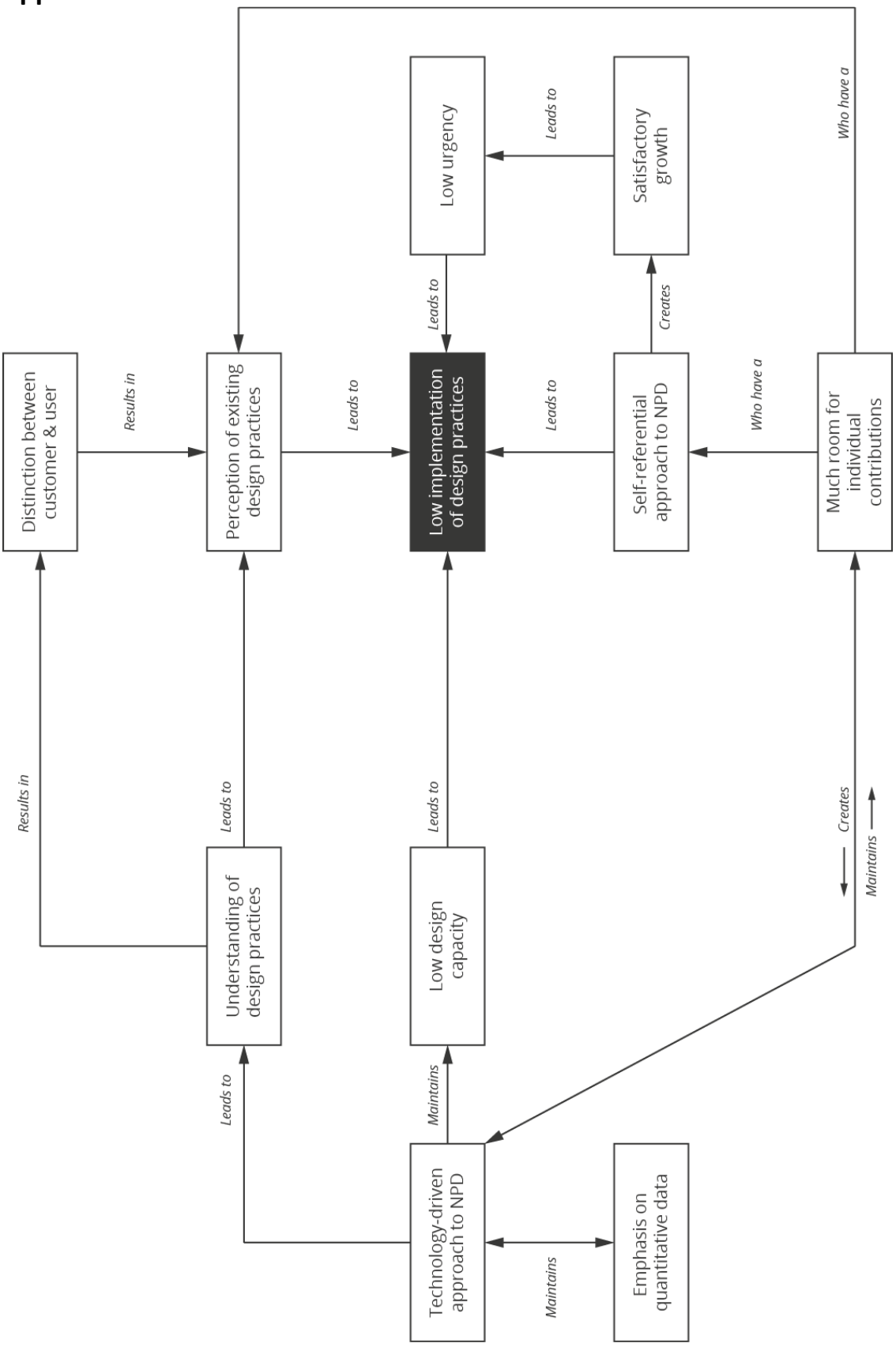
Department	Round	Awareness	Importance	User's involvement	Innovation drivers	Design capabilities
Total	First round	3.79	3.58	2.30	2.53	3.12
	Second round	3.90	3.24	2.14	2.48	3.13
Marketing	First round	3.82	2.64	2.00	1.55	3.36
	Second round	3.88	2.63	1.75	1.88	3.63
Sales	First round	3.80	4.10	2.00	2.40	3.00
	Second round	4.00	3.50	1.80	2.50	3.20
Support	First round	4.13	4.13	2.75	2.75	3.25
	Second round	4.00	3.33	2.00	3.00	3.00
Development	First round	4.04	3.82[a]	2.36	2.77	3.14
	Second round	3.84	3.16[a]	2.16	2.66	3.00
Other	First round	3.30[b]	3.30	2.35	2.75	2.95
	Second round	3.91[b]	3.43	2.43	2.30	3.13

a,b: the difference is significant at the p<0,05 level.



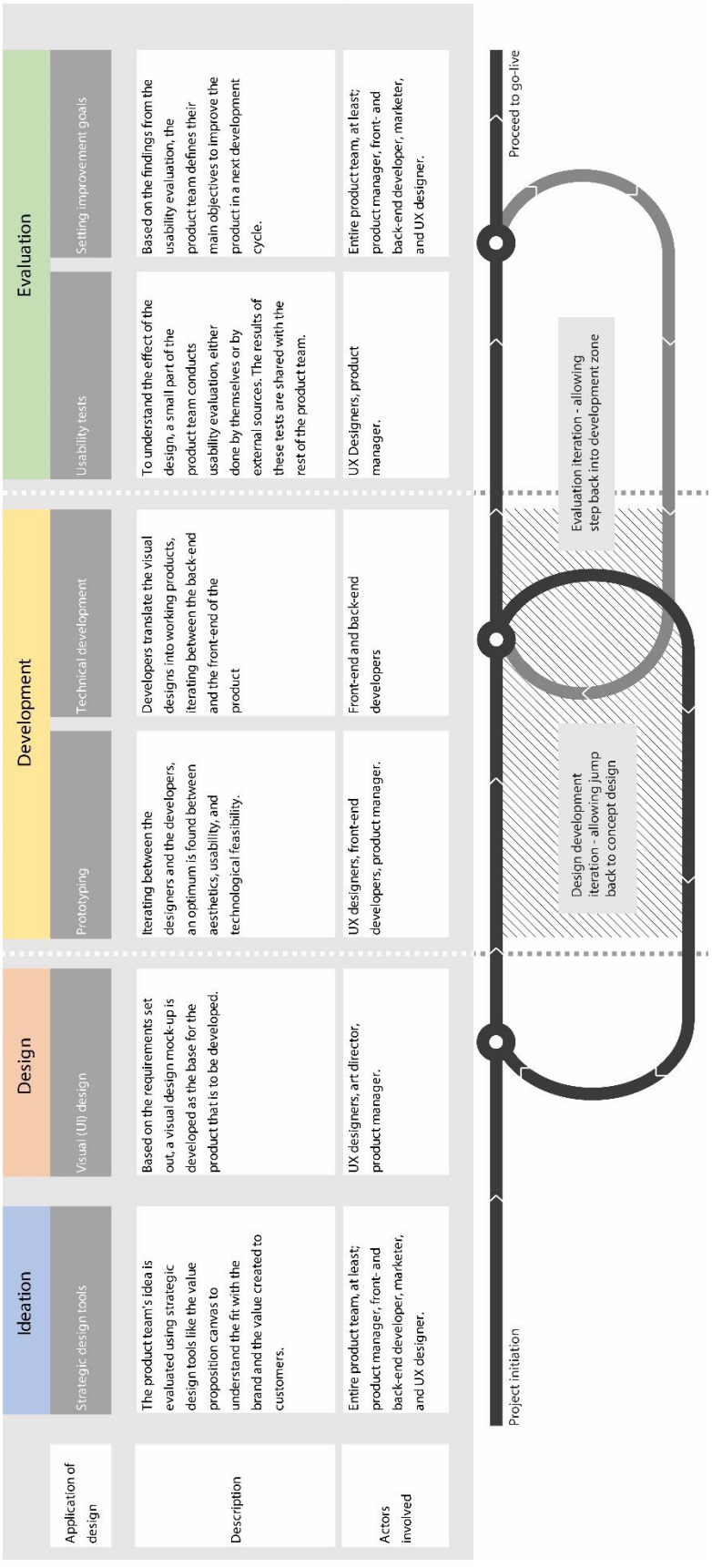
Appendix A: Overall means for the two surveys displayed in the Design Capacity Model. The means contracted in the second round as the knowledge of design increased. The DIC noted this occurred as more stakeholders became aware of the full possibilities of design - their understanding of design was self-evaluated. Should the study be repeated, the capacity model should be applied again to raise awareness of design as well as being a technique for collecting evidence of change.

Appendix B



Appendix B: Interactions between the barriers to the implementation of design practices

Appendix C



Appendix C: Application of design in the product development process

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The View from Within: Design's Voyage to Get a Seat at the Strategy Table

BOZTEPE Suzan

Malmö University
suzan.boztepe@mau.se
doi: 10.21606/dma.2018.398

It is often argued that design serves as an effective change agent in strategy formation. However, the question of how this actually occurs remains largely unexplored. Through case studies of five design consulting firms in Denmark, this paper examines how design gets involved in the making of strategy. The findings show that there are at least two paths to strategy-level work: First, design works its way to strategizing through repeated client engagement and trust building. That is, design consulting firms work with the same client over a long period of time, they gain trust of their clients, so the complexity and strategic importance of their deliverables gradually increase. Second, design consulting firms use human-centered approach as a means for reviewing the business strategy of their clients. That is, user research brings user needs, problems and opportunities into focus, which, in turn, paves the way for strategy-level discussions and solution seeking. Each path is discussed in terms of issues in design management, including, but not limited to, design activities, competence building in design firms and organizational structures.

strategy; strategic design; design consulting firms; design management

1 Introduction

Design has always been associated with the physical outcomes of its work – products, graphics, interiors, etc. However, it has been more and more involved in addressing a broad range of complex organizational, social and even political issues. As a result, new forms of design, where the subject of design is no longer the physical object only, but also the organization or even the society itself, have emerged such as service design, strategic design, transformation design, and design of governance. Companies today are turning to design to figure out not only how to do better products but also for what to do next, or how to create an innovative organizational culture. These are questions which have long been reserved for strategic management consulting firms only. However, as the conventional management solutions fall short to address today's sticky problems at organizational and societal levels, design has gained growing attention. This interest is evidenced, if nothing else, by an unprecedented increase in design-related coverage in the business media over the last decade

(e.g., Brown & Martin, 2015; Kolko, 2015) as well as the trend among strategic management consulting firms to add design capabilities to their portfolios—typically through acquisition of design firms. For example, the first strategic design consulting firm, Doblin Group, has become part of Monitor, and then of Deloitte Consulting. Accenture acquired service design company, Fjord, and McKinsey & Company bought Lunar. At the same time, many design consulting firms (DCFs) have been repositioning themselves as strategic design consulting firms or innovation consultants. Despite the interest, however, we do not know how this shift actually works in reality. For example, according to the Danish Design Center's recent survey with 805 Danish companies, 90% of the respondents that perceivably worked with design at a strategic level reported a positive influence on their bottom line (Danish Design Center, 2016). However, the same report also showed that only 13% of the companies supposedly employed design at a strategic level. Why would there be such a gap between the hype and the reality? One reason perhaps is that employing design strategically is nothing but easy. Due to its capacity to disrupt business as usual, design is often faced with stiff resistance within the organization (see Brown & Martin, 2015). If this is the case, then how will design get a seat in the table? This paper aims to address this issue by examining data from five DCFs in Denmark which have strategy- or policy-level engagements with their clients. It looks particularly at the path to strategic work, and how DCFs themselves have transformed to deal with the evolving nature of their businesses.

2 Expansion of Design

The expansion of design is typically described in three- or four-stage models or frameworks (Buchanan, 2001; Danish Design Center, 2001; Gardien, Djajadiningrat, Hummels, & Brombacher, 2014). These suggest an increased complexity as well as a shift of focus of design activities from objects towards strategic problem solving. Buchanan (2001), for example, was the first to point to the shift of focus in design. In his four orders of design, he explained that design evolved from symbolic and visual to design of material objects, and from there to strategic planning and systemic integration. Similar company-specific models and frameworks have been utilized to explain the progression of design activities. The best-known example is perhaps the so-called design staircase, introduced by the Danish Design Center (2001), where the bottom step is the lack of design, followed by design as crafting, then by design as process, and finally by design as strategy. Using ladder as a metaphor, however, may not be the best way to describe the evolution of design as multiple design practices continue to co-exist side by side, even within the same organization (Heskett, 2017). Thus, rather than linear progression from one stage to another, it would be safer to talk about the expansion of the focus of design—be it within a company or as a discipline.

The expansion of design's focus cannot be considered independently from the realities of the context in which it operates. Design has always been intertwined with its economic, technological, social and cultural environment (Heskett, 1985). Taking a political economy point of view, Julier (2017) attributed design's expansion to be a response to the shifts in the neoliberal capitalism and its changing notions of value creation. For example, in the early days of the neoliberalism, the focus on deregulation has put great emphasis on competition. This, in turn, created increased design focus on branding, portfolio development, and systemic integration of design elements for differentiation. Most recently, neoliberalization has led to drastic shrinking of state functions as a result of privatizations and outsourcing, eventually resulting in austerity measures. In the current period of austerity, Julier wrote, design has responded by taking a social turn. And, it did so in two ways: First, by designing more cost-efficient and human-centered government services, and second, by aligning with civil society that aims to fill the gap created due to shrinking government through community work, alternative economies, etc. Changes in the technological context have similarly forced design to adapt (Norman, 2016). The introduction of computers, communication networks, and other technologies created new spaces for design which called for new knowledge and competencies. As everyday devices became more and more complex, design had to find ways of addressing issues, such as usability and experience.

What enabled design to adapt so well to the changing environment is the deeply rooted idea that design is not bound to specific tangible outcomes and that everything may be the subject of design: "Increasingly there has been a tendency to think of policies, institutions, and behavior itself, as objects of design," Schön once wrote (1983, p. 77). Similarly, Simon (1969) believed that design was core competency for all professions concerned with turning the existing situations to preferred one. And when asked about the boundaries of design during an interview, Charles Eames famously answered: "What are the boundaries of problems?" (Design Q&A, 1972). This all-encompassing approach is based on a set of definitions of design which view design as a basic human capacity (Heskett, 2002), a way of thinking (Buchanan 1992; Cross, 1982; Brown 2009), a set of methods and tools (Jones, 1970) or an attitude, (Boland & Collopy, 2004; Michlewski, 2015). The emphasis is on the ways of thinking and doing, as well as on the systemic, holistic thinking and integrative work of design. This somehow idealized view of the scope of design has enabled design to penetrate management as an approach which may be "at the core of effective strategy development, organizational change, and constraint-sensitive problem solving" (Boland & Collopy, 2004, p. 17).

3 Strategic Design

The idea of design as a strategic tool in organizations dates back to the 1950s, when prominent designers such Donald Deskey and Raymond Lowey argued that design is a high-level planning activity, essential for business competitiveness (see Heskett, 2017). However, the research that views design as a strategic resource and a vehicle for change is relatively recent (e.g., Kotler & Rath, 1984; Dumas & Mintzberg, 1989; Squires & Byrne, 2002; Lojacono & Zaccai, 2004; Ravasi & Lojacono, 2005; Gornik, 2006). This research borrowed from strategy theories to argue that design could be one source of strategic advantage (see Borja de Mozota, 2011). For example, many were inspired by Porter's (1980) positioning approach, which viewed strategy as achieving and sustaining competitive advantage through establishing a favorable position in industry vis-à-vis competitors by differentiation or low-cost (e.g., Blaich & Blaich, 1993; Kotler & Rath, 1984; Lorenz, 1986; Walsh, Roy, & Bruce, 1988). They argued that by creating visually distinct products design achieves low cost and differentiation, and thus, competitive advantage. With the rise of the resource-based view (RBV)(e.g., Barney, 1991; Wernerfelt, 1984) and dynamic capabilities approach (DC) (e.g., Eisenhardt & Martin, 2000; Teece, Pisano, & Shuen, 1997), the attitude towards design's strategic contribution began to change. According to these two approaches, design as a single, visually differentiated product was not hard to imitate, and thus, could bring only a short-lived competitive advantage. Therefore, it could easily be dismissed as a source of strategy. Instead, RBV and DC viewed strategy as building and reconfiguring firm-specific resources and capabilities. This was essentially a shift of focus from design as creator of differentiated products to design as an organizational activity with its own systematic processes which could be ingrained into organizations and reused. For example, many claimed that designers push for a fresh thinking about innovation throughout the organization by the priorities they hold and the tools they use (e.g., Borja de Mozota & Kim, 2009; Jevnaker, 1998; Svengren Holm, 2011). In this sense, it was argued, design became an organizational competence that may lead to sustained innovation, as opposed to delivering one-time creative outputs. Indeed, RBV and DC offered additional framework to explore design's strategic contribution.

Design's engagement with strategy occurs in multiple ways. For example, Boztepe (2016) illustrated that designers may be responsible for (1) redefining existing organizational strategies, (2) creating capabilities for sustained innovation, and (3) being directly involved in strategy formation through future planning. That is, they use design to set vision and direction for a company, as well as identify strategies for systemic innovations which are harder for competitors to replicate and which can lead to long-term competitive advantage.

Designers' ability to engage in strategy problems have been attributed to the properties strategy and design share (see Liedtka, 2000; Martin, 2009; Simon, 1993). As with design, it is argued, strategy making is abductive in nature. That is, it is concerned with envisioning a desired future state, and

creating a blueprint for turning it into reality. Also, the problems design and strategy deal with are of similar in nature: They are too sophisticated with multiple variables that cannot be resolved with statistical means alone. This particularly makes design's ways of dealing with wicked problems applicable to strategy making. Simon (1993, 1996), even suggested that strategizing is actually designing—the reason being that any management activity aims to create a new state for organizations, markets and even industries, and design is precisely concerned with the creation of new future states. In fact, just like Simon, early strategy researchers viewed strategy formation as a "creative act" (Christensen et al., 1982, p. 180) and an "imaginative identification of new possibilities" (Andrews, 1980, p. 59). Andrews even wrote that at "[t]he heart of the strategic process is the generation of alternatives—combining in new ways market opportunity, customer needs, and company capabilities" (p. 41). In search of greater control over the strategy formation process, however, strategic management later took a somewhat different direction, giving rise to approaches with more formalized processes and tools, employing rational decision-making and statistical means, such as the planning approach pioneered by Ansoff (1965). Strategy is created centrally, with a purpose to give direction to all business units within an organization, including design. As such, it is a deliberate planning activity that belongs to the upper management only. Design, according to this view, can merely be an implementer of strategy decisions in a top-down fashion.

The shift to formalized processes in strategic management was not without its criticisms though. For one thing, number crunching may fall short in helping companies answer the question of what direction an organization has to take and why (Simon, 1993; Mintzberg, 1994). Also, several researchers called into question the idea that strategy making may occur only as a result of a conscious process and only at the top of the organizational hierarchy. Drawing on the behavioral theory of the firm (Cyert & March, 1992), they rejected the idea that senior management rationally analyzes the organizational context, then forms, chooses and imposes strategy, as it supposedly denies the realities of organizational dynamics (e.g., Cohen et al., 1972; Mintzberg, 1978). They put forward that strategy could also emerge incrementally, and even unintentionally, and that various organizational members could be involved in strategy formation. Of course, strategy formation is a much more complex phenomenon than the deliberate vs. emergent dichotomy dictates, and may occur anywhere between the two ends of the spectrum (see Levinthal, 2011; Mintzberg and Waters, 1985). Thus, any research on the design's work at strategic level should take into account that design could be engaged in strategy formation both as a part of an explicit strategizing process, or within the daily practices. If everyday actions of organizational members are part of the strategy formation, then how can we distinguish between strategic work and non-strategic one? When are designers' work strategic? Shivakumar (2014) considers decisions as strategic if they affect the company's degree of commitment and exert a significant influence on the scope of the firm. The degree of commitment is about the willingness of a company to take decisions that are difficult to reverse. The scope of the firm stands for the firm's choice of products, activities, markets, as well as its architecture and culture. Heskett (2017) similarly defined strategic design as having a company-wide impact and being engaged with innovative products and systems, rather than improvements of single products. In this study, therefore, I considered as strategic not only design work that was explicitly labelled as such, but also any design work that had a company-wide impact and effect on the client company's scope and commitment.

4 Method

The study involved case studies of five DCFs located in Denmark. They were (1) CPH Design, (2) Designit, (3) DN Group, (4) Red Associates, and (5) Seidenfaden Design Copenhagen. The participating firms ranged in size from 9 to 100+ employees. While two of the firms had only one office, the other three had offices located both in and outside Denmark.

The primary data collection technique was a series of semi-structured interviews. Heskett's (2001) case study guidelines were adapted and used as a framework for the interviews. All interviews were conducted face-to-face on site. At least three interviews were conducted in each firm. The interviewees were partners, design managers, project managers, and designers. Each interview lasted 2 to 3 hours, depending on the interviewee's availability. Additional data consisted of archival information such as company publications, project documentations, media articles, and photos of products and of the workplace, etc. taken during visits. All interviews were tape-recorded and then transcribed. A total of 29 hours of interviews was recorded. The transcribed data was coded for categories, as identified in the case study guidelines. Specifically, I looked for cues as to how design appeared to function at strategy level. Then, patterns of practice across cases, if any, were identified. The question of how design functions at strategy level, including setting vision, distinctive market positioning, future planning, sustained company innovativeness was analyzed along with the management of design activities. Finally, based on the grounded descriptions of design practices and analyses, strategic practices and design functions of the participating DCFs were identified.

5 The Path to Strategy-Level Work

The participating DCFs appeared to operate at strategic and even organizational/social transformational levels. The work at this level was characterized by the use of design knowledge, skills, processes and tools to shape organizational positioning, build innovative capabilities in client organizations, or set future vision or direction (see Boztepe, 2016).

As it emerged from the data, DCFs got involved in strategy-level work in two distinct but related ways: (1) gradual expansion through repeated client engagement and trust building, and (2) human-centered design.

5.1 Repeated Client Engagements and Trust Building

Four of the DCFs initially started as product design firms. Over the years, however, they gradually expanded their services to include graphic design, advertising, branding, service design, user research and strategy design. The driving forces behind their expansion were their clients' demand for complementing products and services, and the firms' own desire to lock-in clients. DN Group's engagement with a Taiwanese client is a typical example: Initially, DN Group was contracted for design of individual products that would appeal to the European market. The client later wanted to have packages that communicated the product's identity, which, in turn, led to design of environments, etc. The complexity and the strategic importance of deliverables increased over time as trust had been built with the client. So, the work of DN Group shifted to aligning the design language across various touchpoints. Then, the company became more and more engaged with the question of what to do next, which led to portfolio management, competitive positioning, and even vision setting.

Expansion due to repeated client engagements and trust building may be said to occur in three phases: In the first phase, DCF is engaged in design of individual, differentiated products that supposedly help to reposition client's existing strategy or represent it in creative ways. This typically requires some commitment on the client's side but does not change the overall scope of the firm. Repeated satisfactory transactions make clients aware of the capabilities of design and help build trust. Developing relationships based on trust is central to any inter-firm collaboration. However, it becomes even more essential when it comes to design projects, due to high uncertainty and ambiguity surrounding the success of design outcomes (Alversson, 2011). Once trust is established, the volume and the frequency of collaboration between the DCF and its clientele increase, and the scope broadens. By now, clients are already familiar with what the design firm can do and how it works. Notice that the majority of the clients of the above-named DCFs were early adopters of design (Junginger, 2009), with limited or no in-house design resources.

In the second phase, the design work has an integrative nature, where each new project is treated as part of a larger system of integrated products, processes, services, environments, etc. This phase is motivated by client's desire to establish consistency across its various touchpoints. Design firms see this as an opportunity to establish a design language for their clients, and, in so doing, they secure longer-term accounts. More exploratory projects and user research become part of the work. As a good track record has already been established, clients are often more open to new ideas. Designers tend to act, among other things, as a source of procedural knowledge. During interviews, participants often referred to the importance of educating or teaching clients through doing. In the early stages of projects, they do this by sharing an initial set of principles, outlining the requirements for successful innovation, such as collaborative work and insights based on user research. When the project is underway, they do it by immersing clients in design work. Designit, for example, requires its clients to assign an employee as a dedicated team member, and expects him or her to actively participate in the design process. Typically, this employee is someone who is part of the client organization's innovation, design or product development unit. CPH Design trains its clients by conducting co-creation workshops, so to say, in which the client is expected to actively participate during ideation. The participants of these workshops include employees from the client organization, ranging from workers to top managers. The expectation is that the client will develop a high level of ownership and enthusiasm over the ideas developed but will also internalize the design process. As many interviewees noted, success depended on the extent to which designers achieved introducing the client team to the innovation process and persuading them to champion design.

In the third phase, design begins to get engaged with products and services that have an impact on the client's strategy, organizational and even social change. Also, projects aiming at building innovative competencies and culture within the client organization are typical. This phase may at first seem to be invisible, running in the form of "ongoing conversations," as defined by the founder of the DN Group. These conversations typically occur in-between projects and revolve around the question of what to do next. Therefore, they have a significant impact on the scope and the direction of the client: "The most important design work happens between projects," he noted. That is, the identification of future opportunities in fact takes place when the client is not officially receiving any consulting services. So, the strategic work remains invisible, and thus, the client ends up with receiving the service for free.

For some DCFs, strategy-level work is an inseparable part of their expanded service range. For example, Designit not only designed Novo Nordisk's NovoPen, but also was in charge of the product launch pack and user manuals in online and print versions. Designit later became part of envisioning their client's brand and communication strategy and devising their design policy. In more recent work with Novo Nordisk, they were involved in long-term vision setting and future scenario development. That is, they moved from design of product systems to devising design and brand strategies, and then to envisioning future directions for their client. In this phase, DCFs are able to influence both their clients' offerings and their ways of doing business. Building innovation capabilities within the client organization is carried out more explicitly. Thanks to repeated engagements, the clients have now developed some understanding of the design process and want to internalize design's innovation capabilities. All participating DCFs in my study were engaged in activities such as innovation training and design workshops to serve this purpose. In so doing, designers invested a significant amount of effort in developing custom training programs and tangible tools, such as templates, games, workbooks, etc. that supposedly facilitated client understanding of and immersion in the design process, even in the absence of designers. For example, CPH Design developed a deck of cards in order to support creative idea generation for one of its clients. This kind of tools, they believed, would help make the client organization employees' transition to the newly introduced ways of doing business less painful.

Notice that the client companies in this phase consisted of organizations both with and without in-house designers. The role of designers within the organization across clients with in-house designers,

however, differed significantly. On the one side, there were designers who merely focused on typical design problems of product development and corporate identity, whereas, on the other, there were clients whose internal design teams were already working at the level of strategy. For the latter, working together with DCFs was a way of reinforcing their limited design resources and benefiting from DCFs' experience of working across industries. As noted by the design manager of a client company, a major medical firm, their work with the DCF helped them secure and even strengthen the in-house design team's position within the company. One reason was perhaps that DCFs communicated directly with the upper management, which, in turn, made design's capabilities more visible, and changed the expectation placed on the internal design team. It could also be the case that, thanks to working together with the DCF, certain skills and knowledge were transferred to the internal design team, which they then made use of when dealing with strategy-level issues.

For DCFs, the search for client lock-in and higher profits was a major driving force for the move towards a more strategic direction. At the same time, however, there was an almost naïve desire to create an impact. One partner at Designit said they were now so saturated, meaning they had no shortage of clients, that they selected only clients for more strategic engagements: "We want to be in projects that have an impact," he noted. This idea of impact was not limited to organizations they worked with. For example, one firm had self-initiated projects targeted towards creating social change and a sustainable future. These were projects typically about future scenarios. There was a high level of enthusiasm within the firm to partake in those projects. Such efforts served the purpose of projecting an image of being on the edge, showcasing design's future-making potential, and of course attracting similar projects.

The expansion in design is represented by an increased footprint in the client's value chain. That is, more activities across the value chain are covered by DCFs. This is achieved by horizontal value integration of DCFs, to which typically diverse design services are integrated. This, in turn, means the added competence of managing transdisciplinary teams. But DCFs differed in their approaches to how teams should be formed. In two firms, for example, the project was assigned to a team. In others, transdisciplinary teamwork applied in all projects from start to end, but the team composition changed over time. Interviews showed that the participants were in fact experimenting, even struggling, with different ways of team formations and the question of how to allocate their human resources, as admitted by a partner from one of the largest DCFs:

> *We don't have a clear organizational structure. It's a spaghetti structure. Increasingly we work together [with overseas offices] over the internet. Each office uses the resources of seven-eight other offices […] We have an informal collaboration system. (Partner, Designit)*

One of the DCFs worked with a professional project manager but had a hard time organizing design work in project management terms. Timesheets, coordination across projects, accounting of every activity seemed to be in odds with the laissez-faire way, long-hours and the relaxed culture of the design studio practice:

> *Designers have a very different way of working. It has not been easy for me so far. They put their heart and soul, and they treat the project as never ending. I try to explain to them that this is business, and no matter how much they work, we are only paid for certain hours. (Project Manager, Designit)*

For designers, what lies beneath the surface of a problem is believed to unfold gradually as the project progresses. As such, each new interview, each new sketch, and each prototype could potentially lead to a totally new direction. Thus, project management tools were seen as restricting, and an up-front accounting for a project in management terms is perceived as a chore. Add to this that many interviewees described themselves as someone engaged in creative work who needed to be free. Also, designers apparently develop an emotional attachment to their projects, as they often referred to their projects as their *baby*, *child*, or *signature*, etc. This high level of emotional

involvement with their work is perhaps another reason for the uneasy match between the management tools and design's work culture.

5.2 Human-Centered Design

User research often serves as a stepping stone for DCFs to get involved with strategy-level work. It brings user needs, problems and opportunities into focus. These may have to be addressed at the level of product, but may also call for changes at organizational processes, structure or even strategy. User research allows for an abstraction of the problem presented by the client—the task changes from designing a product to solving a problem identified from users' standpoint. That is, it paves the way for strategy-level discussion and solution seeking.

As designers typically treat even well-defined problems as ill-defined, they often begin to tackle any project by challenging assumptions and framing the problem in new ways. This study was no exception. A great deal of emphasis was given by all participating firms to uncovering latent user needs, altering client expectations, and setting up of the right brief. The assumption is that it is not possible to know from the beginning of a project what the real problem is, or what kind of offering will solve it. The real problem would be revealed only after research and hands-on exploration. User-centered and participatory perspectives are therefore instrumental in resetting client expectations and bringing strategic issues to the table. As user research in early stages of design aims to understand everyday life and learn from what people actually do, value, and even dream of, to deliver unique value, the findings often have to do with what people care about. This allows for an abstraction of the problem presented by the client—i.e., the task changes from designing a product to solving a problem as identified from users' standpoint. This, in turn, paves the way for strategy-level discussion and solution seeking. DCFs reported several instances in which their clients approached them with a request for a specific product design, but following user research, designers concluded that there was no need for a new product at all. Ironic as it may seem, designers recommended not designing a product. Instead, they reorganized the existing client portfolio according to user needs, simplified the existing products or user interaction with products, and made changes in the brand message. Doing this was a matter of integrity and related to the emphasis designers placed on the identification of the right problem. It also was a way of communicating to their clients that DCFs are not limited to products, but the main task was to identify the underlying problem and provide solutions no matter how deep or what level it was.

As clients did not readily accept user research, DCFs often found themselves in a position to push for human-centered design:

> *They were terrified. We explain in the beginning, we show them that they need to see the whole. Still today I struggle. It's chaotic. When they approach design company, they think designers deal with aesthetics and form. (Anthropologist, CPH Design)*

Some even wanted to skip the user research phase altogether, but the DCFs did it anyways until the client acknowledged the need for it. They viewed research as a waste of time, so the DCFs had to convince them that it is a necessary step in order to reduce the risk of product failure.

To convince their clients, all DCFs developed some illustrations—showing stages of the design process, milestones, so to speak, and the value each stage adds to the outcome. They communicated this to their clients, and most, if not all, made it available on their web sites. That is, they seem to have adopted a human-centered approach even towards their own clients. In addition to studying end-user needs, they also spend time analyzing their clients to understand internal challenges. This is done mostly through immersion in the client organization, collaborative brief development, and co-creative workshops. It is viewed as an essential part of the initial phase of the definition of the brief:

> *You have to control the process. You have to understand what they [the clients] say, how they work and what they value. It is only then that you can help them to design the*

project. We have a process to ensure that we get it right. We start with a foundation day […] It's about ensuring that the problem is right. (Partner, Designit)

Other DCFs too had clearly defined protocols in place that would supposedly help them understand their clients and show the direction the project should take. The design brief was drafted only after some progress has been made to understand the client's needs. Also, having to customize their protocols as needed was part of the work. For example, after realizing that clients tended not to trust the findings of ethnographic work, Red Associates decided to have the scalability of their key findings from ethnographic data verified through quantitative research—in collaboration with a marketing research firm. And it was not uncommon for DCFs to have different deliverables for different stakeholders within the same client organization. What mattered was to be able to manage the complexity of data and create a storyline that was understandable and clear enough for the relevant stakeholder to act upon:

They are business people. It is abstract to them. We present marinated data. We adopt doctor's perspective. We say: "Let me tell you a story about Sam." We prepare boards with photos of Sam, a dairy, a film. What we do is actually taking a theoretical model, show it to them graphically. When they see a model like that, they leave that day saying "That's interesting. How/what could it mean? This could lead us in this direction." (Partner, Red Associates)

With the arrival of human-centered design, DCFs added new tools and competencies to their portfolio. Social scientists joined the teams, and designers acquired new skills, including research, communication, process training, and organizational design. Commonly used tools in design such as visualization, prototyping and storytelling are utilized too in the making of strategy to visualize complex situations, problems, opportunities, and present and future strategies. For example, DN, in partnership with Elevated ApS, has developed a tool called BreakAway based on Kim and Mauborgne's (2005) blue ocean strategy. New forms of deliverables place more emphasis on the process, problem formulation, storytelling and value. Vertical integration also accompanies the human-centered design path to strategy work.

6 Conclusion

This study provided some initial insights into design's ways of expanding to new territories and engaging with questions of strategy. As it emerged from the data, DCFs get involved in strategy-level work in two distinct but related ways. First, as design firms work with the same clients over relatively long periods of time, they build client trust, as a result of which the complexity and strategic importance of their deliverables increase. Second, user-centered design provides a way for reframing problems and resetting client expectations, as well as addressing the key strategy question of what to do next. Both paths were characterized by new ways for DCFs to organize their own work and to relate to their clients. This expansion in activity area is accompanied by (1) horizontal value integration, where a range of diverse design services are offered as a bundle to clients, or (2) vertical value integration, where upstream and downstream activities are performed. Also, new competencies and skills such as research, business development and innovation training are adopted. The existing competencies, on the other hand, such as visualization, creative problem solving, etc., are adapted to the new situation. In their transition to strategic work, DCFs try hard to emphasize the process along with the product and communicate the value of their work to their clients along the way. Yet more research is needed to fully uncover how design makes its way to strategy formation. Specifically, future research needs to focus on the expansion of design in client organizations with varying organizational cultures and levels of design adoption.

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About the Author:

Suzan Boztepe, Ph.D., is Senior Lecturer at Malmö University. Her research interests include generating economic value by design, design-oriented innovation and the strategic impact of design.

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Entangling, Oscillating, Frilux-*ing*: branding the art of design

PANDEY Sumit

Department of Informatics, University of Oslo
sumitp@ifi.uio.no
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Recent strategic design and management discourse has identified gaps in the current framing of design for organisations, specifically highlighting a lack of discussions related to emergent design cultures and calling for a strategic framing of the art of design. Connecting and expanding these conceptual discussions with reflections from practice-based research through design, we seek to further the understanding of how design can be strategically translated into organisations. Drawing parallels between a strategic framing of design, and brands as enacted or manifested strategy, we present reflections from a design process of branding the strategic art of design for an academic research library. The outcome of our process was an overarching brand called Frilux, that manifested the strategic design approach at the library. Specifically, we propose that design can be framed strategically in an entanglement of organisational and design practices and mind-sets. Further, we suggest, this framing should be manifested across design outcomes that oscillate between intangible outcomes like strategic guidelines and values, to tangible outcomes like visual symbols and artefacts.

strategic design; design for organisational change; branding; research through design

1 Introduction

This paper explores the question of strategically framing and manifesting design within organisations. While this question may not have a universally applicable answer, through the reflexive exploration of a practice-based research through design approach, we seek to contribute to the larger discourse in design research related to organisational change and innovation. Specifically, we attempt to further the understanding of strategically framing and translating design into organisations, by connecting and expanding conceptual discussions with reflections from practice.

Design, as a catalyst for innovation, and working with open and complex problems in organisations, has been getting a lot of attention in design research and management, usually as 'design thinking' (T. Brown, 2009; Martin, 2009). However, approaches that apply design practices in organisations,

often use solution-oriented techniques (or a toolbox) that work well for small and isolated problems but do not enable new mind-sets or practices to emerge (Dorst, 2011; Junginger, 2016; Manzini, 2016). Instead, Dorst (2011) introduces a 'frame' as "the creation of a (novel) standpoint from which a problematic situation can be tackled" (p.525), and suggests that 'framing' is a central activity in design practice. He argues that while specific frames could be temporarily adopted by organisations for the duration of a design project, design practices can also be framed more strategically and can become a part of organisational practices and outlook.

Similarly, Junginger (2016) argues that design practices can be framed in different ways within organisations, namely as a tool, method, and a strategic art, reflecting different mind-sets and approaches to problem-solving and inquiry. This is based on Buchanan's articulation of the different facets of design, which suggests that:

> *An art is a systematic discipline for thinking, doing, and making. It provides principles and strategic guidance for the use of the many specific methods and techniques that are employed in design. In contrast, methods provide tactical support in addressing design problems. Finally, techniques are individual tools and ways of working to solve technical problems. (Ibid., p. 38)*

While important, tools and methods usually represent the extent of organisational engagement with design (Junginger, 2016; Tonkinwise, 2011). However, it is the strategic art of design that can lead to "new mind-sets, and new ways forward" (Junginger, 2016, p. 38). Although we agree with the importance and necessity of framing design as a strategic art, we have also found that manifesting and translating the art of design and engaging organisations with it, can be very challenging (Pandey, 2015). Moreover, a 'top-down', designer-created strategic framing of design may not align with the organisation's existing practices, values, and history (Junginger, 2015). Considering every organisation has embedded narratives, knowledge, and values (J. S. Brown & Duguid, 1991), a strategic framing of design needs to be adaptive and contextually situated in organisational processes and mind-sets (Junginger, 2015; Pandey, 2015). Put differently, design practices need to be translated into contextually situated strategic frames before they can play a transformational role (Pandey, 2015).

Using Buchanan's (2001) model of the four orders of design, we describe a research through design process (Zimmerman, Forlizzi, & Evenson, 2007) of framing design as a strategic art for the academic research library at the University of Oslo. The outcome of our process was an overarching brand called Frilux. While brands are usually associated with products, services, or organisations, Frilux represents the situated values, emergent strategy, vision, and approach for design at the library. It consists of brand values and architecture, visual identity and guidelines, a knowledge exchange forum (Flo), avenues for introducing design methods (Flex), a design workbook (Flexbook), and is complemented by channels on social media and a website. We build on a broad understanding of a brand as representations of ideas, vision, history, values, and goals (Breslin, 2007), and not just a visual identity linked to a product, service, or business. Newbery and Farnham (2013) suggest that branding 'enacts' or manifests strategy and that it "elevates ideas from being visual identifiers of who is providing value to expectations about the value itself" (p.69). With this understanding in mind, we suggest that brands can be particular and contextual manifestations of a strategic art. Moreover, applied to the art of design, branding can help contextually and strategically frame design within organisations. Brands can act as the connective framework (Breslin, 2007) linking tangible and particular tools and artefacts, with intangible strategic values and vision within an organisation. Therefore, we propose that the strategic art of design, manifested as a contextually situated brand, *oscillates* (Nylén, Holmström, & Lyytinen, 2014) between tangible and intangible design outcomes.

We further suggest that the strategic art of design in organisations can emerge in an *entanglement* of organisational and design practices and mind-sets. Manzini (2016) describes such an entanglement as 'design culture', defining it as the situated "knowledge, values, visions, and quality

criteria that emerge from the tangle of conversations occurring during design activities" (p.54). He suggests that a design culture allows for new understandings to be produced and that these meanings can catalyse changes within the organisational culture and practices.

In the following section, using discussions from design research relating to organisational change and innovation, we present a brief conceptual background for our work. Next, we present Frilux, as a strategic framework that *oscillates* between intangible outcomes like strategy and approach, and tangible outcomes like visual identity, tools and other artefacts. In addition, we highlight the contextually situated and iterative *entanglements* of organisational and design practices and mind-set, that helped shape the process and its outcomes. Finally, we reflectively discuss the nature of design process and outcomes and their potential implications on the framing and understanding of design in organisations.

	Symbols	**Things**	**Action**	**Thought**
Symbols (1st Order)	Graphic Design			
Things (2nd Order)		Industrial Design		
Action (3rd Order)			Interaction Design	
Thought (4th Order)				Environmental Design

Figure 1 Four orders of design (Buchanan, 2001)

2 Entangling cultures and Oscillating outcomes

Manzini (2016) has observed that the focus of design research is increasingly, "problem based, solution oriented" (p. 52), emphasising the role of the designer as a facilitator, and the tools and methods used over the designed 'product'. However, he argues that "design is not only the sum of its methodologies and tools" (Ibid., p. 54) and calls for design cultures where designers *facilitate* as well as *participate* creatively. We suggest that such a 'dialogic' design culture (Ibid., p. 58) is also crucial for a creative and productive *entanglement* of design and organisational practices and mind-sets and can catalyse a strategic framing of design. However, we also think that a strategic framing of design is essential to cultivate a dialogic design culture. Therefore, we argue, dialogic design cultures and strategic framings of design mutually scaffold and reinforce one another.

Reflective articulations of strategic framings of design, as they emerge in design activities and processes, is important within design research. Connecting theory and practice, they allow design researchers and practitioners to understand the modalities, experiences, and challenges of framing design as a strategic art within organisations for meaningful change. However, we argue that design culture is not only manifested in the processes, techniques, and deliberations that happen during design activities but is also embodied in the outcomes of design processes as well. Gaver (2012) underlines the importance of design outcomes for design research and theory, suggesting that they concretely manifest and embody the design team's choices, deliberations, and beliefs regarding the most appropriate responses to the issues and challenges they faced. Therefore, we suggest that

from the perspective of design research, reflective articulations of strategic design culture within organisations, should have a conjoined focus on the process and outcomes of design activities.

Buchanan (2001) situates design activities and outcomes into 'four orders', which offers a promising conceptual framework for a combined articulation of the process and outcomes of design (Figure 1). The first and second order of design, focus on communication through symbols and physical artefacts respectively. The third and fourth order of design, focus on actions and thoughts respectively, reflecting the recent emphasis on design processes in research and practice. In our experience, we have found that design processes and their outcomes in organisations, tend to move or *oscillate* (Nylén et al., 2014) across multiple orders or design, often with a range of outcomes that work in concert. Brands are a particular example of an oscillating design outcome since they are designed to be experienced across products, services, and other kinds of related materials, like a visual identity mark and communication collateral.

3 Research Approach

Considering the practice-based nature of our work, we adopted research through design as the research approach. Research through design uses the "methods, practices, and processes of design practice with the intention of generating new knowledge" (Zimmerman & Forlizzi, 2014, p. 167). It introduces approaches from design practice as possible research conducts to generate knowledge (Löwgren, 2013; Zimmerman et al., 2007) and takes a constructive and analytical outlook towards doing research (Gaver, 2012). With a constructive outlook, we mean that it is a form of "research that imagines and builds (or constructs) new things and describes and explains these constructions" (Koskinen, Zimmerman, Binder, Redström, & Wensveen, 2011, p. 6). Gaver (2012) argues for a different set of expectations and criteria for judging knowledge outcomes from research through design, compared with scientific theories. He suggests that the theory it produces is "provisional, contingent, and aspirational" and closely linked with the contextual outcomes from design practice, rather being "extensible and verifiable" (Ibid., p. 938). Analytical and reflective accounts of research through design process and outcomes do not just illustrate or establish design theory (Breslin & Buchanan, 2007), but also expand it by highlighting specific dimensions of the design space (Gaver, 2012). In addition, due to their provisional and contextual nature, they create a bridge back to design practice (Breslin & Buchanan, 2007; Löwgren, 2013).

We used detailed notes and images from the design process to analytically and reflectively describe the process and its outcomes. Additionally, five interviews were conducted with three team members and the expert designer. In addition, once the design process had concluded, verbal and anonymised written feedback was collected from seminar and workshop participants.

4 Frilux: Branding the art of design at an academic research library

4.1 Context and Background

The role of academic and research libraries has evolved from information archival and access to new and distributed forms of information and infrastructure access, including creative forms of knowledge production and sharing (ACRL Research Planning and Review Committee, 2015). Academic research libraries are actively engaged in aiding and educating researchers, and in outreach and cultural events, like hosting pop-up maker-spaces and cultural fairs (Pandey & Srivastava, 2016b). As a result, the role of librarians has also evolved to incorporate new ways of interacting, educating, facilitating learning, and knowledge and creative production.

Due to these changes and the proliferation of digital technologies, such as e-books, smartphones and tablets, and shifts in user needs and expectations, the academic research library at the University of Oslo (UiO), re-evaluated the user experience of its digital services by hiring expert design consultants. These expert-led design engagements helped emphasise the relevance of user experience, both for digital and physical service touchpoints, to the involved library staff and

management. However, it also highlighted the need to complement one-off expert-driven design engagements by developing in-house design competence to *continuously* evaluate and evolve service experiences. Consequently, from 2013 to 2015, the library, in collaboration with design researchers from UiO, conducted workshops that introduced design techniques, like customer journey mapping and usability testing to librarians, with the intent of improving the user experience while developing services. While librarians found some techniques like usability testing useful, the relevance of others to their practice was repeatedly questioned. From 2015, in collaboration with strategic design researchers, the format of these workshops was evolved to introduce design through a set of open-ended and semi-structured methods like sketching, mapping, and storyboarding (Pandey, 2015). In these workshops, participants could appropriate and use design methods in the context of problems from their own practice. This approach was successful in provoking reflection amongst librarians about their practices and how they could evolve (Ibid.). Even so, the library staff and management involved in the project found it hard to *translate and communicate* the value and significance of design, and consequently the workshops, in tangible terms to the larger community within the university and in the local region.

Therefore, a process of branding, naming, rethinking of the design methods and tools, and creation of community building touchpoints was carried out. The project was carried out over a period of eight months and involved a multidisciplinary design team consisting of the author, the project leader from the library, three members of the library's web and communications group, and a graphic and strategic design expert. For reasons of brevity, members of the library and the author are collectively referred to as 'the team' and the design expert is referred to as the 'expert designer' in the remainder of the paper. The following description highlights how the design process entangled design and organisational practices and mind-set, over the course of four phases. Furthermore, since each phase was simultaneously engaged with designing outcomes situated in (and across) multiple orders of design (see Figure 2 – timeline), we discuss them in terms of oscillations, rather than as artefacts of specialised activity areas of design, like graphic design. The outcomes are highlighted visually throughout the description and summarised both textually (Table 2) and visually (Figure 9) at the end of the section. However, while outcomes are largely presented as visual artefacts, we emphasise that they should not be read as unilateral solutions created by the expert designer, but rather as touchpoints that consolidated analytical and reflective discussions throughout the design process.

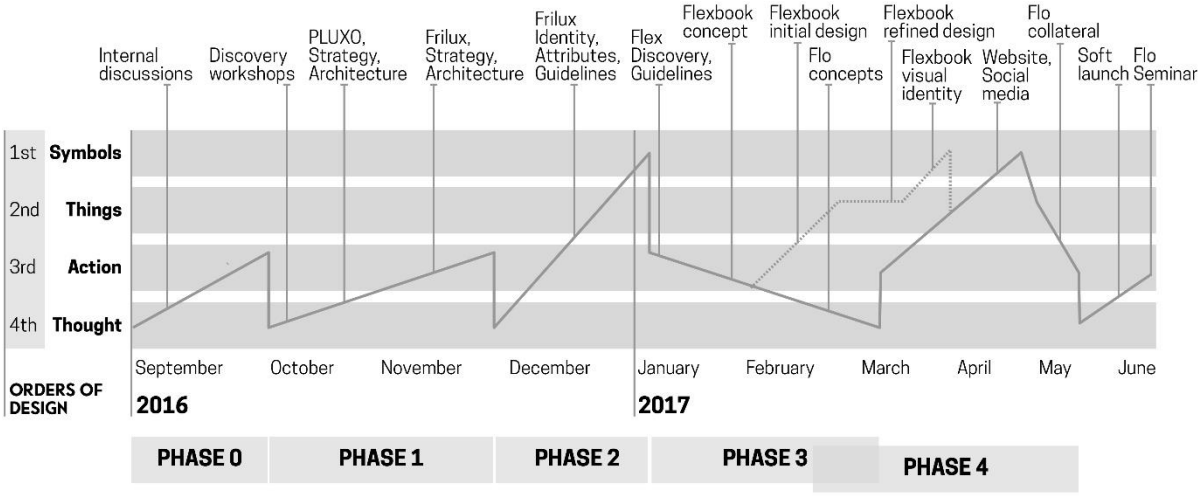


Figure 2 Timeline of the project and design activities. source: Author, adapted from (Nylén et al., 2014)

4.2 Phase 0: Intent, scope (thought) and planned action

We (the team) conceived the project in discussions about existing issues and potential future directions for the design approach. At this stage, the problem with the design approach was articulated primarily as a communication issue: *How could we communicate the design approach in*

an understandable and non-academic way to libraries in the university and the Nordic region? We felt that a unified communication language would help consolidate the design methods and techniques used in the workshops and hence could make it easier for librarians to present, teach, and adapt for (and by) themselves. Therefore, an expert designer was engaged to create visual identity and name for the approach.

Through portfolio reviews and process related discussions with the expert designer, the team saw the potential of situating the visual identity in the broader context of the values and beliefs that the design approach represented at the library and transforming the design approach into a *brand*. We (the team) felt that it would make the approach more adaptable and would help articulate our own vision with regards to design at the library, more clearly. Even so, 'how' this was going to happen, had decidedly become fuzzier and more intangible and compounded with a lack of experience with such a process; it created some discomfort within the team as well. This was highlighted by a member of the team in the interviews at the end of the project: "I didn't see that (the potential of a branding process) when we started. I understood it was a branding project, but I didn't actually understand the concept fully in the beginning. I think it was a bit blurry what we were going to get out of it. I was also a bit worried and not quite sure how to follow up the process."

To alleviate some of these concerns, the process was planned as a series of discussions based on probes and questions created by the expert designer and collaborative workshops where he would also participate fully. The feedback process was also adapted to suit the librarians' practices. The feedback and critique were collected in a written format where the discussion would be summarised and everyone in the team could individually add more comments. This also helped make the feedback concrete and actionable for the expert designer and created an opportunity for written rebuttals or clarifications before alternate design proposals were created. Moreover, it helped prevent instantaneous and impulsive reactions from driving the design process.

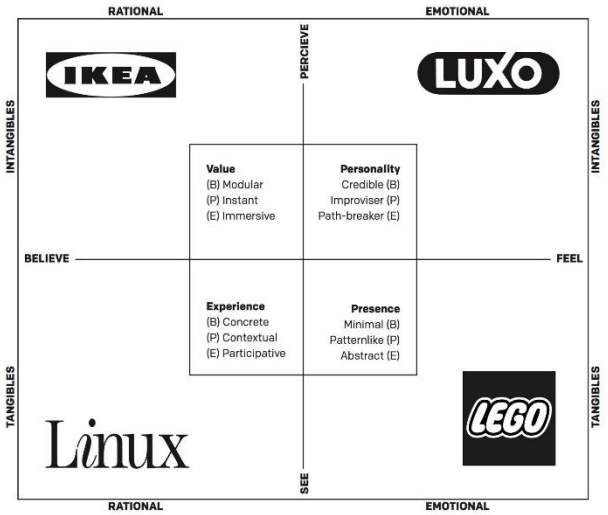
4.3 Phase 1: Between (Inter)Action and (Articulated) Thought

The initial phase of the process oscillated between extensive team – expert designer interactions and an articulation of the organisation's values, perceptions, and strategic expectations with regards to the design approach. Consequently, project discovery wasn't limited to a process of familiarising the expert designer with the design approach and its history at the library. It also involved the team collectively and reflectively trying to articulate the project's intent and goals in the past and its vision for the future. For instance, the team and the expert designer collaboratively brainstormed questions/prompts such as *"What do we want to achieve with the program?"*, in the context of the library's broader goals and vision. One of the important and highlighted goals were: *Self-sustaining and continuously evolving methods. Core ideology of semi-structured exploration, participation, openness, appropriation, and improvisation should stay the same but should not be method/person dependent or specific.*

This and other responses from the initial series of discussions were compiled into a living document intended to act as a common reference point for future decision making and critique. This document also served as a point of departure for follow-up workshops that were used to collectively identify the *brand attributes*, which refer to the qualities that characterise a brand across its oscillating material and dematerialised outcomes, and *brand values*, that articulate the relevance of the brand for participants at a high-level (Newbery & Farnham, 2013, pp. 89–93). Together they represent the foundational elements or "DNA that can be used to guide the development of artefacts, behaviours, and qualities of experience" of a brand (Newbery & Farnham, 2013, p. 168). The expert designer used techniques such as the co-creation of a 'visual brief' to facilitate discussion that could organically lead to the definition of these brand elements. The visual brief situated the brand in relation to other known 'proximal' brands. Since we (the team) had experienced products and/or services provided by the 'proximal' brands, we could use that as a basis for articulating their brand attributes and values on an elemental level such as value, personality, experience, and presence. We placed the identified brand attributes and values between two axes — rational and emotional, and

tangible and intangible. Through further discussions, we translated the visual brief (and brand attributes) into a brand vision: “Driving force of UX in Nordic libraries”.

This phase of the project represented a tangible departure from the initial communication centric expectations (symbol) to a strategic outlook (thought) that went beyond consolidating and communicating design methods and tools to larger ambitions of being the ‘driving force of UX’ amongst regional libraries. This was also represented in the final set of values or beliefs that were articulated and refined during the initial process of project discovery (Figure 3).



CORE BELIEFS

We believe we have a new mindset to share with libraries

We believe we have something important to share that could change how libraries are seen. With the information landscape changing, UX can change librarians' focus from resources (current state) and to the needs of the patron (desired state).

We believe in sharing experiences and being introspective.

Methods are one thing. But sharing experiences puts those methods in context and the result will always be specific in nature.

We believe we have the know–how to affect the day of a librarian.

Limiting ourselves to just being contributors of methods will make us passive contributors to the library community. We believe in investing time and actively reflecting on how our work affects her day.

We believe in ‘always evolving’ more than the desired state.

We believe in always welcoming and listening to find better ways to reach the desired state.

We believe in the Nordic culture of creating, which is participative.

Nordic culture encourages everyone to participate for any creation to find its evolved identity. We believe that the best creation emerges only when we respect one another's skills, culture and perspectives.

Figure 3 (left) Visual brief, proximal brands, and brand attributes (right) Core beliefs. source: Frilux branding documents, visual design by the expert designer. Visual identities of proximal brands, © respective owners.

4.4 Phase 2: Between Articulated Thought and Symbolic Representation

Based on the identified brand values and attributes, the expert designer created a proposal for a brand name, PLUXO (Program for Library UX Opportunities). A *brand architecture*, that outlines the structure and relationship of the offered products or services with one another and to the brand’s strategy as a whole (Newbery & Farnham, 2013, pp. 89–93), was also proposed, using the name as the connective and defining element (see Figure 4). This proposal was received quite critically and highlighted gaps in the mutual understanding of the design approach between the team and the expert designer.

The team argued against framing the design approach as a ‘program’ for ‘opportunities’, since the team felt that it would indicate ‘a structured "X week" course that you take for skill building after graduation’ (excerpt from the feedback document). The emphasis on skill-based *teaching* over an open-ended, mutual learning *mind-set* was considered problematic as well because ‘we would not like to imply that we are here to teach others and certify, just share, initiate change and learn mutually’ (excerpt from the feedback document). Consequently, the name seemed to lack a participative and egalitarian ‘Nordic’ character. Interestingly, the approach was repeatedly framed as a ‘program’ in all the earlier branding tools and probes created by the expert designer (despite never being phrased as such by the team). It can indicate an initial conception of the approach based on the designer’s past experience, that may have implicitly influenced framing of the brand architecture. Through successive cycles of co-creation and deliberation, an important decision was made. The team realised that, in terms of its characteristics and attributes, the brand should

embody ‘the spirit of Nordic design’ and began exploring more descriptive articulations of ‘Nordic’ library brand values and attributes from Phase 1 further.

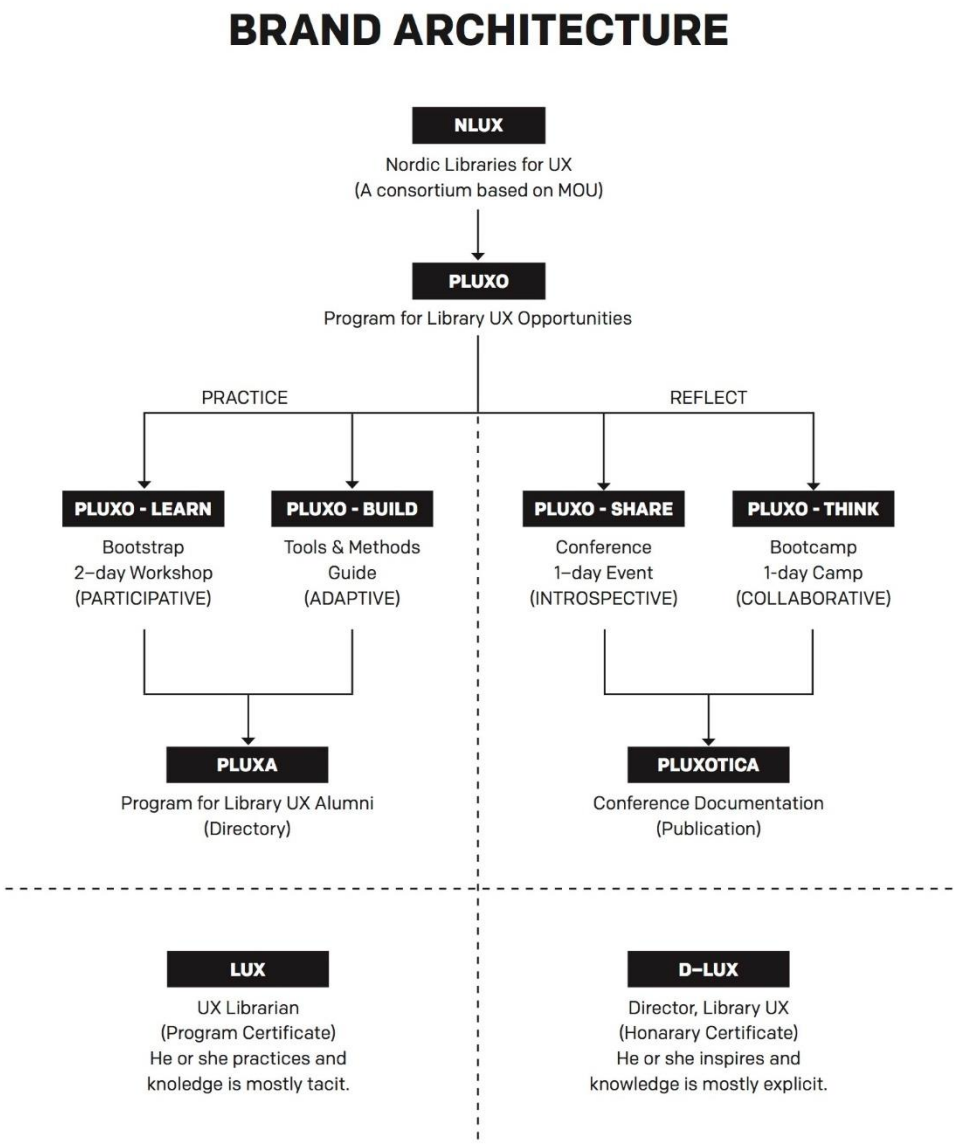


Figure 4 Initial design proposal for brand name (PLUXO) and architecture. source: Frilux branding documents, designed by the expert designer.

The finalised name, Frilux, represented an amalgamation of the Nordic values of *‘fri’* (free), adapted from ‘*friluft’* (free air, nature) and ‘*frilek’* (free play), with *‘Library UX’*. This was further bifurcated into the two central touchpoints in the brand architecture (Figure 5). The first was Flex, a platform for contextually learning and practicing design, and the second, Flo, a seminar for sharing experiences, mutual learning, and reflection related to design in libraries. The intended effect was to organically develop a *‘Frilux kultur’* (culture) and mind-set and eventually build a community or ‘network’ of libraries (NLUX) for sharing experiences and mutual learning. The architecture also situates the identified brand attributes that describe the cultural shift we were striving for with Frilux (Figure 5 – State/Mode/Change/Intent). The emphasis on culture, and a balance of practice and reflection (Figure 5) over programs, certifications, and opportunities (Figure 4), highlights the shift in understanding and framing from the earlier proposal.

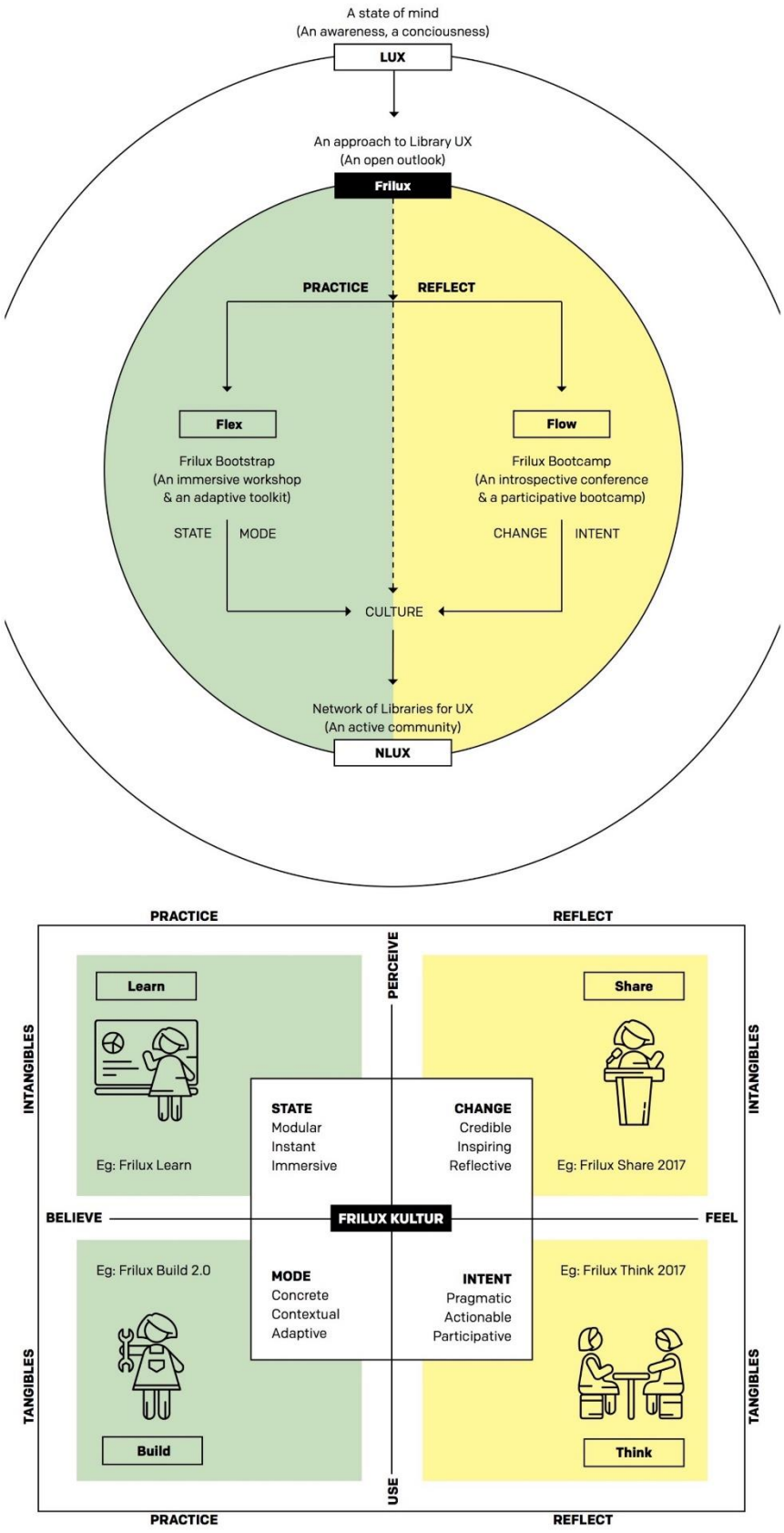


Figure 5 Final proposal for brand name (Frilux) and brand architecture, touchpoints. source: Frilux branding documents, designed by the expert designer.

The brand was further articulated in terms of its '*open*', '*participative*', and '*iterative*', values which were defined descriptively in collaboration with the team to represent an amalgamation of Nordic and the library's own values (Figure 6). It was visually represented with a minimal and flexible identity set in a locally designed typeface. The central visual element, an 'xircle', was conceived as a playful container that can be adapted and appropriated based on the context of use (Figure 7). A summative brand cheat sheet was also created (Figure 7), highlighting the rationale behind the identity, typeface and colours selected, along with showing potential kinds of use. The outcomes at the end of this phase denoted an oscillation between articulated thought – the strategic relevance of the design approach (Figure 6) and brand architecture and symbolic framing – visual identity and guidelines, situated in the context of the larger values and goals of the library.

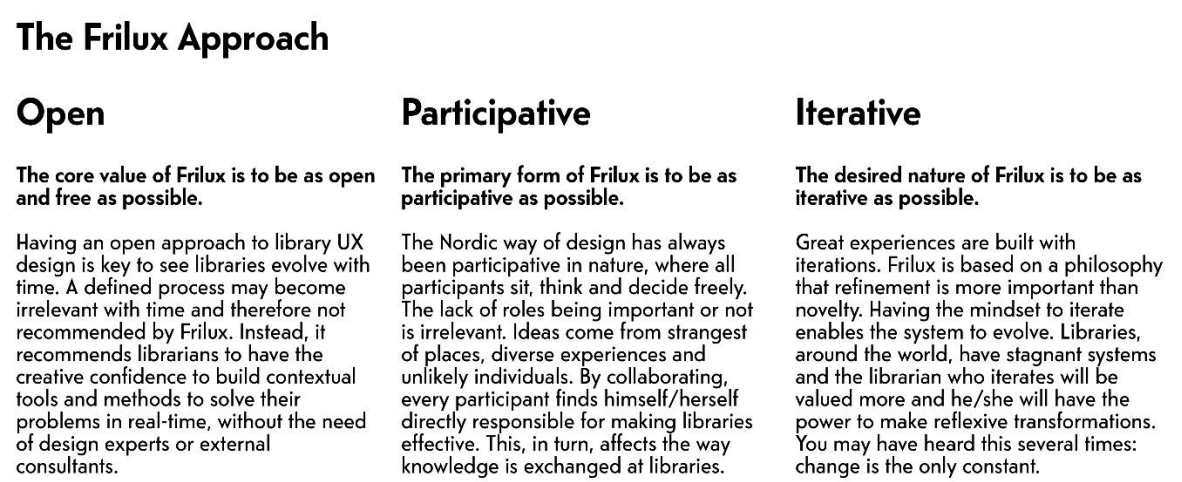


Figure 6 The Frilux Approach, brand values and description. Source: Frilux branding documents, visual design by the expert designer.

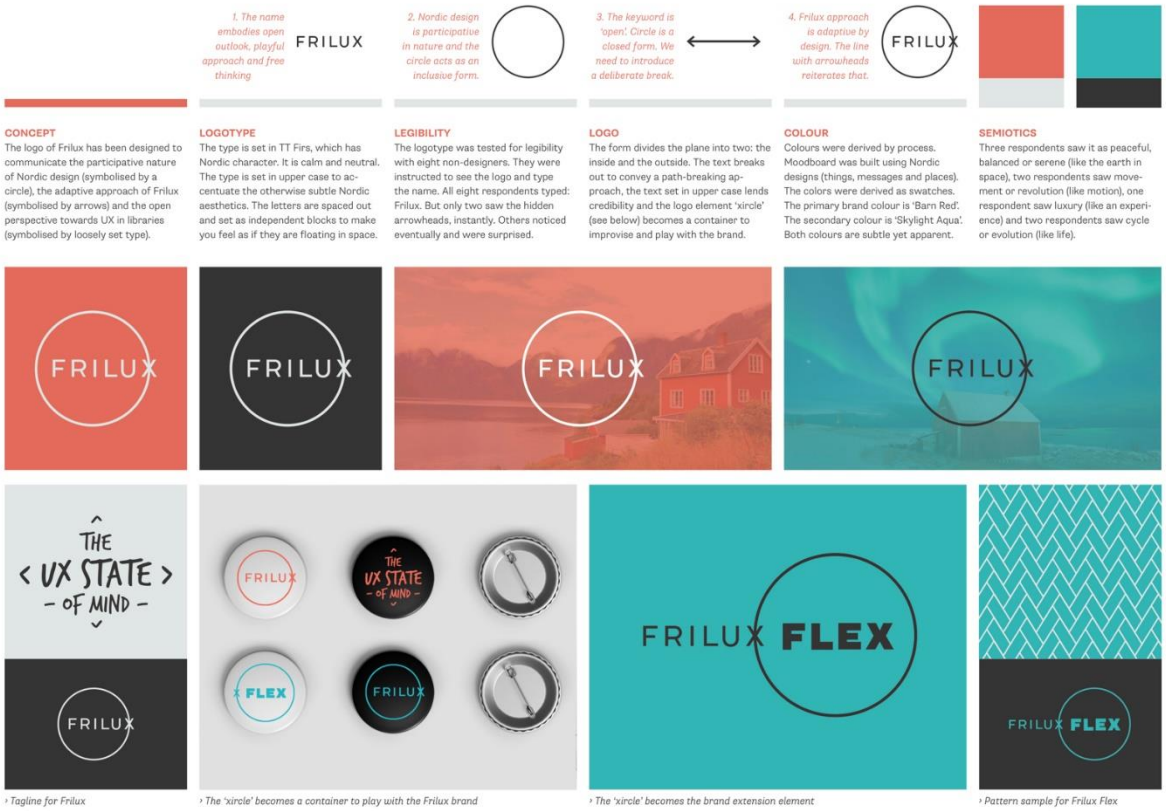


Figure 7 Frilux visual identity, reasoning and usage examples (brand cheat sheet). Source: Frilux branding documents, designed by the expert designer.

4.5 Phase 3: Between Planned Action and Translated Thought

The brand architecture served as a framework that guided the design of the brand's touchpoints – Flex, a platform to learn and practice design and Flo, a seminar for sharing experiences related to service design. Through a critical review of the design approach used in prior workshops, along with collaborative brainstorming sessions, the identified brand values of being open, participative, and iterative (Figure 6) were further fleshed out into guiding principles for disseminating the design approach (Table 1). These guidelines also highlight how the strategic framework could be engaged during the design of tangible outcomes. Based on these principles, a workbook format was conceptualised. A workbook format could be a concrete 'thing' that participants could use in workshops and projects. Moreover, such a format affords adaptability since it is designed to be written in, sketched on, and modified. Over the course of a project or workshop, the workbook could serve as a living record of learning, thought, and reflections. It would enable librarians to improvise, adapt, and personalise the methods, and consequently develop an understanding of the design approach in the context of their own practice (Pandey, 2015).

Table 1 Guiding principles for the Flexbook.

Principle	Definition
Adaptable	Keeping in mind the Frilux philosophy of being open, and not to limit or enforce a style of thinking. It is designed to be used both individually and in teams and across different projects.
Diverse	Frilux values participation and encourages seeing problems and solutions from as many vantage points as possible. Flexbook belongs to a world where homogeneity is far less valued than diversity.
Semi-structured	Encourages 'frilek', or free play, with the structure and methods. Participants are encouraged to modify or recreate the workbook based on the problem they are solving.
Modular	Considering the 'iterative' nature of Frilux, the Flexbook is designed as a platform that affords modification and change over time. Participants can make it their own by adding (and revising) notes, references, photographs, and/or mind-maps.

In addition, ideas related to a full day seminar for sharing experiences and issues related to designing services at libraries (Flo), were also discussed. The team conceptualised the seminar as a platform for exploring the design approach in the context of participants' practice, while also creating a space for discussing and deliberating over experiences with designing services. Rather than working with pre-formulated design briefs, the design approach would be introduced in the context of the issues and experiences shared by the participants. This would allow participants to personalise and adapt the workbook and potentially reflect on ways in which the approach could be integrated into their own practice. The outcomes from this phase highlight the oscillations emerging between planned forms of actions in the seminar and workbook and the translation of the strategic values into more concrete thought in the form of guiding principles.

4.6 Phase 4: Between Actions, Symbols and Things

The final phase of the project mainly involved the design and production of the workbook and the communication collateral for the Flo seminar. The workbook was intentionally designed in black and white to allow for ease of printing, copying, and production. Its content was collaboratively created and iterated over after some internal tests with librarians who were not a part of the team. In line with the design approach, the structure of the workbook was also kept 'semi-structured', with even pages left almost empty or with minimal markings for the participants to sketch, note, reflect, and build on their thoughts (Figure 8 – top). Posters, mugs, buttons, and bands were created for the Flo seminar. The material was kept open for modification and personalisation and represented a translation of the brand values into specific tangible and material outcomes (Figure 8).

Figure 8 Images from the Flo seminar showcasing the Flexbook and communication collateral in use. source: Author.

4.7 Reflection and Initial Effects

On the surface, Frilux resembles the iterative and exploratory structure of most design processes, with revisions and changes in design proposals through deliberation and feedback. However, when viewed closely, iterations and explorations in this case were indicative of deeper *entanglements* and dialogue between designerly thought and action and organisational perceptions and values. This led to design proposals existing as an *oscillating* spread within and across all four orders of design (Table 2, Figure 9). For the purposes of analysis and discussion, we articulate two very similarly worded but fundamentally different versions of the design brief, that reflect and summarise the changes in intent and the nature of outcomes over the course of the project, both for the expert designer and the team:

(Initial) How could we (the team) communicate the design approach in an understandable and non-academic way to libraries in the university and the Nordic region?

(Current) How could we (the library) frame design in an understandable and non-academic way for ourselves and libraries in the Nordic region?

While initially the design brief was focused on communication, dissemination, and generally looking outwards to '*libraries in the university and the Nordic region'*, it evolved into a reflective and introspective process of framing design for the team *and* local and Nordic academic research libraries. This introspective and reflective process helped frame and subsequently 'brand' the art of design strategically through a collaborative dialogue between design and organisational practices. However, it is important to note that with dialogue, we do not only refer to verbal and written discussions but also the dialogue between designed outcomes. Therefore, dialogue is akin to Schon's framing of design "as a reflective conversation with the materials of a design situation" (Schon,

1992). Designed outcomes, across all four orders, acted both as catalysts that provoked reflection (such as the discussions concerning brand architecture) and as points of convergence of thought and action between the expert designer and the library (like articulated brand values). In practice, Frilux has helped the library strategically frame their own 'brand' of design. However, the strategic frame is not just represented by the brand values and attributes, or the identity, or the workbook alone. Rather, the strategic thought (brand vision, values, and attributes), materialised through a simple and flexible symbol (visual identity), exploratory things (workbook and collateral), and participative actions (workshop and seminar), manifest design as a strategic art in terms of *"providing principles and strategic guidance for the use of the many specific methods and techniques that are employed in design"* (Junginger, 2016, p. 38) at the library (Figure 9).

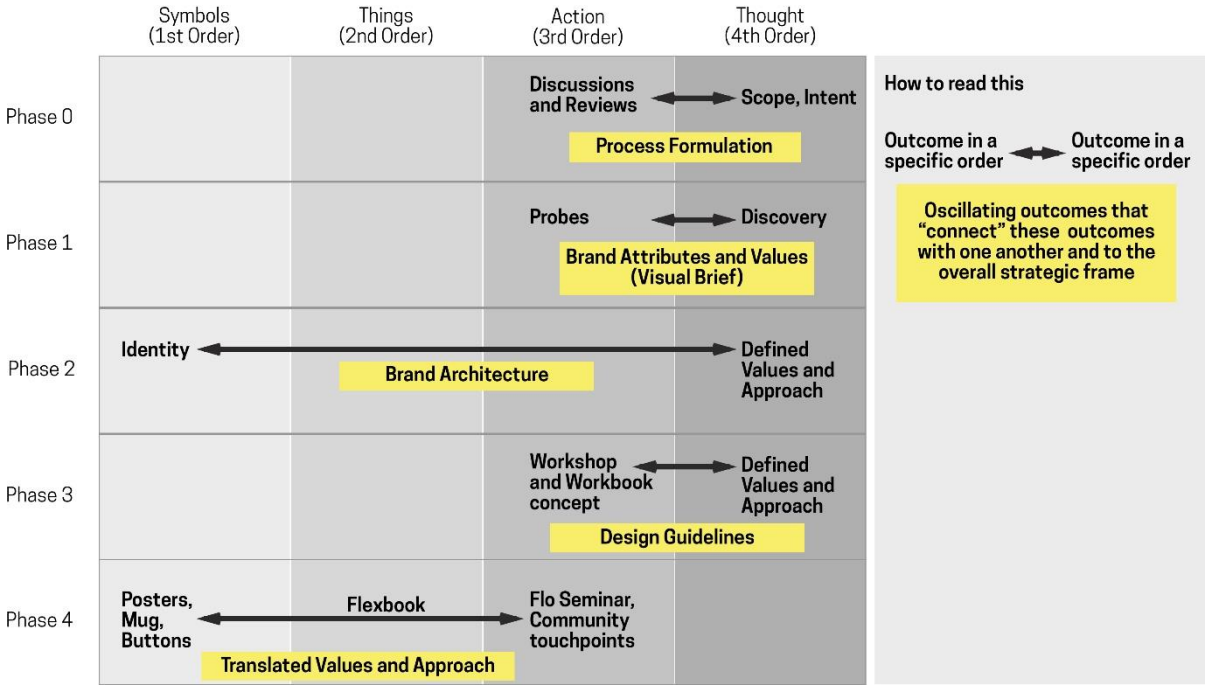


Figure 9 Project outcomes visualised across the project duration and the four orders of design. source: Author.

Table 2 Summarised project activities and outcomes.

Phases	Oscillations	Activities	Outcomes
Phase 0	Between thought and planned action	Discussions and reflection on past activities, deliberating over project intent and scope, Portfolio review	Expanded project scope from communication design (visual identity) to branding, Intent and Process formulation
Phase 1	Between (Inter)Action and (Articulated) Thought	Discussions, discovery, collaborative workshops for brainstorming, critique	Visual brief, Brand Attributes and values/beliefs
Phase 2	Between Articulated Thought and Symbolic Representation	Discussions, critique, refinement of design proposal and strategic goals, values	Brand name, architecture, attributes, visual identity, brand cheat sheet
Phase 3	Between Planned Action and Translated Thought	Discussions, discovery, collaborative workshops for brainstorming concepts	Frilux Flo format, Flexbook design guidelines, concept, and format
Phase 4	Between actions, symbols and things	Concept proposals, collaborative workshops for testing and refinement of concepts and content, soft launch of workbook and brand	Implemented Flexbook concepts and content, Frilux Flo communication collateral, Website, Social media channels

As a result, while still relatively new, Frilux is gradually becoming a part of the library's vocabulary and practice. Within the project team, Frilux is also transitioning into a verb – 'Friluxing', that is used synonymously with designing. Flex workshops have also been conducted by the team from the library without any assistance from the author or the expert designer and two Flo seminars have been conducted with plans of having one every 6 months. As one of the librarians put it, during an interview: "Suddenly, three weeks later, I'm teaching eco-system mapping to the law library, because by then I had done it twice myself. I have been Friluxing with the law library." In another interview, a participant pointed out that Frilux "gives more confidence in our abilities to talk about design and use it (design). I thought I could not meaningfully contribute in the UX forum in another group, but I realised their process is very similar even though the methods they use are different." Interestingly, the team also realises the dilemma between prioritising brand awareness and engaging librarians with the design approach. A project team member highlighted this, saying, "Do they (workshop/seminar participants) need to know that they're Friluxing or do they just need to Frilux?".

While these are initial examples based on specific instances of librarians' engagement with Frilux, they do highlight a shifting mind-set and understanding of design at the library. One of the leaders at the library commented about the shift from an expert-led to a librarian-led design approach in an interview, stating: "We were sort of the experts earlier (while conducting workshops). Now we have a lot of people from the science library and a few from the humanities, and if they build further on their issues and bring that into their local projects, then we could start to see an organic growth of the mind-set. It's difficult to say, 'You should do it.' But if someone just takes it on their own... then it's more powerful and it can have a more lasting effect."

5 Discussion

In this paper, we have identified parallels between calls for a strategic framing of the art of design (Junginger, 2016) and branding as a manifestation of strategy (Breslin, 2007; Newbery & Farnham, 2013) and articulated a reflexive account of a research through design process of a brand that represents a strategic framing for design at an academic research library. We critically engage with discussions on design culture and practice and correlate them with the discourse on design research for organisational change and innovation to make both conceptual and practice-oriented contributions to design research. Conceptually, we underline the potential of design cultures that entangle organisational values and perception with designerly practices and mind-set through collaborative and reflective dialogue. We also highlight the complex oscillating nature of the outcomes from this design space, indicating the mutual co-dependence of the four orders in a strategic framing of design in organisations. From a practice-oriented perspective, we present branding the strategic art of design as a plausible approach that can materialise a strategic framing of design across a range of design outcomes and situate it in the context of the larger organisational values while also allowing for adaptability and future growth. To be sure, we do not present branding as a universally applicable design solution for strategically framing and manifesting design within organisations. However, by reflexively highlighting conceptual themes such as entangling and oscillating in our process and outcomes, we attempt to 'add dimensionality' (Gaver, 2012) and expand the existing understanding of this design space. We conclude this paper by discussing some of these aspects further, in the light of the described process and outcomes.

5.1 Framing the art of design

Dorst (2011) argues that designerly approaches are adept at working with complex problems where the only 'known' is the value that needs to be created. Working backwards from an understanding of this value, designers abductively adopt or develop 'frames' that could potentially lead to proposals for 'what' (the thing to be designed) and 'how' to proceed with the problem. With Frilux, the strategic frame represented the design culture and perspectives, specific to the context we were situated in. Moreover, it was created from a continuous process of mutually exploring, deliberating, understanding, and learning, rather than being adopted and proposed by the designer alone. This is

reflected in the initial design proposals that framed the design approach as a 'program' for UX 'opportunities' and the subsequent framing of the strategy in terms of culture, practice, and mind-set. While on the surface, this may seem like an issue of semantic articulation, we argue that it reflects a deeper process of mutually evolving understandings and perceptions. By engaging and reflecting on a range of design proposals oscillating across the four orders, the organisational perception and vision were solidified and entangled with design practices and mind-set, helping frame the strategic art of design at the library. In Breslin's (2007) words, "Design, with a history of turning needs into products, has become a translator in search of an idea" (p. 44). However, with Frilux, design was simultaneously a translator of contextual values and vision, and was translated into a brand as a strategic art.

5.2 Branding the art of design

Branding helped materialise the design approach in terms of a strategic vision and situate it in the context of the larger organisational values of the library. However, branding as a process of enacting and manifesting design as a strategic art, required continuous and conjoined material and conceptual exploration. Newbery and Farnham (2013) argue, if the way a brand is manifested does not match up with its values and promise, it may compromise the strategy as a whole. Relying only on material outcomes without an overall strategic frame could have resulted in design being translated into a collection of techniques and not a mind-set. An oscillating set of outcomes, across the four orders, allow for a balance between strategy and values and concrete material outcomes. The brand architecture acted like a connective backbone that gave an overarching structure to different touchpoints, like the workshop and workbook (Flex), and the knowledge exchange seminar (Flo). Having a range of outcomes that work together coherently also allows design to be framed concurrently at the level of strategy and thought (Frilux), action (Friluxing), methods and artefacts (Flexbook), and symbol and identity (xircle).

5.3 Facilitating entanglements and dialogue

Working with a dialogic process with a strategic outlook and having an openness to transformation and change from the start, was also important to facilitate a productive entanglement of mind-sets and practices and allowed the brand attributes and values to emerge from the context. Reflective discussions and introspective explorations conducted early on in the process (Phase 0), helped establish a dialogic process. Further, it enabled the team to identify a larger and strategic goal, or in Dorst's (2011) terms, the 'value' we were designing for. Further, the author acted as a 'knowledge broker' (J. S. Brown & Duguid, 2001) in this project, and facilitated productive dialogue between the team and the expert designer. Being a design practitioner and having continuously engaged with the library since 2015, the author was a 'true participant' in both the communities and invested in the outcomes of the project (Pandey & Srivastava, 2016a). Brokers are important to facilitate, translate, co-ordinate and align perspectives between organisational communities (J. S. Brown & Duguid, 2001). Therefore, we argue that brokers can catalyse dialogic design processes while working with complex problems across diverse domains of practice. Further, they can play an important role in facilitating entangled design cultures. While it is not the focus of this article, this aspect can be explored in future practice and research.

Static and universal solutions are impractical considering the dynamic and transformational nature of this field of design research and practice. Therefore, rather than attempting to be conclusive, we have attempted to describe our work in terms that are 'provisional, contingent and aspirational' (Gaver, 2012) for future research and practice. We hope, by entangling theory with practice and oscillating between the material and conceptual, our work inspires new forms of exploration and action in the future.

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About the Author:

Sumit Pandey is a PhD fellow in Interaction Design at the University of Oslo. He is engaged in practice-based research focused on the design of artefacts, methods, and processes that lead to reflective and more open forms of engagement with emerging technologies.

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The Role(s) of Process Models in Design Practice

IVERSEN Søren[a]; KUNØ Mads[b] and VISTISEN Peter[c*]

[a] Spires United
[b] Creuna
[c] Aalborg University
* Corresponding author e-mail: vistisen@hum.aau.dk
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This paper investigates how design process models are implemented and used in design-driven organisations. The archetypical theoretical framing of process models, describe their primary role as guiding the design process, and assign roles and deliverables throughout the process. We hypothesise that the process models also take more communicative roles in practice, both in terms of creating an internal design rationale, as well as demystifying the black box of design thinking to external stakeholders. We investigate this hypothesis through an interview study of four major danish design-driven organisations, and analyse the different roles their archetypical process models take in their organisations. The main contribution is the identification of three, often overlapping roles, which design process models showed to assume in design-driven organisations: *process guidance, adding transparency in external communication*, and internally as a formal description of an *organization's design rationale*. We discuss how the mix of these three roles added together can support and catalyse how design-driven organisations define themselves, and position them in practice, as well as how the theoretical discourse of process literature might be re-catalysed by these very different roles observed in practice.

design process, process models, design thinking, design management

1 Introduction

The point of venture for this paper is an observed paradox in the practical application of design thinking - namely how design process models are implemented and used in design-driven companies and organisations. The role of process models are originally conceived and described as formalised workflow and practices, with the aim of assuring a re-usable and transparent road from A to B in a given process (e.g. Howard, Culley, & Dekonick 2008). Popularised in both management and systems development literature, the recent decades rise of design thinking and design-driven organisations, has created an increased interest in attempting to formalize the archetypical elements of the design process. Since then, multiple different structures, metaphors and rationales has been used to

describe the process of design - all serving as different ways of formalizing the key attributes from design thinking (Cross 2006).

Process models in design has enjoyed a relative success and both practice and academia with the amount of publications on the topic, as well as design-driven organisations explicitly stating a version of an archetypical model as 'their approach'. However, when put under further scrutiny, the practical application of process models does not always seem to follow the ideals of their theoretical foundations, and often seem to carry more than function depending on the situation in the design practice. This is evident both from case studies from design-driven companies, as well as in the different ways they externally communicate their process to stakeholders and design peers. The author's own experiences, from varying design practices, supports this observed pattern - varying from being internally guiding process, to communicating with clients, and further to act as a more abstract cultural guideline for how a specific design practice describes its vision for design.

Building upon this, we hypothesize that there is more to the theory and method of process models in design than meets the eye, and that process models carry a plurality of meanings besides their intended process guiding purpose. Building upon this hypothesis this paper explores the following broad research question: *What is the role of process models in design-driven organisations?* We pose this question to explore the relation between the different, and often ambivalent, roles process models take in different practices, and furthermore to provide a more nuanced perspective on the theory from which the most archetypical design process models are grounded.

To explore the research question, we have made an empirical study of representatives from design-driven organisations in Denmark, ranging from start-ups (20-40 employees) to large organisations (1000+ employees). The research setup is a mix of semi-structured interviews, and a workshop mapping both how the organisations visualize their process, as well as challenging which roles these process models take at different times in their practice.

2 Design thinking as the organizational driver

For the scope of our inquiry, we have chosen to focus on what we label as 'design-driven organisations'. This is to be understood through the umbrella term of 'Design Thinking', leveraging Brown's (2009) description on the use of the sensibility, and methods of designers, to match user needs, technology feasibility and business viability with each other. The recent decades spike in interest in the potential of Design Thinking is especially driven by the efforts to address how it can transform the decision-making processes of organisations (e.g. Martin & Dunne 2009), and spearhead innovation (Brown & Wyatt 2015, Verganti 2009). From traditionally being introduced as a latter step in product development, design thinking has propelled design into a broader adaptable mindset, which can be applied to both product development, customer service, as well as upper management. In 2015, Brown concluded that design thinking had succeeded in both making its way to the top of Forbes 500 companies, as well as being the dominant mindset behind the decades much heralded disruptive startups. As such, when we speak of design-driven organisation we speak of broad range of organisational structure and types, with the one common factor, that they apply design as a decisive mindset for their practice.

Based on this broad definition of design-driven organisations, it is necessary to narrow the scope and contextualize it to practice. The empirical research has been focused on gathering insights concerning the danish branch of design agencies, working with design on a strategic level in the development of digital solutions. In order to frame this specific field, we created a framework to act as a focal point for the empirical research. Based on information from the Central Business Register (CVR) and the Danish branch code system (virk.dk, 2017), the field of interest is defined as organizations with a commercial focus on design, in the sense of both design execution as well as on a more strategic level.

BRANCHE WITHIN DESIGN / PLACEMENT	COMMUNICATION DESIGN AND GRAPHIC DESIGN	INDUSTRIAL DESIGN AND PRODUCT DESIGN	COMPUTER PROGRAMMING	INTERIOR DESIGNERS	CONSULTANCY REGARDING INFORMATION TECHNOLOGY	ARTISTIC CREATION
IN-HOUSE	JYSKE BANK COMMUNICATIONS DEPARTMENT	Danfoss PRODUCTION DEPARTMENT	UNITY STUDIOS		ANONYMOUS CASE COMPANY UX DEPARTMENT IN PUBLIC IT	
DIGITAL AGENCY	KONXION	Designit	THINK		creuna	new creations
CONSULTANCY	grobowski	ideaal	NOVICELL		magnetix	

Figure 1: Mapping the different design-driven organisations considered for the empirical study.

As shown in figure 1, the framework consists of six specific branch areas divided into three organizational practices within the design industry. The study is constrained to organisations who have already adopted design as a decisive mindset for their practice. We argue this scope provides an optimal point of venture for studying the roles of process models i design, with fewer variables to consider, than had we investigated less design mature organisations. A broader organisational focus could have contributed with other, very relevant, perspectives on the role of process models in practice, however these perspectives would require further research into the specific organisations and their design practice, and were thus out of scope of this initiating study. The next section will briefly introduce the archetypical forms of process models, which can be identified across the field of the mapped design practice.

3 Process models in design

In order to identify different roles of process models in design-driven organisations a smaller systematic literature review has been conducted to clarify different theoretical foundations on which process models have been developed. From this we have identified a series of what we argue stands as 'archetypes' for many different manifestations of process models. One of such archetypal perspectives on process models is the linear perspective, which is often associated with the waterfall model as described by Royce (1970). This representation of a linear process resembles a waterfall in visualising a sequential relationship between the different stages of a process. Although the waterfall model is often used in order to describe a pure linear process it was developed as a means to show a process that is "*(...) risky and invites failure*" (Royce, 1970). Even though the linear rationale has since been much criticised (e.g. Buchanan 1992, Fallman 2003, Jonas 2007) for not reflecting practice, a degree of linearity is still often identified not only in engineering, but also in design-driven organisations process models.

As process models evolve and the need for visualising the iterative nature of design processes emerge, the representations of processes co-evolve accordingly. A classic occurring example of this is the so-called 'double diamond' (TBDC, 2007), showing the process as a continuous shift of convergence and divergence. A related archetype, which shows progression from linear convergence as well depicting divergence as the iterative part of the process, is the *Design funnel*, proposed by Pugh (1990). Through the design funnel the iterative aspect of a process is shown by visualising activities as alternating between either diverging or converging activities. The model can further be described as being *controlled-convergence* (Buxton, 2007). Controlled-convergence covers a process that essentially shows the overall convergent nature of the process but through integrated evaluating activities the iterative aspect of the model is shown. The overall nature of the model seems to be convergent where Pugh broke with the waterfall model by integrating divergent activities and thereby implementing an approach to process models less rigorous than the waterfall model. Another perspective on the nature of iterative moves in process models is presented by Gould & Lewis (1985), where it is stated that innovative solutions and designs demand time, development, and redefining. An iterative approach creates the possibility of redefining the problem space and thereby the possibility of specifying the solution space (Gould & Lewis, 1985).

In the direct opposite the linearity of the waterfall model we find the various depiction of the iterative process as a *Spiral model*, which in contrast clearly visualises iterations throughout a

continuous process (e.g. Boehm, 1988 and ISO, 2010). The spiral archetype is developed, like the waterfall model, to organise the development of larger product development. As seen in the visualisation of the model, the process undergoes several iterations where each step in an iteration builds upon the previous iteration and the included steps, again this serves as a representation of the co-evolving problem space and solution space. Other oft-quoted variations of this archetype is the ISO-9241-210 model of user-centered design, operating through the same basic metaphor and logic.

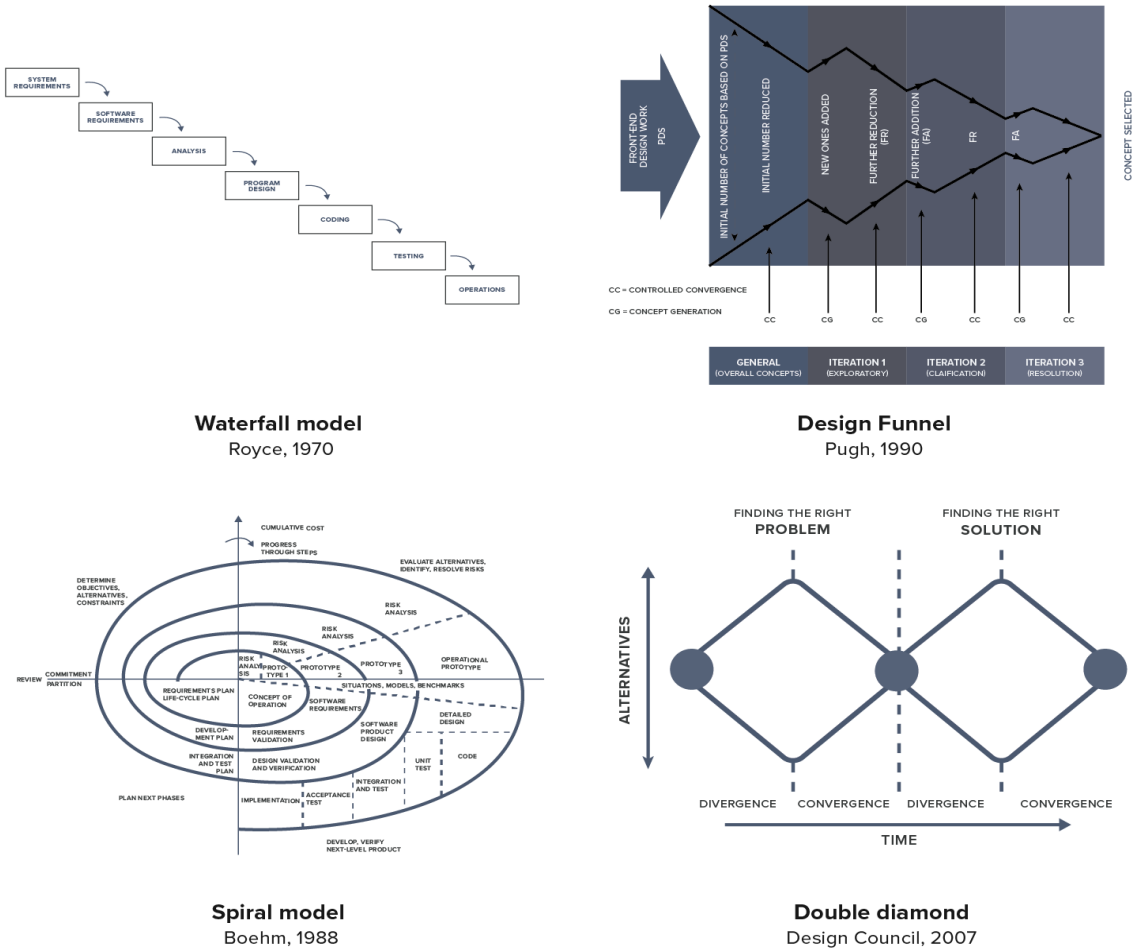

Figure 2: The four archetypical process model designs, which depicts the metaphors and logics of many related models.

When researching different perspectives of process models one thing, at least, seems to be in common whether it is the linear or the iterative models. They serve the purpose of visualising the road undertaken in getting from problem to solution in a structured way. In a similar way to this brief review Howard, Culley, & Dekonick (2008) have done a thorough review of different process models and have come up with six general stages on which design processes are commonly built. The six stages are; *Establishing a need, Analysis of task, Conceptual design, Embodiment design, Detailed design* and *Implementation*. We argue these six stages can all be identified in the four archetypical process model design we have listed in the above. The difference is thus not the individual parts, but how the sum of the parts describes different logics and rationales for, how the process of design should be organised. As such, the four archetypical process models represents an interesting point of venture for identifying, how these different logics come into play in different applied practices. To this end it becomes a critical factor both to identify whether the logics are

followed, but if the role of models in practice actually follow the rationale for why the models were created in the first place.

4 Data Collection

The scope of the review was a search for archetypes, which could be identified across a broad range of prior contributions in design research, inspired by the *systemic quantitative review* (Pickering & Byrne 2014) approach in which groups of related sources are gathered and organised to identify their 'common ground' (appendix 1). As such, the identified archetypes, are the result of identifying which original common ground many different variations of process models seem to originate from.

The empirical study was conducted as a series of semi-structured qualitative interviews, following the principles of Kvale & Brinkmann (2009) and Bryman (2016) of addressing the interview situations as getting a reflective introspection on the interviewees practice (appendix 2). In order to promote the articulation of more tacit and latent information Sanders & Stappers (2013), we devised an interview canvas (appendix 3), to guide the interview situation, in which the participants were asked to sketch out different aspects, such as organisational values, their interpretation of design thinking, and provide a visualisation of their process model.

The elective criteria, for which organisations to study, was to provide as broad a scope as possible - from small agencies to large departmentalised organisations with in-house design competencies. Furthermore, a criteria was also the maturity of the organisation - for how long had the organisation had a design-driven focus, or even existed at all? From these criteria, we invited design managers from the following organisations to participate in four interviews:

	ANONYMOUS CASE COMPANY UX DEPARTMENT IN PUBLIC IT	magnetix Linked by isobar	THINK	creuna
"ABOUT US"	We have a broard varity of services, such as; software, systems and infastructure, aswell as consultancy, operations and development. (Edited to anonymize)	We have stubbornly insisted on integrating a digital agency's focus on creating customer contact, with a direct marketing agency's focus on retaining it.	We are a team of designers and strategists who live, breathe and dream digital. Our approach is strategic, our tool is design.	Creuna is a customer experience agency. We have made it our mission to help you wow your customers with smooth and memorable online experiences.
SIZE CVR DATA	1000+ employees 3. QTR. 2016	100-199 employees 2. QTR. 2017	20-40 employees 2. QTR. 2016	50-99 employees 2. QTR. 2016
VALUE PROPOSITION	"IT infrastructure" "Everything under the UX hat"	"Dialog" "Insight-based intelligent solutions"	"Own the front end" "Digital products and services"	"Strategic customer experience bureau" "Born digital"
INTERVIEWEE	**Anonymized interviewee** (AI)	**Christina Rind** (CR) COO & Partner **Morten Kold** (MK) Creative Director	**Klaus Silberbauer** (KS) Creative Director & Founding partner	**Nicolai Borchorst** (NB) User Experience Lead

Figure 3: Sampled information, and interviewed stakeholder, from each studied design-driven organisation.

Each interview ranges from 1-2 hours, in which the participants gradually sketched out the canvases in response to the interview questions. In this regard, we consider both the canvases and the

transcribed interviews being triangulated data sources - qualitatively informing aspects of each other.

When seeking participants from a broad scope of criteria it naturally limits both the amount of included cases of each specific organisational setup, and includes some margin of error in regard to whether one of the setups are an anomaly or a fitting representative of the given practice. Thus, the scope of the data is to be considered as a pilot study, qualifying if there is merit to engage in more studies of the different roles design process models can take in design-driven organisations.

5 Analysis

This section will present the key themes and insights from the interview study with the four design companies. We present a descriptive analysis of how the companies frame their design process, and further how they elaborate and reflect upon the role their respective process models play in their practice. The analysis is categorised in a series of sub-themes, each given their own sub-heading to organise the section. The section summarises the insights into three distinctive roles design process models shows to take in practice; process guidance, internal design rationale, external stakeholder communication.

5.1 The need for a process model

When surveying the multiplicity of different process models in the industry, there is an industry tendency to lean upon one or more of the four archetypical process models described above. However, the majority of companies promote their own company specific adaption of the archetypical process models. This wide usage of company specific models have been raising the question of why and how these models are formed and implemented across the companies. The interviews give an indication that the implementation of internal processes is a result of company growth and a need for a common work culture:

> *"They [process models] were originally created, because we had grown too much for Martin and me to be able tell everyone how they should act. So they were made to create clarity and because we had grown too much to be properly aligned". (CR, Magnetix, 00:41:12).*

The companies implement formal processes and visualize these by designing process models, as a result of an internal growth and increasing staff numbers. These internal processes are designed as a way to insure a consistent way of work as well as contributing to a common work culture. In the quote, one of the founders of Magnetix describe how they found it necessary to create a consistent way of work, because the company had grown too much for them to be able to pass on the existing and non-described internal processes. This need for internal structure is a recurring theme among the interviewed companies. At the anonymized company, the largest of the involved companies, they are undergoing a continuous (re)construction of their process model which, as described by their Head of UX, is a result of streamlining and formalising the internal processes:

> *"... what we want with the process model is to ensure that people work more structured." (AI, Anonymous company, 00:38:25).*

At Think, the smallest of the companies, they are in the initial stages of the construction of their design process. One of the company partners describes the stage they are in, as in between informal and formal processes:

> *"It's also kind of a project model and the two things often get messed up together [...] we have basically been running it without a design process, letting the individual project guide the process, but now we have become a bit more structured and therefore we have recently introduced, or at least tried to become, a bit more formal about our design process, but it is still very informal." (KS, THINK, 00:56:09).*

The company is in the process of implementing more formal processes and is utilizing the process models as a tool and a guide for structuring their process, for thereby to clean up their current approach or lack of the same. This unstructured way of working has some very specific side effects, affecting the company's overall development process in a negative way, causing them to repeatedly make the same mistakes:

> *"We could really get better at it [structuring the processes], sometimes we are a bit too Laissez Faire and a little too custom made, trying to reinvent the wheel all over again." (KS, THINK, 01:16:24).*

As made clear, the companies implement more formal process models, as a result of growth and in need of more structured internal ways of work. It is also clear that the companies draw on different process archetypes approaches in solving these structural issues. It is one thing to accept the need for a more structured approach and acting accordingly, and to actually implement a process across the company. This can be difficult for companies working from a Design Thinking approach. This calls for a process model which is structured enough to firmly guide the process, creating a strong way of work, but still provide openness and transparency, making room for human intuition and agility. But process models and strict ways of work can also be a limiting factor, creating boundaries too firm which limits the creativity and the participating employees. In these cases, the structuring and internal processes have been too dominating, leaving the companies paralysed within themselves. As detailed by THINK:

> *"We are becoming increasingly sceptical concerning the types of project models, which claims that they can do everything [...] It quickly ends up in a Prince2 kind of thing, where you have to take every potential outcome into consideration. And where you sort of try to remove the human aspect and the intuition from the equation. [...] The problem is that you rarely know what to make and then all the models fall apart." (KS, THINK, 01:00:07).*

The companies want structure and guidance, but do not want to compromise their agility and possibly removing the human aspect in doing so. They seek a common middle ground between structure and openness, by which they seek to utilize different models as a basis for creating their own. This is an indication that more theoretical described approaches, mentioned in this article as the archetypical models, are not directly compatible in the company's everyday practice:

> *"...it's true that the first part is mostly 'waterfall', and we do that part in minor stages because otherwise we will never get to this point [implementation]. There are some things that need to be done in that way, because we cannot continue to reconsider the objectives, as well that we cannot continue to reconsider the platform selections. So, therefore, this part, quite right, becomes very waterfall'ish." (CR, Magnetix, 00:55:10).*

We here see a hint of how both linear and circular processes structures not just the process, but also inform the culture of the company on more abstract level. They are creating a work culture where the initial phases of the process are strongly structured, inspired by the Waterfall model, whereas the latter phases are more iterative and agile. This is, for the company, a necessary approach because they, pressured by upcoming deadlines and external factors, need to move forward in order to reach implementation and thereby the more iterative stages. This method has been used in spite of the recognition of other more suitable approaches, as described by the company COO "[...] *There are some things that need to be done in that way*." (CR, Magnetix, 00:55:10). This need for building upon the theoretical methods, for thereby to modify and adapt them to their current practice, is for Magnetix a way of coping with the more external factors. By modifying the theoretical approaches, they seek a way to push projects forwards towards the externally specified deadline, without compromising their own way of work. The theory describing the iterative approaches to the design process, is not providing the companies with a specific answer to when or how to end the process. In practice the companies are experiencing a process, that is strongly framed by their client's deadlines

and other external factors. Therefore the companies combine linear and iterative approaches in different stages of the process, to ensure progression - internally pushing the project forward and externally visualizing and documenting the actual progression of the process.

This need for building upon the more established archetypes, for thereby to modify and adapt them to their current practice, is also described by the UX-lead at Creuna, by exemplifying how they roughly use the Double Diamond model as their way of working..

> *"... what we really do is, roughly speaking, in ... I'm sure you know about Double Diamond - converging and diverging. That's basically what we do." (NB, Creuna, 00:45:45).*

This way of redesigning the theoretical frameworks known from academica, is an approach used by all involved companies. As illustrated in the visualizations beneath, all companies draw on several different theoretical archetypes in their process model. As it shows the companies all seek inspiration or simply guidance in several different theoretical frameworks, when designing their own. This indicates that the existing process models as described in the academic literature are not directly transferable to the company's' actual practice. This underlines the article's initial assumption, of a gap between theory and practice, concerning the usage of design process models, in the field of design-driven companies.

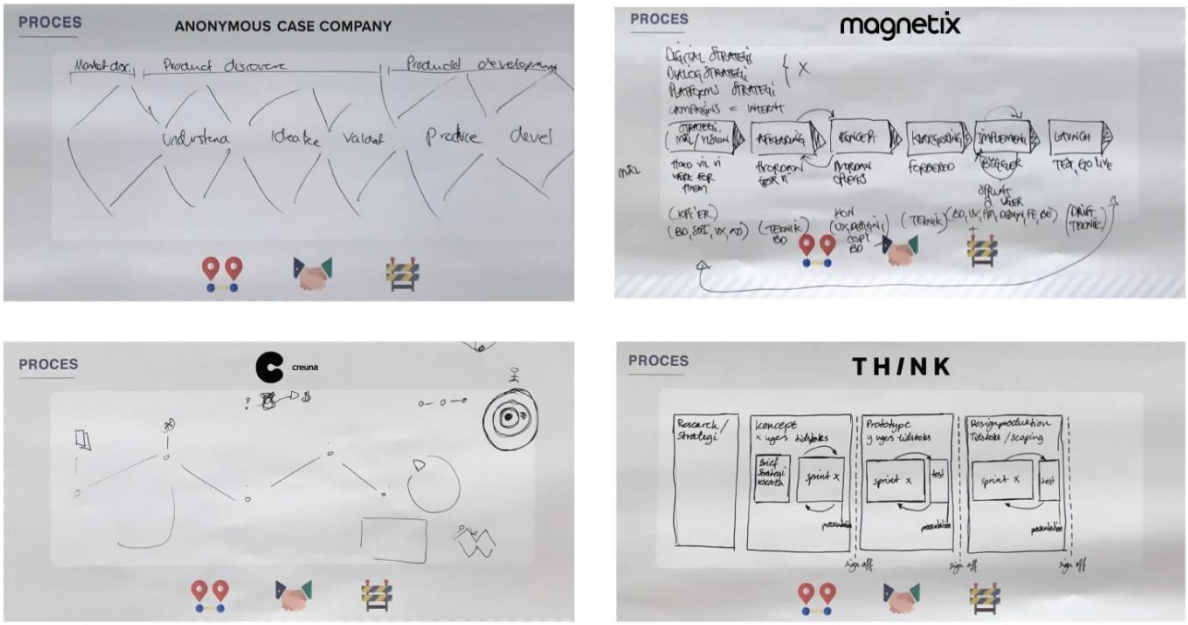

Figure 4: The four sketches made by the interviewed organisations of their process models.

5.2 Internal and external models

Another theme throughout the interviews is the two-sided purpose, internal and external, of the process models. One of the organisations have developed their process model, primarily, for internal use and argue they would have to create a simplified version in order to use it externally. As the following quote states, the external purpose of the process model is a secondary priority for the company.

> *"... to make a simplified version we can use externally, but then again, we have agreed that this is actually a secondary objective" (AI, Anonymous company, 00;41;24).*

Stating that the process model has a secondary purpose makes it clear that a process model can be used in different contexts and with different purposes. The quote also shows that within the given company there is a difference between a process model with an internal focus opposed to a model aimed at external use. An internally aimed model has a higher complexity and must be simplified in

order to be used externally. The complexity of the internal models is substantiated when the same company explains how different stages of their process model is followed by a "checklist" of potential activities for each stage;

> *"This is where it starts to show why it is a tool, because here we have some of these… Some sort of checklist. What do we need to know at this stage?" (AI, Anonymous company, 00:46:25).*

Thus, the internally aimed model is supported by a list which assists the company in the different stages throughout their process.

Another perspective is the case in which the process models are flexible in nature. Multiple instances in the interviews show how the team in collaboration with the client discuss how the process should be structured and how different tools are chosen based on the desired outcome of the process:

> *"...then we'll discuss back and forth and coordinate and develop some sort of process that we… And try to convince them [the client] to go in our direction, what we think is a good process to structure the tasks. It isn't always successful." (NB, Creuna, 00;27;48).*

> *"What is the right tool for this process, and then we'll choose based on what we what to gain from the process" (NB, Creuna, 00;29;39).*

It is also shown how the process and discussion about the process isn't always successful and how the discussion is influenced by the desired outcome. This indicates that the company is working with different processes or at least different elements that are put together in order to combine a suitable process for a given project and client. By working with a process model in this way the company underlines the need of an external orientation in their process model. The company use their model in collaboration with their clients as an external communication tool as well as process guidance. This points back to the aforementioned perspective on how process models, which do not take the human aspect, intuition, and knowledge of what you are designing, into account often fall apart.

These perspectives give merit to the claim, that the needed level of flexibility in the different process models indicate that process model have multiple purposes, beyond just formally guiding the process. A process model can't be used in internal or external contexts without some level of context adaptation.

5.3 Design and creativity

This final part of the analysis serves to show how the organisations put their process models to play as tools for external communication as well as guiding the process and serving as an internal design rationale.

The organisations all agree on design thinking as a foundation for their activities but they utilize different theoretical perspectives to catalyse their design practice. As well as the organisations have different perspectives on design thinking, they are also met with different definitions from collaborators and clients. As shown through the following quote one of the organisations are often contacted much later in the design process than they would prefer.

> *"Yes, and what mostly happens is that the first couple of times people call us, then they have called us in the 11th hour and asked for some design or usability test. And then I'll respond "of course, sure we'll help you but you have to be aware of what you are actually asking me, is to put makeup on a dead pig." [...] So can we agree that we'll help you with this and next time you'll call us a bit earlier in the process, because for the same amount of money we can actually provide so much more value to the project." (AI, Anonymous company, 00:20:31).*

By often being involved later in the process than they prefer, the organisation must explain their competencies externally. The need for this external orientation in a process model can be seen as result of the missing alignment between the differences in definition of design in the organisations and with their clients and collaborators. These different definitions underline some of the challenges the organisations must overcome when creating their process models, because the models do not only have to take the organisations views into account but also the contradicting views of their clients and collaborators.

Even though the organisations are met with different definitions they also seem to identify a change in definitions they meet. This change and the growing alignment is experienced with both clients and amongst other organisations within the same line of business. One of the organisations have started to submit designs to various award shows recently and only because the submissions are being judged based on complexity over pure visual qualities. This shift in criteria can serve as an indicator showing how design as more than visual design is gaining traction with both clients and collaborators.

One organisation emphasizes how they contribute to changing the mindset of the people they interact with as a means to push the different understandings and definitions of design.

> *"I usually say that our primary task is to change the minds of people. Because when we meet people for the first time who have never worked with us before then working with us should make them never go back to their prior ways of doing things." (AI, Anonymous company, 00:36:41).*

This quote underlines how the organisation is trying to help the change in mindset along by focusing on the minds of the people they work with. By doing so the organisation may encounter certain needs with regards to their process model, because the model needs to portray the organisational process for internal and external users alike. And by encountering these certain needs during a process that involves clients and collaborators, the organisations experience a need for process models which also serve as external communication tools. By having a process model, which ensures that an organisation's definition of design is clarified, they have a tool that can help the organisation reach the desired level of alignment with their clients and collaborators.

6 Discussion

Through the analysis we saw how the four involved organisations experience different purposes for their process models as tools for guiding their processes, external communication, and as manifestation of the organisation's internal design rationale. This underline one of the initial claims made in the introduction where we stated experienced differences in the theoretical foundation for the process models opposed to their practical application within four different design-driven organisations. The practical application of a process model can, based on this study, be oriented in three different orientations; process guidance, external communication, and internal design rationale.

As process guidance the process models are often used to ensure that a given project goes from A to B in the desired way. The organisations experience a need for this process guidance when growing in size and thereby becoming too big to ensure the same level of quality across the entire organisation and across their different projects. As a result, the organisations formalize their processes and thereby they secure a certain quality level in their design practice. As such, the process models are practiced as they are preached theoretically so to speak. However, it is also evident, that all the interviewed organisations claim that the process is more of a guide, than strict doctrine to follow step by step. Investigating less design-driven organisations, and from entirely other fields of business, could further nuance the reasons for implementing design process models in an organisation. From our study it could be hypothesised that implementing design processes in non-design organisations would be used as an internal communication device to clarify the benefit of

design throughout the organisation. Introducing a design practice into a non-design focused organisations entails a foundation for explaining and justifying the involvement of design on higher organisational levels.

With regards to process models as an external communication tool, the organisations are met with differing definitions of design from all external factors. To accommodate these varying definitions and needs, the organisations experience a need to explain their competencies and internal definitions to all external stakeholders in a process. To accommodate this the organisations, create process models which take the different external factors into account. They incorporate some level of scalability into their models in order to be able to scale their process model according to the varying needs they are met with. This scalability empowers the organisations to scale their process in compliance with any given stakeholder. At the same time the need for scalability comes with a cost, which is a smaller level of detail in their respective models. We saw one organisation explicitly stating that if they were to show their model to external stakeholders, it would require them to create their process model in a simplified version for external use. This observation underlines the point made through the previous review, where the common understanding of design has matured. The organisations' experienced needs regarding external use of process models exemplifies how design thinking still needs further maturing to be fully transferable to stakeholders outside the design practice. Until this maturity has reached the desired levels, rendering the translation of design obsolete, design practitioners face a challenge in translating design to stakeholders and the scalability of a process model can be seen as a step in the translation process. Thus, through the role as external communication tools, process models act as way to de-mystify the 'black box' of the design process, providing an ethos for how design thinking can provide value for the given stakeholder.

The external stakeholders prompt the design-driven organisations to align their internal design practice. In the interviewed organisations, this is practiced by increasing the complexity of the process models, and by doing so, the organisations are able to align the internal definitions required throughout the entire process. This dilemma result in a need for the organisations to be required to explain their internal competencies to external stakeholders. Thus, by having their internal process thoroughly described they are able to account for different scenarios and explain how their competencies can be of use in the specific scenario of a given design situation.

By articulating the different purposes a process model can have, an organisation is able to frame their process model accordingly. If the purpose in a given context of use is to externally explain a company's process then scalability is more important than complexity. Because if the company can make their process model "fit" with the requirements of a stakeholder then they are able to align their definitions, and the stakeholder might be able to better see a convergence between their own definitions and the definitions of the design-driven organisation. In the same way an organisation is able to ensure that their competencies are articulated in the same manner across the organisation, when focusing on their process model in an internal perspective. When organisations are able to clearly articulate their internal competencies through their process models they are also able to utilize this articulation as an external representation of the organisation culture. By doing so an organisation can utilize their internal efforts externally. By increasing the complexity in this context an organisation is able to take many different contexts of use into account and thereby embracing the different needs they experience in their design practice.

7 Conclusion

The main point made through this article is that design-driven organisations can benefit from articulating the purpose of their specific use of archetypical process models of design. Process models can be aimed at several different purposes and undertake a multitude of roles. Through the article we have identified three main roles that process models take in practice; process guidance, External communication, and internal design rationale.

We argue that design-driven organisations need to be aware of the desired context of use concerning their process model, and when the role changes from e.g. process guidance towards demystifying the black box of the process to external stakeholders. Through this awareness the organisations should be able to focus their process model accordingly. Through the analysis it was stated how the different design-driven organisations, implicitly, focus on different characteristics with their design practice through their process model.

One common thing seen throughout the article and the different involved organisations is that scalability seems to be very important with regards to developing a process model. For more obvious reasons the ability to scale a process model is beneficial for an organisation when focusing on process guidance. If a model is scalable the organisation is able to use their model in varying projects with different stakeholders.

In the context of an external communication tool, scalability is an essential quality in an organisations process model because a scalable model is more versatile in nature. By being versatile the model can be applied to different contexts and with different stakeholders. This is crucial for the organisations by the fact that they encounter many different stakeholders with very different understandings and definitions of design. These organisations utilize their process models as a tool to help them translate their design practice towards different stakeholders. This feeds into the discussion of how the results of this study could potentially be valuable beyond design-driven organisations. The examination of the roles of design process models could be sculpted to investigate other organisational types, and look for both differences and similarities in their practice use across multiple organisational types and stakeholder setups. This broader application of theoretical perspectives in practice could also potentially help organisations outside of the design domain see the value of design thinking.

Regarding process models as an internal design rationale, the organisations experience a need for articulating internal processes and specific design activities. This need again can be met by incorporating scalability into the internally aimed process models. The initial need for an internal model often emerge when the organisation experience growth in size and thereby experience a need for internal alignment. If an organisation develops a process model that is scalable then the organisation is able to scale their model according to the growth the will experience.

In summary, for a design-driven organisation to be able to clearly encompass the different contexts of use, they can benefit from articulating their process model according to the specific context of use - process guidance, internal design rationale, or external communication tool. In this regard, we conclude on the principle that practice without theory is blind, but theory without practice is likewise without much value. Thus, we argue that there is a need to re-examine how theory dictates the role of the process models in design, and for design-driven organisations to catalyse their practice through this extended theoretical scope of the different roles of process models.

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Appendices

Appendix 1:
Systematic quantitative review, Retrieved 8. November 2017, from https://www.dropbox.com/sh/47zu0tcnc8s9xtt/AADjw2lxOtKYIdvW3BmuY_D1a?dl=0

Appendix 2: Interview transcriptions, Retrieved 8. November 2017, from https://www.dropbox.com/sh/ofmrmwu97gbmwbl/AADVGmzeVT5dKYK9Aw0YI5ZXa?dl=0

Appendix 3: Interview canvas, Retrieved 8. November 2017, from https://www.dropbox.com/sh/9bglc5wg7821izo/AAB9BqnALh5t77thYQy9ywjCa?dl=0

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Perspective: the gist of public tender for service design

PARK-LEE Seungho* and PERSON Oscar

Aalto University
* Corresponding author e-mail: seungho.p.lee@gmail.com
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Governments around the world are increasingly formalising design as an innovative approach to renew public services. In this development, the capabilities of external service design consultancies often play an important part, which calls for new insights into how public organisations procure the expertise of consultancies and what contributions designers can make to public-sector organisations. In unravelling such insights, we review preliminary data from an ongoing case study of service design procurement practices in Finland. Our initial findings suggest that the types of work service design consultancies carry out for public-sector clients are dictated in part by the requirements set in different procurement practices. Through reviewing real-life cases against the backdrop of extant literature in design, we discern three emergent challenges in existing procurement practices and present opportunities for future research. The implications are relevant for practitioners in design consultancies and public organisations alike in identifying new practices for service design.

briefing; design procurement; public sector; service design

1 Introduction

Design is increasingly recognised as a way to drive change in public organisations, improving public service provision and policymaking. For example, several innovation teams have been set up, employing design as one of their core capabilities (e.g., Kimbell, 2015, p. 3). As an early indication of this development, these include MindLab under the Danish government, the Strategic Design Unit (also known as "Helsinki Design Lab") at the Finnish Innovation Fund (Sitra), Government Digital Service and Policy Lab and Policy Lab under the Cabinet of the United Kingdom.

With this emergent phenomenon, however, the capacity to execute service design projects within public organizations is not always in pair with the growing demand. Consequently, the expertise of external design consultancies plays a significant part in furthering the use of service design in many public-sector organisations around the world. In Finland, the public discussion on the importance of service design in renewing public services intensified with the World Design Capital Helsinki in 2012. Along with the initiatives that integrated designers into the government (e.g., Aalto, 2012; Bennes, 2017), a large number of public service design projects involving external consultancies have been

initiated, and the number is projected to grow in the coming years (e.g., Boman-Björkell, Korva, & Nieminen, 2016, p. 6). Examples of such service design projects includes a new online service for residence permit applications ("The Finnish Immigration Service" 2015), a participation game to transform the city of Helsinki into a more citizen-centric organisation ("City services," 2017) and a ministerial programme to foster new ways of working in the public sector, including service design ("Digikuntakokeilu," 2016).

Given the dependency on external consultancies in the aforementioned developments, it is vital to understand how public-sector organizations go about in procuring service design, and how that impacts the possibilities for designers to instigate change in such organizations. In reviewing initial data from an ongoing case study, we discuss how public procurement functions as "design before the design" (Bernsen, 1996, p. 3) in setting the boundaries of service design projects. We elaborate on public procurement as an important domain of service design research, and its implications for integrating design knowledge and capabilities into the public-sector.

Below, we briefly outline how we go about studying briefing and public procurement practices from the perspectives of a Finnish service design consultancy and the public entities it strives to serve. We then continue to introduce the context of public procurement in Finland and outline three distinct cases from our on-going case study. Next, we explore possible benefits and pitfalls of the outlined processes in each case against extant literature in design. We also discern how the challenges in employing external design expertise in the public-sector mirror similar challenges in the private sector, while recognising the distinct contextual peculiarities that are inherent in public-sector for design. Our discussion invites a renewed interest on past lessons in design and charts new territories for future research in service design for public-sector.

2 Method

The ongoing expansion of service design presents challenges for scholars in delineating the scope of their inquiries (e.g., Ritchie, Lewis, & Elam, 2003). As the extent and boundaries of service design remains open to interpretation, what represents and constitutes the work of professional service design consultants remains ambiguous in many ways. The field is also quickly expanding to various directions in literature (e.g., Baek, Kim, Pahk, & Manzini, 2017; Costa, Patrício, Morelli, & Magee, 2017; Hyvärinen, Lee, & Mattelmäki, 2015; Junginger & Sangiorgi, 2009; Kimbell, 2012; Pirinen, 2016; Polaine, Løvlie, & Reason, 2013; B. Reason, Løvlie, & Flu, 2016; Secomandi & Snelders, 2011; Stickdorn & Schneider, 2010; Yu & Sangiorgi, 2017). The situation is further complicated by the fact that established design consultancies – with expertise in other sub-fields of design (such as digital interaction design, industrial design and spatial design) – are increasingly offering service design as a part of their offerings. As a result, the definition and (perceived) usefulness of service design vary depending on the application area and/or the tradition researchers and design practitioners subscribe to (e.g., Kimbell, 2011a, pp. 45–46).

As a response to these challenges, we selectively approach public procurement cases on service design through a single service design consultancy – referred to as the Consultancy hereinafter. We use the work pursued by the Consultancy to demarcate the extent and scope of service design and in purposefully sampling relevant cases on service design in the public sector for our study. The first author sat in the Consultancy few days a week from April to December in 2017: observing the daily work of the designers at the Consultancy; participating in weekly meetings; internal seminars; and interviewing the employees and public-sector clients of the Consultancy.

In probing into public procurements of service design consulting work in Finland, the Consultancy is relevant for a number of reasons. The Consultancy started out as a spatial design consultancy in early 2000's providing designs for exhibitions and commercial spaces. In 2011, the Consultancy purposefully set out to redefine itself by including service design as the core component of its offering. This decision coincided with broader service design developments in Finland during the World Design Capital year. Since then, the Consultancy has actively aimed to become one of the

leaders in service design consulting in Europe; carrying out a large number of projects and receiving several national and international design awards. Today, the Consultancy host a multinational staff of less than 100 employees and have offices in few European cities. Pursuing a holistic view on service design, the Consultancy is positioning itself as a consultancy specialised in identifying opportunities and strategies from user insight for its clients rather than implementing technical solutions.

In exploring the practices of the Consultancy, we have been collecting both generated and naturally occurring data to understand the everyday activities and challenges of the Consultancy and how public procurement processes are organized and impact the work of designers in practice. Generated data include field notes and semi-structured interviews with the employees of the Consultancy. We have also interviewed public sector employees involved in the procurement cases we followed in order to understand why and how each procurement case was organised. Finally, we have performed ancillary interviews and email communications with civil servants and a number of lawyers specialising in public procurement to understand the broader context of public procurement in Finland. The naturally occurring data cover publicly available documents from various government websites and archives, including regulations, public tender notifications, decision documents, as well as offer documents collected from the Consultancy.

For the purposes of this paper, we review some of the initial data to explore the roles public procurement can play in effectively utilising the expertise of service design consultancies and in building service design capabilities in public-sector organisations (see Table 1). Through three select procurement cases, we exemplify different paths public procurement can take in terms of the client organisation, budgetary scope and specific reasoning for procuring external service design expertise. The procurement cases display similarities in their foci on understanding people's needs and how this information can serve different organisations.

Table 1 Data corpus of the ongoing case study (as of November 2017)

Type	Content
Interviews and email communications	– Interviews with the Consultancy employees – Interviews with civil servants – Ancillary interview a leader of an internal innovation team in a government agency – Ancillary interview with a service designer of an internal innovation team in a government agency – Ancillary interview with a civil servant, design advocate at a municipality – Ancillary interview with an external lawyer specialised in public procurement – Ancillary email communications with two internal lawyers in public-sector organisations specialised in public procurement
Procurement documents	– Invitation to tender document – Public procurement notification document – Question and answer document – Decision document – Explanation for decision
Legal document	– Act on Public Procurement and Concession Contracts (In Finnish: *Laki julkisista hankinnoista ja käyttöoikeussopimuksista*, 2016) – General Terms of Public Procurement in Service Contracts

3 Public procurement in Finland and its implications on service design

In Finland, public procurement of service design expertise is governed by *the Act on Public Procurement and Concession Contracts 1397/2016* – referred to as the Act hereinafter. For the purpose of this paper, we use the English translation of the Act by Finland's Ministry of Economic Affairs and Employment adhering to the opinion of a legal expert interviewed for this study. The Act applies to any procurement item from cleaning services to construction work, except some special

sectors, such as water, energy, transport and postal services (1398/2016) and public transportation (869/2009). All public entities are bound to follow the Act in their procurements, including authorities of central and local government, churches and, state commercial institutions (Part I, Chapter 1, Section 5, *The Act*, 2016).

The Act allows public-sector organisation to customise their procurement processes, as long as the process is transparent to all participants and tenderers are treated "in an equitable and non-discriminatory manner" (Section 3, *The Act*, 2016). The contracting entity may conduct "Market Consultation" (markkinakartoitus in Finnish) with suppliers, independent specialists, and/or other public authorities to prepare for procurements (Chapter 9, *The Act*, 2016). Further, the Act details various procurement procedures that can be customised for specific purpose including procedures for open procurement, restricted procurement, negotiated procurement, and so forth.

Despite the flexibility allowed in the Act, the procurement cases we are following in our case study do not vary much in terms of the procurement value, the steps and selection criteria and the degree of communication. We have also seen a number of instances in which the contracting entity have restricted the communication with suppliers (i.e. service design consultancies) before or during the procurement processes, e.g., avoiding face-to-face interaction.

3.1 Threshold values and their implications

Public procurements in Finland follow different rules depending of the value of a project (Figure 1). For instance, the Act does not apply to procurements whose value fall below the national threshold of 60 thousand Euros. When the procurement value exceeds the national threshold, however, the Act requires the procurer to open a public tender competition and post an open call on the national procurement notification website (www.hankintailmoitukset.fi often referred to as the official abbreviation in Finnish, Hilma) maintained by the Ministry of Economic Affairs and Employment (Part III, Chapter 11, *The Act*, 2016). Despite the benefit of attracting more tenderers, putting out a public tender competition tend to add a degree of administrative burden. A greater number of tenderers participate, which requires more resources for communication and evaluation throughout the process. When the procurement value exceeds the EU threshold of 209 thousand Euros, the procurer is bound to follow a stricter set of requirements, such as opening up the competition to tenderers from all EU member states and accepting supporting documents of tenderers that are issued in other EU countries. In short, the gist of the Act is such that the degree of formalization (and hence rigidity) in the public procurement processes increases proportionately to the monetary value of a procurement.

When the procurement value falls below the national threshold, many public organisations are yet to follow internal guidelines for procurements, in which the threshold values are set below the national one – e.g., 20 thousand Euros or lower. When the procurement value exceeds the internal threshold, the guidelines prescribe inviting multiple tenderers and compare their offers before making decisions. Further, in case the procurement value falls below the internal threshold, the person-in-charge is required to document the justification on why a direct purchase is made. Congruently, our observation informs us that the Consultancy often gets an invitation to tender with procurement values below 20 or 10 thousand Euros.

In reducing the resources involved in public procurement, the Act enables (one or) multiple public entities to establish framework agreements with a set of providers for serving various parts (e.g., departments) in the organisation(s). This allows the selected suppliers (e.g., design consultancies) to carry out projects without having to engage in a separate procurement procedure for each project for a period of up to four years. The terms for engagements can be adjusted according to the needs of the contracting party, and a so-called "mini-tender" (minikilpailutus in Finnish) can also be carried out to procure a project from the selected providers for the framework agreement without having to initiate a new public procurement process.

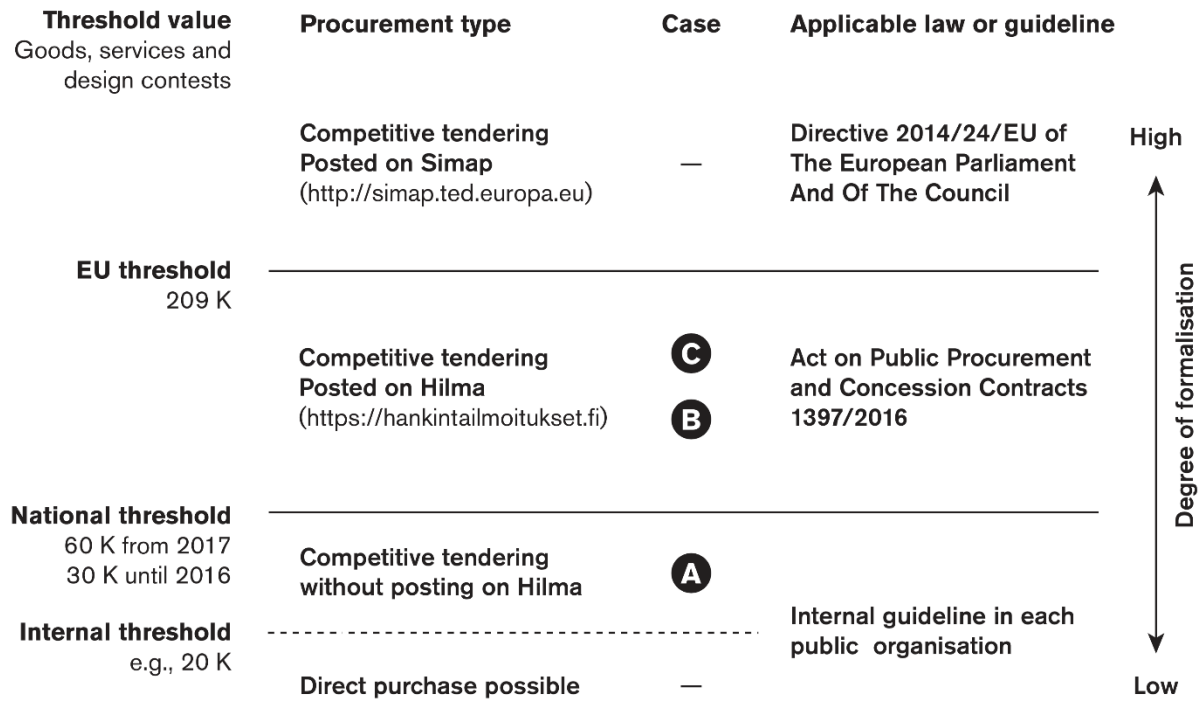

Figure 7 Rigidity at different public procurement threshold values, and the real-life cases A, B, and C

To conclude, the Act "seeks to enhance efficiency in the use of public funds, promote high quality, innovative and sustainable procurement" (Part I, Chapter 1, Section 2, *The Act*, 2016). However, highly customised procurement processes for the specific needs have not been frequently observed in our data collection thus far. Congruently, a lawyer specialised in public procurement in our interview stated that he/she often had to remind the importance of the aforementioned Market Consultation to the public-sector clients. Having noted this phenomenon, the Finnish Association of Designers (Ornamo) has also published a guideline titled 'Effective Dialogue' that emphasises early communication and encourages using more qualitative evaluations of tenderers of design services (Boman-Björkell et al., 2016).

3.2 Case introduction

Below, we present three select procurement cases from our on-going case study. The cases are chosen to unveil different dimensions of public procurement of service design in Finland, and the conscious choices – and perhaps unanticipated impacts – made by public-sector employees in procuring service design expertise. While the Act does not provide a specific procedure for procuring design expertise, the way in which public procurements are organised within different organisations seem to have a decisive impact on the contribution service design(ers) can make in public-sector organisations.

3.2.1 Case A: Public Company

The first procurement case stems from a 'Public Company' in a state of transition. As an independent body governed by public law, the Public Company serves more than a million customers with its hundreds of employees as of 2017. For decades, the Public Company has been the sole provider of a specialised service that reaches different parts of the Finnish government. Facing a potential transformation of the market, the Public Company was in the pursuit of better identifying the needs of a specific segment of its customers by using service design. This was the first attempt for the Public Company to procure service design expertise and was considered as a pilot. If the project would yield satisfactory results, the Public Company would consider opening a public tender with a framework agreement to meet the needs for different functions of its organisation.

At the time of preparing the procurement, the Public Company did not host formal service design capabilities internally and therefore needed to rely on external design expertise. The capabilities of the team responsible for the procurement included market research and customer satisfaction, but none of the members had a formal (service) design training. However, the team did not perceive service design as "new" in itself and aimed to internalise service design techniques to develop own skills through projects with the selected design consultancy.

As the procurement value fell below the national threshold, the procurement process followed the internal guidelines of the Public Company. As the Public Company had for long been approached by service design consultancies, the team met with few of those consultancies without a predefined idea for the project. The team had got some ideas on how to carry out a service design project through the discussions with the consultancies, and later invited three of the consultancies to tender for the procurement. By having separate meetings with each consultancy, the team iterated on how to tackle the challenge and finalised the tender invitation text. The tenders were evaluated on the overall economic benefit, in which the price and quality had an equal weight.

3.2.2 Case B: Municipality

The second procurement case stems from a 'Municipality' renewing its internal procedures with citizen-centric approaches. As one of the larger cities in Finland, the Municipality has thousands of employees under various departments in the city organisation and its public companies. As the city's new mandate recognises emerging needs for more citizen-oriented public services, the Municipality has procured a framework agreement to understand people's needs and develop internal procedures to implement the mandate. The aim was to lift satisfaction of both citizens and municipality personnel. As the Municipality has rather limited service design capability, this framework agreement was an attempt for the Municipality to encourage different parts of the city organisation to use service design. Although exact number was unavailable, it was estimated that the total number of personnel with service design background was less than five in the whole Municipality.

The procurement was carried out by a task force that consisted of few municipal employees with various backgrounds: ethnology; IT engineering; public administration; sales and account management from consulting field; and welfare. As an attempt to give equal opportunities to service design consultancies of all sizes and varied track record of their projects, the team required the tenderers to make a proposal on a hypothetical project for the Municipality. During the process, the team issued a question-and-answer document answering acute questions from all the tenderers. A limited number of consultancies was selected based on the overall quality and the economic benefit. The tenderers were evaluated based on the qualification of the designated consultants, as well as the proposal to the hypothetical project. The evaluation criteria for the proposal included the methods for user observation and involvement, prototyping and quality of the outcome.

According to the framework agreement, the Municipality (its departments and public companies) should approach the consultancies in the order of winning rank to inquire about the availability of the designated service designers for the framework agreement. If the predefined designers in the winning consultancy are not available, the next consultancy among the winning ones would be approached. This way, the Municipality can acquire the expertise and resources of one of the winning service design consultancies with a project fee up to few thousand Euros. If the sum goes over this threshold, a mini-tender (minikilpailutus in Finnish) should be pursued among the winning consultancies. Although not mandatory, the Municipality could also open mini-tender for assignments with the procurement value falling below the threshold.

3.2.3 Case C: Ministry

The third procurement case stems from a 'Ministry' providing support for municipalities to implement a recent government programme that aims to foster efficiency and experimental culture, among other things. Through this framework agreement, municipalities in Finland can use

consultancies with different expertise. The themes of the call included resident-driven services, experiments involving citizen participation, and service innovation. Accordingly, the public procurement was carried out under those parallel categories that sought for the various capabilities, of which service design was one.

The service design capabilities vary across the municipalities for which the framework agreement was intended for. Our observation in the Consultancy also informs us that the municipalities of Finland show various degree of interest in using (service) design – some of the larger municipalities invest heavily and regularly, while others only have made early investments.

The selection criterion for the framework agreement was set in relation to the overall economic benefit against quality points of the designated consultants: the number of relevant projects executed; and the amount of experience in working for municipalities. Three service providers with the highest overall score were selected for each capability-category. Through the framework agreement, the municipalities can acquire the resources (time of the consultants) of one of the three winning service design consultancies with a project fee up to few thousand Euros. Unlike case B, there was no possibility for mini-tender. However, each municipality could freely select one consultancy from the winning ones based the fit between its own needs and the qualification and experience of the consultants.

4 The gist of public procurement and opportunities for future research

In following the procurement processes in the cases above, our initial analysis suggests that the type of work service design consultancies carry out for the public-sector clients is often embedded in – and ultimately dictated by – the public procurement practices. In specific, we note that the public-sector clients conduct "silent design" activities (Gorb & Dumas, 1987) that impacts the work of service designers by often unknowingly imposing restrictions on the scope, means of communication, and selection criteria in procurement processes.

In elaborating on the consequences of such 'covert' design activities, we discern three challenges and present opportunities for future research in relation to how public procurements for service design are organised in Finland. Reflection upon the extant literature in design, the challenges span across different stages of design adoption – from early project discussions to how service design expertise is used and embedded into public organisations.

4.1 Briefing as an integral part of public procurement practices

The first challenge we note pertains to how public procurement practices impacts briefing in design. As an integral part of settling the aim, scope, and requirements for projects, design literature often place emphasis on establishing a partnership between the client and the designer early on during briefing (e.g., Phillips, 2004) and involving multiple stakeholders in the process (e.g., Blyth & Worthington, 2001; Luck, Haenlein, & Bright, 2001). Further, briefing is predominantly conceptualised as a continuous and iterative process in dialogue between clients and designers (e.g., Blyth & Worthington, 2001; Dorst & Cross, 2001; Lawson, 2004, pp. 13–29; Phillips, 2004; Ryd, 2004).

As noted earlier, the Act provides guidance for how to structure the dialogue between public sector organisations and service providers in early communication in the form of "Market Consultation" (Part II, Chapter 9, Section 65, *The Act*, 2016). It also outlines provisions for how to structure communication and decision-making depending on the specific needs of a procurement. To this end, we note that the Act in many ways provides enough freedom to pursue briefing in a way that is close to what is advocated in design literature. However, examining the procurement cases pursued by the Consultancy, we note that such practices may be prevented by the requirements applied to the different threshold values for procurements, as well as the administrative burden those thresholds place on civil servants.

For example, the Public Company in case A seems to methodically have followed the guidance in literature by hosting open discussions with various service design consultancies before finalising the invitation to tender. Faced with higher procurement values, however, the practices pursued in case B and C could not readily adhere to such recommendations; holding only limited dialogue with consultancies during the early stage of the tendering process. For example, the Municipality in case B submitted the invitation for tender on the national procurement notification website in complying with the rules for competitive tendering in Finland. The invitation led to a great number of tenderers participating in the procurement, and the procurement team in the Municipality used a question-and-answer document to respond to inquiries for clarification. The one-time question-and-answer document reduced the administrative burden while providing answers to acute questions in a manner that was fair to all tenderers.

Yet, we note that a lack of iteration emerged in reducing the dialogue to single document, which might have prevented the civil servants and service designers – both experts in their own rights – to learn from each other and further develop the scope and content of each procurement. Studies show that design consultants often have only partial insights into the processes and operations of their clients before a project begins (e.g., Hakatie & Ryynänen, 2007), and therefore the scope of a project is often subject to change and iteration (e.g., Dorst & Cross, 2001). This is also true to service design projects for public sector where the foci of the work often lie in engaging with various people throughout the process and/or identifying a broad network of stakeholders that provide the public service in concert. In other words, the changing and iterative nature of design is very much present in public sector projects, not unlike to those found in the commercial sector. For public procurements, however, it is seldom possible to simply add a small extension to accommodate changes in a project once it has been procured, as it runs the risk to raise the accumulated value of a project over its initial threshold value. The scope of the public-sector service design project we are following have often been set slightly below the threshold values – likely to avoid more complex procurement processes at higher thresholds. In such cases, the public-sector client is required to start another public procurement process (Part IV, Chapter 15, Section 141, *The Act*, 2016), otherwise face sanction by the Market Court.

Given the criticality of briefing emphasised in the literature, we conjecture that inadequate briefing could impede achieving the aims of public sector organisations in making successful investments in service design. In responding to such challenges, we recognise research opportunities in how service design procurements are initiated in public-sector organisations, how the aim and scope are settled through which mechanism of Market Consultation, and how and why these activities are aided or discouraged by observing the real-life work of civil servants. For example, in-depth studies could fruitfully be directed towards further understanding the specific context of briefing for service design projects in the public-sector, potentially profiting from the practice-theoretical approach (e.g., Kimbell, 2011b, 2012).

4.2 Proficiency of public-sector clients in using service design

The second challenge pertains to the proficiency of client organisations in using design and its impact on the work of design consultancies (e.g., Micheli, 2014; Ramlau, 2004; von Stamm, 1998). In tandem with the challenges associated with briefing above, we note that the (limited) design proficiency in the public-sector organisations in some cases contributed to situations where the expertise of service design consultancies was not effectively assessed and/or utilised.

A case in point can be found in the assumptions that drove the hypothetical project assignment in case B. As noted earlier, the hypothetical assignment had been devised to give a fair chance to each participating tenderer regardless of its size and/or track record of past projects. In evaluating the capabilities of consultancies, participating tenderers were invited to submit proposals on how to go about in creating a project for the municipality that was not fully specified. While well-intended, the open nature of the assignment also caused confusion among the tenderers. Roughly one fourth of all questions in the questions-and-answers document revolved around the assignment, including fundamental details about its aim, scope and budget. The questions were predominantly answered

in terms of being “at the discretion of the tenderer” (translated from Finnish). In short, the Municipality set out to evaluate the capabilities of the consultancies (their process and/or creativity) without actively considering the substance of the assignment. To this end, how the assignment was organised came to overlook the inherent problem-solution dependency in the work of designers (e.g., Dorst & Cross, 2001), which warrants a discussion about how design is understood in public-sector organisations.

Questions about how the work of designers was understood within public-sector clients also surfaced at other instances. For example, the values (scope) set for direct purchase in the framework agreements in both case B and C were only few thousand Euros. As the going price of one design consultant per day is around a thousand Euros in Finland, this translates into a few days of work for a service design consultant leaving little time for the consultants to engage with the substances of individual assignments. Further, it also present practical challenges for designers on how to conduct more encompassing user engagements, as often suggested in service design literature (e.g., Polaine et al., 2013; Stickdorn & Schneider, 2010). Our observation in the Consultancy also informs us that the impact of the phenomenon is not unique to framework agreements. For instance, we have noted that the Consultancy sometimes rejected invitations to tender because the tendering and briefing process would consume most of the monetary return already before a project would commence.

In addressing these challenges, future studies could be directed towards action research by participating in – and improving on – the procurement practices for service (e.g., Reason & Bradbury, 2006). Exploring the impact of varied procurement value thresholds, the actions of interventions may illuminate theory and vice versa. We also recognise possibilities for protocol studies, inviting civil servants with varying degrees of experience in procuring service design to gain insights into their practical knowledge in procurement processes and how to potentially advance their design understanding thereof.

4.3 Use of the tacit knowledge of designers

The final challenge we distinguish pertains to how the tacit knowledge of service designers can benefit public-sector organisations and how public procurement processes may enable or hinder the use of such knowledge. Design literature has explored various ways to reveal tacit knowledge from client organisations and harnessing the creativity of users (e.g., Akama & Prendiville, 2013; Visser, Stappers, van der Lugt, & Sanders, 2005) and how to surface and expand the tacit knowledge of designers (Park, 2011).

As observed in the Consultancy, a large part of service designers’ work is about transferring the insights gained from observation and/or facilitation activities to the parties that are planned to use them. The handover often takes place in the form of a presentation or report, in which the tacit knowledge accumulated throughout a project can rarely be fully captured. For this reason, practical guidelines emphasise the importance of involving designers from problem identification through solution implementation in the form of “stewardship” to guide the development work in the public-sector (e.g., Boyer, Cook, & Steinberg, 2011). As pointed out earlier, however, the premises of public procurement challenge the possibilities for such engagements to take place as the procurement threshold values are set relatively low for design work, and each procurement is required to invite tenderers anew. In short, projects for creating citizen-insights and for designing solutions from those insights tend to be carried out by different consultancies, which limits the effective transfer of tacit knowledge across projects.

In addressing these challenges, studies point to the importance of building and maintaining long-term relationships between client organisations and design consultancies (e.g., Bruce & Docherty, 1993; Bruce & Morris, 1994; Paton & Dorst, 2011). In such a relationship, both parties accumulate tacit knowledge about each other and can utilise them for their benefit. Although keeping a single design consultancy over years of collaboration is not practically possible in public procurement in Finland, framework agreement may resemble the benefit of a long-term relationship for up to four years. For instance, utilising tacit knowledge may be conceivable if a framework agreement is

created for a relatively narrow target user of service design – e.g., a department in a municipality – for a long-term development project.
Given the complexity of challenges often found in public sector work, how to transfer and benefit from the tacit knowledge gained in different projects would be a key area of development both in design research and practice. In order to kick-start this development, future studies could explore highly customised procurement practices within the current legal boundaries in collaboration with experienced service design consultants.

5 Final remarks

In many ways, the challenges we present in this paper mirror the obstacles design consultancies face in selling their expertise to commercial organisations. For example, large and international companies often follow systematic procurement processes to ensure cost-savings and prevent insider trading. Despite these obvious benefits, rigid procurement procedures may also cause challenges for design outcomes due to poor briefing, lack of design proficiency, and underutilised tacit knowledge of external consultancies. Therefore, the research opportunities we recognise are closely coupled to fundamental areas of research, which design and design management literature have addressed in the past.
Having said that, the peculiarities inherent in the public-sector context call for a renewed interest in these areas of research. As pointed out in recent literature (e.g., Hyvärinen et al., 2015; Junginger, 2009, p. 4), the tools and methods developed within the commercial context are often based on a different set of premises than those prevalent in public-sector organisations. For example, various dimensions are uniquely inherent in the work of civil servants who need to operate within specific legal and administrative frameworks as outlined in this paper. What is more, the immaterial nature of service design (e.g., Secomandi & Snelders, 2011) and "unavoidably political context" (Bailey & Lloyd, 2016, p. 3629) of public-sector work may render some of the lessons from the extant literature in other sub-fields of design incompatible with the context of procuring service design expertise. Finally, the changing landscape of the public sector may also require more "flexibility, provisionality and anticipation" in responding to the rapid change in the society and politics (Kimbell & Bailey, 2017, p. 218).
To conclude, there is much to gain in reinvigorating past discussions on design and design management towards service design in public-sector organisations on the one hand, while on the other hand there are important contextual gaps in knowledge that calls for future research attention. Although our insights arise from the specific context of public service design procurement practices in Finland, we encourage readers from all design fields to consider the topic in their own context, as it may be relevant to other areas of design and/or other geographical areas.

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About the Authors:

Seungho Park-Lee is a doctoral candidate at the Department of Design, School of Arts, Design and Architecture, Aalto University. His research focuses on the role of briefing in design. In 2013, he has founded Design for Government course at Aalto University.

Oscar Person is an assistant professor at the Department of Design, School of Arts, Design and Architecture, Aalto University. His research concerns the strategic integration and management of design with a special interest in the expressive nature of design work.

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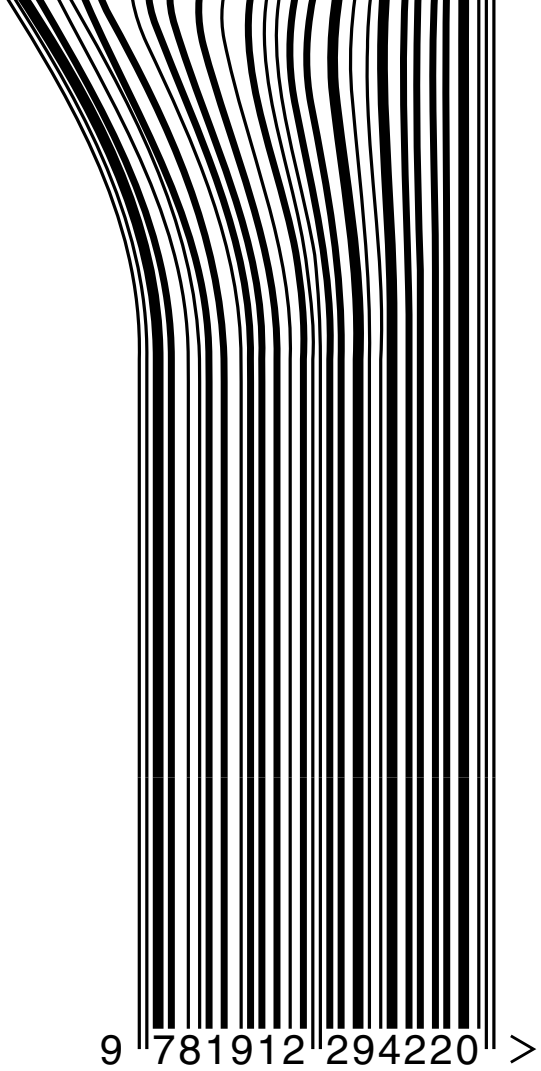

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