VISUAL TOOLS FOR DEVELOPING CROSS-DISCIPLINARY COLLABORATION, INNOVATION AND ENTREPRENEURSHIP CAPACITY

Edited by
Selena Griffith
Kate Carruthers
Dr. Martin Bliemel

Part of the Curated Series:
Transformative Pedagogies in the Visual Domain

Series Curators:
Dr. Arianne Rourke and
Dr. Vaughan Rees
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It has been a great pleasure to work on this book with my multidisciplinary and collegial colleagues Selena and Martin. Over the years we have often discussed the challenges of building skills in entrepreneurship and innovation and it was great to have this opportunity to distil knowledge from such wide group of practitioners. I would also like to thank my colleague Barbara Chmielewski for her support throughout the process of writing and editing. It has been a challenging and rewarding process, and I’m grateful for the opportunity to work with distinguished colleagues around the world – I have learned so much from their work. – Kate
Learning to teach one topic is difficult enough. Learning to teach how to guide people across disciplines to collaborate can be even more daunting. However, arguably, cross-disciplinary collaboration is vastly more important since that is how all organisations function as a whole. And, if done well, cross-disciplinary collaboration can be the source of major breakthroughs, such as those we see in our research on the emergence of nano-biotechnology commercialisation. So, I was delighted when Selena asked me to co-edit this volume along with her long-time collaborator and multidisciplinary colleague Kate. This is an exciting and challenging topic with amazing co-editors, so I couldn’t be happier to contribute. Thank you, both! Editing the chapters in this book has also provided the pleasure of working with colleagues around the globe who contributed hard work and deep insights into their world of practice and pedagogy, for which I am extremely grateful. Their contributions and their tolerating my occasionally pedantic editorial requests (sorry!) were greatly appreciated. Thank you! – Martin

We would all like to thank Dr Arianne Rourke and Dr Vaughan Rees for the vision they had for creating this series, the ambition and passion they had for following through, and the patience and belief they had in us as proposers and editors of this book. It has been a great learning journey that we embarked upon with you while you ran an unbelievable publishing marathon. We have enjoyed your support, mentoring and collegiate persistence. Much, much, much thanks to you both!

– Selena, Kate, and Martin
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Mapping the Global Reach of Authorship for *Transformative Pedagogies in the Visual Domain*
Curators’ Essay

Dr Arianne Rourke and Dr Vaughan Rees

The Editors of Visual tools for developing student capacity for cross-disciplinary collaboration, innovation and entrepreneurship, Selena Griffith, Kate Carruthers and Martin Bliemel in the sixth book of eight in the Curated Series: Transformative Pedagogies in the Visual Domain, explore through twenty-two chapters and four sections, how visual tools and artefacts have been utilised historically across a range of disciplines and speculate about the possibilities for the future.

Innovation and entrepreneurship are key threads throughout this book. Excellent examples of case studies are provided in which students engage in cross-disciplinary collaboration using visual tools and visualising techniques. As technology enables greater collaboration, students need to be skilled in working across disciplines and, across cultures. Visual tools and visualising techniques can act as a workable communication mode in a multicultural and multidiscipline global environment where work and “learning will be increasingly borderless” (Australian International Education, 2025, 2016).

The book also teases out the idea of sense-making as a skill important to students engaged in the social dynamics of collaboration, co-designing and co-learning. Sense-making is the relationship between different types of information or data (as experienced in working in a multi-disciplined group) and the different “… frames that can be used to interpret, makes sense of, or explain, these data” (Baber, et al. 2016). Therefore, how does a student make sense of the large amounts of information that are now digitally available to them and how can visual tools assist in reflecting upon and drawing reasonable and informed conclusions in a group situation that requires some consensus? This book gives examples through case studies of how this might be achieved and how this can transform student learning.

Case studies are used in this book to illuminate best practice and to focus a lens on the multifaceted nature of learning. Here collaboration is promoted as a imperative methodological approach to foster interaction and team-building skills that as is demonstrated, can lead to innovative far reaching outcomes that move beyond the traditional notion of learning. Learning in this context is enhanced when there is the opportunity to work in multi-disciplinary teams using visual tools to provide a vehicle for transcending ‘cultural linguistic and disciplinary barriers’. This can be achieved through instigating an integrated multi-disciplinary practice within student teamwork where learning outcomes are achieved through utilising and valuing each learner’s strengths. It is an educationally sound practice as Laurillard (1993) argues, to facilitate “mediated learning allowing students to acquire knowledge of someone else’s way of experiencing the world” (p. 29). It is argued that pooling skills, knowledge and experiences in a collaborative, supportive and open-ended learning
environment, innovation and creativity can be fostered, and through this process entrepreneurial outcomes can eventuate. According to Duxbury (2012) “Creativity is important to entrepreneurs because it is the first stage in the process of innovation, providing the stimulus for opportunity, discovery and new venture creation” (p.10). Educating learners to ‘think’ entrepreneurially relies on educators being flexible and innovative in their methods of facilitating learning and as the case studies in this book demonstrate, visuals are a means of expressing and communicating creative processes and outcomes to assist towards achieving this goal.

Duxbury (2012) defines a creative person as having acquired a “high valuation of esthetic qualities in experience, broad interests, attraction to complexity, high energy, independence of judgment, autonomy, intuition, self-confidence, ability to resolve antinomies, and a firm sense of “being creative” (p.12). It takes great confidence in one’s teaching and enthusiasm for promoting learning, an ability to think broadly and intuitively as well as to think ‘outside the box’, to facilitate students to develop creative and innovative approaches to their learning. This book is a gathering of perspectives and insights, practical examples and approaches that can be used in both industry and educational environments to promote creative approaches to address worldly problems and global issues. It also views the creative process itself as a precursor for promoting future entrepreneurial activity and that this can facilitate opportunities for learners to link their classroom learning to real world practice while studying for their degrees.

Learning is viewed as a progressive scaffolded process across all levels of expertise, where both undergraduate students through to professionals are involved in ‘active learning scenarios’ utilising visual tools to improve their skills and knowledge while they co-create and design. This book has been cleverly structured into themes of collaboration, cross-disciplinary collaboration, innovation, entrepreneurship where integrated visual tools are utilised to build progressively a logical path towards acquiring personal knowledge and insight. The book promotes experiential learning and reflective practice as important approaches to enlightened learning. Here educators employ visual tools to illustrate the learning process, insight understanding and to promote innovative outcomes, while providing a traceable exemplar and record for others to emulate. This book is about transformative practice for both the educator and learner who see the visual as a vehicle for expressing their views, knowledge and understanding of the world.

The genesis for this series Transformative Pedagogies in the Visual Domain came from The Curators’ observing and experiencing how a fertile field of higher educators were strategically creating visual material to ignite both a knowledge transfer and indeed knowledge exchange, between the educator and the student. One of the advantages of working in higher education is the opportunity to observe throughout the various disciplines and modes of delivery, the extraordinary variety of pedagogical practices where visual material is an important primary ingredient for promoting an engaging rich educational environment. For the last few years both Curators have identified examples of best practice within their professional network and created a place to publish where a practitioner can reflect on practice and share examples of best practice to a wider, critical and appreciative international audience.
This opportunity creates an ongoing practice of discipline specific practitioners not only exhibiting, researching and creating outcomes within their main focus but also to contribute to the scholarship of pedagogy about how practice and higher level thought is communicated and shaped within a creative learning environment.

During this time the network formed into a Community of Practice that crossed professional disciplinary boundaries, geographical locations, cultural constructs, contemporary and traditional methods, varied research methodologies and theories. This community is corralled within a framework of overlapping territories of higher education, pedagogy and the visual. Taking on the premise of a Community of Practice as Wenger, McDermott and Snyder (2002) argued, where: “Groups of people …share a concern, a set of problems, or a passion about a topic, and …deepen their knowledge and expertise in this area by interacting on an ongoing basis” (p.4). As our network expanded we were able to see naturally forming clusters of knowledge and sufficient depth within the Community of Practice to create this series with eight separate books with each focussing on the visual, higher education and pedagogy within: the environment, Asia region, contemplation, community engagement, innovation and entrepreneurship, innovative learning, work integrated learning and, the embodied.

The legacy of Donald Schön’s (1983, 1987) pivotal work on the modelling reflective practice and educating the reflective practitioner created scholarly guidelines, that seem to naturally fit with many visual educators as his notion of a purposeful reflective mode resonates with those in the creative industry education sector. Sellars (2012) when commenting on Schön’s (1983, 1987) reflective practice model, argued the importance of educators beginning this process by reflecting on their “own individual experiences and perspectives”, believing there is a need to “consider these in their contextual variations and draw upon the theoretical, professional strategies that they have encountered or plan to explore” (p.466). This approach permeates throughout the book series where many point of views and theories as well as practices are shared and united under the visionary core idea of recognising the important role visuals play in the communication, engagement as well as ‘meaning’ of learning.

Through case study examples, theories and personal reflections, authors have provided a visual lens for observing and studying the thought processes and actions of their students, audiences and participators whose lives have been enriched through their unique visions, creative approaches and experiences. With technology bombarding our tertiary learning spaces with its avalanche of visual imagery, there has risen an imperative need to develop multi-modal literacy (Kress & van Leeuwen, 2001) skills to understand the complex ever-evolving interconnected visual world, this series envisages to contribute further knowledge and understanding to this field.

The series of eight books would not have been possible without the dedicated work of sixteen book Editors, who reviewed and then selected 163 authors from all over the globe to contribute their reflections and transformative pedagogical approaches to assist in understanding the visual world. Authors from twenty-one countries and ninety-eight different educational institutions and businesses have contributed to the series their expertise from fields as varied as lyrical prose writing to
sports psychology, with educators from health sciences to cultural anthropology and business entrepreneurship.

The global contribution of so many authors and editors, their geographical location and associated institutions offered the opportunity to present visually the numerical and locality data generated by the authorship of this book series. Graphic designers Bernadett Butson and Zeeshan Khan working with the Series’ Curators, visually mapped the global reach and the critical mass of the authorship. A graphic language of colour saturation and intensity, organic and mechanical shapes, structuring and focusing lines and the relationship between these elements (influenced by Russian artist Wassily Kandinsky 1866-1944, and his 1923 highly graphical painting, Circles in a Circle) present the visual overview seen on the previous page and acts as a basis for the various coloured and cropped versions that are printed on the covers of the eight books.

Current international developments in social data visualisation have identified the need to establish new forms for representing identity in terms of research networks and connectivity. Together with Dr Kim Snepvangers, the Curators have been addressing research questions of the unstable nature of relationships, deliverables, outcomes and impact in the cultural sphere. The graphical visualisation of the eight books in the Curated Series, gives new insights and potentialities to identify questions of local, national and international research strength in the visual, creative arts and humanities comprising the titles and subjects of the eight books. Visualisation is the premise underlying the series and so the significance of the cover design and related design identities is that it seeks to overcome barriers to connectivity and the complex nature of collaboration. Visual adaptation of hotspots, hubs and moments of intensity as a graphical articulation of participatory academic practice, highlights the significance of this Curated Series as a collaboration stepping stone for future research potentialities in the visual domain.

This inclusive series brings together practitioners from all stages of academia from Early Career Researchers to Emeritus Professors, from beginning teachers to retired educators with many years’ experience who have come together to contribute their inspirational insights for the Transformative Pedagogies in the Visual Domain book series.

REFERENCES


Section 1: Tools for Collaboration

and Cross-Disciplinary Collaboration
CHAPTER 1

The Value of Using Visual Tools to Enable Students, Clients and End Users

Selena Griffith, Martin Bliemel, and Kate Carruthers (UNSW Sydney)

This volume identifies and documents pedagogical and practice-based visual approaches to scaffolding and developing capacity for cross-disciplinary collaboration, innovation and entrepreneurship.

This first chapter introduces and contextualises the key themes of this book, outlining the value in supporting acquisition of cross-disciplinary collaboration, innovation and entrepreneurship skills in students and why visual tools are particularly useful in doing this. Chapter authors, and editors of this book, have chosen to divide the content of the book into four sections: i) visual tools and artefacts for Cross-disciplinary Collaboration; (ii) visual tools and artefacts for Innovation; (iii) visual tools and artefacts for Entrepreneurship; and (iv) Integrated approaches using visual tools and artefacts. The main chapters take a social, cultural and historical look at the evolution of visual tools, followed by a final chapter which takes a look into future possibilities.

INTRODUCTION

In our roles as educators, facilitators, consultants, participants and consumers we are faced with increasing complexity of the systems in which we operate. As producers of value, the projects we work on grow in complexity. Collaborative, multidisciplinary teams are required to deliver them with an innovation remit to keep ahead and differentiate in competitive, internationalised markets. Even as consumers, we are shifting from consumption to consumer experience, from products to product service systems, and to services which have increasingly participatory, collaborative, co-creative or social elements to them. Subsequently, for all contributors to a productive economy, communicating becomes a key issue, whether it is how to effectively execute a project’s myriad facets or how to interact in consumption scenarios. Frequently we are being asked to be more innovative with our solutions to projects and to be entrepreneurial in identifying project opportunities, seeking support for them and their delivery. Visual tools allow us to transcend the many cultural, linguistic and disciplinary barriers faced with only utilising our primary verbal communication tools. As the saying goes, a picture is worth a thousand words.
Visual tools for developing cross-disciplinary collaboration, innovation and entrepreneurship capacity, will identify and document pedagogical and practice-based visual approaches to scaffold and develop these capacities. These are also not mutually exclusive capacities; one builds on and complements the other, toward their integrated practice.

The book has been divided into four sections, logically sequenced to assist in planning activities around a scaffolded approach to skills development. The first section focuses on collaboration and cross-disciplinary collaboration. This lays the foundation for the second and third sections on Innovation and Entrepreneurship, respectively, followed by the final section with case studies of fully integrated practice.

Figure 1.1: Progression of visual tools usage across section themes reflecting the logical learning path of these skills.

The editors have selected chapter authors from a global pool of educators and practitioners in order to provide a broad range of perspectives. The term ‘student’ is applied such that it could include people enrolled in a course, clients in active learning scenarios, researcher teams using visual tools to learn more about their subjects, or members of a co-design or co-creation exercise.

**VISUAL TOOLS AND ARTEFACTS**

Visual tools and artefacts have been used across human history by all cultures to assist individuals, groups and teams to navigate social rules, teach and learn, record, communicate, outline strategies, define ownership, way-find and communicate and collaborate between and across cultures and languages. They have evolved in parallel with, and contributed to, the development of new technologies, leveraging novel and different approaches as they have become available. They range from simple markings drawn by sticks in the dust through to elaborate augmented reality experiences and continue to be used across that entire spectrum.
In a pre-literate world, graphics and visualisation was an important way of communicating. Starting with the simplest visual tools, people were able to communicate tribal alliances, family groups and social status through the style, colours, shapes and patterns of what they wore or adorned their bodies with including tattooing and scarification. In many aspects of our lives we still use colours and shapes such as ‘team colours’ for your sports club, universal shapes for road signs and combinations of shape and colour to communicate entire alphabets in code such as the naval flags or to operate equipment safely (red = stop, green = go).
Over time, shapes and colour evolved into symbols which were used to record ownership (cattle brands) and became guarantees of quality for specific craftsmen or guilds (smith’s and jeweller’s hallmarks, potters stamps and printers chops) and then to modern day brands. Some of the earliest symbols were numbers, used for accounting and trade. As currencies developed to facilitate trade, size, shape, patterning, colour and materials were used to visually represent value.
Partnered with a growing knowledge of the natural world, symbols were used to describe locations of food and water and other important sites such as ritual and meeting places. Neolithic sites such as New Grange and Stone Henge were giant visual tools to track the movement of the Sun and other celestial bodies, the passing of time was observed and recorded.

*Figure 1.5: Aboriginal rock carving featuring a human figure and hunting tools taken in Ku-Ring-Gai National Park, thought to be one of a number of educational engravings used to teach traditional lore.  
Source: Selena Griffith*
Symbols evolved into writing, initially only accessible by the privileged, it led to a literate elite. With the advent of printing presses, access to portable, mass scale, uniform communication was possible and in a relatively short period of time. This technological advance enabled democratisation of information exchange through mass education resulting in the rise of skilled employment, the middle class and mass markets for goods and services.

As we developed new technologies, they have been adapted as visual tools. Drawing evolved into sketches, maps, measured, technical and annotated drawings, illustrations, visual manuals, diagrams, painting, photography, facsimile, computer graphics, animation, medical imaging such as X-ray, ultra sound and medical resonance imaging, video, film making, virtual reality, gaming and beyond the two dimensional into both physical and virtual three dimensional prototyping, 3D printing, modelling, testing and iterating.

Figure 1.6: Section of a computer aided design (CAD) survey map of a property for development approval
Source: Selena Griffith

Figure 1.7: Lego visual assembly instructions.
Source: Selena Griffith
Technical and measured drawing facilitated fabrication, making it replicable by others through shared information. Trades could work in parallel using these to achieve faster and better outcomes. Assembly and other instruction manuals now almost always come as a visual set of instructions that even non-literate or pre-literate people can follow independent of any language. A great example is the Lego instructions most 3 year olds can follow to make complex toys with multiple moving parts (Refer to Figure 1.7).

Specific types of measured and descriptive drawing, maps, were an excellent innovation as they were a portable, editable way-finding system that could be used to navigate to and from locations even if you had not been there before. Venetian cartographers and merchants collaborated to join their various maps together to expand knowledge and trade routes, some of these can be viewed today in the Duomo, Venice, providing, from the 16th century, a fairly complete (although inaccurate) world map. These became even more interesting when made into a 3D visual tool, a globe, which much more readily describes orientation and relationship of not only land masses and oceans but also planet earth. Both these visual tools helped to expand exploration and trade across the globe. Many explorers would return from their journeys with a new visual tool: scientific specimens.

![Map of the world from by Abraham Ortelius c 1570.](image)

*Source: Rosario Fiore*
One big challenge for educators, particularly in biological sciences, is the need for students to learn from specimens. Specimens tend to degrade rapidly over time losing shape and colour, are seasonal or location dependent, expensive to maintain or impossible to obtain due to rarity or expense. Some very innovative tools have been developed over time to solve this. Of note are the anatomically perfect glass replicas of sea life commissioned for the Natural History Museum Dresden by Professor Ludwig Reichenbach in 1863 and plants for teaching at Harvard University by Professor George Lincoln Goodale in 1886. These were made by master lamp workers Leopold and Rudolf Blaschka. Despite their fragility, glass ‘specimens’ meant many students could learn at any time or season about anatomy and physiology without needing to be in the field or dipping into preserving alcohol filled jars to fish out compromised samples.

![Figure 1.9: Example of Blaschka glass flowers from the Harvard Museum Collection. Source: Selena Griffith](image)

New 3D physical models and computer simulations tackle the issues of cost and ethical considerations of some specimens, such human bodies for medical students to learn from. BioDigital have produced a 3D web and mobile application which is a map of the human body. It can be used to visualise data, anatomy, disease and treatments.

Data Visualisation is an emerging practice which produces visual tools that help researchers organise, process, analyse, compare and communicate large amounts of data in various ways. It can be used to communicate very complex sets of information in ways which a lay person can understand. A good example is the interactive data visualisation of energy consumption below which demystifies the use of energy across America and can be used by specialist and lay alike.
Photography and film-making were technological advances which allowed not only accurate documentation through images (still and moving), but also democratised image consumption. Image production was democratised immediately after, as it became increasingly affordable to personally own cameras. More recently, the internet has democratised the sharing of visual information. Most of us carry a smart device with us at all times capable of accessing, recording and distributing visual information, privately or publicly. With social media platforms such as facebook, twitter, or Instagram, combined with freely available editing, annotating and filtering tools anyone can share anything at any time with almost anyone else. This means we are now visually literate in two senses. We are visually literate as consumers and as curators and producers, and our productive capacities make us more critical as consumers.

While most of the output of these visual tools is personal, entertaining or informative, a select few are suited for educational purposes. The question as educators and facilitators is how do we use visual tools to engage and provide meaningful learning and development experiences for our students and clients in a visually saturated world?
Working with others in collaborative groups and teams brings many benefits. We can complete tasks faster and work beyond our own individual physical, skills, knowledge and experience capacities. Ironically, in both education and business scenarios we tend to reward competition rather than collaboration and reward individuals rather than teams. As such capacity and willingness to collaborate often both need to be developed and supported. Visual tools can be an important part of scaffolding collaboration activities. Some of the greatest challenges in collaborations are to communicate the common goal, keep the team motivated to work together towards it, communicate progress, learn from the collaboration and understand and celebrate success. Mind Mapping and collaborative drawing and visual story telling can be a great way of developing shared experiences and resources to bring a team together. Design Thinking, Service Design Thinking and Social Design Tools have emerged as a very useful set of approaches to collaborating visually across teams and in co-design scenarios with end-users and stakeholders. Notably, these tools have more to them than the visual feature. They all feature ethnography and empathy aspects which help individuals to learn how to understand who they are working or designing with and for.
CROSS-DISCIPLINARY COLLABORATION

Extending collaborations to include team members from across different disciplines can bring great benefits. Complex projects can be worked on from different disciplinary perspectives to provide whole systems, multifaceted solutions. The challenges around cross-disciplinary teamwork lie in the different disciplinary team members having their own unique cultures, jargon, methodologies and practices which can cause confusion and friction and hamper collaboration. Using visual tools to share and compare information, and ‘see’ the problem in a way that transcends or
integrates disciplinary boundaries is particularly useful. When successful, cross-disciplinary collaboration can be an effective way of delivering innovation as it often lies at the nexus of different knowledge sets.

INNOVATION

Figure 1.14: Innovation

In this section, we view innovation as an activity in which participants are asked to address a question, problem or opportunity through developing a new, unique or different approach to previous solutions. Innovation is increasingly being used as a key performance indicator in business and as an assessable outcome in an education context. Most innovation activities are new combinations of diverse knowledge areas, and it remains rare for individuals to be interdisciplinary. Thus innovation inherently requires collaboration in addition to some risk taking. For students or those new to innovation activities, who may initially be risk averse, it can be useful to introduce them to tools to help them collaborate across disciplines and mitigate risks such as having an incomplete perspective of the problem. Many visual tools, particularly in the Design Thinking, Service Design and Business Design and Innovation areas are available in the form of templates, canvases and interactive visual exercises. They have been developed and made freely available under creative commons. As teams become familiar with using these visual tools they become less risk conscious and more comfortable with experimenting and failing their way to an innovative solution to their question. Once they have an innovative solution (or while they are developing it) they will need to also design a way to deliver that innovation to the audience who may benefit from it, that they innovated for. This can be done through a number of mechanisms, the two most obvious being intrapreneurship and entrepreneurship. For the purpose of this book both these approaches will be covered by the term entrepreneurship.
For this section, we follow Stevenson and Jarillo’s (1990) definition of entrepreneurship as “the willingness to pursue opportunity, regardless of the resources under control.” (p. 23). Therefore, an entrepreneur is someone who sees opportunity and works either internally to a business unit or founds an enterprise of their own in the pursuit of resourcing the development of a solution to the perceived opportunity and successfully bringing the solution to market. Innovation and Entrepreneurship are a natural partnership and as such many of the visual tools used for innovation have aspects of entrepreneurship built into them as well. One of the most popular types of visual tools for entrepreneurship education and training are canvases such as the Business Model Canvas and the Lean Business Canvas where innovation and entrepreneurship can be explored in parallel. These canvases build on those mentioned in the previous section, to ask how the value created by the innovation for the customer can be monetised to sustain the new initiative or new venture. Others include pitch decks to impress potential investors and customer journey maps, personas and other service design and user centric tools. These aid in finding alternative sources of capital to sustain the initiative or venture, and take a more longitudinal perspective of how potential customers engage with the product or service over time.
INTEGRATED PRACTICE

Integrated practice, successful collaboration, across disciplines, to innovate and be entrepreneurial in that activity, is the ultimate goal. It is an iterative process of trial and error to reach a fully integrated practice. To master this practice, the earlier one can start the better. In planning to support your students, clients or team through to an integrated practice, a staged approach may be best. Over time, as they become familiar and comfortable with using different visual tools they will be able to select from their tool box as they need to.

USING THIS BOOK

Readers of this book could choose to dip in and out or read cover to cover. Either way there are many excellent examples you can draw on to use in your teaching, training or personal projects. The core purpose for curating this book was to draw together multiple successful perspectives on how to develop collaboration, innovation and entrepreneurship capacity through team work, using visual tools. We view learning as an incremental (scaffolded) process and best learning outcomes are achieved through experiential learning, seeking feedback, reflecting and iterating.

REFERENCES


CHAPTER 2

Engaged Learning—Planning, Implementing and Evaluating

Dr. Diana Whitton (Western Sydney University)

Curriculum needs to be robust, rigorous, relevant, rewarding, reciprocal and most of all, realistic. To develop this type of curriculum known as Engaged learning a framework was developed to demonstrate how teaching and learning does not need to remain in the formal structure of the classroom. Learning needs to be engaging and one way of developing a suitable curriculum was to work in partnership with a community outside the university. Engaged Learning developed the four components of curricula – content, process, products and learning environment to demonstrate how to write the most appropriate teaching and learning that benefit the students, the community and the academic staff. Within schools and universities, the focus has moved onto engaging with the community to develop programs both for students and the community members – often in a voluntary capacity. Engaged Learning is ensuring that the work with the community is part of the mainstream curriculum and therefore supported by the university and the community alike and the final products are relevant to the students and the community as well.

This chapter will give a justification for Engaged Learning, and the components of it, and then demonstrate the process of using the Engaged Learning Canvas, a modification of the Business Model Generator (Osterwalder, & Pigneur, 2010), to work with community groups for students to successfully implement engaged learning. There is no point in using the Engaged Learning Canvas if the curriculum does not have the integrity to ensure the students are prepared to work successfully with a community partner.

INTRODUCTION

Curriculum, in schools and universities, has seen a change from the classroom based learning to more action learning within a community (Tolich & Paris, 2012). This community may be specifically related to the areas of study or a professional requirement for certification, such as an accountant’s office or a primary school, but more often students are working within their community to support the work for different social needs. To ensure the experience is valuable the Engaged Learning Planning Canvas requires the students to carefully plan their project with the community using the framework previously developed for use in business. The canvas
ensures the students are accountable for the actions they are undertaking with the community group, and, with each other throughout the Engaged Learning.

However, prior to the students using the canvas to plan their learning the educator needs to plan the curriculum that the students will be participating in. Curriculum at any level of education needs to be robust, rigorous, relevant, rewarding, reciprocal and most of all, realistic (refer to: Figure 2.1) for the learners and the educator. These characteristics of the curriculum give a framework for planning the process that the educator works through in developing the Engaged Learning.

![Figure 2.1: Facets of the curriculum](image-url)
Table 2.1: The accepted definitions of the terms

<table>
<thead>
<tr>
<th>Accepted definitions</th>
</tr>
</thead>
<tbody>
<tr>
<td>Relevant</td>
</tr>
<tr>
<td>The content, skills and products that the students encounter relate to their learning needs. For educators the professional development relates to where they are in their development.</td>
</tr>
<tr>
<td>Rewarding</td>
</tr>
<tr>
<td>All stakeholders are rewarded in the learning process through the development of skills, knowledge and contribution to the community.</td>
</tr>
<tr>
<td>Realistic</td>
</tr>
<tr>
<td>For the student, educator and other stakeholders they all can achieve what is desired in a given time.</td>
</tr>
<tr>
<td>Rigorous</td>
</tr>
<tr>
<td>The relationship that is developed needs to be rigorous and challenging for the students, educators and community members to ensure that it is challenging and stimulating to all.</td>
</tr>
<tr>
<td>Robust</td>
</tr>
<tr>
<td>The learning will stand up to scrutiny and evaluation from both the teaching institution and the community the engagement occurred.</td>
</tr>
<tr>
<td>Reciprocal</td>
</tr>
<tr>
<td>All stakeholders in the education will benefit from the relationship that is developed.</td>
</tr>
<tr>
<td>Reflection</td>
</tr>
<tr>
<td>Is examining the whole engagement process to determine the benefits of the relationship that had been developed and the learning that was a result of the engagement.</td>
</tr>
</tbody>
</table>

For Engaged Learning to be successful there are three stages of learning for the students. They need to learn about, for and with Engaged Learning. About engaged learning means the students develop an understanding of the whole process; for engaged learning they learn about the steps in preparing for the learning; and, with engaged learning the students develop skills and knowledge to implement the engaged learning. Each of these may be analysed in relation to the academic, organisational and social/emotional development of the students. Table 2.2 gives a matrix that is used for planning the Engaged Learning for students by educators.

Table 2.2: Planning matrix for educators developing Engaged Learning

<table>
<thead>
<tr>
<th>Knowledge</th>
<th>Understanding</th>
<th>Preparation</th>
<th>Implementation</th>
</tr>
</thead>
<tbody>
<tr>
<td>Academic</td>
<td>ABOUT</td>
<td>FOR</td>
<td>WITH</td>
</tr>
<tr>
<td>Organisational</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Social/emotional</td>
<td>Theoretical knowledge</td>
<td>Practical Theory</td>
<td>Demonstration Application</td>
</tr>
</tbody>
</table>

A simple example of academic knowledge that may be needed is: what is a media release? When are they used? Who are they sent to? This would fall under ABOUT, then the writing of a media release by students using a preforms would be part of the FOR and preparation for the engaged learning. Then the students would write a media release when participating in their project.
BACKGROUND TO ENGAGED LEARNING

Engaged learning’s outcome is social innovation in different domains (see Figure 2.3). Through planned projects with specific agencies various levels of engagement occurs. Students may undertake direct, indirect, advocacy or research to assist the agency in their endeavors. There are four distinct types of Engaged Learning: direct, indirect, advocacy and research. Each one is valuable to the student, as well as the agency, as skills and knowledge are developed and final outcomes are achieved for each type of service (see table 3 for examples of service).

Table 2.3: Types of service

| Direct service – directly affects and involves the recipients. The students may undertake activities that are already in place – serving food in a soup kitchen [http://www.homeless.org.au] or develop a program to assist a particular need in the community - working with other school students to assist them in literacy and numeracy skills [www.alnf.org]. |
| Indirect service – does not provide service to individuals but benefits the community or environment as a whole – students organising a food drive for a local charity to increase the supplies of foods for hampers [www.anglicare.org.au], students participating in the ‘Knit in’ with Wrap with Love and make rugs for under privileged people [http://www.wrapwithlove.org/]; or running a cake stall for the RSPCA [www.rspcacupcakeday.com.au]. |
| Advocacy - creates awareness of or promotes action on an issue of public interest – creating and distributing leaflets on a local cause – promoting an educational centre for refugee students [www.scarf1.org.au]. |
| Research – finding and gathering information to inform service – surveying the local community to see their reaction to new development or changes; students test the water in a local stream to see what is contaminating it and give a report to the local council. |

It is the collaborative approach to learning, striving for all participants to gain from the experience. To this end the students need to be supported with a framework in their planning.
The focus in schools and universities has moved onto engaging with the community to develop programs both for students and the community members – often in a voluntary capacity. Engaged Learning is ensuring that the work with the community is part of the mainstream curriculum and therefore supported by the university and the community alike and the final products are relevant to the students and the community as well. Through engagement with the community students needed a framework to assist in planning of a project to ensure they examined all facets of the work they wanted to achieve with a community partner. The nine areas in the Business Model Generator (Osterwalder, & Pigneur, 2010) have been streamlined to the community engagement needs. Utilising the Engaged Learning Planning Canvas, the university students work through a planned process to develop a comprehensive analysis of the project they are hoping to develop prior to commencing the project. This ensures the concepts they are considering are viable and realistic. The use of a graphic organiser identifies all the elements that need to be addressed.

**THE LEARNING TOOL**

The Engaged Learning Canvas (refer to: Table 2.4) is a graphic organiser to be used in the planning of the partnership with the community. “A graphic organiser is a communication tool that uses visual symbols to express knowledge, concepts, thoughts, or ideas, and the relationships between them with the purpose to provide a visual aid to facilitate learning and instruction or to follow a procedure” (Meyen, Vergason & Whelan 1996, p. 132). Graphic organisers are spatial representations to make efficient use of the information in a text. As a learning tool students use the framework to assist in the development of their ideas using both symbols and text.
The Business Model Generator (refer to: Table 2.4) was revised to suit the development of a social enterprise between university students and a local community group. The nine areas of the Business Model Generator and the Engaged Learning Canvas are shown in table 5. The parallels are obvious between the two canvases as the aim of both a business and a social enterprise is to ensure there is a positive result for all stakeholders in the business and the social enterprise.

Table 2.4: Comparison of the areas in the Business Model Generator and the Engaged Learning Canvas

<table>
<thead>
<tr>
<th>Business Model Generator</th>
<th>Engaged Learning Canvas</th>
</tr>
</thead>
<tbody>
<tr>
<td>Key Partners</td>
<td>Community Partners and Team</td>
</tr>
<tr>
<td>Key activities</td>
<td>Activities</td>
</tr>
<tr>
<td>Key Resources</td>
<td>Resources</td>
</tr>
<tr>
<td>Cost Structure</td>
<td>Budget</td>
</tr>
<tr>
<td>Customer Relationships</td>
<td>Relationships</td>
</tr>
<tr>
<td>Customer Segments</td>
<td>Business Partners</td>
</tr>
<tr>
<td>Value Propositions</td>
<td>Benefits and Values</td>
</tr>
<tr>
<td>Channels</td>
<td>Communications</td>
</tr>
<tr>
<td>Revenue Streams</td>
<td>Support</td>
</tr>
</tbody>
</table>

Through the use of graphic organisers, students develop a structured plan of a viable project to implement within their selected community group.

EXPLANATION OF THE COMPONENTS OF THE ENGAGED LEARNING CANVAS

The nine areas used in the planning canvas require extensive consideration and consultation before the project may be implemented. The completion of the information challenges the students to think comprehensively before the commencement and also means that a planning canvas may be completed which is never implemented as areas of concern may arise. Each component would be developed at the same time, not in isolation from the other aspects of the planning canvas.

The community partners are the connection to the community and give the students an introduction into working with a community group. Often students have an idea of what they would like to do but have no connection with a community group and so creating a link with a community group is essential. This first step in the process of planning students may be assisted by the educator who has connections in the community. The second component of this area is the team who will be working on the project, once again knowing who will work with you sets the tone of the working relationship that should be maintained throughout the project.

The activities that the partners are undertaking are the next focus and this needs comprehensive planning. The use of different types of graphic organisers at this stage would also clarify the project. Gantt chart, timelines and work schedules are important.
The benefits and value of the project are extremely important to the community partner and the students’ planning would need to identify the different aspects that would be addressed. The Enactus guidelines ask students to focus on the livelihoods which are the ‘means and activities involved in sustaining an individual’s life’. These are their financial, social, natural, physical and human assets (Revised Judging Criteria beginners’ guide).

Throughout the planning process the resources required need to be listed and also the availability of these. From the major items to smaller requirements students have to account for all of them.

The relationships need to be developed to ensure the project will succeed include those between team members, the community partners and business partners. How partners will work together and communicate with each other needs to be identified to ensure that the relationships work smoothly and no one’s time is wasted.

The communication between the partners in the project is important but also communication with the wider community about what is being undertaken. Good online communication and links with media would create a more inclusive community project.

In difference to the community partner whom the students are working with there are business partners who may be involved in the project. Establishing the links with other organisations, which may be businesses, government organisations, or local schools.

For students developing a community project and working with limited funding the development of a budget that is comprehensive is imperative. The budget needs to account for each and every item that would be needed throughout the project and also allow for contingencies. Both the cost and the availability would need to be considered as well as when the items or money would be needed.

The final component of the Engaged Learning Planning Canvas looks at the support that may be available, which could be in kind, from different organisations including the business partners or the community partner and the fundraising that maybe undertaken. Students should be encouraged to apply for grants that may support their projects which may also be in the form of money or in kind, such as the waiving of the hire cost for a building.

DEMONSTRATION OF THE PROCESS WITH CHESTER HILL HIGH SCHOOL

A partnership was formed with a local, comprehensive high school to assist in the development of their curriculum to meet the needs of the gifted students. The teachers were aware that the planning for students as they enter high school is a challenge, and particularly when they are selected for their academic ability. Separate to the development of the Engaged Learning for the university students, specific teacher professional development addressed curriculum differentiation and how to meet the academic needs of gifted students, which meant teachers from five different disciplines worked together as they gained knowledge and skills of curriculum development, plus the use of technology. The professional development focussed on the traditional areas of how to differentiate the content being taught, the teaching and
learning processes used, the development of a supportive learning environment and the students’ final products.

From this foundation a format was developed for the planning to accommodate each of the areas of differentiation (Samara & Curry, 1992). Through the matrix the content is differentiated from the simple to complex, the processes go from lower order to higher order thinking skills, the variations of environment are achieved through various ways of grouping the students and a wide range of products are offered or selected by the students which meet the needs of the objective of the activities. This form of planning may be used at any level of teaching and ensures that the curriculum is developed to challenge students of all levels (see Table 5).

Table 2.5: The complete planning matrix

<table>
<thead>
<tr>
<th>Unit Content</th>
<th>Knowledge</th>
<th>Comprehension</th>
<th>Application</th>
<th>Analysis</th>
<th>Synthesis</th>
<th>Evaluation</th>
</tr>
</thead>
<tbody>
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</tbody>
</table>

**MAKING THE CURRICULUM ‘ENGAGED’**

Through the linking of three major organisations: The Australian Red Cross; the government high school; and, a university, a partnership was created to support each agency. The purpose met the educational needs of the Chester Hill High School students through an Engaged Learning partnership within their mainstream curriculum. The Red Cross presented the students with a brief of their requirements, which formed the basis of the curriculum. The requirements were for the students to create instructional films on financial literacy for humanitarian refugees. This dictated the content of the curriculum – from learning about refugees, aid agencies, financial literacy and then the visual literacy and skills in videoing. This content is on the left hand side of the matrix. From this point the various relevant activities were developed in relation to the products to be developed and the various forms of groups.

This unit of work was taught over a 10-week term with the final products being presented to the Red Cross at a special student led assembly at the school. The university students’ role was to be mentors to the high school students when they
were completing their products for the Australian Red Cross. Figure 4 shows the links between the different stakeholders in the teaching and learning.

**Figure 2.4:** The relationships between the different community members

The Engaged Learning Planning canvas was used as a devise for university students to work through the various aspects of the project and their role in each stage. Figure 2.4 is a brief example of the ideas that the students would be considering when planning their partnership with the school and Red Cross.

**WORKING WITH** **OzHarvest**

A second pilot is being undertaken using the same program to develop a curriculum for students in years 5 and 6. This unit is focusing on food sustainability and waste. Working with another community partner, OzHarvest, the work is being created to be used nationally as a curriculum framework. Prior to this level of planning the Engaged Learning Planning canvas was used to determine all the aspects of the engagement with OzHarvest.

Following a request for support from OzHarvest for the development of their education focus of the organisation the university students accepted the challenge. Their first step was to start the planning. Students were required to consider the nine aspects of the project as highlighted in the Engaged Learning Canvas to identify all the work involved and whether the team was capable to undertake the tasks.

A brief overview of the canvas is given in Figure 2.5 to demonstrate the areas that needed to be analysed.
EVALUATION OF THE PROCESS

Following the implementation of the learning, the three areas are used as an evaluation of the learning: academic, social/emotional and organisational skills (refer to: Table 2.6). These areas apply to all stakeholders in the Engage Learning and relate closely to the objectives that were determined in the planning stages of the subject.

<table>
<thead>
<tr>
<th>Table 2.6: Summary of potential learning for the stakeholders</th>
</tr>
</thead>
<tbody>
<tr>
<td>Organisational</td>
</tr>
<tr>
<td>Technology skills</td>
</tr>
<tr>
<td>Time management</td>
</tr>
<tr>
<td>Running a meeting</td>
</tr>
<tr>
<td>Phone and internet communications</td>
</tr>
<tr>
<td>Keeping abreast of paperwork</td>
</tr>
<tr>
<td>Presentation skills</td>
</tr>
<tr>
<td>Working to schedule</td>
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<tr>
<td>Record keeping</td>
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</table>

THE WHOLE PROCESS

For Engaged Learning to be successful, the planning of the teaching and learning must be carried out in a particular process. Figure 2.7 shows the parts of the planning that the educator needs to go through to prepare the students to use the canvas in their planning. The planning canvas may be used as an assessment item and be given feedback for improvement, alternately it may just be a planning tool in the preparation stage of the Engaged Learning and discussed with the different stakeholders.
CONCLUSION

The benefits of using a structured planning tool with university students means they have a framework to follow. It will only be of benefit if the planning of the unit has integrity and the focus is on the students’ development of skills and knowledge meets their needs.
REFERENCES


Figure 2.5: Engaged Learning Canvas
Figure 2.6: Engaged Learning Planning Canvas Chester Hill High School

Figure 2.7: Engaged Learning Planning Canvas OZHarvest
Visual Tools for Developing Cross-Disciplinary Collaboration...
Chapter 3

EducArt: The Digital Cultural Object at the Heart of Transdisciplinary Education

Mathieu Thuot-Dubé (Head of Education at BAnQ, Bibliothèques et Archives nationales du Québec)

Are We Witnessing the Emergence of a New Approach?

Over 2015 / 16, the Montreal Museum of Fine Arts’ EducArt project has been sharing a part of its encyclopedic collection online. In connection with its social mission, the Museum’s artworks are organised thematically and analyzed through various perspectives, above and beyond the art history approach. The broader, cross-curricular approach to these cultural objects creates a framework for transdisciplinary aesthetic appreciation. This approach, inspired by Art Integration (Silverstein and Layne, 2010) and Art-based Learning (Catterall, James S., with Richard Deasy, 2002), among others, is made manifest in the co-creation of learning and evaluating situations with participating educators from various educational fields. These pedagogical co-creations, based on cultural objects available online, are then modelled on the platform and made available through open access to the academic community and general public.

This new pedagogical relationship with the virtual cultural object unites student and teacher in a common collaborative cognitive space, or in the interstitial spaces between disciplines (Marshall, 2011, Klein, 2014, Moran 2002), in which transdisciplinarity leads to a dialogue strategy: first between the artwork and the student, and then between the student and the disciplines being taught, and lastly between the student and the teacher. The established roles of teacher and learner (student) are put into question, since this dialogue is open, its efficacy rooted in the freedom of choice and discourse and in the participants’ underlying motivation.

The virtual cultural object thus becomes a vector for the converging disciplines, contributing to a shared project while optimising their specificity.

The teacher asserts his or her disciplinary specialisation, unleashing the pedagogical potential of the virtual cultural object through his or her own discipline, on the one hand, and taking into account the array of disciplines contributing to the project, on the other. The teaching practices of these educators are thus expanded to include a transdisciplinary approach, and aspects of these contributing elements reveal themselves over the course of the project. This type of approach demands the taking of certain pedagogical risks. However, the roles defined by Klein (2014) - the
spinners, weavers and learners - seem to emerge as a result, facilitating professional
growth and perhaps a more profound integration of knowledge, full of meaning for
the learner.

In this article, we will explore the foundations underpinning the development of
the Montreal Museum of Fine Arts’ EducArt platform, specifically the discrete steps
leading to the completion of transdisciplinary co-creation projects, and we will
explain the roles of the various players (MMFA, academic community, etc.).

INTRODUCTION

The first part of this article introduces the EducArt platform of the Montreal Museum
of Fine Arts (MMFA), and the types of resources implemented in connection with its
development. It will then present the pedagogical foundations that emerged at various
points during the co-creative work initiated by the platform. The information
presented here is based on preliminary subjective observations in the field. This report
is an exercise in reflective practice and praxis in order to identify the pedagogical
practices observed at play among the teachers and Museum staff involved with the
development of the EducArt platform.

On the one hand, there are the MMFA’s goals, propelled by EducArt, and on the
other, the pedagogical imperatives that emerged through the Museum’s collaboration
with participating schools. These two aspects are subsequently united in a common
effort, that of unleashing the cross-curricular and transdisciplinary potential of the
cultural objects in the MMFA’s encyclopedic collection. To experience the EducArt
platform, go to www.educart.ca.

The EducArt project was initiated and developed by the MMFA with the
financial support of the Government of Quebec. This initiative corresponds to
Quebec’s digital cultural plan. EducArt is presented in connection with the Michel de
la Chenelière International Atelier for Education and Art Therapy, in the Museum’s
new Michal and Renata Hornstein Pavilion for Peace.

PART I: THE EDUCART PLATFORM

Effecting a digital transformation and integrating new technologies into its mediation
tools, the EducArt project, cocreated by Mélanie Deveault and Mathieu Thuot-Dubé,
aims to make the Museum’s vast encyclopedic collection accessible beyond its walls.
EducArt is an educational resources project available online and designed for
secondary students and teachers. EducArt favours a thematic approach that is
multidisciplinary and collaborative, in which art and culture are engaged in dialogue
with all areas of the curriculum.

The cross-curricular, open-concept, decompartmentalised, reading of digital
cultural objects in the collection initiated by the EducArt project required a platform,
form of presentation, which would not imprison these objects in a formal reading.
We had to devise a virtual experience that would support and maintain this cross-
curricular approach. However, a cross-curricular reading of these digital cultural
objects suggests and permits several possible points of entry that can enhance an
appreciation of these objects. In addition to the cultural objects in the collection, EducArt offers access to at least three experts per theme by way of a video interview, which, depending on their respective disciplines, has a bearing on theme selection. Through the complementarity of these experts, members of this thematic community, EducArt provides an open-concept experience. This calculated decompartmentalisation immerses the visitor in a thematic virtual environment that is open and inviting. It also proposes that students and teachers think in new ways about the acquisition of knowledge. EducArt is an educational resources platform. This nomenclature is as important as it is precise. Teachers exploring the platform are seeking pedagogical resources. Will they be able to recognise a resource when they see one? At the moment, and because the seventeen projects are still in the pilot phase, the Museum is guiding the teachers through the process, an active participant in the integration of these resources into the pedagogical act. The fact of approaching the teaching of a discipline with a theme as a starting point is a challenge in and of itself, while open-concept teaching is another. To engage in a cross-curricular reading of the digital cultural object, teachers must be guided towards a transdisciplinary style of teaching.

**TYPES OF RESOURCES**

To support this initiative, three types of resources have been developed and offered.

**Themes**

EducArt is a universe in motion, in which each planet is a thematic tour that permits a cross-curricular reading of the Montreal Museum of Fine Arts’ encyclopedic collection. Through its collection, the Museum explores various themes and issues that are at the heart of its social mission: the body, memory, identity, the street, light, the family, and so on.

Once students and teachers have selected a thematic planet, they enter into a spacetime in which every digital cultural object is placed on a timeline and linked to various keywords. In just one click, users can choose to approach a theme historically and/or conceptually, by way of related ideas and attributes.

**Digital Cultural Objects**

The MMFA’s encyclopedic collection comprises more than 40,000 objects, including artworks, decorative-art and design objects, and artifacts, i.e. historical objects. It is therefore valid to qualify them as cultural objects. Inspired by Diet’s (2010) definition, “The cultural object is a material object imbued with meaning and selected for its aesthetic and historical qualities (eg. artwork, design object, daily disciplinary object, historical object, etc.)”, it is important to specify that the topic here is making digital version of cultural objects virtually accessible. Depending on the objects’ theme and pedagogical potential, the Museum will provide contextual information and sets of questions with cross-curricular relevance. Therefore, for each digital cultural object,
the enabling timeline and questions offer users cross-curricular access points, so as to
guide them through an appropriation and interpretation based on the very essence of
this object. Once a pedagogical project is completed, the outcomes can in turn be
considered as digital cultural objects, as they are vehicles of explanations and
knowledge, a disciplinary interpretation that can inspire teachers.

The Experts

A theme can also be explored according to different perspectives, thereby giving
access to several areas of training. What would an urban planner and social worker
observe when looking at works relating to the street? What perspectives would an
astrophysicist or a historian have to offer on the theme of territories and identities?
What issues related to the theme of light must be taken into account by an art restorer?
The artworks are thus unpacked from fresh angles, enabling us to appreciate the world
in all its complexity.

Schools

Ultimately, by exploring these resources and by implementing the pedagogical project
co-created by the Museum and the school, it is the class perspective that emerges and
is shared online. The collaborative work, first between the Museum and the teacher,
then the teacher and student, thus becomes a model, a way of working [methodology]
that can guide school teams in their future EducArt efforts. These projects, based on
the EducArt resources, can be found on the platform, thus becoming part of the
greater EducArt educational and cultural network. This network boasts an
extraordinary quality; it engages its subscribers in open-concept multidisciplinary
exploration.

PART II: PEDAGOGICAL FOUNDATIONS

During the completion of the first EducArt projects, pedagogical attitudes and
approaches emerged. These strategies seem to belong to an approach that is still in
development. In fact, whatever the area and the discipline, common pedagogical
stances arose. This approach, inspired by art integration (Silverstein & Layne, 2010)
and art-based learning (Leavy, 2011), among others, is made manifest in the co-
creation of learning and evaluating situations using digital cultural objects as the
starting point, along with participating educators from various educational fields.

The goal of this new pedagogical relationship with the digital cultural object is to
unite student and teacher in a common collaborative cognitive space, inspired by the
new social and cognitive space discussed by Marshall (2014) and the transformative
practice zones defined by Bresler (2004). In this space time, transdisciplinarity leads
to a dialogue strategy through the process of co-creation: first between the digital
cultural object and teacher, then between the teacher and the other disciplines, and
lastly between the student and the teacher. The established roles of teacher and learner
(student) are thus put into question, since this dialogue is open, its pedagogical
efficacy rooted in the freedom of choice and discourse and in the participants’ underlying motivation.

The virtual cultural object thus becomes a vector for the converging disciplines, contributing to a shared project while optimising their specificity.

In this established and voluntary dialogue, teachers assert their disciplinary specialisation, unleashing the pedagogical potential of the digital cultural object through their own discipline, on the one hand, and taking into account the array of disciplines contributing to the project, on the other. The teaching practices of these teachers are thus expanded to include a transdisciplinary approach. This type of approach requires that certain pedagogical risks be taken. However, the roles defined by Klein (2014) - the spinners, weavers and learners—seem to emerge as a result, facilitating professional growth and perhaps a more profound integration of knowledge, full of meaning for both teacher and learner.

**An Aesthetic Experience That Is…Transdisciplinary?**

It is important to remember that the museum experience is our starting point. Visiting the Museum means having access to unique, precious cultural objects that have been selected because they are part of humankind’s heritage. But this experience—an aesthetic experience—can also be overwhelming. The word “aesthetic” is used in the same sense as John Dewey (1934) in *Art as Experience*:

> An aesthetic experience can be crowded into a moment only in the sense that a climax of prior long enduring processes may arrive in an outstanding movement, which so sweeps everything else into it that all else is forgotten. That which distinguishes an experience as esthetic is conversion of resistance and tensions, of excitations that in themselves are temptations to diversion, into a movement toward an inclusive and fulfilling close.

To Dewey’s description we would add that of Stavo-Debauge and Trom (2004): The aesthetic experience is “a model of experience that is rich and broad, unifying the fragmented, bringing together the scattered, collectivising the personal.”

Architecture, exhibition design, reception staff, activity leaders and educators feed an initial experience that could be qualified as aesthetic. Neophytes find themselves immersed in an environment made rare by its beauty, its attention to detail and the atmosphere created day after day. Then visitors are confronted by the cultural objects in the Museum’s encyclopedic collection. They marvel before the treasures thus assembled. They are permitted to develop a relationship to the artworks, historical objects [artifacts], design objects, i.e. cultural objects imbued with meaning. This is when there is a second aesthetic experience, one that is more profound, unique and relational to the object. In order to give access, and to immerse teachers and students—future users of the EducArt platform—in a series of comparable aesthetic experiences, this time at a distance, the Museum elected to create a virtual open-concept aesthetic environment that is rich and innovative, as much by design as by functionality, replicating a first Museum visit.
Transdisciplinarity

Gravel’s definition (1980, in Legendre, 2005) of transdisciplinarity corresponds precisely with the observations made over the course of the two first years of the platform’s development, i.e. the school years 2014 - 2015 and 2015 - 2016. Gravel defines transdisciplinarity thus:

“It is the highest level of learning integration: it is total integration, which presupposes a way of unifying the teaching methods while respecting the specific didactic methods; it is interdisciplinarity organised in such a way that none of the materials or disciplines previously divided can take precedence over the other; it is integration that moves towards the complete decompartmentalisation of the disciplines being taught.

In fact, inspired by art integration, the EducArt platform accords equal importance to the project’s implementation process and to its outcomes. For the attentive educator, observing, compiling, participating and exchanging with learners while implementing the various steps makes it possible to determine the mental constructs and cognitive processes at work. This approach, which lends itself naturally to visual arts classes or creative workshops, is the prime objective, always available for transposition to all disciplines. Here, questions are not meant to elicit the right answer, but rather to decode how the learner’s creative process takes into account the various concepts of the disciplines under discussion. This way of approaching the teacher-student relationship corresponds to the definition of art integration proposed by Silverstein and Layne (2010), who qualify it as “an approach to teaching in which students construct and demonstrate understanding through an art form. Students engage in a creative process, which connects an art form to another subject area and meets evolving objectives in both.”

This approach to teaching proposes that the art form as final result. For the development of the EducArt platform, the idea of artistic outcome has been associated with the notion of aesthetics, whose meaning has expanded to include the range of disciplines. What would be an aesthetic outcome in the eyes of an expert in mathematics, science, language, music? And then, could this outcome contain an aesthetic shared by each discipline? It is the search for answers to these questions that inspire teachers to spring into action and the outcomes of the pedagogical projects to offer pathways to answers and solutions.

Teachers of all disciplines are thus called upon to release the potential of digital cultural objects presented during a multidisciplinary co-creation session. This collective assessment, whose goal is to develop a common project, is shaped around a digital cultural object. This assessment also takes the form of a multidisciplinary exchange (several disciplines are represented). This exchange is intended to give rise to a framework for transdisciplinary assessment, so that by the end, the teachers know and understand the strategies necessary to address concepts from other disciplines and potentially to integrate them into their own classroom. Rather than teaching disciplinary concepts, the intention is for them to share the meaning of their respective
discipline within the project framework. The quest for meaning and disciplinary complementarity is central to pedagogical co-creation, manifesting itself in significant, powerful pedagogical actions that result in pedagogical vignettes broadcast via the platform’s learning zones.

**Common Collaborative Cognitive Space: Co-Creation**

This moment, initiated by an entity external to the school milieu, in this case the MMFA, is possible in large part because this organisation is not the school. Strictly speaking, it does not represent the educational system, and so does not bear the same obligations. None of this precludes, however, that the Museum serves as an acceleration vector and a unifying force. The common collaborative cognitive space exists thanks to co-creation. The literature provides similar examples. Bresler (2004) refers to this spacetime as transformative practice zones. In fact, she describes these zones as a collaborative space, a place for exchange and debate, which, although sometimes uncomfortable, allows interaction and dialogue. Bresler associates this discomfort, this destabilisation, to a much desired reaction: mobilisation. The teachers who participate are forced to expose their ideas, preconceptions and fears as the project develops. This zone allows for a genuine, real encounter. In the case of the pedagogical co-creation produced with the EducArt platform, the initial proposal is always to create. Setting creation as a goal allows the participants to free themselves from the constrained techniques of the training programme, administrative context and daily realities of teaching at the secondary level. In her article, ‘Trandisciplinarity and Art Integration’, Marshall (2014) calls this meta-disciplinary space the new social and cognitive space. She goes on to explain that this space is located outside the borders between disciplines, beyond disciplines altogether, and that the desire to cross these borders is what propels us into a new social space rooted in transdisciplinary learning. The space of transdisciplinary learning possesses four distinct components: “1) a coherent conceptual framework, lens, or meta-disciplinary perspective; 2) a critique components discipline; 3) a distinct epistemology; and last but not least, 4) an array of particular methods and practices.”

It is important to understand that the common collaborative cognitive space takes into account these two definitions while adding a fundamental objective admitted and above all named: the freedom to create. Participating teachers thus gain a new perspective and have fun exploring the possibilities, while keeping in mind their respective contexts, yes, but also by accepting the risk that this participation implies. Rather than requiring the creation of new programmes, new concepts, it is enough to create one, or to create projects that are as significant for teachers as for students by designing the project around a digital cultural object imbued with meaning. It is thus possible to anticipate that these sessions will yield new ways of perceiving, understanding and teaching the selected disciplinary concepts. And it follows that these new perceptions, methods and approaches are likely to see the light of day.

The act of creation comprises phases and processes. As an objective, it is distinct from collaboration, in its intention to place the participants in the same state, in the same initial position. Starting from zero, so that all the participants are in the same
place, equal, at the same point. Therefore, the participants arrive at the meeting from
the same starting point, *tabula rasa*, without predefined intentions or predetermined
ideas. Starting from zero is essential, because the intentions and ideas must emerge
from the meeting, first with the theme, and then, with the selection of the digital
cultural objects within the theme’s framework. The co-creative dynamic must first
start with a dynamic of individual creation. As presented by Gosselin, Potvin, Gingras
and Murphy (1998), the creative process involves distinct phases united by a dynamic.
It was easy to observe these various phases in the eleven co-creation meetings held
during the 2014 - 2015 and 2015 - 2016 school years. Thus, a diagram clarifies the
dynamics and processes recognised in the work of these various co-creative
experiences. Teachers will retain the following synthesis, which frames the co-
creative experience and the implementation of the EducArt project.

![Diagram of the EducArt co-creative process rooted in the creation dynamic of Gosselin, Potvin, Gingras and Murphy (1998).](image)

What this means is that throughout the project, teachers must never lose sight of these
key elements of success for a project like EducArt. The dynamic of creation and
pedagogical outcome for this type of project requires a continual back-and-forth, first
between the theme and the teachers’ pedagogical ambitions (between A and B). This
initial dialogue, formulated in a collective environment during the co-creative
exchanges, possibly implies a transdisciplinary stance. According to the dynamic of
Gosselin et al. (1998), these teachers will be in the inspiration phase and open to a
new experience. In fact, the links created between a discipline and a theme during
these co-creative encounters seems to correspond with an ideological view of the

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discipline in question. Teachers who make this effort are not following their usual routine, plunged into an immediate didactic investigation. Rather, they are looking for ways that their discipline could be of use in unpacking the theme and complementing the other disciplines. They are acting within a framework of transdisciplinary aesthetic assessment. They look for meaning in what they do. Then we have the digital cultural objects that, once associated with a theme, become vehicles of a more tangible, more concrete process. The teachers that associate the theme (A) with their pedagogical ambitions (B) and who interact more precisely with the digital cultural object (C) that they are using in the classroom have moved from theory to practice, from didactic to pedagogical co-creation. This would occur in Gosselin’s implementation phase, because the project is in process, it is manifesting itself, it is turning ideas into action. The teachers can mentally evaluate the possibilities that have emerged in co-creation to then launch the project with a group. At that point, they will be entering Gosselin et al.’s final phase, the distancing phase, because a constant return to the theme is necessary. The other disciplines (D) are always present, a white noise. They serve to guide individual and collective effort and to function as markers, defining the creative process and its outcome.

The following is a breakdown of the roles played by the various elements of the co-creative process.

**Theme**

The first step of the co-creative session is to find a shared definition of the proposed theme. As the group works together to define and grasp a meaningful theme, disciplinary specifics will come to the fore. In fact, all the teachers channel their disciplinary stance in the exchanges while revealing how they are trying to anchor the disciplinary concepts to the theme. Because of this, a necessary dialogue naturally arises between teachers. Perhaps they consider for the first time what is taught, and how, in the other disciplines. A comparison is inevitable. Thus, the entire team is engaged in a collective choreography of creation, in which the disciplinary specialisation becomes essential, but not sufficient unto itself. It requires the other disciplines to complete its vision, intentions, pedagogical ambitions.

**Digital Cultural Objects**

These digital cultural objects are the markers of a pedagogical co-creation. A selection of digital cultural objects becomes the catalyst for the design of a pedagogical project. The role of the teachers, always as a team, is to release the pedagogical potential of these objects, all the while relying on the shared definition of the theme. This direct application of art-based research (Leavy 2011, Marshall, 2014) is then transmitted to the students, whose turn it is now to unpack meaning from these virtual objects by completing a project. Leavy (2011) describes art-based research as a way to consider artworks, projects, outcomes, in this case the digital cultural objects, as a demonstration of acquired knowledge and as a learning object, and not as mere aesthetic objects. Through exchanges, some ideas will emerge. These ideas originate in the specialised disciplinary stance, but because they are engaged in dialogue, in an
act of exchange, initiated by a cultural object imbued with meaning, history and humanity, the participants refrain from looking for a way to structure an activity, nor do they try to recycle old ideas, but rather they are engaged in the act of creation, seeking something new and unique that will convey the richness and potential of the cultural objects underpinning the work. They are seeking the meaning behind the discipline.

**Pedagogical Ambitions**

This search for disciplinary meaning will lend the project a rare density and disciplinary and multidisciplinary depth rarely achieved. Participating teachers have already adopted a stance of pedagogical creation. Through the exchanges, they are seeking to grasp the vision the other teachers have of the theme, and to understand the cultural objects at their disposal. They are also seeking to determine their own role within the team, both personally and professionally. In fact, they are trying to discover how their beloved discipline can meaningfully contribute to this collective project. As a result, teachers draw on their pedagogical ambitions, or, more simply put, on what they want to do within the project’s framework. These choices are crucial, as they carry precious links the teachers have made between the theme, the digital cultural objects and the disciplinary concepts. This choice will also be what remains on the EducArt platform of the effort expended. Once the project has been implemented and completed, a pedagogical synthesis will be published online, and this synthesis will be a valid pedagogical resource, tested in the field, as it were. The synthesis will take the form of a learning zone, in which short videos will offer the opportunity to understand the transdisciplinary and disciplinary implementation process. These clips are designed to address students as well as teachers. In this way, they respect EducArt’s fundamental values, which is to open dialogue between teacher and student by engaging them both in a shared pedagogical experience. It is important to note that the outcomes of the pedagogical projects become resources in their own right, vehicles of knowledge and of learning. They are an illustration of what was and of what could be.

**A Role for Everyone**

The Museum guides each of its seventeen teams of teachers through the implementation process for these innovative projects. In addition to being a catalyst, driving force, vector, the Museum goes so far as to intervene in the classroom. The Museum is thus personified, by a real presence in the various milieus, in meetings, workshops and the unveiling of the outcomes (results). During the co-creation sessions, the Museum acts, guides and frames the project through the above-mentioned elements: the theme and cultural objects. It recalls the importance of co-creation and of the pedagogical freedom it allows. But it also actively participates in the process, in the dynamic. It offers, questions, argues, listens and advises. In most cases, it has been fairly straightforward to determine that the roles as defined by Klein (2000) function well in the co-creation sessions. Klein identified three types of practitioners: spinners, weavers and learners. Spinners can be disciplinary teachers who continually specialise and who know their discipline so well that they are able to...
make links with all the concepts taught. These super-specialists are useful for the weavers, who, even if they are also disciplinary specialists, are able to make links between the various disciplines by finding multiple points of intersection between concepts, knowledge, methods and strategy. These weavers adopt a transdisciplinary stance, because they have moved beyond their own discipline as well as the others. They are possibly skilled at operating in a mode of fused knowledge (Marshall, 2014). By necessity, the Museum falls in the latter category, navigating from one discipline to another, making use of the contextualisation of cultural objects in order to offer a perch to the disciplines participating in the project; however, most of the teachers who have participated to date fall in the former category, the spinners, which is to be expected, as it is their traditional role. Sometimes the roles are relaxed enough to allow a language teacher to find possibilities in sciences, visual arts, mathematics. The Museum, through its EducArt platform, opens the door by the role it plays, by the themes and digital cultural objects it offers up for free interpretation in an open exchange with all. It sets the example. In this way, spinners explore the role of weavers and are positioned to transmit this attitude to the learners, defined by Klein as the students.

CONCLUSION

The preliminary outcomes and testimonials collected during the platform’s development, as well as the observations made throughout implementation, seem to underscore the importance and relevance of these educational resources. In fact, the resources developed to make use of the MMFA’s collection of digital cultural objects are offered here so as to create virtual crowdsourcing. The Museum, in addition to assisting with this virtualisation by providing historical and formal validation from an art historical perspective, offers a cross-curricular reading of its encyclopedic collection. This unusual initiative attests to the MMFA’s desire to continue to explore new ways of relating to its multifaceted public, and in particular, to challenge and redefine the Museum-School relationship.

It is interesting to catch a glimpse of the role that a cultural institution, like the MMFA, could play in an educational system that attempts to make culture a priority. Approaching all the disciplines taught at the secondary level through digital cultural objects seems to be facilitated by a mediator. The MMFA serves in this case as a new mediator beyond its walls, and the practice appears to be bearing fruit. Not only are the participating teachers apparently opening themselves up to the world of art, but they are also looking for ways to parlay this interest into an aesthetic investigation focused on their discipline while attempting to redefine their idea of and relationship with the Museum in a wider sense. It is possible that this re-evaluation will affect the underlying relationship that these teachers have with culture in general, and that they themselves will become vehicles of a new culture, a pluralist culture, a transdisciplinary culture. The decompartmentalisation of disciplines, like the social mission of the new humanist Museum, views the human experience as a vehicle of meaning and of the possible. It is therefore a response to the idea of an organic society, which is constantly redefining its points of reference, values and future. The
virtual platform that corresponds to this reality and that features cultural objects in an organic way is still in process. But already, guiding educators, teachers, bearers of knowledge and learners in an experience that democratises culture can only serve to usher in a new reciprocal Cultural Institution-School and Culture-School relationship, in step with the twenty-first century as much by its form as by its content.

REFERENCES


CHAPTER 4

Visual Tools for Problem Framing and Problem Solving

Dr. Judy Matthews (QUT Business School)

“If I had an hour to solve a problem, I’d spend 55 minutes thinking about the problem and 5 minutes thinking about the solutions.”

– Albert Einstein

Problem solving is important in everyday situations, and it is understood to be of critical importance when attempting to confront the major challenges facing the world today. Problem framing and problem solving have received much attention over many decades, from people facing personal and professional challenges, as well as from confronting difficult workplace issues at strategic, tactical and operational levels. This chapter summarises the case for using visual tools and visual representations to gain better understanding of current situations from multiple perspectives, to generate and explore new possibilities and to systematically explore potential solutions.

Creative solutions often benefit from an initial deep understanding of the problem space, gaining insights from multiple perspectives rather than moving too fast to attempting to identify possible solutions. Furthermore, the information and understanding that emerge during the exploration of the problem space with thorough investigation of multiple possibilities, including testing of emerging ideas, leads to better, more appropriate co-created solutions. We present a learning approach to problem framing and problem solving informed by multiple experiments. Visual tools and visualisation capture multiple perspectives, generate new ideas and new combinations of ideas to find new opportunities and multiple solutions. They also build creative confidence in creative thinking abilities and imagining new possibilities. Brief examples of the application of visual tools in a problem framing and problem solving framework used in real world problem solving, and suggested resources are provided.

INTRODUCTION

The benefits of using visual tools are well known in the professions of engineering, design and architecture and are also widely used in education (Mayer, Bove, Bryman, Mars, & Tapango, 1996). While researchers have broadly encouraged the use of visual tools to develop insights and gain richer perspectives, with few exceptions, the
explicit use of visual tools to assist in processes and practices has largely remained an ad hoc process rather than a set of organised processes.

Visual tools and representations have the potential to develop the participatory construction of information, generate new possibilities and workable solutions and guide effective implementation. Within this broad arena, visual tools can be applied for generic as well as specific purposes. For example, visual tools can be used to gather and present information in a more understandable form; for reframing situations; to assist with generating new ideas and possibilities; and for evaluating possibilities and for implementation.

The chapter begins with extracts from the extensive literature regarding the contribution of visual tools to problem framing and problem solving, where visual tools are an essential component of an approach to problem solving and the development of new possibilities. Second the dimensions of visual tools for generating a deep understanding of the nuances of current situations before further investigation. Third, tools for reframing and applying visual tools to generate multiple problem frames for idea generation and idea evaluation, and implementation are presented, as well as suggestions for further experimentation and learning.

**VISUAL TOOLS FOR VISUAL THINKING**

Visual thinking is a process of capturing and organising information and expressing ideas using visual representations, where the representations themselves may help to clarify notions and the differences between different notions. We all respond to visual cues and with cultural variations, respond to symbols, such as STOP signs, speed signs and interpret data for better understanding in everyday life. The purpose of using visual tools is to gather and represent relevant information and to stimulate new ways of thinking and acting, individually as well as collectively. The power of visual representation is well known (Clarke 2011; Dziersk 2007; Larkin & Simon 1987; Meyer, Höllerer, Jancsary & van Leeuwen 2013; Wikström & Jackson 2012) and educators have developed programs to enable and enhance visual thinking (Buzan 2014; Buzan & Buzan 2013).

Simple examples of visual representation are often found in tables, figures and diagrams. Figures and diagrams can also indicate temporal characteristics, such as when and where to start, what sequence of events or activities occur and in what order, and when a process is completed. Process mapping can be used to indicate the details of such sequences. Presenting processes in visual form provides both a representation of existing processes as well as the potential for identifying gaps or missing steps in processes. Visual mapping processes are used for processes to indicate the start and finish of a task, as well as relevant relationships. Examples of such tools include GANTT charts and PERT Charts.

Figures and diagrams can indicate spatial relationships between items or events, in terms of the distinctiveness of each component, their relationships and connections to other components, and forms or types of connections. For example, a diagram of a supply chain can show the different stakeholders, and the nature of the connections with other stakeholders as distinct entities, such as suppliers and distributors in a
sequence of interactions with a company; and indicate where suppliers are also distributors or consumers of products and services. Figures can also show the frequency of interactions, the direction of interactions and the nature of interactions. These relationships are commonly shown in system maps where positive or negative reinforcing relationships are illustrated.

Problem framing and problem solving tend to be richer and more successful when people are individually and collectively engaged to share their knowledge, experience and ideas. Visual tools and representations have the potential to involve many stakeholders in the participatory construction of information, and the generation of new possibilities. These tools are collectively used for broad engagement with other stakeholders such as customers, fellow employees, and ensure that stakeholders contribute at all levels.

**VISUAL TOOLS AND METHODS FOR DIAGNOSIS-GATHERING AND PRESENTING INFORMATION**

Visual tools gather and present information in an organised way, and assist in gaining a more accurate view to help make better sense of what is happening in the current situation. Visual tools can be used to map out the range of factors that are likely to influence an existing situation. This process can also indicate gaps in our knowledge and indicate areas where further information is required. For example Tony Buzan’s work on mind mapping (Buzan 2014; Buzan & Buzan 2010) identifies multiple ways that visual representation can lead to new ideas, and assist individuals and collectives to identify potential and real factors that may influences choices and possibilities.

**Mind Maps**

Mind maps were first developed by Tony Buzan (1993) based on research on the functioning of the brain, and the associative processes of interpreting information, generating knowledge through the notion of radiant thinking. Buzan’s research found that structuring information in certain ways, starting with the major concept examination of research in the middle of a page, and using clear labels and symbols of figures for related sub-issues was a productive way to gather, and then present information in an organised way. Tony Buzan (2014) argues that a mind map represents a ‘whole brain’ way of thinking that reflects multiple patterns of the brain and the brain’s associatively linked storage of information. The process of Mind mapping indicates shows relevant influences, as major and minor and also indicates connections to other themes. The maps are used to help generate and organise ideas and different components are illustrated by different colours, as shown in Figure 1.
Mind maps like most visual tools not only help to organise information for individuals but are particularly useful in group situations, where they can form an initial starting point that can be added to by group members. Visual tools are commonly used in project work with cross-disciplinary teams (Whyte, Ewenstein, Hales & Tidd, 2008), where diverse perspectives regarding situations, problems and issues and provide an opportunity to build common understandings before proceeding to explore potential solutions.

Another essential and useful tool for gathering information about a current situation of problem framing and problem solving and a major contributor of vital information for deep understanding and problem definition is known as Kipling’s Six Honest Serving Men, sometimes referred to as 5WH - Who, What, Where, When, Why and How.

<table>
<thead>
<tr>
<th>Gathering Information “Six Honest Serving Men”</th>
</tr>
</thead>
<tbody>
<tr>
<td>Who</td>
</tr>
<tr>
<td>What</td>
</tr>
<tr>
<td>When</td>
</tr>
<tr>
<td>Where</td>
</tr>
<tr>
<td>Why</td>
</tr>
<tr>
<td>How</td>
</tr>
</tbody>
</table>

Table 4.1: Template for gathering relevant information.
Some visual tools are commonly used in daily life to assist in speedy location of routes, through maps or mapping software on Google maps. Visual tools include mapping dimensions of an experience such as a visual representation of a journey from A to B and the highlights of such a trip. Visual tools can help to map a current situation as well as an individual and a group or organisational future more ‘desired’ future state. Such identification can become a focus with milestones for easy assessment.

Visual tools to examine the external environment tables that summarise external factors such as the Political, Economic, Social, Technological, Environmental and Legal (PESTEL). Useful summary of external as well as internal factors are shown in a Strengths, Weaknesses, Opportunities and Threats (SWOT) analysis. Stakeholders whose perspectives are important can be analysed using a Grid that maps relevant stakeholders on the Stakeholder Analysis Power/ Interest Grid indicates not only where such stakeholders are located, but also suggests particular sponsors and their information and communication requirements.

Often we jump to think about solutions without spending a lot of time exploring the dimensions of the problem. This response can be useful behaviour in situations of immediate urgency, but many of the problems that we are trying to address are often those which have no easy solution.

Mapping all the information about a situation on one page can lead to more and better ideas, as well as help to gain a better understanding of the issues at play. Often when we are concerned about a situation we might try to think of solutions or try to brainstorm some ideas that we think might lead to quick solutions. Such an approach may be sufficient in a situation with a technical problem, and may lead to a quick resolution. However often situations that are more complex benefit from gathering all the relevant information onto one page, before any further steps are taken.

Peter Checkland (1998) represented what he called ‘soft systems’, gathering all relevant information about a situation on one page. Checkland’s soft systems methodology (SSM) (Williams & Hummelbrunner 2010) maps the major elements that are affecting a problem, using sketches or figures or diagrams criteria of customers, actors, transformation process, world view, owner, environment (CATWOE) and Rich pictures in Table 4.2.

<table>
<thead>
<tr>
<th>Customers</th>
<th>Who are they, and how does the issue affect them?</th>
</tr>
</thead>
<tbody>
<tr>
<td>Actors</td>
<td>Who is involved in the situation? Who will be involved in implementing solutions? And what will impact their success?</td>
</tr>
<tr>
<td>Transformation</td>
<td>What processes or systems are affected by the issue?</td>
</tr>
<tr>
<td>World View</td>
<td>What is the big picture? And what are the wider impacts of the issue?</td>
</tr>
<tr>
<td>Owner</td>
<td>Who owns the process or situation you are investigating? And what role will they play in the solution?</td>
</tr>
<tr>
<td>Environmental</td>
<td>What are the constraints and limitations that will impact the solution and its success?</td>
</tr>
</tbody>
</table>
These questions help to focus the situation exploration process and can individually as well as collectively contribute to a detailed ‘Rich picture’ that maps the key players and issues. Following identification of each of the elements of the system, Checkland suggests that these ideas should be developed into pictorial representations that are relevant to the context. Rich pictures with combinations of figures and symbols are used to express the complexities of situations. These representations of the components of problematic situations are visual tools to organise available information and perspectives to better understand the dynamics of the situation, and identify problems and influences. Here the stakeholders and their interests and interconnections as well as the owner and can play important roles.

Rich pictures provide an indication of forces at play and may be presented as metaphors. It is important to reflect the characteristics of the situation, using language, symbols and pictures relevant to the context for greater understanding. See example of Rich Picture in Figure 4.2.

![Figure 4.2: Rich Picture of Current Situation.](image)

Other visual tools include tables which summarise the evidencing of information gathering processes.
VISUAL TOOLS FOR REFRAMING SITUATIONS

Reframing a problem situation may be assisted by a Reframing Matrix that represents a range of perspectives regarding the issue and captures views of multiple stakeholders in business contexts. A Reframing Matrix is a simple technique that helps to look at organisational problems from a number of different viewpoints, and expands the range of creative solutions that can be generated. The basic approach relies that different people with different experiences approach problems in different ways. This technique helps groups to put themselves into the mindsets of different people and imagine the solutions, or problems, they would come up with regards to a key question or problem (Morgan, 1993), as shown in Figure 3.

![Reframing Matrix](image)

*Figure 4.3:* Reframing Matrix captures views of multiple stakeholders.

Similarly, Ishikawa or Fishbone Diagrams can show potential influences contributing to the current situation and its problem. Fishbone technique or Ishikawa Diagram helps to question multiple facets of a situation.

Ishikawa diagrams (also called fishbone diagrams, herringbone diagrams, cause-and-effect diagrams, or Fishikawa) are causal diagrams created by Kaoru Ishikawa (1968) that show the potential causes of a specific event, as shown in Figure 4.4.
Other visual tools include tables which summarise the evidencing of information gathering processes.

**VISUAL TOOLS FOR GENERATING IDEAS AND NEW POSSIBILITIES**

Visual tools are commonly used in encouraging idea generation and combination (van der Lugt, 2005). We usually begin with information that is already gathered and move on to generate new ideas. For example, extend the SWOT analysis previously developed to propose new possibilities using a TOWS framework maximising positives and minimising negative influences as shown in the Table 3.

*Table 4.3: TOWS Strategic Alternatives Worksheet*

Morphological analysis with the objective of improving existing models of quality of cars might initially generate variations of improving elements optional equipment internal processes and temporary properties. Mapping all possibilities into a template table similar to Table 4.4, generates more ideas (Zwiecky, 1969).
Mind mapping can also be used for brainstorming, and making new connections. **Brainstorming** and variations such as “What are the worst ideas? What are the Wildest Ideas? Wishful thinking, if resourcing was not an issue”. Using “What if?” often generates lots of ideas which can be then grouped into themes. Using lateral thinking processes such as a random stimulus, or analogy are useful processes. For example, “How is this problem like a spider’s web?” can lead to new and interesting ideas. Another alternative is to assume the best possible solution has been achieved and then working in reverse. For example, identify “What would be the ideal solutions to the situation?” Then using reverse brainstorming, identify the barriers that were overcome to reach the ideal solution, and ask “How did we overcome them?” Mind mapping can be used for brainstorming, and making new connections, and other visual tools such as rough sketching often lead to new perspectives.

Edward de Bono was an early thinker and educationalist who developed multiple tools for clarity of thinking. De Bono (1970)’s lateral thinking includes the possibilities of Plus Minus Interesting as shown in Table 5. To evaluate ideas, de Bono suggests placing all idea/answers in a table to indicate positive influences, negative influences and interesting ideas not previously considered.

### Table 4.4: Example of Morphological analysis.

Example of Morphological analysis

<table>
<thead>
<tr>
<th>Improving Elements</th>
<th>Optional Equipment</th>
<th>Internal Processes</th>
<th>Temporary Properties</th>
</tr>
</thead>
<tbody>
<tr>
<td>1. fuel consumption</td>
<td>ABS</td>
<td>Automatic</td>
<td>powerful engine</td>
</tr>
<tr>
<td>2. breakdowns</td>
<td>Air-conditioning</td>
<td>Operator controlled</td>
<td>perfect tyre</td>
</tr>
<tr>
<td>3. vibrations</td>
<td>heated seats</td>
<td>random continuous</td>
<td>absence of dust</td>
</tr>
<tr>
<td>4. noise</td>
<td>CD player</td>
<td>continuous</td>
<td>cleanliness</td>
</tr>
<tr>
<td>5. odor</td>
<td>Bluetooth technology</td>
<td>intermittent</td>
<td>new car smell</td>
</tr>
</tbody>
</table>

Mind mapping can also be used for brainstorming, and making new connections.
De Bono also proposes using specific criteria for success of ideas to prioritise among ideas generated to meet criteria of benefits, feasibility, resource requirements and fit of ideas with the organisation. Such information when pasted into table format can help to clarify and prioritise ideas.

**Visual Tools and Methods for Implementation**

Force Field Analysis is a method used to gain a whole view of all the forces for, and the forces against, so that all interests are included in decision making. See Table 4.6.
After deciding the actions to be taken, mapping out implementation and necessary evaluation processes is the next step. For example, an implementation plan based on the previously mentioned 5WH could provide a useful detailed summary of the next steps to be taken, by whom, where and when and how, as well as timeframes to monitor success and change.

**Visual Tools for Capacity Building**

Visual tools contribute directly to capacity building as individuals gain experience, confidence and competence in expressing their ideas and in capturing new possibilities. These processes are demonstrated through the ease and familiarity with the use of visual tools to capture the multiple dimensions of situations, as well as in their increasing application of visual tools to convey information through sketches, icons, pictures and photos and generate new possibilities. Using visual tools in group settings assists in enhancing collaboration and co-creation processes that capture the nuances of varied experience, building increased understanding, new possibilities and a positive workplace culture.

**Using Visual Tools in Teaching Contexts**

We suggest that visual tools and their potential contribution should be a focus from the beginning of any unit or course. The unit outline can be expressed as a Mind Map and the tools to be used will be already available on a Blackboard or Moodle site, so
students can explore the possibilities before formally beginning the unit as shown in Figure 5.

![Figure 4.5](image)

Figure 4.5: Example of Unit outline and links.

Classroom exercises applied to encourage visual tools initially can start with many examples in classroom materials as well as links to online resources on YouTube. Seeing and hearing the originators of these tools is a powerful introduction. Learning by doing and learning by using leads to understanding and acceptance of the use of visual tools and repeated application and increased confidence with their use in a variety of contexts. Early access to online tools collections such as Mindtools presented as templates with examples, is a useful introduction.

As well as increasing confidence in using visual tools, overcoming barriers to using visual tools can usually be encouraged by individual ‘out of class’ tasks as well as small group tasks in classroom time. Some students may be initially reluctant to experiment with these tools so presenting information in such formats, setting some tasks and demonstrating with written material and relevant examples, are essential for introductions, with early and frequent use.

**Practical Exploration and Application of Visual Tools in Teaching Problem Solving**

Engineering and architecture students tend to be initially more comfortable with visual representations, and other students soon gain confidence in their abilities. Providing information in both text and visual format, and requiring application of visual tools to classroom exercises are useful exercises. For example, a visual summary in Figure 4.6.
Students participating in problem framing and problem solving tend to bring a range of diverse experience. To extend the range of experience, the course needs to explicitly demonstrate the possibilities that come from using visual representations in form of diagrams, figures, photos, sketches, icons and setting clear expectations of requirements as well as time set aside in class to practice with multiple media.

Mind mapping can be a useful and relatively straightforward step to introduce multiple concepts and is a good start and introduction to visual tools. Mind maps can be used with the unit outline of material to be covered, as well as while introducing major concepts. Mind maps can outline how to address the questions used for essays and assignments, identifying relevant concepts and may be generated individually or collectively. Mind maps are also useful for taking notes as well as planning presentations and are invaluable for summarising concepts covered in class and then later individual revision, with further applications explored in ‘Mind maps for Business’ (Buzan, 2014; Mento & Martinelli, 1999).

Sketching as a source of ideas and a way of collaboratively developing new ideas has been thoroughly explored in a number of books by Dan Roam (2013) beginning with “The Back of the Napkin” to “Draw to Win” (Roam, 2016). As previously mentioned, sketching in form of rich pictures can be useful preliminary activity before the details of a situated context are well-known.

Figure 4.6: Visual representation of Nine Stage Problem Solving Framework
Resources for Visual Representation

Visual tools in popular use range from a simple representation of a table where the important characteristics are compared with two or three different alternative approaches and their benefits. Visual representation using a time sequence like a calendar can enable better planning and more thorough preparation. The addition of milestones to such a calendar indicates specific goals and can also measure progress towards certain goals. Score cards are used to indicate progress to goals and even traffic lights are used to indicate stages of progress.

The internet is a rich resource for templates, examples and even YouTube videos of how to further explore visual tools, from Mind mapping and Mind Mapping software, to Rich pictures. Websites also provide information about likely tools such as Mind Tools: a repository of tools for visual thinking and problem solving.

Assessment of learning and application of this material can include developing a Learning portfolio that demonstrates knowledge and application of problem solving frameworks and an individual toolkit for problem solving. A useful component of a Learning Portfolio might be a Mind map of all the Visual Tools used as well as a summary table such as Table 4.7 for future use.

Table 4.7: Proposed Summary of Tools for Six Stages of Problem Solving framework.

<table>
<thead>
<tr>
<th>Stages of Problem Solving</th>
<th>Aim</th>
<th>Primary Tools</th>
</tr>
</thead>
<tbody>
<tr>
<td>Objective Finding</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Fact Finding</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Problem finding</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Idea Finding</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Solution finding</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Acceptance finding</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

CONCLUSION

Visual tools are invaluable in today’s workplaces, as organisers of information, records of events and also as collaborative and co-creating processes for problem framing and problem solving. Research has shown us that visual representation of information not only leads to deeper understanding but also the possibility of generating new ideas and solutions as well as new opportunities (Clarke, 2011).

This chapter has presented a small sample of the many visual tools used in problem framing and problem solving. Application of these visual tools assists
students not only frame and solve problems in more creative ways, but also to build collaborations and inclusive relationships with stakeholders and co-create better solutions. Feedback from students indicates that their success in generating better solutions to long-term problems has given them new confidence in their abilities to frame and engage with others to solve problems, and led positive and long lasting positive changes in their work practices. Their new abilities have generated new business for existing organisations and generated solutions that have built new enterprises. Have fun exploring these and other visual tools available on the internet!

REFERENCES


CHAPTER 5

Visual Problem Appraisal: A Learning Strategy, which uses Filmed Narratives

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This chapter describes the film-based learning strategy of Visual Problem Appraisal (VPA). It assesses its strength of simulation and its impact on learning about cross-disciplinary collaboration. VPA is used in workshops dealing with cross-disciplinary problem analysis and policy design, and involves the participants ‘meeting’ stakeholders through the latter’s filmed narratives. Workshop participants consult stakeholders through watching them on films. A VPA set consists of a series of filmed interviews (between 20 and 30) complemented with two documentaries. These films provide particular perspectives on the contextual reality as perceived by diverse stakeholders. Within a learning design of ‘scoping’, ‘stakeholder consultation’ and ‘action’, the participants get access to the filmed narratives and ‘interview’ the stakeholders.

All textual and visual information provides a chance to explore the complex and conflictive arena of the issue at stake. The learning becomes a transformative experience as participants soon come to realize that stakeholder consultation is not about finding out one final truth, but is about diverse framings of reality, it is about the exposure to and interpretation of the personal narratives by the observer. As the recorded films do not allow asking questions to the interviewee, the audience has to leave the initiative for knowledge sharing to the interviewee. The realization that careful listening and observing is a difficult competence adds to the learning experience.

This chapter presents and discusses the learning outcomes of recent uses of VPA in Higher Education based on students’ evaluations and reflections. The results build on the evaluations and reflections of MSc-level and PhD-level students who participated in two different training programmes in Uganda and the Netherlands. The results demonstrate the effectiveness of the simulation, compare film and reality, and confirm the existence of social learning in a cross-disciplinary context.
INTRODUCTION

This chapter assesses the film-based learning strategy called Visual Problem Appraisal (VPA), which is used to enhance the analysis of complex issues and facilitate a plan of action by concerned stakeholders. VPA is used in the public domain whereby the filmed narratives represent overlooked and excluded stakeholders. In Higher Education the VPA is used in training programmes dealing with cross-disciplinary problem analysis and policy design, and engages students in ‘meeting’ stakeholders through the latter’s filmed narratives. The students consult and learn from the selection, observation and analysis of a series of filmed interviews and visualised stakeholder bound contexts.

Figure 5.1: Students watching an interview with Diamond Bozas, a landscape painter in KwaZulu-Natal.

Since the production of the first VPA set in 1996 that addressed rice production in the Guyanas, we could not envisage that 20 years later we would still further develop our insights into this visual learning strategy. We have produced the VPA on integrated coastal zone management in Kerala, India, (Witteveen, 2003) and the VPA rural livelihoods in KwaZulu-Natal, South Africa (Witteveen, Van Rijn, Bele, & Lie, 2012) in collaboration with and for use in cross-disciplinary master programs at universities in Kerala, India and Kwa-Zulu Natal, South Africa. Although it was considered that the contextual specifics of the issue at stake would define the relevance of a particular VPA package it was acknowledged that VPA packages also became integrated in curricula in other countries and programmes for the relevance of contemporary generic learning outcomes. In a parallel trajectory we accumulated experiences in our own institutes of Higher Education in the Netherland with groups of international students enrolled in various disciplinary and cross-disciplinary bachelor and master programs. With the continuing use of the VPA we embarked on a long journey to
further explore visual learning and the production implications for VPA. In bits and pieces we were informed about how around the globe VPA was used and we recognised that innovating education is a complex endeavour as changing conventional learning requires dealing with patterns of (un)certainty avoidance and stretching comfort zones of the learners involved, but also of the lecturers and the institution involved.

The chapter will share some of our experiences with producing and using the VPA and innovating with visual learning. We will describe the main characteristics of the design and use of this visual tool, address it as a visual learning strategy and discuss how a VPA programme in Higher Education builds students’ capacity in dealing with cross-disciplinarity. The chapter presents and discusses reflections on the learning outcomes of two VPA programmes in Higher Education that ran in The Netherlands and in Uganda by assessing the evaluations of the students who participated in the programmes. It also presents how students experience the strength of visual simulation and how they deal with the issue of ‘film versus reality’.

**WHAT IS VISUAL PROBLEM APPRAISAL?**

A VPA set consists of a series of filmed interviews complemented with documentaries in relation to a particular problematic and conflictive issue. These films provide particular perspectives on the contextual reality of the stakeholders. The set gives (prospect) practitioners, civil society actors, decision- and policy makers an opportunity to watch and reflect on a series of stakeholder interviews. These filmed interviews and the accompanying documentaries offer the students a chance to explore the complex and conflictive arena of the issue at stake (Witteveen, Put, & Leeuwis, 2010).

‘Meeting’ a number of stakeholders with the filmed interviews allows the participants to learn about the different perspectives of these interviewees and the way they frame their problems. The VPA participants analyse and structure the information encapsulated in the interviews and formulate recommendations for action. This can take various shapes such as scenario development, policy design or elaborated project proposals. Participants work individually and in small groups on a facilitated programme structured by the VPA films and a reflective workbook. The students soon come to realize that stakeholder consultation is not about finding out one final truth. The mediated encounters with predictable as well as with overlooked stakeholders is an often disturbing experience as the filmed narratives exposes students to conflicting problem perceptions and contrasting inter- and intra-personal framings of reality. Making a story out of all this does not emerge in a logic, sequential procedure but turns out to be a complex endeavour the student learns to be accountable for.

During the simulated stakeholder consultation, which is at the core of the VPA, the students view a selected number of interviews out of the available ones. The selection simulates conditions, which are in line with the reality of stakeholder consultation where constraints of time, resources and access to respondents are
influential. This procedure makes students feel responsible as they realize it is a consequential decision.

Figure 5.2: Most often it takes a long discussion for students to decide which VPA interviewee to select.

The VPA creates a space where the VPA interviewee tells her or his story, filmed in a way that the audience experiences the role of interviewer. The audience may feel sympathy; antipathy or confusion and these feelings are not simulated but real. This becomes apparent during presentations when students reveal their identification with their filmed informants by talking in first person: “we first went to see Mr. Reza” or whilst debating with another group of students: “but during the interview with us she told us […].” To create this space of mediated dialogue, the VPA film uses an ‘interview driven’ film style. The VPA interview films are extended narratives with only the interviewee on screen in long steady frames filmed on location and during activities in his/her daily environment.

The VPA film style implicates an extended production process due to the rapport that needs to be built with the interviewees and the long interviewing times and the ambition to represent the diverse stakeholders, and other diversity aspects, for example seasonality. Moreover, the selection process of the stakeholders, the search procedures and the technical set-up of the filming are crucial and demand time. In narration-driven films less footage is needed because the narration can melt the scenes together.
The particular VPA interview driven style also defines the editing. VPA editing is limited as compared to conventional documentary filming as the editing process is not intervening the narrative. The sequencing and arguments are not alternated; the editing makes the interview accessible to the audience by cutting away technical problems (light, sound) while respecting the complete narrative as it was delivered during recording. The process often described by film editors as of how ‘the story revealed itself’ (Tobias, 1998, p. 255) is, in case of the VPA interviews, not taking place in the editing room. Inaccuracies, hesitations, repetitions and contradictions in the narrative of the interviewee do not exist by default and therefore are not cut away. In line with the typology of Nichols (2001) the VPA interviews are produced in the observational mode whereby the filmmaker is “simply to observe what happens in front of the camera without overt intervention” (p. 109). In this way interview conventions are contested and do not match the audience expectation to consume an “informing logic carried by the spoken word” (Nichols, 2001, p. 107) as in expository modes practices in most educational documentaries. The VPA films represent the everyday discourse of social actors obliging the audience to deconstruct and reconstruct the storyline.

A VISUAL LEARNING STRATEGY

Over the past decades it is widely acknowledged that visual images, still and motion, have gained an important place in all spheres of life (Austin & De Jong, 2008;
Knoblauch, Schettler, Raab, & Soener, 2009; Rose, 2012). This development is not reflected in studies in relation to visual learning strategies. The search in open and academic web sources with the terms ‘visual learning strategies’ and with the term ‘visual learning styles’ delivers few relevant results. Besides the statement like ‘a picture says more than a thousand words’, we often read a plea for the effectiveness of using visual (still) material rather than studying the distinctive specifics of a visual approach. The VPA learning strategy uses a visual approach for achieving learning outcomes, which are otherwise difficult to achieve capitalising on the specific value of film to alter distances of time and space (Witteveen & Lie, 2012).

The VPA was initially designed as a simulation, and a second best option after learning in reality to address complex, cross-disciplinary multi-stakeholder problems. Yet the opposition of reality versus simulation has become out-dated with framing the use of the VPA as a space of social learning whereby the VPA audience or VPA learners are in the spotlight of reality. Using the VPA in the public domain implies that audiences or VPA users are stakeholders with “different discourses [which] tend to collide at social interfaces.” (Leeuwis & Aarts, 2011) whereby for reality to become manifest for the VPA audience it is not imperative to have the live presence of all social actors. In Higher Education the VPA is used in curricula for students who are considered as prospect actors in similar problem situations in a nearby future. In line with Leeuwis and Aarts (2011), we can consider the mediated participation of particular stakeholders through the VPA films as a communicative strategy enhancing the basic processes relevant to support social learning (p. 31).

Figure 5.4: As the VPA aims to document views of remote and often overlooked stakeholders long travels are imperative during the production.
Similar to Van Herk, Rijke, Zevenbergen, Ashley and Besseling (2014) we align here with Muro and Jeffrey (2008, p. 339) who reviewed theories and applications of social learning in participatory natural resource management processes, and concluded that:

“social learning requires the communication and interaction of different actors in a participatory setting which is believed to result in a set of social outcomes, such as the generation of new knowledge, the acquisition of technical and social skills as well as the development of trust and relationships which in turn may form the basis for a common understanding of the system or problem at hand, agreement and collective actions.”

Multiple authors (Enserink et al., 2010; Van Herk, Rijke, Zevenbergen, Ashley, & Besseling (2014) elaborate on the relevance of social learning processes in complex multi-actor processes whereby stakeholders such as decision makers, managers and scientists may adopt a rather regulatory and technocratic approach and thereby disregarding the dynamics in the process. Enserink, Kwakkel and Veenman (2013) brings this notion further in a detailed description on dealing with epistemic uncertainty by policymakers and politicians in complex problem situations like climate change adaptation.

The limited space of this chapter is not the place to elaborate more on interpretations of the above for outlining contemporary competences to be addressed in Higher Education. We aimed to provide a glimpse of the ambition with which the VPA is designed to enable encounters between stakeholders who relate to complex or wicked problems, with a special focus on the (mediated) participation of overlooked and excluded stakeholders. These ambitions are positioned in a context of participation and “voices of the poor” (Chambers, 2007, p. 38) as well as in relation to social learning and cross-disciplinarity.

**VPA DYNAMICS AND LEARNING OUTCOMES**

Participants in a VPA training go through a three-tier programme: scoping, stakeholder consultation and action. The Scoping Stage varies from a quick scan to a desk study. The Scoping Stage starts with a Kick-off Meeting. Once participants have a basic idea of things to come they see the first VPA documentary. The documentary is the introduction to a desk study focusing on mastering subject-matter knowledge. Reflective forms guide this desk study. Participants answer reflective questions on the subject(s) they want to study, study strategies, activities and outcomes (whether their questions were answered or not). The facilitators provide feedback on these reflective forms. This reflective journal enhances an active-learning of the students and staff: it allows them to assess the information gained to monitor progress and their own learning activities, as after each step they have to make up their mind before taking a conscious decision about the next step.

During the simulated stakeholder consultation the VPA participants view a selected number of interviews out of the available ones. The selection simulates
conditions, which are in line with the reality of stakeholder consultation where constraints of time, resources and availability of respondents are influential. Reflective forms guide the process of selection and interviewing: each team has to convince the facilitators about the appropriateness of the selected interviewee, before they are allowed to ‘meet him or her’. After each interview, teams fill in a reflective form articulating their actions and decisions as a basis for the feedback session with facilitators. The feedback sessions of the team and facilitators provide opportunities for a variety of instruction activities. ‘Meeting’ a number of stakeholders allows the participants to learn about the different perspectives of these interviewees and the way they frame their problems. These stakeholder interviews are experienced by VPA participants as a mediated though realistic simulation. In the Action Stage participants have to interpret and organize the overwhelming palette of confusing, contrasting, and contradicting information and formulate recommendations for action. This can take various shapes such as scenario development, policy design or elaborated project proposals.

In Higher Education, formulated learning outcomes of a VPA training are that:

Participants are able:
- to explore the complex problem and position it has in a professional and societal context;
- to make an analysis of the different positions of primary stakeholders and the strategies they employ towards the complex problem at stake;
- to integrate information obtained from a variety of sources and an understanding of earlier achieved knowledge or experience;
- to formulate argued opinions and conclusions during a structured procedure for problem analysis;
- to re-formulate, adapt or discard these opinions and conclusions during the research;
- to develop a focus on public participation and realize a stakeholder consultation;
- to design a policy and action oriented perspective considering the issue at stake;
- to give examples of ethics of the practice of research and stakeholder consultation;
- to compare and relate contrasting and confusing findings of a stakeholder consultation, and;
- to identify and act on their frame of reference and formulate new ideas and intentions for their learning processes.

**Methodology**

The reflections on the learning outcomes, which are presented in this chapter result from using the VPA in two training programmes, which were given in 2015. The first programme ran in October and November 2015 with a cohort of 33 international
students (mainly from Africa and Asia) enrolled in the MSc programme Management of Development (MoD) at Van Hall Larenstein, University of Applied Sciences in The Netherlands. These students worked with the VPA Rural Livelihoods in KwaZulu-Natal, which was produced in 2012. In May 2016 they were invited to reflect on the learning outcomes of the training to activate their (appreciation of) existing research competences as they were preparing for their thesis research. All 33 students submitted with one student submitting an erroneous file. Although the assessment was designed as an instrument for self-monitoring, the results of the 32 contributions are reviewed here as an evaluation of the VPA impact.

The second training programme ran in May and June 2015 at Makerere University in Uganda with a cohort of 14 PhD students coming from different countries in Africa. The VPA was incorporated alongside an actual field visit in a PhD course entitled Application of Innovations in Agricultural and Rural Development (ARI). The ARI students first went on a fieldtrip to visit the Integrated Seed Sector Development (ISSD) supported Local Seed Business (LSB) group to in Kyazanga town in Lwengo district. The farmers here are very active in the production and marketing of bean seed and have organised themselves in a larger farmer cooperative society. All 14 PhD students reflected in written field reports. These reports demonstrated some issues with regard to the methodological understanding of the field visit. For instance an activity of one day can hardly be termed a study; it is a one-day field visit or a tour as described correctly by some of the students. Some of the reports also mentioned that descriptions, especially introductions, tend to become generic for ISSD Uganda or seed systems at large, rather than contextualizing these experiences in light of the one-day field visit. Interesting quotes and direct observations were hardly reported as if no conversations had taken place.

The tendency to overlook these methodology related particularities of the experience was discussed with the students as a reflection of insufficient dialogue, respect and interest for the actors involved. The reliability of this particular experience was not meant to result in a worldwide validity, but was meant to generate the specifics of the stories, the discourse and current concerns as expressed by the farmers visited during the field visit. The opportunity provided to the ARI students to observe the daily practice of innovations, or stated otherwise, to appreciate the farmer group for being guest lecturers for a day, would have been most appropriate.

After intense discussions on the students’ performance during the field visit, it was decided that in a following ARI module the 14 students were to undertake field research in a mediated way using the VPA Rural Livelihoods in KwaZulu-Natal to focus on issues of methodology, without the complicated logistics of a field visit and even more without further bothering real people in a rural community. Evaluations of the students on the process described above have been included in the results below and are presented in the original formulation.

Both pools of evaluative reflections about MoD and ARI are used below to address the strength of the VPA simulation and to assess the quality of the VPA in addressing cross-disciplinarity.
RESULTS MOD

The Strength of the Simulation

The reflections on the learning outcomes were described by the 24 respondents in first person statements using ‘I’. They often used the phrase ‘as a researcher I …’. The other 8 students used ‘we’, ‘the student’ or other ways. This way of writing and reflecting about their own performance and the critical observations about the practice of doing research as exemplified by the following statements is considered to confirm an (aspect) of social learning.

One of the reasons that respondents and informants may not respond to questions raised by researcher is because they perceive professionals as being judgmental or holding negative attitudes toward them. As such, it is important for professionals to critically examine their opinions and attitudes toward respondents and informants for research data collection, within the context of larger social structures, for the purposes of identifying those views that might interfere with the relevant responses. #8 (boldness by the student)

Another aspect considered indicative for the forte of the simulated space of reality are the action verbs used to formulate personal learning experiences other than the standardised / conventional learning outcome formulation of ‘I am able to’.

To value the differences of respondents opinion when doing research. #3 (boldness by the student)
As a researcher I need to be always alert. #29 (boldness by the student)

I realised that many stakeholders who are involved in solving the wicked problems have their own issues and they will create new problems in different ways. #6

I am also impressed by the concept that, there are multiple realities, which can be experienced, and the researcher is not independent of the researched. #18

Students did reflect on the VPA as mediated or simulated action research formulated as interviewing stakeholders through recorded films, to learn by watching films or to observe the visualised challenges of rural communities.

I recognized that a mediated film can also be an interview. I never thought this otherwise. From the mediated film valuable information on the livelihood of the interviewees can be collected for that region. Further, we can feel their way of life by watching and listening to their voice like in real-life situations. #33
I learnt that research can be done using visual recordings as a data collection strategy and other data collection methods such as observation and listening. #6

Aspects of social learning are also found when students express empathy towards the filmed interviewees and convert this experience into formulating a learning outcome that relates to themselves, to their competence to analyse the interview.

*It is important to feel the conversation or situation to understand the respondents.* #1

For example, most of us can empathize with someone who has been injured or sick – we can quite easily put ourselves “in their shoes” and understand, to some extent, what they are feeling. We can share their emotional experience, because observing their pain activates regions of our brain which are involved in processing the emotional aspects of pain. #8

Students elaborate further on specific communicative qualities which resulted directly from the visual learning process.

*By watching film regarding Kwazulu-Natal, I learn how to sharpen my senses to obtain relevant information, even for tiny information but useful information. I also learn to use my feeling to obtain non-visible information.* #14

*I knew that when we are collecting data from interview or mediated by film, it is very important to use all our senses, such as listening, observe, feeling by using our hands or noses to our interviewee or the environment surrounding the issue in fact. These help to describe the issues or problems we are dealing with during the analysis of the situation.* #17

*During the watching films of various interviews, I have learned that careful listening is important to understand the answers and explanations of the informants. In video it is possible to re-play it again, but in reality it is hardly possible to go back to respondents after recoding their answers. Observing was one thing I have not given attention to it before, but I learned that observation is another source of information to triangulate what has been said* [...] #18

**Learning about Cross-disciplinarity**

Although the VPA learning outcomes do not explicitly address the concept of cross-disciplinarity, many of the learning outcomes address it implicitly by for instance referring to being able to make an analysis of the different (disciplinary) positions of
stakeholders and being able to compare and relate contrasting and confusing findings. Many students report that they have learned in this regard.

I am able to conduct research with intercultural teams. I am able to work with different people with different cultural background and able to understand how to approach peoples with different background, expertise and value the opinion of others. #11

I learnt that stakeholder consultation helps to understand an issue at stake. Involving stakeholders helps the researcher to identify issues of concern and also get ideas from the stakeholders. #2

It is possible to find respondent or informant that express opinion that against my value. I have to respect their opinion. Furthermore, I also possible face the informant that lie, I have to be wise to not directly against their opinion. #14

The student gathered sound understanding of the diversity of rural livelihoods problems and socio-economic dynamics, and associated mechanisms of social exclusion. #15

Visual Problem Appraisal (VPA) used during this module as a visual learning strategy. This often trigged the researcher’s mind to reflect on past interactions on what was exchanged and body languages of respondents communicating. #15

To experience the various stages of analysing complex problems in a multi-actor system from the professional perspective of a consultant. #12

I am able to realise the importance of interaction between problem owners and interested parties. It helped me gain sound knowledge that it is better to involve the stakeholders rather than relying on pre-assumptions. #29

I have learned that, what makes a development research complicated is by the fact that it deals with people and in the course of trying to solve, the problem leads the discovery of another layer of complexity. There is no linear solution to this kind of problems because it is the outcome of interaction of issues and difficulty in defining the problem it’s self-let alone solving it. #18

**Learning about Interactions of Different Actors in a Cross-disciplinary Environment**

The process learning about interactions of different actors, the recognition of interdependencies is crucial for being able to work in a cross-disciplinary
environment. The learning outcomes of the VPA that address this by using verbs such as ‘integrate’, ‘reformulate’, ‘adapt and discard’, and, ‘compare’. Students confirm this learning with the following statements.

*I have been able to recognise that acknowledgement of respondent’s indigenous knowledge is important during research. #5*

*I learnt that the reality of poverty can be described well from the point of people who feel are poor. Thus as a researcher my perception of poverty is different from the perception of affected research participants. #6*

*I have been able to identify the indigenous knowledge of the respondent. #13*

Respondents are also stakeholders in the research. # 20

*That a researcher should listen to the different opinions presented by the respondents, during the data collection and to incorporate different respondents to acquire information since it is attained form different sources. #20*

*To become aware of my own positionality and bias in the conduct of development research. One important insight I gained from the VPA was how even in a very small community people can be as diverse as possible and how those diversity influence their livelihood. #27*

Some students (re-)formulated their own learning outcomes in relation to language and translation.

*To recognise the difficulty of language and socio-cultural translation. # 22*

*Learned that a translator is important when doing research to the community which does not understand your language. #24*

**RESULTS ARI**

**The Strength of the Simulation**

Similar to the MoD VPA experience the ARI students formulated the learning in the report as if it was real.

*On 4th, June 2015, I travelled to KwaZulu- Natal South Africa (KZNSA) interested in understanding agricultural services delivery. #U9*
I visited three farmers in about three hours in different locations. The farmers are able to tell their life story without necessarily meeting the farmer directly. The farmers are well prepared to better tell their stories and exhibit quite good confidence in their expression. For example, Juliana Mthembu, a female farmer was confident enough and was excited to tell the story about her life and the family. What was interesting is when she said that; 'I have struggled to make a living given the circumstances my husband is going..."#U2

Learning about Cross-disciplinarity

Quite a few students applied a comparative view to the Kyazanga field visit and the mediated VPA encounters without ranking or defining the best, but rather by describing major differences in implementation and the resulting learning outcomes.

Both the mediated and actual learning have informed that learning as a process can take place using different pathways with relative effectiveness. #U3

Limitations indicated by some students show a preference for real field visits, especially mentioning the option to formulate ‘own’ questions to the interviewee. Following a more comparative view, several students reflected on this VPA characteristic for its specific qualities.

In mediated interviews the interview does not change the responses to satisfy the interviewer as there is no face to face contact. #U1

Listening being part and parcel of the communication process is also a hard earned virtue as was evidenced at the Kyazanga field visit. The conversation flow whilst in the field was skewed to the researchers’ side without the consideration of the farmers’ views and opinions. Mediated field research on the other hand offers a golden opportunity for the researcher to be a ‘silent’ learner, availing no other option but an open door for critical reflection, analysis and observation of what can be seen and heard. #U13

Remarkably, the ARI students reflect on the cost and efforts of fieldwork.

The use of VPA was a new venture all together, offering a cheap and fast method of interacting with interviewees through filmed narratives. This contrasted with the long field journey to Kyazanga where we spent close to 6-8 hours of the day travelling to meet the farmers we were to interview, notwithstanding the entire cost of the journey comprising vehicle hire, fuel costs, driver’s per diem and allowance. In addition was the likelihood of the occurrence of an accident(s) as was witnessed on our way back from the field. Such expenses and high opportunity costs involving the endangering of
lives is one of the pluses of a mediated field visit against a real field experience. #U13

A limited number of students elaborates on the critiques discussed after the Kyazanga field trip.

Moreover, weak preparations in actual fieldwork and dependence on highly synthesized public relations (PR) materials, hedge critical debate and learning, to PR direction. Learning in Kyazanga fieldwork was, likewise, significantly hampered by delays, fatigues for the farmers, instructors and learners during travel, hijacking of the day’s program by the host and the translator – who happened to double as host. Because, translation was never a prior arrangement, the translator ended up being the host who repetitively distorted the context of the messages from the farmers with uncalled for additional explanations. In the end, the translator ended up dominating the conversions. #U12

Figure 5.5: Group session during the field visit questioned for the lack of active involvement of all participants in the conversation.

Most students value resulting learning outcomes for the specifics of the methodologies and compare for their specific relevance and look at diversity of methodologies.
VPA and actual field work are central in promoting learning and research exploration despite their differences in the mode of operation. They need to be used interchangeably to meet different learning interests to complement and supplement each other than surpassing themselves. #U2

Learning about Interactions of Different Actors in a Cross-disciplinary Environment

Similar to MoD students, they report on empathetic experiences.

Women till larger gardens in a monoculture system. In one of the field visits they are seen weeding and happily singing to maintain their morale. What an exhibition of ‘bridging social capital’ amongst these farmers in service delivery within their community! For they have come together as colleagues in rural transformation. #U9

One student reports about his emotion, followed by his opinion about these emotions.

‘The interview with L. could easily evoke emotions: [quote from the interview] However, a RDP must at all times remain composed despite the day-to-day encounter of such emotional situations. #U6

A particular aspect of learning is shown where students indicate advantages of the VPA for the interviewees.

In mediated interviews the interviewee operates from the comfort zones and thus is not inconvenienced unlike the actual field work where the interviewee may be required to move to another place like the Kyazanga case the farmers moved to a common place leaving their work. #U1

It also inadvertently offers an opportunity for the marginalized and voiceless to be heard, appreciated and understood as it restricts interface with the interviewer/interviewee, profoundly favoring the interviewee. #U13

There are situations where important stakeholders are physically absent during collaborative dissemination of technologies making their voices not to be heard by the target group. To counter this problem, the use of videos can be employed. This will make the stakeholder present though not physically. #U7

CONCLUSION

The results obtained from the student evaluations reports confirm that the VPA has been experienced as a simulation of stakeholder consultation and action research in KwaZulu-Natal, South Africa. This is in line with earlier research conducted by
With the VPA we achieve to create a space of learning for students in Higher Education, which allows the students to explore a complex and conflictive arena in a cross-disciplinary manner by meeting and interviewing a diversity of stakeholders. Organising a selection of interviews, the observations and analysis are experienced by students as a realistic setting to achieve relevant learning outcomes. The students’ reflections from the MoD and the ARI students indicate that students are able to reflect on their experience and indicate learning outcomes in relation to social learning and cross-disciplinarity.

The visual learning strategy leads to a multi-sensory experience, which seems to contribute intrinsic motivation and active interest for the learning process. Even though not proven as such, it can be imagined that the empathetic approaches towards VPA interviewees contributes to social learning in a sense of having been confronted with embodied interdependencies. In line with Leeuwis and Aarts (2011) we argue that the VPA re-orders social relationships by exposure to storylines that intertwine deliberate and everyday communication. Westerlund and Leminen (2011, p. 25) write in this context about establishing new cultures and mind-sets “as well as providing facilities that support increased openness”. In this regard the results have illustrated that cross-disciplinary learning outcomes and social learning outcomes of a VPA learning strategy address learning as well as de-learning.

The VPA is not meant to replace the reality of a live encounter. The VPA seeks to replace the reality of the professional or the everyday encounter with stakeholders by providing an authentic experience for the VPA audience to explore and learn about complex multi-stakeholders’ issues. The VPA learning ambitions are realized by the specific visual learning strategies requiring specific configurations of time, space and facilitation and also the material production of the VPA. To facilitate integration of the VPA in Higher Education it makes sense to articulate the VPA as part of ICT learning modalities. This will relate the VPA to contemporary discussions on ICT. It will as such contribute to ICT-based learning with expertise on visual learning and mediated realities. All these aspects require further studies and we agree with Tubin (2006, p. 96) who stresses the need for outlining an ICT typology that recognizes the specific characteristics of learning outcomes for each type to be able to select a suitable ICT learning strategy.

REFERENCES


Increasingly design research, thinking, and practices involve understanding users and engaging with individuals in meaning making to support society through the process of reconstructing itself to meet the challenges of our age. Understanding how human beings engage and interact with each other and the world, and the contexts and relationships that exist, needs to be at the heart of the design process.

One of the major challenges facing society today is the ageing population and increased instances of dementia. Ageing is a process whereby changes to the brain and body continually impact on how the world is sensed. Age related conditions such as dementia further impact on sight; hearing; taste; smell; proprio-centric and kinesthetic functioning; and individuals’ memory; their sense of self; their wants; needs; likes; and dislikes. People, who are living with dementia and are non-neurotypical, may not be able to verbally articulate their likes, dislikes, desires, or concerns. Furthermore, the design process can pose limitations on their ability to be actively involved. Inclusive approaches can engage directly with people living with dementia and stakeholders in their care (family members; carers; and professional care staff) by using visual prompts and visual analysis tools that enable them to share their wealth of intimate knowledge of living with the condition.

This chapter will provide a brief overview of some methodologies and frameworks that use visual data and inform design research projects. It will then report on a collaborative design research project that used a ‘distributed expert’ approach in a series of workshops with visual analysis tools to engage with people living with dementia and stakeholders in their care. The workshops used visual and haptic probes to elicit feedback, and audio and video recordings to support qualitative post-event analysis of the overall process, and verbal and non-verbal responses. This approach enabled all participants, including people living with dementia, to contribute to the design process.
INTRODUCTION

Design research, thinking and practices increasingly focus on the needs and wants of users and stakeholders and aim to contribute to people’s lives in a meaningful way. To gain an understanding of how design can enable users and stakeholders to be involved in the design process, methodologies are being adapted from other disciplines (Desmet & Pohlmeier, 2013; Dourish, 2006; Krippendorff, 2006; Treadaway & Kenning, 2015b; Wildevuur et al., 2013). They include, for example, ethnographic approaches such as interviews; questionnaires; focus groups; case studies; observation; and visual analysis. However, these approaches need to be flexible and adaptable, particularly when users are from vulnerable groups, such as, the very young, old, or people living with dementia.

It is critically important that people living with dementia have a say in the design of objects, activities and processes that impact their lives (Swaffer, 2016). But, in trying to understand the wants and needs of people living with dementia it is often not possible to engage potential users in focussed discussion or the completion of detailed questionnaires. Therefore, approaches are needed that can facilitate input from individuals who may have limited verbal communication skills, memory loss, and impaired judgement, without causing embarrassment or stress.

The ageing population is one of the major challenges facing society over the coming decades. Scientific and medical successes and improved social and economic conditions mean that more people than ever before are living into advanced old age. As a result there is a predicted increase in the number of incidences of age-related conditions such as dementia (National Institute on Aging, 2015a, 2015b). Over time the body and brain age and changes occur in physical and cognitive functioning. This impacts individuals’ wants and needs, and their perceptions of the world (National Institute on Aging, 2015b; World Health Organisation, 2014, 2015). These changes do not always result in an overall loss of ability. Evidence shows that as they age, many individuals feel happier and more content with their lives (Cutler, 2009; Renehan et al., 2012). But, for those diagnosed with dementia abrupt changes occur in their lives and the future may initially appear less positive. Opportunities to engage with others may be reduced, employment opportunities fewer, and as the disease progresses people can no longer engage in activities they previously enjoyed. People living with dementia often have long periods of time without social stimulation or activity, and simply have nothing to do.

This chapter reports on a collaborative design research project between researchers at the University of Technology Sydney (UTS) and The Whiddon Group, a large care organisation in New South Wales, Australia. The pilot project used an inclusive approach to design objects and activities to entertain and occupy people living with dementia. It shows how visual prompts and analysis can be used to support the design process.
AGEING AND DEMENTIA

How to improve the quality of life for people living with dementia is a growing issue (National Institute on Aging, 2015a, 2015b; World Health Organisation, 2014, 2015). As the population ages the prevalence of dementia and age-related conditions will also increase. The number of people currently living with dementia is estimated to be 46 million worldwide and by 2050 this is expected to reach over 130 million; more than 1% of the global population (Prince et al., 2015). Dementia is an umbrella term used to describe a number of neuro-degenerative conditions, the most common of which is Alzheimer’s. People living with dementia often transition into increased dependency and require help to carry out activities they once did unaided. Dementia impacts on physical and cognitive functioning and, as a result, impairs memory and judgement. However, consciousness and emotional memory are retained and individuals are able to experience pleasure and joy (Jiska Cohen-Mansfield, Dakheel-Ali, & Marx, 2009; J Cohen-Mansfield et al., 2012; Sabat, 2006; Zeisel, 2009).

While there are consistencies in the pathology of dementia, every person’s experience of the condition is different. In recognition of this health professionals employ what they call person-centred approaches which aim to treat all people, regardless of the level of progression of the disease, as individuals, offer them dignity and respect, and recognise their potential and personhood (Killick, 2013; Kitwood, 1997; Zeisel, 2009). An individual’s potential and personhood can be supported by engaging in social interaction, fun activities, or through creative occupation (Kenning 2016; Sabat, 2006; Swinnen, 2014). But, people living with dementia often have reduced opportunities to engage in social activities, or pursue intrinsically motivated hobbies and pastimes (Cutler, 2009; Ryan & Deci, 2000). Outside of organised activities arranged by community centres or residential aged care facilities (RACF) people living with dementia often have little to do, which leads to boredom and depression and compounds the disease (Chenoweth et al., 2009).

DESIGN

How people choose to pass their time, and which objects or activities bring them pleasure and allay boredom is highly personal and subjective, and personalised approaches are needed to account for individual’s wants and needs. Methods are needed that echo the person centred approaches employed by the care industry, such as human centred design which focuses on the needs of individuals, their relationships, and context. Therefore, the design challenge for this project was:

- how can we understand the needs of people living with dementia and the context in which they live;
- in order to make objects and activities that will entertain and occupy them;
- by using inclusive design processes;
- that are, in themselves, entertaining and fun and provide opportunities for social engagement.
Dementia does not only impact on the person living with the disease, it also impacts stakeholders in their care. To cater for this the design process needs to be able to consult with a range of people impacted by dementia, who are distributed throughout the system of care and might be considered ‘experts’ in aspects of the disease. These include family members, formal and informal carers, and for those living in RACF, the directors of nursing, and leisure and care staff of the organisation. But, asking these ‘distributed experts’, including people living with dementia, to articulate their desires or concerns, complete questionnaires, or engage in focus groups, is not always appropriate and alternative approaches are needed. Probes, in the form of visual imagery or physical objects can promote affective responses. They can also give individuals time to consider and reconsider their responses; allow people to think about how they feel in relation to other peoples’ responses; and encourage non-verbalbehaviours (Dervin & Foreman-Wernet, 2013; B. Fredrickson, 2013). Furthermore, visual and haptic probes promote open-ended, inclusive, and emergent responses which can be observed and subjected to in-depth analysis. This enables users and stakeholders with limited verbal communication skills to contribute to the design process.

MIXED METHODOLOGY APPROACHES

Design research, thinking, and practices are increasingly being used across non design disciplines, including business, IT and systems, public communication, and policy making, because of the way they embrace openness and complexity (Bailey & Lloyd, 2016; Dorst, 2011). Design research, thinking, and practices can also ‘borrow’ from other fields and disciplines. They may draw on communication theory, ethnography and anthropology (as used in the social, behavioural and health sciences), and mixed methodology research practices (Cresswell, 2013; Dervin & Foreman-Wernet, 2013). Inclusive, co-, and participatory design often use methods akin to Action Research, Grounded Practical Theory, and empathic or Positive Design models (Craig & Tracy, 1995; Desmet & Pohlmeyer, 2013). These approaches and methodologies provide tools and frameworks for designers and researchers to engage in stimulating innovative and creative design outcomes, while evaluating each step of the process (Rodgers & Yee, 2015, p. 123).

The collection and analysis of data is a key element of design research. In mixed methodology design research projects, designers and researchers may collect quantitative data that include objective measures, such as how long individuals engage with objects or activities. In addition the collection of qualitative visual data, such as, video recordings, photographs, sketches, notes and journals, can support reflective and reflexive analysis (Mitchell, 2011). Data from existing literature and design research projects can provide verification for methods selected and show how they support reliable evaluation.
Bridging

An example of how methods might be ‘borrowed’ from other fields and disciplines is given in the pilot project discussed in this chapter. The design research project deliberately did not bring together people living with dementia and stakeholders and designers in the same workshops. Instead, it drew on research approaches from communication theory and used researchers to ‘bridge’ (as used by Dervin and Foreman-Wernet) an exchange of information between people living with dementia and their stakeholders and designers (2013). This ‘bridging’ approach is discussed in Sense-Making methodology and recognises that individuals and groups engage in ever-changing conversations, and exchanges. It suggests that individuals need space and time to understand and test out their own responses to objects, ideas or comments before sharing them or providing feedback (Dervin & Foreman-Wernet, 2013). Allowing space and time for individuals to reflect on or develop their response can counter influences that might inadvertently encourage compliance, consensus or agreement (Dervin & Foreman-Wernet, 2013, p. 153-55).

Visual Analysis

The verbal communication skills of people living with dementia are often compromised and their ability to deal with abstract concepts may be reduced. But, even in late stages of dementia individuals are able to communicate through gesture, expression, inflection, and respond to visual imagery and tactile objects (Kenning 2016; Sabat, 2006). Therefore, using visual probes and visual analysis methodologies can provide insights into the responses of people living with dementia, their level of engagement and interaction, and take into account the broader context in which the interaction takes place (Kenning 2016). Both verbal communication and non-verbal embodied responses can be observed and provide insights into how individuals and groups of participants ‘feel’ about the design process and design outcomes, and how individuals form connections to each other with and through design objects and outcomes (Fredrickson, 2004).

Methodology

The aim of the pilot design research project was for designers and researchers to use a co-design approach with people living with dementia and stakeholders in their care, to make objects and activities to occupy and entertain them. The project involved a series of three workshops (for people living with dementia and stakeholders in their care) and a series of ‘meet ups’ with designers in an art studio in Sydney, Australia. Researchers on the project had experience in art, design and psychology and were committed to a visual research and analysis approach. Four researchers attended the workshops at the RACFs and ‘bridged’ information between the workshops and the remainder of the design team attending the ‘meet ups’. This approach was used to:
1. Keep the number of participants in workshops to a manageable level and not cause anxiety or stress for the participants, particularly those living with dementia;
2. Ensure the workshops were of a suitable size for observation;
3. Avoid any intimidation participants might feel in being asked about creativity and design processes in the presence of professional designers;
4. Avoid any discomfort for designers not experienced in working with people living with dementia;
5. Introduce space and time into the process for iterative and reflexive analysis.

The researchers attending the workshops also attended the designer ‘meet ups’ where they answered questions about the people living with dementia for whom the objects and activities were to be made. They were encouraged to share their opinions, viewpoints, information and observations about the participants, environment, the design objects and activities under construction, and any extraneous information they felt relevant to the process.

**PARTICIPANTS**

Participants in the study consisted of people living with dementia resident at RACFs in New South Wales (NSW), Australia, their family members (when available), selected staff at the facility, and designers in and around Sydney. All participants were recruited using a sampling approach focussed on “information-rich cases yielding insights and in depth understanding rather than empirical generalizations” (Patton, 2015, p. 230).

**PARTICIPANTS AT THE RESIDENTIAL AGED CARE FACILITIES**

Two RACFs were selected for the study in South West, Sydney and Northern NSW. This allowed potential access to people with a wider variety of cultural and ethnic backgrounds, experiences of past occupations, and general life experiences. The participants living with dementia were selected on the basis that they were residents of the RACFs; had a diagnosis of dementia; had been assessed by medical professionals as being late stage in the disease; would be able to participate in a workshop environment for a period of one to two hours; would benefit from the experience of engaging with people, objects and activities; would not experience undue stress or anxiety from participation; and were able to engage in verbal or non-verbal communication. Family members of the selected participants living with dementia were invited to participate alongside them. Staff employed by the RACFs were selected based on their close proximity and experience of working with the selected participants.
THE DESIGNERS

Designers were selected following a general call for interest through social media and art, design and technology networks. To participate they needed to have formal or informal training in art or design practice or research; and/or an awareness of social design and design approaches for positive impact; and/or an interest in working with potentially vulnerable groups (no prior experience of designing for people living with dementia was required); and/or an ability to commit time to the project; and/or willingness to engage in a co-design approach and contribute ideas, skills, and develop prototypes.

The designers were from in and around Sydney and had been educated at undergraduate and postgraduate level (including PhDs) in art, industrial design, product design, textiles, jewellery, fashion art and design theory, design research, media studies, and psychology. They were in design related employment, had an art or design practice or were preparing for further postgraduate study. Some designers had in excess of twenty years’ experience.

THE COHORT

Eight people living with dementia, five family members or friends, and nine care staff took part in the design research project. The client group was made up of four people in each RACF. There were six females and two males between the ages of 66-96 years of age with a diagnosis of dementia and comorbidities, which included depression. Four people involved in the study were in a wheelchair or reclining chair. Most participants finished their formal education at age 14-16 and they had a range of occupations including housekeeper; retail shop assistant; factory worker; and police officer. Participants’ previous interests included riding horses; horse racing; watching
sport; playing poker machines; and two people were listed as having had no interests or hobbies.

MATERIALS

The research project engaged with two distinct sets of visual materials. The first set of visual material was in the form of visual probes which were used in a series of workshops to find out about likes, dislikes, wants and needs. Each person living with dementia attending the first workshops at the RACFs was provided with a ‘fiddle bag’ and encouraged to engage with the visual and tactile materials inside. The sturdy canvas bags contained a range of customised imagery, objects and materials, such as, drawn, printed and photographic imagery on paper and fabric; digital imagery and movie files on small handheld screens; objects, such as clothes-pegs, craft materials, and nuts and bolts; digital music files to listen to; and brightly coloured patterned fabrics and threads. In a series of ‘meet ups’ designers were later given access to the same visual and tactile materials.

![Figure 6.2: Visual probes were used to understand likes and dislikes.](image)

The second set of visual material used in the project was the visual data generated by the workshops and designer ‘meet ups’. The events were video and audio recorded and researchers made notes based on direct observations and their post-event reflections. This provided material for visual analysis of verbal and non-verbal responses to the materials and prototypes and for evaluation to be undertaken.

PROCEDURES

In the first of the three workshops people living with dementia and stakeholders engaged with the ‘fiddle bags’ containing carefully selected visual and tactile
materials. Participants were invited to make comments, or tell stories about their associations with the stimuli and make notes on the paper tablecloths provided. Information about the workshops, comments made on paper and information relating to participants’ responses to the visual and tactile prompts were relayed to the designers. This informed the development of a series of prototypes to occupy and entertain the people living with dementia attending the workshops.

After the first workshop at the RACFs a call went out to artists, designers, and technologists to attend a ‘meet and greet’ briefing to find out more about the project and register their interest in taking part. A series of ‘meet ups’ were arranged over a period of four-months. Designers were provided with information from client profiles provided by the RACFs, general information and literature about dementia, and details about the organisation and the participants. The ‘meet ups’ were held in an artist’s studio with space for individuals to work on drawings; with materials; with technology; or to discuss their designs. These were opportunities for designers to engage in ‘show and tell’ of prototypes as they developed and group ‘problem solving’ sessions in relation to design challenges that arose.

Figure 6.3: Workshops were video recorded to allow for post-event analysis.

In the second workshops in the RACFs the people living with dementia, and stakeholders, engaged with the prototypes developed by the designers. Participants were asked to explore the objects and provide feedback. Researchers analysed written and verbal responses and visually analysed non-verbal responses and group dynamics from the video recordings. This information was provided to designers for further development of the prototypes. In the third and final workshops people living with dementia and stakeholders engaged with, and provided feedback on a set of nine prototypes and products that had been developed. They included picture making kits, musical objects and interfaces, fiddle objects, and assemblage kits.
**DATA ANALYSIS**

The data collected included audio and video recordings of workshops, ‘meet ups’, debrief sessions with researchers at the end of each workshop, interviews and follow-on discussions with stakeholders; observation notes; researchers notes; and survey questionnaires. A set of inductive themes were established prior to the workshops based on existing literature and researchers’ previous experience of designing for dementia, (Kenning 2016; Killick & Kenning, 2015; Treadaway & Kenning, 2015a; Treadaway, Kenning, & Coleman, 2014). These themes were used as observation guidelines for researchers who were also asked to note if visual and tactile stimuli prompted emotional responses (laughing, smiling, crying, anxiety, etc.); story telling; affective memory responses; or prompted an interaction between participants. Researchers also made a note of deductive themes arising from the workshops.

Discussion between designers in ‘meet ups’ were recorded and email exchanges and ‘ad-hoc’ conversations about design, design research and dementia were also collected as data. Data was reviewed and analysed during the project, and used to inform its development. A final analysis of the data was undertaken at the end of the project.

**RESULTS**

As this chapter is about the use of visual probes and visual analysis methodologies the results and findings reported here will focus on the impact of the methodology used and not provide details about the particular design objects produced. There were two primary aims of the design research project, they were to enable people living with dementia and stakeholders to contribute to the design process of making objects and activities to occupy and entertain, and to socially engage in and entertain individuals throughout the process. The use of visual and tactile probes and the analysis of the visual data collected showed that this was achieved in a number of ways:

- The data showed that in the workshops the behaviours of people living with dementia and stakeholders was consistent with that of people enjoying the event. For example, they interacted with each other, were engaged, laughed, smiled, talked, chatted, and told stories;
- Feedback from stakeholders overwhelmingly reported that they, and the people living with dementia, had enjoyed the workshops. For example ‘Angie’ reported that her mother had enjoyed the whole morning and said, “It was a good giggle, and doesn’t hurt anyone”. Angie commented, “She enjoyed the group atmosphere and observing others”.
- All client participants remained engaged right until the end of the two hour workshops and some showed dismay when the event came to an end—staff commented that it was usually difficult to engage
people living with dementia and keep their attention for such a prolonged period;

- Staff and family members commented that they had discovered new things about the likes and dislikes of the people living with dementia;
- Staff reported that they would adopt some of the workshop activities, such as, using ‘fiddle bags’ with visual and tactile materials to enable people living with dementia to discover items for themselves.

A further aim of the project had been to produce a series of prototypes objects and activities:

- In total fourteen prototypes were developed, nine of which were able to be taken to a level of completion where they could be left at the RACF for people living with dementia to engage with on an ongoing basis;
- The people living with dementia and stakeholders engaged with all prototypes and products and expressed delight. One of the stakeholders commented, “You have really outdone yourselves with this one!”

The project aimed to encourage designers to take an ongoing interest in designing for people living with dementia and to offer an alternative to the more prevalent pathologised view of dementia. This aim was achieved as shown by:

- The designer ‘meet ups’ continued on a weekly basis for a period of four months.
- Four of the nine designers registered an immediate interest in being involved in, or setting up similar projects to allow them to develop their skills and understanding in this area. Five designers currently in full time employment or education expressed an interest in continuing in this line of research in the future.

One challenge that arose was that while the workshops were enjoyable and fun for all involved it became apparent that the ‘performative’ and sometimes ‘party’ atmosphere did not fully support some of the more contemplative visual material and prototypes. They were not seen at their best in the lively workshop environment, as it did not provide a true representation of how the prototypes would be engaged with on a day-to-day basis.

**DISCUSSION OF FINDINGS**

The workshop approach gave all participants an opportunity to engage with the visual stimuli in a way that was fun and not overtly ‘academic’ in its approach (all
participants were aware of the nature of the project and had completed consent forms prior to taking part (Dewing, 2007). The ‘fiddle bags’ acted as probes to explore the likes and dislikes, and wants and needs of people living with dementia and their stakeholders while also occupying and entertaining them. This approach:

1. Gave individuals time to respond to visual probes in a supported relaxed environment;
2. Enabled people living with dementia and stakeholders to engage in the design process;
3. Showed that in designing activities to occupy and entertain the co-design process can occupy and entertain;
4. Built up the confidence of people living with dementia as shown in the second and third workshops, which were more explicit about asking participants for ‘design advice’. For example, participants were asked “How would you change this to make it more interesting” and were seemingly pleased to be asked their opinion.

Visual analysis and observation was an important aspect of the project. The post-event analysis revealed individual and group responses that were not apparent to researchers whilst ‘in the field’. For example, it was only under analysis that it became apparent the extent that some participants were reluctant to touch and hold some objects, and the extent to which the confidence of some participants grew as they engaged with other participants and the artefacts.

**GENERAL DISCUSSION**

This chapter has shown the importance of visual probes and visual analysis in the context of exploring how design research can support health and wellbeing. The design research pilot project set out to make objects and activities to occupy, engage and entertain people living with dementia. It used inclusive design approaches to ensure that a wide range of ‘distributed experts’ (that is, people living with dementia, family members of people living with dementia and care staff—all stakeholders in dementia care) were able to contribute to the design process along with experts in design. The project shows the complexity of designing in this area and the importance of using appropriate methods of engagement to explore how to design for, what may be perceived as, vulnerable groups of people, and stakeholders in their care. It also demonstrated how the design process can be reciprocal. For example, the designers and researchers learned a great deal from the ‘distributed experts’ and in return were able to give all participants the opportunity for fun and social engagement.

This project shows how design research, thinking, and practices can inform cross-disciplinary work by using interpretive, reflexive and reflective qualitative approaches. It also shows how design practices and research can draw on existing methodologies, approaches, and methods to structure design projects that facilitate co- and participatory design.
PRACTICAL APPLICATION TO RESEARCH TRAINING

For design practitioners working with vulnerable groups and diverse stakeholders with an inclusive design approach it is important to have a clear understanding of what outcomes are required and the steps to be taken to achieve them. For example, in this project the outcomes included:

- A series of developed objects and activities (prototypes and products) for people living with dementia.
- An enjoyable inclusive design experience for all participants;
- A design challenge for artists, designers and technicians;
- A research design template for an inclusive design approach that could be replicated with other participants with dementia or other vulnerable groups;
- A research report theoretically framing the project and the findings and providing practical ‘how to’ steps for RACFs wishing to engage with designers in an inclusive design approach;

The project framework provided a timeline and pre-set milestones. In setting out clear objectives it was possible to have flexibility in the content of each workshop, and in how the prototypes developed, and enabled the project to be emergent and open to change to suit the needs of the stakeholders or designers. Table 1 shows the timeline for the stakeholders and designers:
Visual Tools for Developing Cross-Disciplinary Collaboration...

Table 6.1: Project Timeline

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<thead>
<tr>
<th>Phase 1</th>
<th>Stakeholders</th>
<th>Designers</th>
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<tbody>
<tr>
<td>Preparation and ethics application</td>
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<tr>
<td>Preparation of questionnaires</td>
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<tr>
<td>Gathering client information</td>
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<tr>
<td>Preparation of initial materials for ‘fiddle bags’</td>
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<td>Workshops 1</td>
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<tr>
<th>Phase 2</th>
<th>Workshop 1 – Visual and tactile probes</th>
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<tr>
<td>Recruitment</td>
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<tr>
<td>Group meet and greet</td>
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<tr>
<td>Sharing of information about participants from workshop 1 and dementia as a condition</td>
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<tr>
<td>‘Meet and greet’ of all designers</td>
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<th>Phase 3</th>
<th>Weekly ‘meet ups’</th>
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<th>Phase 4</th>
<th>Workshop 2 – Engagement with early prototypes</th>
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<td>Weekly ‘meet ups’</td>
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<th>Phase 5</th>
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<tr>
<th>Phase 6</th>
<th>Workshop 3 - Engagement with final prototypes and products</th>
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<tr>
<td>Debriefing with Designers</td>
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**FUTURE RESEARCH**

Design research, thinking, and practices can offer innovative strategies for cross-disciplinary work, particularly in relation to arts and health. Designers can draw on existing visual tools, ‘borrow’ from other practices, and develop research approaches. As the search for treatments and a cure for dementia continues the number of people living with dementia continues to rise. Being engaged and occupied can contribute to the quality of life for people living with dementia. Finding out what brings pleasure requires highly customized approaches, and therefore design research, thinking, and practices have an important contribution to make. Governments and funding organizations are increasingly recognizing that support is needed, not only for
scientific, medical and clinical research, but also for alternative approaches that can support people living with dementia in their day-to-day lives. For example, in 2015 the Arts and Humanities Research Council in the United Kingdom funded the LAUGH: Ludic Artefacts Using Gesture and Haptics design research project in Wales to enable researchers to make objects and activities for people with late stage dementia. Similar projects are being set up in the UK and Australia. Using visual analysis tools design research, thinking, and practices can contribute in supporting people living with dementia and stakeholders in their care.

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Section 2: Visual Tools for Innovation
Visual Tools for Developing Cross-Disciplinary Collaboration...
CHAPTER 7

A Cross-Disciplinary Trailblazer: Creative Village Studio

Catherine De Lorenzo and Elizabeth Ashburn (UNSW Sydney)

Between 1992 and 2006 the University of New South Wales ran a cross-disciplinary and cross-faculty studio known as Creative Village. Initiated by the Arts Council of New South Wales, the model enabled community representatives to collaborate with professional artists, designers, architects and landscape architects to develop proposals for environmental and amenity improvements to small regional towns. On the ACNSW’s panel of experts were specialists from two universities. Those from UNSW’s Faculty of the Built Environment and the College of Fine Arts determined to develop a cross-faculty studio with interdisciplinary student teams operating in parallel with the professionals. When funding for the ACNSW program ceased, university staff familiar with the studio continued to develop the model when approached by community groups to assist with ideas development.

This case study reflects on some of the ways the teaching team developed skills for cross-disciplinary collaboration within the Creative Village studio. We re-examine how the studio setting fostered meaningful knowledge exchange within the multi-disciplinary teams, and look at skills they developed to communicate ideas to each other, the community, and their peers. Students were encouraged to think across concepts of community, collaboration, environmental sustainability and place as they listened to community members talk about needs and opportunities before developing integrated proposals for town discussion and implementation. This paper is a reflection on a pioneering model of cross-disciplinary teaching between art, landscape architecture, architecture and design at UNSW, and its legacy today.

INTRODUCTION

In the early 1990s the Arts Council of New South Wales (ACNSW, now Regional Arts NSW) sought to develop a model for regional town improvements by encouraging community collaboration with professional artists, designers, architects and landscape architects. Named Creative Village, the program was intended to address the social, economic and design concerns of each town selected for the program, and provide it with design solutions to specific needs. Local people took responsibility for implementing any proposed changes for their town. Included on the panel of experts were staff from the Faculty of the Built Environment (now BE) and the College of Fine Arts (COFA, now UNSW Art & Design), University of New
South Wales (UNSW), who sought to develop a cross-faculty studio with interdisciplinary teams of students operating in parallel with the professionals. When funding for the ACNSW program ceased, university staff familiar with the studio continued to develop the model when approached by community groups to assist with ideas development. Always marginal, or certainly alternative, to the core disciplines involved, the Creative Village studio was nonetheless something of a trailblazer for the participating staff and students who, but for this studio, would have had little contact with the needs of diverse communities in Sydney and regional NSW. The studio, which ran from 1991-2006, had a number of consistent attributes, yet it is also true that it demonstrated remarkable flexibility as it evolved over time.

**Methodology**

We begin our analysis with an historiographic analysis of the development of the Creative Village model and its links with shifting national and international trends. This is followed by a closer examination of institutional forces that enabled the development of the studio. Attention is then given to explaining how cross-disciplinary collaboration and innovation were enabled. We draw on archival documents relating to the project as a whole as well as student-centred components. To illustrate how the core values of the project played out in the classroom, we look at how one student team worked at developing visual tools that enabled them to work together meaningfully, and to communicate their ideas back to the community. We contacted former students from one team, now established mid-career professionals, to capture their long term reflections and identify any legacies from the Creative Village experience. We also accessed a 1997 questionnaire to pre-1996 students, professionals and town representatives, which gauged critical feedback and perceived benefits within their early professional careers. Finally we evaluate the legacy of the project in relevant literature and critically reflect on the challenges faced by staff and students.

**Background to Creative Village**

The Creative Village studio was developed in response to regional and national debates within the design and community arts sectors. In the 1980s a series of developments within the Australia Council saw specialised cross-disciplinary programs, such as Art & Working Life in 1982 and the Community Cultural Development Unit in 1987, designed to enable artist-community collaboration. Then in September 1989 the Victorian Ministries for the Arts and for Planning and Environment, Melbourne City Council, the Australia Council, the Commission for the Future and the Australian National Commission for UNESCO teamed up to run The Creative City symposium in Melbourne. National and international experts from various cultural and design disciplines showed how cities and precincts could be revitalised through coordinated and incremental design interventions. Evidently, when cross-disciplinary art and design teams worked with a community to understand the local histories, environment, places that mattered to people, social tensions, needs and

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opportunities, they were more likely to develop proposals that were seen to be grounded, realisable, and distinctive (see Yenken et al, 1988: 597-667). Sue Clifford from the UK’s Common Ground insisted that ‘you can make your places from whatever is there’ (in ibid: 626). Robert McNulty, from the US-based Partners for Liveable Places, outlined his model for an ‘economics of amenity’ whereby the skills of cultural planners, artists, architects, landscape architects and the local communities feed into innovative designs (ibid: 614-624). Joan Winch, an Aboriginal health worker, urged Australian design teams to consult Aboriginal communities, not least because ‘we always take a holistic approach to living’ (ibid: 656). It was a heady cocktail of ideas for transforming cities by thinking creatively about public space.

Together these ideas challenged the familiar models of town interventions, which were often centred on the refurbishment of a heritage building, a makeover for the main street, or a community arts mural in a public space. The ACNSW seized the opportunity to radically rethink how it could service the cultural needs of people in non-metropolitan NSW. In late 1990 it established a Creative Village Committee to devise a model for enabling community-informed cross-disciplinary design teams to look at the needs of the town as a whole. Mindful of the economic and time constraints facing rural communities, the design model aimed to be consultative, collaborative and responsive to the built and natural environment (Colman & Zanetti, 1994, p.14). Unlike the Main Street program, which targeted the commercial revitalisation of town centres, usually delivered by city-based architects, Creative Village offered multi-disciplinary teams to work with the community in addressing ‘the local environment and opportunities to improve it’ (Dickinson, 1993). Additionally, artists were seen as an important part of the mix since many had experience liaising with others in community and public art projects, and they could look afresh at the problem-solving imperatives of designers. Over the next year the Committee devised a system that began with selecting towns, establishing art and design teams, running workshops for all participants, and helping organise town visits for the team to hear concerns, observe the lie of the land, and develop a brief to be ratified by the community. Roughly six weeks later the team would return to present their proposals and advise on priorities and implementation. Proposals were to be ‘owned’ as much by the community as by the design team. As seen in the submission to the twin towns of Harden Murrumburrah (see Figure 7.1), many schemes had both precision and flair that captured the imagination and contributed in measured ways to design solutions.
At exactly the same time the Australia Council developed CEAD – Community, Environment, Art and Design – in order to stimulate integrated and innovative approaches to designs in the built and natural environments. There was also a burgeoning literature on new modes of public art and urban and environmental design that were distinctive because their responsiveness to social and environmental issues encapsulated a sense of place (Winnikoff 1992; LM Communication Pty Ltd 1996; Kins 1998; De Lorenzo 2000).

One other element emerged as vitally important to the Creative Village program. Because the Committee had trouble finding sufficient design practitioners with community experience, it was decided to run a studio for students in architecture, landscape architecture, design and art so that a new generation would have some skills in community consultation and cross-disciplinary design. The Committee included academics from two universities. Those from architecture at the University of Sydney were proactive in developing courses that moved ‘beyond a narrow perception of aesthetics to socially responsible design processes’ (Fotheringham et al, 1994, pp. 32-3). But it was those from the University of New South Wales, especially in the first instance Helen Armstrong in Landscape Architecture, who took up the challenge to develop a cross faculty studio that worked alongside the ACNSW Creative Village teams. Prior to Creative Village, students in art, architecture, landscape and design were used to single-discipline studios with an emphasis on individualistic design. The opportunity to work in multi-disciplinary teams, learn techniques of community consultation and gain a deeper understanding of both rural and complex urban cultures, was appealing.
A CONDUCIVE UNIVERSITY ENVIRONMENT

The early 1990s at the UNSW provided a propitious environment for the Creative Village program. Although the university was originally established with an emphasis on science and engineering, over time it also had developed creative arts areas such as music, drama and film studies. In addition, inspired by C.P. Snow’s theories of *The Two Cultures* (Snow, 1959), namely art and science, the university had a reputation for its General Studies program that required undergraduate students to take elective subjects outside their discipline-based faculties. With the entry of the faculty of art and design in 1990 the university increased its encouragement of the creative arts, setting up a reference group linking academics across the university interested in the potential benefits of collaboration (Beck, 1996). The early 1990s also saw UNSW, through the efforts of COFA, acquire a studio at the Cité des Arts in Paris, an internationally-recognised gesture by the university to embrace the arts.

This was a time of relative freedom in the development of initiatives in the content and delivery of subjects. With the support of the Heads of Architecture (John Ballinger) and Landscape Architecture (James Weirick) and the Dean of COFA (Professor Ken Reinhard), a combined subject available to eligible students across both faculties was established. An unusual component was the cross-disciplinary team work that put the needs and opportunities of the community at the very centre of the project. Although a mixture of individual and group projects was common in design and architecture, individual submissions were usually required of art students. The really radical departure from the norm in the Creative Village studio was that no one could guarantee that an architecture student would design a structure or a painting student present a painting. Although there were some bureaucratic challenges, such as the very diverse program structures and timetables, there was never any doubt that approval for this innovative subject suggested a level of institutional trust given to the team of academics supporting the program.

Fortunately for the development of the Creative Village studio, staff involved took responsibility for its operation unconstrained by more recent changes in the institutional culture which require a multi-tiered approach to the signing off of safeguards within Occupational Health and Safety. It would now be extremely difficult to informally transport groups of students into remote country towns and billet them with willing, but not previously scrutinised, residents. Current ethical requirements for preliminary disclosure of any interaction with individuals outside the university, if rigidly applied, would cripple the kind of extensive (and often unplanned and unstructured) consultation with townspeople that took place during site visits. All participants were expected to exercise mutual care and responsibility and, as perhaps luck would have it, there were no problems or complaints. Of course, as time went on and ethics approval procedures were introduced, the studio staff had the wherewithal to meet those requirements.

For the first four years of the studio, the university partnered with the ACNSW and, with the exception of the first year, when students were incorporated into the professional teams, student-only teams typically ran parallel to those of professional artists and designers. One professional and one student team was sent to each town, with typically five towns being addressed by the studio in a year. Students, along with
the professionals and community representatives from the towns, attended workshops run by the ACNSW. They then travelled to the town to consult with people, observed the town and the wider environment, and assisted in drawing up a community brief and having it ratified. Back at the university they developed design proposals before returning to the towns to present and defend their ideas. Meanwhile the teaching staff set various assessable tasks, some individual others necessarily shared, concluding with a team-based presentation to a panel of experts. After the ACNSW ceased to be involved, the studio only ran at the invitation of a community or interest group. Most of the subsequent studios were in the wider Sydney region.

The significance of student involvement was important. Communities had the benefit of enthusiastic students learning to listen to real needs so as to come up with creative ideas for consideration. Students were given an experience approximating a real life scenario where they had to help refine the brief and work alongside others with complementary skills. The studio also brought together teaching staff across faculties, thus establishing a model for later refinement and adaptation.

CROSS-DISCIPLINARY AND INTERDISCIPLINARY COLLABORATION

There was no cross-disciplinary blueprint for those teaching in the subject. Inspired by the projects and believing in the value of educating students for a world in need of integrated designs responsive to cultural and environmental issues, they invented a program that essentially adapted the Creative Village schema to an amalgam of the disciplinary-based studios. Advice was sought from an expert about building productive and happy teams, with a variety of techniques being used allowing students to self-select teams, each with the required number of disciplines. They also kept abreast of national and international currents in urban design, place-making, community arts, environmental art and design, theories of social equity across gender and ethnicity – all of which enabled the studio to shift attention from the ego to the public realm. While the community was always the studio catalyst, the teaching staff was never in any doubt that the studio had to be a rich educational experience, one that expanded the mind and heart with big-picture imperatives. At the same time it had to hone personal (and employable) skills in productive team dynamics, and foster new insights into future professional practice.

The first task of the studio was to form the teams. Each group had members of disparate disciplines and once these were formed and expectations discussed, they were usually sent away to engage in an ice-breaking activity before returning to the studio for a show-and-tell. In those early days the internet was not what it is today, so students were required to collect information on a wide range of issues and instrumentalities likely to be of significance to the town, and they were encouraged to consult this studio resource to help them argue for the viability of their design. For the duration of the studio both academics and students had to negotiate unfamiliar areas implicit in the culture of each discipline. Initially internal tasks were allocated according to the dominant subgroup’s perception of the capabilities of the other members. Students were sometimes surprised to realise the degree of proto-professional enculturation that would assume only architects could design structures,
landscape architects landscapes, and so on. There was little to be gained by harbouring limited concepts of what other practitioners do. Over time, the class came to realise that each individual has different capacities and the potential to contribute to a project as a whole, even if working in unknown territory. Students gained insight into common strengths across the group in areas as diverse as problem solving three-dimensional conceptualisation and representation, and often into the strengths or weaknesses within their own practice.

Appreciation for particular strengths and skills, common to cross-disciplinary teams, meant that many teams were poised to transform into interdisciplinary ones. Lattuca (2002, p. 712) quotes a definition of interdisciplinary learning as: ‘common effort on a common problem with continuous intercommunication among participants from the different disciplines’. There were elements within the structure and rationale for the Creative Village studio that enabled an interdisciplinary process within both the student teams and the staff team.

Creative Village studios were always run in response to an invitation from a community or similar organisation. These invitations never came with an explicit brief; it was always the task of the student teams to consult with stakeholders to find out what the problems were, to think about them in relation to their own site studies and research into a broad but targeted range of literature from scholars and policy makers, and present their proposed design brief to stakeholders for ratification before proceeding with the design development. Another way of putting it is that the design brief could only be realised through the collaboration of the team and the community. Not only did this process engage the students with the project, but the many research tasks needed to get to the starting point of design development meant that teams had to hone skills of initiative, listening, trust, commitment and ownership of the end result, all of which worked in favour of team cohesion. The design propositions were then developed and refined by the teams before presenting them back to the community for further refinement, adaptation and implementation.

Generally, those teams committed to interdisciplinary work were the most productive and happy. Even so, it was made clear from the outset that the final, self-reflection, task, one that required each student to evaluate the strength of their own contribution to the team, would expose the boaster, the laggard and the honest assessor, and would be used, if necessary to vary the group mark. So where necessary, marks were varied within a team and, once again, we recall no complaints.

**THE STUDIO EXPERIENCE**

Typically, all the students were involved in the entire process – research, analysis, brief development, and design resolution; they understood the issues and were able to devise shared visual tools that were comprehensible to themselves and to others.

Within cross-disciplinary design teams not only is it important to develop a visual language that works for all participants, but the final submission also has to clearly communicate the ideas to a lay clientele. Practically, this often meant that students were encouraged to annotate designs so that the elements and arguments could be grasped by the interested viewer.
Until Creative Village, most students had worked only in studios with their own discipline, occasionally in teams. Of course not all teams jelled, and sometimes students expressed frustration with the parallel professional teams, for one reason or another. In a 1997 survey students from classes in 1992-1995 were asked about the strengths and weaknesses of the studio. Whatever its failings, all found something positive to say about the studio experience. One landscape architect student learnt to “Collaborate with other disciplines; Acknowledge…many approaches; make compromises for a more balanced solution to the design problems; [receive] guidance given by the professionals to the student participants”. An art theory student “enjoyed working with older, more experienced [professionals]. People who had alternative views. The strengths for me were the diversity of knowledge brought together”. And an architecture student enjoyed “the studio’s level of involvement with the full act of design – not the heroic but the process of client consultation, assessing the realities of a situation, preparing a realistic plan of action and then designing a solution to fit this context”.

The results could be seen in the proposals. In Coonabarabran, for example, responses to community needs and those of the nearby Siding Springs Observatory resulted in detailed sketches and scaled drawings within an overarching proposal that captured the complementary skills of the art, landscape architecture, design and architecture students, (refer to Figure: 7.2). Annotated designs and images proved an excellent communication device for all.

Figure 7.2: Students with their annotated and montaged design for Coonabarabran. The design included an Aboriginal-designed path, solar lit roller blade area, a kiosk, a performance area, the retention of old buildings and new plantations.

THE JUNEE STUDIO

From 1991-2006, there were about twenty-five Creative Village sites. Each required teams to collaborate across disciplines and communicate their ideas to each other and the wider community. When the collaboration was successful, innovative ideas were galvanised into bold yet grounded proposals readily understood by the community. The Junee project has been chosen to demonstrate how one team responded to the particularities of the place and the team.

Situated on the south west slopes of NSW and once a vibrant mid-point on the rail link between Sydney and Melbourne, Junee was reeling from massive cut backs to its rail services; the extensive rail precinct in the town centre was all but dead, unemployment was double the national average, and the first private jail in NSW had just opened. Over 150 people surveyed prior to the town visit identified issues and contributed suggestions, so the task of the professional and students teams was to consolidate these and other suggestions into a coherent proposal for town renewal. The town endorsed a brief that prioritised environmental sustainability as the key driver for change in the town centre and the wider region.

Figure 7.3: Junee concept design over map, using sketches, logos, miniature models, photographs and concept images to draw attention to key elements in the town.

The big breakthrough in terms of finding a meaningful visual language for the diverse teams and the community came early during the five day consultation when the teams constructed rudimentary town models. The first of these was a blown-up map of the town, which served as a base for sketches, photos, concept models and graphics that served as a storyboard for the town project (refer to Figure: 7.3). Whipped up in no time and designed to be interactive, it allowed the design teams to understand the town and the townspeople to understand the emerging design issues. The landscape architecture student recalls that “everyone had a notably different approach in terms of appreciation of the issues as well as how to move to design in response to them” (Pers. Corres., 24th June 2016). Whereas the Design students “had a great ability to derive inspiration from a variety of sources (whether it was theatre, sculpture, art, built form) and see how that could trigger ideas”, the architecture students “had a distinct ability with model making and tackling built form ideas in an evocative, yet precise and 3-Dimensional manner” (ibid.) (Refer to Figure: 7.4). The detailed model of the railway station and town centre was augmented by the professional team with a topographic model (refer to Figure: 7.5) situating the town within the wider geographical setting and showing broad landscape proposals. This latter model came back to the town with more developed environmentally-conscious designs, the most significant of which was the serpent, a protective ring of indigenous plantings suggested by Robyn Coughlan, the Aboriginal artist on the professional team, and incorporating a pioneering permaculture proposal for a town setting (Refer to Figure: 7.6).
Figure 7.5: Junee topographical model by professional team. From Junee Report 1993.

Figure 7.6: Masterplan for Junee, showing the proposed protective ‘serpent’ to be realised by community planting, by the professional design team: Steve Kennedy (architect), Robyn Coughlan (artist) and Gavin Wilson (landscape architect). From Junee Report 1993.
LEGACIES

In her critical overview of ‘Learning Interdisciplinarity’, Lisa Lattuca (2002: 736) found that such courses ‘created a facilitating context for interdisciplinary thinking, which later found expression in conference papers, journal articles and books. The interdisciplinary course was not designed to serve as an incubator for interdisciplinary research, but it did’. This is most definitely the case with Creative Village. In the early years of the project, when the ACNSW was involved and made use of long-established networks with rural towns, the rural presses and television stations carried stories about the various town visits by team members to harness data and present ideas. Michael Dickenson in the Sydney Morning Herald and Jim Colman in the Sydney Review also promoted the goals of the ACNSW in particular. Eventually, Jim Colman and Peter Zanetti published Creative Village: Rural Town and Environmental Design Manual (Colman & Zanetti 1994) to assist rural towns wanting to instigate similar programs. However much of the literature generated by the program was presented and published by the academics involved. Analyses of the wider program and the teaching studio in particular were presented to diverse audiences of architects, artists, landscape architects, urban planners, art historians and public artists, throughout Australia and overseas (Armstrong 1993; Armstrong 1999a; De Lorenzo, Ashburn & Armstrong 1994). Much of the literature provided critical histories and evaluations. Theoretical frameworks stretched well beyond pedagogy to embrace contemporary Australian cultural history and theory. Many addressed specific environmental and social issues at the heart of the studio, for example, opportunities for renewal at the adjacent towns Harden Murrumburrah and disadvantage and racism in Bourke and Walgett. Lessons from the varied and innovative solutions for environmental problems developed within Creative Village have even been referenced in a major study on water management in the US (Goldstein et al, 2004: Appendix C). From the mid-1990s the studio model was also adapted for urban precincts in Sydney, including a project for the rethinking of a public precinct near Liverpool station, environmental repair at Manly, cultural recovery and renewal with the Gandangara people at Heathcote, and the rehabilitation and cultural renewal of the heavily polluted Alexandra Canal precinct.

Community and environmentally-informed studios were being developed in other tertiary courses around Australia (Fotheringham 1994; Newmarch, 1997). Helen Armstrong, who transferred to Brisbane in the mid 1990s, continued to be the most pro-active scholar analysing the studio experience in terms of the design studio as research – (Armstrong 1999b; Armstrong 2000; Armstrong 2003) – a persistence that contributed significantly to transformations within universities recognising certain modes of practice and teaching as research. When the Emergent Paradigms in Design Education conference was held in Sydney in 1997, speakers from Canada, Chili, England and Scotland, the United States, New Zealand and most major cities in Australia, pooled their knowledge on issues of sustainability, collaboration and community especially, if not exclusively, within design studios (De Lorenzo, Laurence & Samuels, 1997). It revealed the extent to which so many thinkers and teachers were grappling with ways to address urgent environmental problems through community engagement and collaborative team work.
Of more importance than the literature was the impact on the lives of the participants. Did they enter their profession with an expectation of more collaborative and integrated art and design practice than their peers? From the 1997 student survey we know that the majority of respondents acknowledged the impact of the studio on their own design philosophy, with one adding that it made her “very open to multidisciplinary design”, seeing “the need for excellent communication” and to reflect on “when to be firm or flexible in personal ideas”, with another recognising his “thinking widely and long term [by having] consideration of the end user”.

Well over twenty years later, participants were more articulate and passionate when contacted recently by the authors. One design student, now a professor of urban design and landscape architecture initially responded with the realisation that it is now “very clear that a whole bunch of stuff that I do and the reasons that I do it came out of that studio. It was a cracker” (Mark Jacques, 17 June 2016). Another, who now works as a storyboard artist in Hollywood, remembers the studio as one she “enjoyed immensely …. The ability to work a range of collaborators on creative projects has served me well since… [allowing her to understand ] constraints and work harmoniously amongst these disparate collaborators to create the best realization of the director’s vision” (Nikki Di Falco, 22 June 2016). The landscape architecture student recalls studio as “one of the highlights” of his undergraduate career. “The multidisciplinary student teams were instrumental in this, as everyone had a notably different approach in terms of appreciation of the issues as well as how to move to design in response to them” (Steven Hammond, 24th June 2016). And one of the architecture students, now an academic, recalls that “Creative Village brought us face to face with diverse techniques of representation – of recording, describing, formulating and explaining. It was through the adjacency and combinations of diverse representational techniques that new modes of design thinking and production emerged.” (Maryam Gusheh, 17th June 2016). Mark Jacques’s recollection is probably worth quoting in full because although it cannot be construed as a typical outcome, it encapsulates the goals better than any course outline would have dared suggest:

I blame Junee. That studio was the end of an idea I had about what I was going to do after study (I quite fancied photography since you ask) and the beginning of some other thing. That other thing emerged out of a series of wonderfully uncomfortable Junee experiences that still itch at my career.

The Creative Village studio was the first time that I’d ever worked directly with other disciplines and the first time that I’d met a landscape architect. And it was an underwhelming, Peggy Lee kind of thing - Is that all there is? Is that all there is to landscape architecture? I became preoccupied with the gap between what that particular discipline promised and what its tools actually were to the point where now, I find myself a card-carrying registered landscape architect. The doubt is still there, but now I’m paid to prod it. This was true looking over the fence at the other disciplines too – the grass was
never always greener on their side. Each profession had its limits and its unquestioned orthodoxies. My version of multidisciplinary working is now about ways to describe and invert those orthodoxies – to get them out of the way and to get to an idea.

The CV studio was the first time that I’d worked with a multi-headed, multi-opinionated group of stakeholders and collaborators. It was a deeply annoying experience at the time – people kept getting in the way of the neat resolution. Seeing the work of the different studios and subsequent work of my peers (much of it an ode to the neat resolution) made me realise that in fact, the best parts of the work and the best behaviours of each discipline were brought out by contestation rather than splendid isolation. Pure work, the work without contingency, was thin and anaemic. Work that had been charged through contest, that had a mongrel kind of energy was the work that could hold its own in a messy world.

The third realization was that the Academics in the studio seemed to have more fun. They dressed better, understood coffee and read fiction. The professionals were always a little ruffled and mumbled a lot about billing and insurances. This was a portent to my future life as both fractional academic and owner of a design practice. Negotiating the two roles became an extension of the understandings above - purity is stifling. In breaching the two worlds of practice and the university, there might be something to keep one's mind alive. Indeed, the combination of fiction and insurances is an intoxicating one.

The final and in some ways most tactile souvenir from the CV was the understanding that the convention of the plan had no traction in Junee. The people of the town couldn’t read the plan and you couldn’t win an argument with your team mates by producing one. It was the model that carried the idea, carried the argument and carried the day. Truth be told, I already knew this, but Creative Villages convinced me to turn that knowledge into an operation. My subsequent work habitually deploys the model as a tool. Junee also taught us all that the best and most unified team can come apart on the decision on how to model trees. Trees almost did us in.

In retrospect, it is both a relief and slightly terrifying to say that the single experience of the Creative Village studio utterly transformed my professional life and contained the germs and ashes of ideas, irritations and behaviours that I still engage with on a daily basis. I’m profoundly grateful for the opportunity to have done it. I blame Junee (Personal Correspondence. 1st July, 2016).

Disciplinary silos within the university also began to crack. In the early 1990s both the built environment and art and design faculties were multi-schooled but with
virtually no collaboration between disciplines. Creative Village helped change that, and the staff involved relished a new dimension to collegiality. Before long, Built Environment commenced its multi-disciplinary Masters of Urban Design and Development (MUDD), and later Studio X was launched between BE, COFA and Engineering. Today, many students in each of the now single-schooled faculties of BE and UNSW Art & Design are more exposed to cross-disciplinary teaching experiences. For example, digital media now blurs previous boundaries between photography, video, art, and many design disciplines across both faculties. The spirit of working with outside agencies, such as the City of Sydney, on both design and heritage studies, has also continued.

CONCLUSION

Creative Village was not the only cross-disciplinary studio in the country, but the distinctive elements of the studio – usually 4 disciplines, working with the community, developing a design brief, and figuring out ways to return with comprehensive and coherent proposals for the community - was never formulaic and always demanded creative thinking within the teams and the studio as a whole. The question always was: given this unprecedented set of problems and this particular team, what can we do to develop viable and strategic ideas that will assist the community to address the problems and enhance the place? In that sense it was perpetually innovative, for it required the students – and staff – to think beyond their disciplinary borders and engage with a broader context of shared problem-solving. This shared focus allowed cross-disciplinary teams to coalesce into interdisciplinary ones. Quinlan et al (2010, p.1) quote research claiming that interdisciplinary collaborative learning, as opposed to ‘discipline specificity’, equips students for leadership roles in their professions. That may well have been true for Creative Village, but it aspired to exceed even those goals by cultivating a spirit of communitarian entrepreneurship.

PRACTICAL RECOMMENDATIONS

- Working with outside organisations and in real locations gives a sense of real politik to the exercise and drives students to perform to their best.
- Listening to others and exercising initiative consolidates team work.
- Encouraging all team members to propose ideas across the whole project, and not feel constrained to act only within their areas of developing expertise, brings greater cohesion to the exercise.
- Forging relationships with the community is important, but educational goals remain paramount.
- Devising clear and creative visual tools can strengthen the proposal and team dynamics, and ensure communication of the central concepts to wider audiences.
Incorporating digital tools in the mix facilitates communications within the team and with other parties. Diverse community members can readily access design proposals and supporting documentation.

At assessment time, brief colleagues so they appreciate the need for flexible visuals tools that exceed any one discipline’s conventions.

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Chapter 8

Supporting Innovation and Co-Design Process Skills by Visual Tools

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This chapter analyses the learning by doing methods within cross-disciplinary innovation courses where integrated real-life business projects have included brand, customer relationship and service design challenges. The complexity of current innovation challenges justified the cross-disciplinary work especially with design-business students. The pedagogy applied the assumption that applying design thinking type of visual scaffolds and explorations is beneficial for learning cross-disciplinary innovation practices since visual both concretes the abstract development discussion and it catches the non-verbal emotional experiences.

The innovation methods included ambiguous fuzzy front-end search tools such as societal trend analysis and context mapping for a rich opportunity space. For generating ideas especially idea producing divergent thinking rooted in the associative mental images has been promoted with visual stimulus. Special effort has been put also into user orientation to gain insight form the user information for creating positive customer value experience. For the concept creation convergent analysis methods for synthesising the solutions were applied.

The results show that visual methods provide tangible thinking materials supporting integration, dialogue and interaction for shared cognition. In addition to understanding the visualisations help joint motivation with results coming concrete. Challenges in the cross-disciplinary value creation learning concentrate on getting the students to tackle the ambiguous challenges with exploratory and experimenting methods as their background can hinder the willingness for this. Visual means require explaining about their functional benefits and seriousness.

In a world of accelerating change cross-disciplinary creativity with complex development situations is in demand as a future work life skill. The visual tools can support idea generating divergent thinking with intuitive and open relationship to information materials and different perspectives and they also support synthesising holistic solutions including emotional experience with feel of things achieved through visual concepts. Visual is a means to develop empathy as an asset towards both the offering users and also with other team members.
Keywords: front end innovation process, interdisciplinary sense making, visual innovation, visual communication, user experience.

INTRODUCTION

This chapter analyses the pedagogy, methods and outcomes from over ten years of cross-disciplinary innovation, service design and branding courses. These courses have included guidance and learning by doing activities about innovation processes applying especially design thinking based approaches. The contents have included visual means to promote mutual understanding, ideation, evaluation and concept building. Integrated real life business projects have consisted of brand, customer relationship and service design challenges. The study curriculum has been carried out through rather quick team based cross-disciplinary innovation sessions and for this reason the innovation activities have focused on initial search steps, user perspectives and concept creation. Visual scaffolds and concretizations had proved useful in earlier work for user research, user participation and co-design in design processes (Miller – Kälviäinen 2004; Kälviäinen – Miller 2005). The basic pedagogy applied for the innovation learning process then assumed that these kinds of visualization are beneficial for learning and conducting cross-disciplinary innovation practices. The follow up of these processes further revealed practical advantages and nuances in using diverse visual materials and working practices (Kälviäinen – Räty 2011).

VISUALISATIONS AS A CROSS-DISCIPLINARY INNOVATION TOOL

The accounted experience of the processes and outcomes of using visualisations in cross-disciplinary innovation learning is based on innovation, service design and branding courses in Finnish applied universities since 2006 (further reporting in Kälviäinen, 2007; Kälviäinen, Moilanen, Kurula & Niskanen, 2009; Kälviäinen, 2010; Kälviäinen & Räty 2011; Silva, Temple, Kälviäinen, Mantzalos, Horký, Stoklasa & Orme 2012). Based on this ten years of experience, instead of specific innovation process descriptions, the chapter discusses in general how cross-disciplinary innovation learning is supported through visual tools. Cross-disciplinary learning in the analysed innovation courses has mostly taken place with design and business students but also tourism, media and engineering students have participated. The courses have often also been international adding to the diversity of understanding and working styles.

The cross-disciplinary studies about innovation, service design and brand development have included lectures, small joint value creation tasks and development methods from front-end innovation, service design or branding. Design thinking based visual methods have been emphasized with the initial learning phase orientating the students to practical innovation projects and learning by doing approach. In the orientation phase even the definition of innovation has been studied by a visual team exercise using images relating to innovation and post-it notes as movable elements to build joint, visual mind maps about the concept of innovation.
Psychologist Paivio (2010) has presented a view of the mind’s dual coding system where verbal way of understanding and communicating covers only part of human experience. The other part is based on our mental images and maps that rule our sensual experiences and visual understanding. Ideas and evaluations reflect that mental map we use unconsciously to organise and understand our experiences. Mental images and maps are internal connected ideas, individual holistic interpretations of past experiences that are preserved in the mind in intuitive and multi-sensory ways other than in verbal ways. A large part of human meanings are shared without words via intuitive and emotional understanding. The verbal communication scales do not easily catch the kind of experience based in the relationships of the multi sensual images, physical experiences and emotions. (Belk, 1998, pp. 294-295; Zaltman, 1997, pp. 427-428.) This mental imagery world is a source when we interpret the world around us. The different participants in cross-disciplinary innovation have built their own maps though life experience and in addition to different understanding of specific issues their relations to one another can vary with different participants. For these reasons it is beneficial to transfer abstract thinking into visuals especially with cross-disciplinary team members.

The increasing interconnected complexity and rapid, un-linear change due to global markets and information flow, technological advancements and sustainability challenges has changed the development processes. The term “wicked problems” describes the difficulties of defining the problem in the innovation processes (Rittel & Webber 1973). Complexity and change demand an open view at the initially set problems. With interconnectedness and trends from one life area spreading to other areas the professionally divided, specific development processes are not functional. The understanding of the problem requires cross-disciplinary sense making and stakeholders’ co-design operations where visual mapping is a vital support. The front end innovation process beginning is described as the fuzzy front where the challenges and opportunities of the development case are ambiguous.
The squiggle process by a designer Damien Newman depicts well the nature of fuzzy front end with the ambiguous beginning in the wicked problem type of innovation research. 

Source: Damien Newman 2006, from Central Office of Design released under a Creative Commons License.

The innovation learners have been guided how the beginning requires cross-disciplinary search instead of pre-focused and specialized work processes. Visualisation used for demonstrating this has related to the idea that certain typical mental models arise from learning a specialized work and guide us to become efficient at thinking “inside the box” (Stefik & Stefik, 2005, p. 11). Multidisciplinary groups force us to see out of the box as varied perspectives lead to combinations of the different boxes that form at least Big Box thinking (Clarke & George, 2005). Multidisciplinary knowledge gives more and different sorts of preparation, pathways and experience to the cross-disciplinary innovation process. All of this rich opportunity space for business or other solutions should be mapped in front of the participants to see and be able to use for new value creation.

Brown (2008) describes design thinking mentality as one postmarked with empathy, optimism, experimenting, integrative thinking and collaboration. Design Thinking is taught also for business professionals for tackling ambiguous, wicked problems and providing emphatic development for customer experience. Design grounds ideas and solutions in contextual observation, frames user contexts, and appropriates visualising and rapid prototyping (Hargadon, 2005, p.37). As a cognitive process design thinking strives for a holistic understanding via synthesis of perspectives that shows how different variables fit together and takes guesses in filling gaps with ideas. It uses visual tools to clarify unclear ideas and demonstrate how the functional or aesthetic principles would work (Kelley & Littman, 2001, pp. 103-110).

By concretization, optimistic design thinking stresses the significance of quick experiments and learning by doing as risks can be lowered and uncertainty endured by
experimenting (Grenryd, 1998). Generating alternative options by divergent thinking and analysing options by convergent thinking intermingle in iterative process where the strategy is trial and error, to search alternatives quickly, have a lot of them and to abandon the bad ones. Design thinking searches for insight for estimate solutions and tests and improves the alternatives through feedback (Stefik & Stefik, 2005, p. 15). The high rate of exploration and the permission to fail and learn are important. The future potential can be searched for with producing tangible alternatives and depicting the possible new-to-the-world concepts. After this, the evaluation and restriction or synthesis of potential solutions is possible.

Design thinking applies empathy trying to understand the development context from the user point of view. To effectively find successful ideas for real customer value and new combinations in producing value, the front end must be informed in various ways with customer insight. The user experience as the business value goal is relating to the new marketing theory emerging especially from the service sector growth (Grönroos, 2006). In the saturated markets businesses strives for value—in—use, a deep emotional connection and engagement between the user and her experience with brands, services and products.

Various development tools can be used to inform innovation and design with evidence-based approach. These tools support navigating the complex societal change, stakeholder networks and consumer environment for successful and differentiated value solutions. (Curedale, 2013). Divergent generation and convergent analysis allow many different methods to be applied for achieving beneficial results in different innovation stages. Examples of these methods have been presented for the students in order to give them choice what to apply pushing their own projects forward. For this choice it is important to explain the functional ideas behind different tools. In many cases efficiently supportive methods for cross-disciplinary work are visual or include visual elements. One rehearsal demonstrating the value of visual tools to the students has been building modular platform solution with Legos about a customised tourism solution.
Figure 8.2: Based on the analysis of the New York based Humantific innovation consultancy the different mind sets for the innovation process vary from the generating, conceptualising, optimizing and implementing and these mind sets for pushing the innovation process forward can be supported by differing methods.

Source: Teaching material, Kälviäinen 2012.

VISUAL METHODS FOR FUZZY FRONT END SEARCH

As described by Figure 8.2, the first step with innovation process is about developing a broad understanding of the problem and generating new ways to frame the problem. Enough insight, ideation and analysis make sure that the valid and relevant directions are continued in the process. The rich problem space methods for the fuzzy front end try to structure both complex societal trends and stakeholder networks. (Hargadon, 2005, p. 34). Above all these the value offering is produced for the future purposes of customer. Complex thinking deals with the complexity in which one engages simultaneously with a number of stakeholders and elements turning the problem around from one part to another (Gedenryd, 1998, p. 91). One of the most difficult points of learning the innovation process is actually to get the initial, ambiguous inquiry process going. The pedagogy needs to convince the students that instead of set and given, logical steps arbitrary search for spotting opportunities is necessary and it includes weak ideas and failing as useful part of the process.

Complex thinking deals with the complexity in which one engages simultaneously with a number of stakeholders and elements turning the problem around from one part to another (Gedenryd, 1998, p. 91). One of the most difficult points of learning the innovation process is actually to get the initial, ambiguous inquiry process going. The pedagogy needs to convince the students that instead of set and given, logical steps arbitrary search for spotting opportunities is necessary and it includes weak ideas and failing as useful part of the process.
With cross-disciplinary approach the extra value lies in the structural holes in between the different perspectives and stakeholder specialization (Parjanen, Harmaakorpi & Fantsi, 2007). The rich opportunity space is produced with a dialogue where different perspectives describing the system for the development case reveal opportunities and structural holes in it. The joint visual mapping of the space for innovation with diverse perspectives and knowledge revels, in addition to opportunities, also holes that are not covered at all by the participants’ output to the innovation case. The analysis of the opportunity and challenge space can first encompass the wider societal frame and then dive deeper into the specific development context. A good way to start mapping the development opportunities and challenges is to analyse the societal future trends surrounding it. Their interplay is essential and presenting PESTEL-type of analysis in circular visual form helps to observe how, for example, environmental, technological and social aspects of the future trends have strong influences on each other. rs in their specific use contexts.

![Figure 8.3: A PESTEL analysis in a circular form has been presented as an analysis tool for inspecting the interconnected societal trends surrounding the innovation case. Source: Kälviäinen teaching material, 2012.](image-url)

A contextual analysis of the value offering users, their user situation and information channels is an important visual mapping task. This can be complemented with mapping the multidisciplinary producer context and distribution channel stakeholders. The knowledge, advantages, benefits and collaborators surrounding the user and the producers and the future developments that might have an influence on the offering stakeholders are of interest. The stakeholder, user and context mapping tools describe the roles, habits and resources of the offering stakeholders and allow a critical view on the development context. These kinds of visual mappings might show that the former points of channels and delivery in the business solution are not the most sensible ones since there are more typical or interesting ones for the customers or that
there are some barriers with the stakeholders that should conduct the communication in the former channels.

![Diagram of trend interrelations]

Figure 8.4: A basic frame for a joint user and stakeholder context mapping.
*Source: Kälviäinen teaching material, 2012.*

In many of the innovation learning projects the development context understanding has also been enhanced with real life visual observations through site visits. The concrete environments, especially in the tourism business innovation cases, have helped the students to grasp the spirit of the place. Other context insight opportunities have been producer factory visits or even a photographic exhibition of the rural renewable energy solutions in the Northern Europe. The site visit or other sensory material have offered both factual producer information and multisensory experience of the possible emotional triggers and experience building possibilities available for the innovative solutions.
IDEATION AND SENSE MAKING WITH VISUAL MEANS

Although ideation methods can be applied in several, process stages they are especially relevant after the initial mapping of the development context and opportunity space. Visual and other sensual stimuli can be helpful even before starting any ideation as mind shift to get into a relaxed and creative mood. This need is emphasised with preparing the minds of diverse participants sharing ideas in a respectful way. (Innosupport, 2005, p. 42). The need for this operation has been explained to the students and different examples of mind shifts have been applied. In addition to site visits the clients have, for example, provided some experiential video material or tastings to immerse the students in a positive way to the case. Sometimes the study environment has moved to the countryside cottage or some other exceptional environment or the normal classroom has visually modified to help the innovation experience.

The divergent idea generation that produces multiple or alternative answers is rooted deeply in the use of subjective judgements and intuition. It can be supported by enhancing lateral thinking capabilities for making new combinations, open mindedness, intellectual fluidity, perception of possibilities and positive attitude (Leiviskä, 2001, pp. 53-60; Innosupport, 2005, p. 40). Divergent thinking is about recognising links among remote associates and idealising as the purpose to bring the solution closer to a desired state. Intuitive, emotional and empathic immersion supports idea generation with mental imagery processes. (Vidal, 2006, Fundamental concepts, pp.6-7). Intuitive, emotional reactions and associative mental imagery processes are easily probed with using visual and other sensual materials (Kälviäinen
Associations, so called ‘Stimulus Chaining’ that occur in human cognition is one way of understanding the preference for any stimulus and also business offerings. In our brains synaptic connections form routes through our brain cells. When we encounter a stimulus some nerve centre gets stimulated and it causes multisensory association and chaining of associations (Franzen & Bouwman 2001, 49-63). Human experience is inherently multisensory as through associations we perceive a stimulus in one sensory mode even via another sensory mode.

Divergent thinking is supported by ideation methods that enhance creative abilities such as fluency, flexibility, and elaboration. Fluency is the production of multiple ideas, alternatives and solutions but with initially set narrow category the ideas can point to a similar direction. Flexibility is the ability to process ideas into variety. Elaboration is about structuring complex situations in expanding ways. (Vidal 2006, Creative tools, pp. 2-10). The initial information can narrow the flexibility of ideation by building mental conceptual categorisations, grouping like things together, that easily provide boxes for our imagination (Roth & Bruce 1995, pp. 19-54, 73-95, 111-130). Categorisation defines also suitable user roles and stereotypes for solutions (Kälviäinen, 2002). In categorisation we form mental, often visual images of the solution. Many free association or situation analysing tools do not encourage diverting from the prevailing categories. Unrelated stimuli and lateral thinking methods support flexibility and some tools really force us to think about the solutions as different categories. (Vidal, 2006, Creative tools, pp. 12-15). Starting from far-fetched or new categories supports inventing new solutions and producing new combinations. These can also be presented in visual forms.

Different ideation methods applied in the studies have been at least partly visualised since as an emotional trigger visual helps idea building and presenting. With brainstorming type of idea generation without criticism and building on the ideas of others the ideas can be presented also as visual or turned into visuals after verbal ideation. To enhance flexibility, the students have been asked to apply a series of modifying verbal checklists such as combine or make bigger to the solution ideas. One of the checklists is Scamper: substitute, combine, adapt, modify, magnify, minify, put to, eliminate, reverse, rearrange. (Vidal, 2006, Creative tools, pp. 7-8). These verbs indicate possible ways of modifications that actually are also visual in the change they imply. Mind mapping, elaborating and structuring complex thoughts in a radial and expansive way, can be executed as a verbal and visual tool. Mind mapping is not only a tool for idea creation but is also useful for structuring ideas after brainstorming. Pictures, colors, icons and texts can be combined to illustrate ideas in a holistic way (Vidal 2006, Fundamental concepts, pp. 17-19).
It is possible to use picture stimulation to promote mental images and maps in the association networks for flexible categorisations and ideas beyond using words. Visual materials have been used by the students in exploring values, empathetic understanding, emotions and creating ideas and meanings. Pictures from several sources have been selected or the students have made photographic image collecting excursions. Visual stimuli can be in the form of generic – colors, abstract forms, historical styles, visualisations from different walks of life (film stars, animals, scenery, human activities), specific design aspects – forms, textures, details or quite concrete – existing or proposed service or products. (Kälviäinen & Miller, 2005.) Visual stimuli can promote analogy and metaphors that help lateral thinking and originality. In analogical reasoning and using metaphors similarities are remembered from a past experience and transferred to a new situation. (Vidal 2006, Creative tools, p. 9.) As visually based style discrimination differentiates brands, services and products through overall composition and impression also the visual ‘feel’ is necessary to develop for a business offering (Schmitt- Simonson, 1999, pp. 84-85; Kälviäinen, 2002). Often experiences relate to storytelling and this can be promoted from our minds through visual input.
Figure 8.7: A chart that reminds the student to use various means for building visual communication for brand visualization search and ideation tools such as visual meaning sources, metaphors and stories.

Source: Kälviäinen teaching material, 2012.

The stimulation material can also be used for sorting tasks presenting different categories or preferences. Unstructured sorting tasks give participants the opportunity to show how they structure and associate with the visual world in a variety of ways. If the teacher facilitator has made the choices of or has pre-organised stimuli, what is missing or how the students would organize the stimuli should be discussed. (Kälviäinen & Miller, 2005). The visual sorting and analysis tasks grasp the instant, intuitive and emotional responses and promote the work of mental images and associations. The ideation can continue by the preferable associations that the visual sense making evokes or by building experience creating mood boards. All these kinds of activities require the visual material to be in the form of separate pictures easy to sort and handle.
With cross-disciplinary participants their mental categorisations introduce variation and add value and richness to the innovation efforts (Vidal, 2006, Enhancing Your Creativity, p. 11). Visual material offers the possibility of exchanging ideas about how different people ‘see’ things and ideas and establishing consensus within the development team (Kälviäinen & Miller, 2005). The same words can be understood in different visual ways and carry various value-based meanings for different people (Kälviäinen, 2002). Externalizing the abstract verbal dialogue into tangible form reveals what the discussion was about and allows sharing and synthesising ideas to test the solutions with the group. Visual methods also offer means to produce play and interaction between the design team and the real user.

After the information mapping and ideation it is vital to organise the results often with an affinity diagram type of grouping the data and information into themes. Each of the result items can be on post it notes or as separate pictures. This way all the development ideas or issues can be organised into jointly discussed and agreed theme groups visually in front of the team. Then the themes can be further used for evaluation and concept building following the front end search phase. It is beneficial to define even the themes also by visual means so that mutual understanding is secured.

**VISUAL INFORMATION FOR CUSTOMER EXPERIENCE DESIGN**

User orientation looks after the user insight and relevance in the ideation and solutions for real customer value. As in the process description in the Figure 2 it is often beneficial to introduce them into the process after building the initial rich opportunity space. Visual activities are efficient in involving emphatic user information and inspiration in the innovation work. Some user information is available from existing consultancy and research sources such as user trend...
descriptions that predict consumer lifestyle changes often specified by exemplary visual material. They can serve as kind of scenarios for alternative future user lifestyles with meaningful traits. Research organizations provide earlier user information at the general level and in specific industrial and service fields. In the analysed study processes there has been projects involving forest owners, Russian tourists and elderly consumers where earlier consumer information has served as a source for relevant user information. This information has consisted of demographic features and value segmentations that describe the targeted user groups.

The students have transformed the earlier user segment information into visuals by user persona visualizations and mood boards for user lifestyle. This visual information is usable even in quick ideation since it shows the diverse segments in a holistic way. The ideation can concentrate on a specific segment group or user information can be applied as a basis for appealing concept to various user groups.

In some cases, the students have themselves interviewed or observed the users although typically in short term day sessions earlier information has been applied. The student work has included a task to search from the Internet related user information including user situation pictures or videos. Also some smaller groups of students have made additional study weeks by conducting more extensive user studies for others.

![Figure 8.9: Four students observed and interviewed 22 elderly people in their home environments producing observational material that was applied as information about the elderly home environments in several innovation sessions.](image)

Deep user information can be acquired with practical user observations, participatory observation, interviews and users making self-reporting. The purpose of this qualitative and rich user research is to discover also the hidden, latent user needs that the users are not able to tell themselves if asked as specific need questions. The site visits have produced possibilities to observe the possible user paths with the offering. In some cases, the students have also made user trips conducting themselves the user
activities that the company expects the user to follow and observed the possible user difficulties.

*Figure 8.10:* The students collected pre-task pictures from Scotland, Portugal, Cyprus, Czech and Finland before an international two week intensive innovation project where business and design students were innovating together food related stone products and their branding to an oven company.

From the user information, it is also possible to create user persona descriptions. User personas support experiencing empathy, an emotional relationship with the user and they set dimensions of the users’ characteristics, life goals, experience goals, end goals and use context. These character descriptions can provide rich details with personality and activity descriptions often for fictional users created to represent potential, typical target users. As a persona is created by giving her/him a name, photo, likes and dislikes, habits, skills, background, expectations, goals that will help to identify with the user situation, all realistic visualisation materials are also beneficial.

*Figure 8.11:* The students have been offered a box filled with different types of user pictures and a basic form to make user persona description to promote visual user persona descriptions as a tool for empathy and imagining solutions for realistic users.
The quality of experiences has been explained through the consumer lifestyles that help to make sense of what people do, and what doing it means to them (Chaney, 1996, pp. 4-12). Consumption also plays a profound role in differentiation from others, comparison with others and integration into social groups. Positive experiences in products and services relate to practical goals but also to intuitively and socially interpreted qualities such as emotional bonds, personality, identity, aspirations, embodied aesthetics, social roles and impressions producing a suitable general ‘feel’. Preferable themes of life or ‘ideal world’ stories can be studied though visual mood boards. (Kälviäinen, 2002). The students have been supported to do mood boards as visual collections of pictures describing the users’ experience world in a visual way.

Figure 8.12: Mood boards for nature park tourism innovation and service design project describing the different lifestyle related feels for different user types.

Scenario envisioning, depicting in detail the alternative future use scenes and the use processes in them has been a situating strategy to explore ideas and opportunities. As Gedenryd (1998) analyzes, even a single scene about the real, complex use situation develops understanding by creating a test case, providing requirements and solution at the same time. User scenarios are like a fiction stories presented as cartoons, play scripts, drama or acting it out. They depict the future situations of use and the functional, social and emotional actions in them recreating the various parts of the yet non-existing situation. The students have imagined how the real users could go through the intended service describing the offering in terms of users, goals and as aspects of use. As the descriptions of the alternative future users, use activities and situations, scenarios help the students to feature the whole use experience with engagements points and how they differ with product or service alterations.
User stories have been a way of depicting the user persona’s life as scenes concerning the use and the experience of the case offerings. They have been based on a goal, task and an analysis of the interaction touchpoints that relate also to the concrete service environments. Visual tools such as in the Oslo School of Architecture and Design created touchpoint concretising cards exist to support service path creation (Clatworthy, 2013). These have been applied for the analysis of service touchpoint alternatives and service path flows. Also drawings, collected pictures or freely available icons have visualized the user stories to storyboards. User scenarios might not be only about functional use but also descriptions of different service styles. The student groups have created the storyboards as they develop the product or service and this has served as a practical tool for development communication. The user stories have been both stories how the activities are done at the current situation and also about envisioning the future solutions.
Involving users as co-designers in the development sessions offers both user insight and means to test the emerging designs. In spite of how useful user participation is, in the short-term innovation study sessions it has been rare. As participation means to test the emerging designs also excursions to meet the users have been applied such as elderly day center visits. In Russian tourism cases Russian students have presented the real customer point of view. Visuals have been applied also for the user participation by stimulus probes and co-making methods as these especially seem to cherish out latent needs and let people creatively express memories, thoughts, feelings, dreams and new ideas (Sleeswijk, Visser, Stappers, Lungt & Sanders, 2005). Using different sorts of visual and other building materials in a participatory session supports the users envisioning the use situation, and the future, by identifying the important moments from their perspectives. Building different levels of tangible outcomes as drawings, collages or prototypes is a way to reach synthesis from the discussion about the complex and abstract user conceptions.
After going through the phases of opportunity mapping, ideation and user perspectives the students have reached the stage where synthesizing concept solutions is possible. As depicted in Figure 8.15 this phase is the stage where the process is turning to the direction of the convergent process stage. In the innovation courses the articulation of concepts has been done in several different ways where the visual material produced in the aforementioned earlier stages has formed material for these synthesis. The main issue has been synthesising the best possible results, ideas or solution parts from the initial development process and defining the concepts also visually. Concept results in the innovation studies have included definitions of the core content strategy for the brand or products, customer journeys and service systems. The choosing of the good solution possibilities has been discussed inside the smaller teams. In the mid project result presentations evaluation has taken place also jointly by the whole study group. Typically, this has been quick voting with post it notes that shows also visually the votes for the interesting ideas. The best ideas have been further developed as concepts and presented to the client or even tested with the users.

The concepts have many times been presented as user process type of solutions or business model analysis charts where the value production network also becomes evident. These might be modifications of the business model canvas or other visually based analysis tools to remind of the value creation goals and the means to achieve the customer value proposed in the concept. In the Customer Journey Mapping type of concepts different current user stories or future orientated user scenarios have been synthesized as a joint customer journey.
Service concept definitions can be analysed as a format that both allows the different customer journey episodes and touch points to be seen and that shows how to organise the production system. The service blueprint tables have been applied as these are both concept describing and production system showing tools. The system tools help to optimise the solutions so that in addition to a pleasurable customer journey also the feasibility, economical, partner and human resources of the production can be considered.

The visual analysis presentations and prototypes help to communicate the concept solution holistically, making the new to the world concept concrete. Concept presentations are analysis type of convergent phase of the process that is squeezing the richness of the possibilities into defined value production models. The process of creating these concept presentations still enables the discovery of new insights by making real and concrete the possibilities imagined in the ideation process (Hargadon, 2005). The synthetic visualizations present the holistic view of the issues in discussion with the compositional relations of the smaller details and their weight in the whole solution. This kind of presentations help the further evaluation and optimization by pointing out how the possible holes are filled and allow to discuss if the synthesis is acceptable to the different stakeholders and if the solution parts and their relations are suitable.

Concept descriptions explain not only physical attributes, but also quality such as social attractions, individual desirability, value for money, reliability and customization capabilities. The students have been supported in creating the concept parts simultaneously in order to show how they create value together. The substance of style defines the concept not only in a rational way, but also through intuitive, emotional understanding for user experiences (Kälviäinen & Miller, 2005; Postrel, 2005). In addition to words concepts have been described visually as a style solution: brand values and identity have been followed by a consistent visual brand identity and consumer experiences have been described with visual style. Even if the final work
for business based operations and visual identity has been partially separated in the successful outcomes the business and design students have understood that the different professional results have to produce consistency.

Figure 8.17: Lahti city multifunctional service center concepts depicted both with an architectural and atmosphere catching drawings.

Tangible concept solutions are also the starting points for prototyping and evaluating the concepts and then refining and finalizing solutions. Prototypes as lifelike models of the solutions in progress are means to consider how the concept will work in eventual use. The prototypes have served for the purpose of quick iteration and small user testing. With the rapid and few hours lasting innovation sessions only crude prototyping or virtual modeling has been possible. Typical prototypes have been created with computer-based rendering without the actual functionalities, but sometimes design-based students have created also physical prototypes.

Figure 8.18: Service design course concepts by students: a wild food application concept model won the second price (inspirational series) and regional information applying concept the first price (national broadcasting company series) in an open data application competition by Forum Virium Helsinki (2014).

The concept visualisations and prototypes in the innovation learning processes have made it possible for the students to present the outcomes to the clients, to the users or
for competitions to be evaluated. Evaluation of separate smaller teams’ achievements has also been done with the whole participating student group. The learning content has included some techniques and content also for evaluating the outcomes through requirements or with functional usability or social acceptance testing. Typically, the further testing, development and implementation has been left to the client business’s hands.

**CHALLENGES**

Challenges in the cross-disciplinary value creation learning concentrate on getting the students to be sharing stakeholders with inner motivation to participate (Stamm, 2004, p. 16). Motivation is essential in interdisciplinary work with several difficulties: dealing with the different views and disagreements, team logistics about finding time together and with the client and pushing the development work forward (Leiviskä, 2001, p. 145). In student groups each individual should find intrinsic motivation through their own interests to a joint, mutually understood goal. User value creation through user understanding is a good common goal. In imagining the user value visualisations about the user and the use context play an important role for making this goal concrete.

Motivation increases through the right to work on the ideas that one feels passionate about and experiencing enough credibility about the client’s commitment to the innovation work (Innosupport, 2005, p. 86). The positive motivation has grown from the possibility for the students to bring their own personal interests and experience into the innovation. The pet owners have introduced useful products for pets. With Russian tourism solutions in Finland Russian students have found their input about Russian cultural habits valuable. The concrete efforts from the client companies, such as visits to sites or food product tastings have also provided student commitment.

The structure and roles of cross-disciplinary teams is of importance and would be a separate phenomenon to discuss. Business students take easily lead but at the same time they apply convergent and verbal processes that do not promote open divergent thinking nor understand the nature of visual innovation. Highly effective teamwork and creativity seems to flourish only in conditions of flexibility, openness, honesty, consistency, tolerance and respect (Leiviskä, 2001, p. 121-123,152-153; Vidal, 2006, Group work, pp. 20-21). With cross-disciplinary work there is easily dispute among the specialized student groups that others do not do anything since there is no appreciation nor understanding to the different approaches. There are problems in pedagogy for learning by doing since this or the visual and tangible experimentation process imbedded in it is not familiar or comfortable for all the students. Providing the orientation basics for learning by doing and why visualisation is important is vital part of the learning.

At the fuzzy front end the challenge is the endurance of ambiguity since the expectation for many students is that there should be a set, even by the teacher given, algorithm to solve the development issues. Some students find the ambiguous search undoable and then the ideation is difficult. Even when methods of tackling the
ambigious fuzzy front end are presented there is a great suspect for this. Also, the fear of going out of the box is evident and any means that help the students to break their categorisations and comfort zones can be helpful in promoting idea creation. International pedagogical differences play a role as in some countries the innovative and independent mode of learning has been cherished but many countries still have a teacher led learning style and students from these countries find innovative learning by doing hard. Professionally designers with mixed design thinking resources for collecting the information for problem finding are more comfortable with the ambiguous phase. To stand out the initial ambiguity can be supported with different visuals such as the PESTEL analysis and the stakeholder and context mapping.

Even if visuals support divergent creation it is important to pay attention to challenges with visual material especially when it is picked up form magazines or from the commercial picture banks. These sources favour superficial and polished media images meant for marketing purposes and not real people in realistic life contexts. Even when students come from the different disciplines the visual material they pick up can be surprisingly similar through influences of global youth cultures and narrow life worlds. The media based conceptions and visual material creates superficial and stereotypical outcomes not deep experience solutions with real, motivating drivers for the users. For this reason, diverse sources of visual materials should be promoted and even teacher based materials offered. Also, the observational and other deep user approaches are difficult for the youngsters as they are mainly used to questionnaire type of data collection. Designers are a bit more inclined to observational studies but in general students easily propose questionnaire type of set questions.

Visualisations should theoretically help joint motivation with results coming concrete. Non-visual background can hinder the appreciation and willingness of using visual means. Typically, business students prefer abstract, marketing speech type of verbal outcomes. Visual means require explaining about their functional benefits and seriousness. Society and the market place is currently highly visual and this should be part of the business concepts, e.g. the offerings should reach the right mood and lifestyle impression for the customer. The companies should be able to manage their visual design elements through their brand creation and product development processes.

The visual means are beneficial but they should be appropriated in a way that they facilitate differently skilled students. Students easily slip into their earlier familiar, own discipline based development habits. Even the design students are not familiar with the different possibilities of creative methods and how to promote creativity with visuals. Support is required in using creative techniques and appropriating user empathy. The support for divergent thinking, empathy for customer value creation and making the evolving user experience solutions tangible and assessable are important justifications for visual innovation. In the saturated markets businesses strives for a deep emotional connection, engagement between users and their experience with products and services. Learning about people, their meanings in life and use of context to open up innovation opportunities for deep user experience is achieved through insight and empathetic understanding.
To move from the idea to the value results both adaptive and innovative skill sets are required (Stamm, 2004, p. 14). Exploring a problem from different angles and generating alternative ideas and concepts is divergent and selecting the problem and the concepts is convergent. Evaluation means divergent monitoring of the use and convergent action. (Rieple, 2004, p. 40-42.) The students possess different cognitive styles tuned to these different approaches. So, it is an advantage to have both sorts of students in an innovation team. With producing the visual outcomes this is seen, for example, in service design where the designer students are good at creating the new customer journeys and the business students are good at producing the blueprints presenting the organisational analysis of the services.

The visualisations and tangible materials produce play, interaction and solution creation between the team members and are means to establish consensus. Work-in-progress in clear view invites critique and fosters eliciting feedback. Such practice encourages discourse and reflection during the process. (Kälviäinen, 2007.) These advantages are also evident with cross-disciplinary innovation learning especially with international student groups with different language backgrounds. The process of explaining your ideas to a different-minded person can also fundamentally aid in thinking outside the box. With talking-it-out process unconscious assumptions get revealed and questioned as explaining issues to someone else helps to see the problem differently. (Stefik & Stefik, 2005, pp. 14-15.) When the students from different backgrounds both professionally and culturally show as visuals what they mean by their ideas this provides further specification for the verbal, often abstract and still undefined conversation.

Cross-disciplinary innovation needs in the global economy point to relevance and appropriateness of products, processes and systems. In successful products or services different success aspects are required. Professionals and even students easily come experts in their own interest area and would like to refine this area even above the optimal customer value. Successful innovation is about separating the unnecessary features from the critical ones and editing out what is not essential. (Kelley & Littman, 2001, pp. 255-258). Too much technology, too specific design acumen, too much emphasis on marketing vocabulary and too little on specifying the visual communication consistently are typical problems in the solutions. The cross-disciplinary group can perform the task of the editor if they reach a consensus that only the things valuable for the customer, not for the different disciplines, are the goals of the value creation. To do this editing a proper and holistic visualisation of the created concept, making the outcome for everyone to see, is important. Most preferably also the users should be involved in the evaluation to inform the students of their views.

In cross-disciplinary work, there are challenges for finding joint time. Innovation session based work in the cross-disciplinary studies has guaranteed co-work time but has forced the work to be done efficiently in rather short time span. Visual can be a quick and dirty tool for searching ideas, building understanding and synthesising the results. The lack of joint time has diminished the possibilities to finalise the whole innovation process. This would require curriculum for longer projects with cross-disciplinary work slots and concretisation possibilities towards the solution.
optimization and implementation. Partly, after the fuzzy front end and concept creation the work could be also divided to specialised professional outcomes with only some consistency checking collaborative work.

**CONCLUSIONS**

Learning how to cope with the cross-disciplinary and creative development process seems to be a future work life necessity, as team creativity and innovation are becoming critical business skills for coping with a world of accelerating change. The visual tools can help to learn divergent thinking that requires emotional, intuitive and open relationship to inspirational information material and different perspectives.

Visualisations provide tangible thinking materials that make the world part of the cognition and help integration, dialogue and interaction for shared cognition in a cross-disciplinary team. Getting abstract thinking into external observables is useful when each participant has its own vocabulary, concepts and thinking styles. Tangible work-in process outcomes prevent misunderstandings, help building on the ideas of others, describe alternatives and variations, show the missing parts in the discussions, build up joint synthesis of the different ideas, invite the practice of eliciting feedback, critique and reflection. They make the student group, stakeholder and user feedback and evaluation possible for the purpose of informed further development decisions.

The now so important value creation for user experience is relating to holistic, emotional experience with feel of things. The creation of this kind of outcomes requires both visual insight and visual outcomes such as visual brand identities and service styles that are consistent with the proposed value concept. Visual is the means to develop the emotional experience both as a growing consensus with the development team members as with the users since people relate to it intuitively and with unconscious emotional reactions. Also empathy with the offering users but also with other team members is an important business asset that needs to be nurtured as a future work life skill.

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Pedagogy for Visually Supported Acquisition of Cross-Disciplinary Innovation Skills and Knowledge

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The ability to be innovative is a key skill which governments are increasingly asking universities to equip their students with. This chapter focuses on how visual tools can support the uptake of innovation skills and knowledge in cross-disciplinary student projects within a higher education setting. It recognises that exposure to cross-disciplinary collaboration is an increasingly important element of student learning in order for them to develop transferable’ skills such as cross-functional communication. It illustrates how visual tools can support activities such as project planning and facilitate the development of ‘transferable’ skills such as the ability to seek mutual understanding amongst diverse team members, despite differences in students’ disciplinary vocabulary.

This chapter reflects on how knowledge learnt in the field of design education, has been utilised effectively with students engaged in several cross-disciplinary modules and programmes, exposed to a range of learning environments to facilitate the development of innovative thinking processes. Seven visual tools which have been effectively used to enhance the teaching of cross-disciplinary teams of students at Loughborough Design School and the Institute for Design Innovation at Loughborough University London are presented. The potential benefits and challenges that these tools offer cross-disciplinary team members as they develop their innovation skills and knowledge are reflected upon. Particular attention is paid to the need to bridge gaps in communication, often common in cross-disciplinary teams.

INTRODUCTION

In the UK, it is widely recognised that the ability to innovate is an important skill for our graduates to develop at university in order to participate in the increasingly knowledge-based economy (UK commission for employment and skills, 2014; Wright et al., 2015). Innovation is understood to be a “multi-stage process whereby [students] transform ideas into new/improved products, services and processes” (Baregheh, Rowley & Sambrook, 2009, p. 1334). This chapter builds on the understanding...
outlined in Chapters 1 and 2. In particular that cross-disciplinary collaboration is important (though not without its challenges) and that visual tools have a valuable role to play in supporting activities of cross-disciplinary student teams. Not only can they help to support job ‘specific skills’ such as project planning but they also facilitate the development of ‘transferrable’ skills such as the ability to seek mutual understanding, across disciplinary boundaries by enabling communication of ideas amongst the team members, despite differences in their disciplinary vocabulary. Specifically, this chapter will focus on how visual tools can be used to support the uptake of innovation skills and knowledge in cross-disciplinary student projects within a higher education setting.

The visual tools and teaching practices presented in this chapter have been drawn directly from the authors’ experiences of projects with industrial design, service design and sustainable design students. They have been selected as they have been seen to support the learning of cross-disciplinary student teams, specifically regarding the acquisition of innovation skills. These visual tools have the benefits of enabling ‘social creativity’ as they can be used to externalise and visually represent tacit knowledge (Hyerle, 2008; Moen, Mørch, & Paavola, 2012; Peter Anthony Busch, Richards, & Dampney, 2001), enabling reaction and conversion (Mengis & Eppler, 2006). Further they enable information to be visually synthesised and provide a vision for a project solution to be collaboratively explored and developed.

Through this chapter, we will present seven visual tools which we have found to be effective with cross-disciplinary teams of students at Loughborough University. The key characteristics of each tool will be introduced, and how they are used to support the acquisition of cross-disciplinary innovation skills and knowledge will then be illustrated by drawing on a series of five educational activities run across Loughborough Design School (LDS) which is located at the main campus in town of Loughborough in the UK (refer to: Figure 9.1) and the Institute for Design Innovation at Loughborough University London (refer to: Figure 9.1), based at the Olympic Park in East London (LU London).

![Figure 9.1](image-url): Loughborough University located in town Loughborough (left) and Loughborough University London located at the Olympic Park in London (right).
INTRODUCING THE ACTIVITIES

The following sections introduce each of the ‘educational activities’ in turn, in order to set the context for the visual tools introduced in latter sections of the chapter:

- Group Project
- Design Thinking
- Collaborative Project
- Design Innovation Project
- Lufbra Service Design Jam

The nature of the activity, the number of students involved and how these students were assessed are outlined.

The reflections in this chapter are a compilation of outputs obtained from ‘in class’ observations, reflection with staff members and discussions with the students involved.

Group Project

The Group Project module is compulsory for all the Masters Design students enrolled at LDS on two programmes: Industrial Design & Technology and User Experience Design. It provides students with an opportunity to work in collaboration with external UK based organisations, which have included: BT, ArjoHuntleigh, Derby Hospitals NHS Foundation Trust and the Environmental Ergonomics Research Centre. The aim of the module is to make students more aware of design innovation within the context of business. The postgraduate students work in teams, under academic supervision, to analyse a problem-oriented ‘consultancy’ type project. It is the representatives from the partner organisation who provide a project scope for the specific student project teams.

The student project teams attend the briefing sessions at the collaborative project partners’ location. They also deliver the final project teams’ presentations at the partner’ locations (refer to: Figure 9.2 and Figure 9.3). Otherwise, the contact between the student project teams and their partners is undertaken via weekly teleconference meetings and online dedicated project blogs.
The class size has varied from 18 to 50 students and team sizes vary between 5 and 7 members. The overall expected workload per each student is 300 hours inclusive of 45 contact hours with the academic supervisors and around 10 hours contact with
their collaborative partners. Students in this module were assessed on these three group submissions:

- Submission 1: Project Brief (20%)
- Submission 2: Project Deliverables (30%)
- Submission 3: Project Report (50%)

Past project covered topics such as: Smart Home, Smart TV, Smart Lock, Smart Displays, Tele Medicine, and Walking Safe (Preventing Falls in Hospitals). These topics provide a wide enough scope for the students to propose how they might specifically tackle the given issue which is then negotiated with their collaborative partners. These projects last between 6 to 10 weeks. For many of the students this is the first time they are asked analyse an open-ended business issue and to articulate a design led approach to provide potential solutions.

**Design Thinking**

The Masters level ‘Design Thinking’ module incorporates students from the Institute for Design Innovation and the business focussed Glendonbrook Institute for Enterprise Development at LU London. The aim of this module is to enhance students’ ability to use design approaches and tools for identifying and implementing human centred innovation opportunities. Students are expected to deploy knowledge learned in this module into the Collaborative Project module (see the next section). It is delivered to around 150 students per annum who come with a diverse range of educational and professional backgrounds, including product design, architecture, fashion design, business, media, marketing and management. The module comprises lectures and seminars to introduce theory, complemented by field work and tutorials to cover practical application, review progress and understanding. Students work is undertaken in teams. The overall module’s load is 150 hours inclusive of 40 contact hours.

The students are set a live ‘wicked’ problem (Kolko, 2012) to investigate over an intensive 5 week period. In 2015/16 academic year for example the Councillor at Hackney Borough Council (of East London) challenged the students to ‘set out the sustainable transport solutions that would enable the different communities of Hackney Wick to:

- Take full advantage of the employment and leisure opportunities in the neighbourhood, in the Borough and London.
- Ensure there are the best possible connections within the Ward to help bring the community together.

The desired impact was to ensure people of all ages, means and backgrounds have available affordable transport options, which have minimal effect on the local and wider environment but give people the widest opportunities to develop their lives. This multifaceted problem not only addressed a range of challenging societal issues
but also encouraged the students, who were typically new to the area, to get out and better understand the Hackney Wick area, adjacent to the campus location.

The students work in small cross-disciplinary groups of 5 or 6 and are assessed via a formative 2 minute pitch to their client, a 2500 word report (80%) and individual peer feedback (20%) provided by their team members. Through the module the students are introduced to a range of tools and techniques, including how to create and use personas, empathy mapping, customer journey mapping and prototyping. Observations and discussions with the student groups have shown that in the vast majority of cases these approaches are new and often alien to the student group, and as such they found them quite challenging. However, students go on to say that they have found them to be very valuable and in many cases the tools have been used again in the Collaborative Project.

**Collaborative Project**

The ‘Collaborative Project’ is a unique interdisciplinary module through which all the Masters students across the five Institutes (Design Innovation, Enterprise, Digital Technologies, Sports Management, Media and Creative Industries) in LU London work in mixed groups to address a live brief for an external sponsor, over a 15 week period. The students have diverse backgrounds in subjects such as history, geography, product design, architecture, fashion design, business, marketing management, media, and sports management students. In 2015/16, 350 students were divided into 55 groups and delivered outcomes for 12 companies (see Table 9.1).

<table>
<thead>
<tr>
<th>Company type</th>
<th>Organisation</th>
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<tbody>
<tr>
<td>Large (&gt;1000+ Headcount)</td>
<td>AECOM, Cisco, FDM, Foster + Partners</td>
</tr>
<tr>
<td>SME (&lt;500 Headcount)</td>
<td>Flamingo, MediaMath, Speedo, Youth Sport Trust,</td>
</tr>
<tr>
<td>Start Ups (&lt;20 Headcount)</td>
<td>Bespoke Beverages, Blaze, CCD, City Insights</td>
</tr>
</tbody>
</table>

Two sample briefs are illustrated in Figure 9.4 and Figure 9.5.
Gym Membership

The world of fitness is changing. Gyms are seeing their membership levels decline as people move to bespoke fitness studios. Services such as Classpass are enabling people to customise their fitness routines to incorporate diverse classes across numerous studios.

The US is leading the industry in this regard with the changes now beginning to impact the UK too. Boutique studios like SoulCycle now make up at least 21% of the $22.4 billion American fitness industry. Up to 45% of people quit their full-service gym membership every year, according to The New York Times.

Boutique studios earn twice as much per customer as commercial gyms. Some of the bigger chains, including Equinox and David Barton Gym, are even partnering with these studios to gain clientele and finances in exchange for space and amenities.

Your task is to provide strategic opportunities for chain gyms to stop their membership decline.

**Figure 9.4:** Sample brief from Flamingo (2016).

Sense of Place

In the 21st century things move fast, from transport to skylines, so it is becoming increasingly difficult for a place to hold onto and share its identity.

Understanding how sense of place develops and changes is vital to understanding how people interact with their environment, what it means to them and how this sense can be used to promote positive behaviours, feelings and future thinking. In places that are changing, the sense of place can become a controversial issue, with incumbent populations being pushed out by incoming groups who may have their own perceptions and stories. Shared perceptions encourage positive feelings of identity and cohesion.

City-Insights has the potential to help revitalise and create ‘sense of place’ using 21st century tools and techniques and technologies – accessed through hand held devices.

Your task is to show how a City-Insights Platform (or similar web-based interventions) be implemented in changing environments to preserve and develop a location/area’s ‘sense of place’. Demonstrate this by means of digital placemaking using hand held smart technology.

**Figure 9.5:** Sample brief from CityInsights (2016).

Within the projects the students learn to work in cross-disciplinary teams, whilst addressing a live brief for a company. Through this experience, they develop their understanding of the importance of project planning, try different research approaches and have to deal with the legal issues associated with date collection, amongst other things.

Lufbra Service Design Jam

Lufbra Service Design Jam is a 48 hour service design challenge that has been hosted by Loughborough University for its students consecutively for four years on two campuses (LU LDN in 2016 and LDS 2013-2015) with the numbers of participants increasing up to 80 students in 2016. Lufbra Jam is part of the Global Service Design
Jam event (Global Service Jam, 2015) that occurs in more than 100 countries at the same time. Vezzani & Tang (2014) describe Design Jams as a way to enhance design education. Lufbra Jam has been set up for Loughborough University students as an introduction to the practices of service and user-centred design (Loughborough University, 2015).

The aim of Lufbra Jam is to bring students with various disciplinary backgrounds and degree levels together, on a voluntarily basis, to dedicate 48 hours to co-designing new services that could make the world a better place to live. The focus of the Jam is on the use of a human-centred, service design-based approach to problem solving: the problem is introduced to the participants via video by the global organisers as a ‘secret theme’ that requires re-interpretation from the jammers. Students are expected to form teams during the event, and discover, develop and prototype solutions through the event, rather than come with a prepared idea. Throughout the 48 hours, students are supported by the organisers and design industry mentors, who usually have expertise in innovation, creativity, service design, and project management. The expected outcome of the jam is a physical functioning prototype of a service, ranging from low tech to high tech, and a plan of action that the team can take forward (Kuzmina et al., 2016).

In 2016, 11 teams were formed during the Lufbra Jam (Loughborough University London, 2016) comprising students from design innovation, industrial design, art and design, business and entrepreneurship disciplines and across undergraduate at Master and PhD levels. Seventeen design industry mentors were involved across 5 design organisations (Deloitte Digital, DesignThinkers, Foolproof, Pancentric Digital, and NorthHighland Worldwide Consulting) developing projects around the Global theme for 2016, ‘A sound of splash’. This resulted in 11 service projects ranging from volunteering networks to mental health services were created over 48 hours (Loughborough University, London, 2016).

Students were introduced to the visual service design tools during the event by the keynote speakers, team mentors and had an access to a range of printed and online resources through the Lufbra Jam website (https://lufbrajam.wordpress.com/resources/service-design-methods/). Students were free to select the tools that they felt were most suitable to enable them to complete the challenge in 48 hours. The non-prescriptive approach to the use of the tools meant that the tools did not dictate the outcome of the solutions, but were chosen to support the evolution of the creative ideas.

**Design Innovation Project**

Design Innovation Project is a module which provides a platform for the students studying in the Institute for Design Innovation to further their understanding of innovation processes by working in collaboration with external partners. During the 2015/16 academic year 16 students divided into 4 teams worked in collaboration with CitizensUK to develop innovative design solutions focusing on issues of youth unemployment and fuel poverty in London’s borough of Hackney. CitizensUK is a
non-profit community based organization which provides training to people to advance civil society by advancing their capacity to take action on issues that affects them, as well as to shape how society develops (http://www.citizensuk.org/). Examples of two project briefs developed by CitizensUK are illustrated in Figure 9.6 and Figure 9.7.

**Energy and Fuel Poverty**

The energy market is confusing and complicated. Ordinary citizens have no power to constructively engage with the process as a whole. Many struggle to pay for their fuel bills, bills themselves are too complicated to read, and pre-pay meters charge higher rates for energy for the poorest in society. Many people are forced to switch to pre-pay meters because they default on their bills. However, once they have switched they are required to pay a significantly higher rate for their fuel leaving them forced to spend weeks in the cold. The system is broken and fuelling inequality. However, we have calculated that across London Citizens we are the second biggest consumer of energy in the whole of London…

Project: Finding innovative solutions enabling energy consumers to have more power in the energy market.
- Addressing the premium charge added for those on pre-pay meters
- Exploring the development of an energy cooperative who could purchase energy wholesale from the grid using the power of our 20 institutions initially in Hackney as a pilot. This could then be expanded across London.
- Working out innovative ways to address the poor relationship between providers and consumers, particularly regarding ethical conduct, clear communication, and availability of options. Education is key.
- Any other options that you would like to explore.

*Figure 9.6: Project Brief on ‘Energy and Fuel Poverty’ provided by CitizensUK.*
Youth Unemployment
Youth Unemployment is high in Hackney. At the same time, the levels of wealth and business development are at an all time high. There is a growing opportunity gap for young people who have been born in Hackney but don’t have relational networks or experience to enable them to get into employment. We would like to bridge this opportunity gap by creating a model (perhaps even an industry kite mark for Hackney) which demonstrates what we would consider to be good business i.e. employment opportunities for young people in the area. A piece of work needs to be done to identify what businesses might require for young people in order to make this possible, as well as means for which they might achieve this aim. I.e. would paid work experience be a better starting block than apprenticeships? We also need to identify what skills/interests young people have, and what businesses and innovative employment opportunities their might be? i.e. engineering, coding, graphic design etc… Project: Finding innovative solutions to bridge the opportunity gap for Hackney students into Hackney businesses. -Research to identify both why there is an opportunity gap, the skills/interests of young people, and which areas of growth are creating potential employment opportunities -Developing a kite mark/brand that would enable the championing of good business in Hackney i.e. what does a good local employer look like? What are their requirements? -Development of an alliance of Good Businesses in Hackney -Any other ideas/opportunities

Any other options that you would like to explore.

Opportunity – There are lots of animated and talented young people in Hackney who are already starting this process. Having a team of technically minded innovative students to support, strengthen and enable the process to take place would enormously encourage them and enable their hopes to be realised in imaginative and effective ways.

Figure 9.7: Project Brief on ‘Youth Unemployment’ provided by CitizensUK.

Students had 150 hours to complete all module assignments, meet with their internal and external collaborators, attended tutorials and guest lectures. At the end of projects one of the collaborative partners commented:

“I was extremely impressed by the students’ presentations on innovative solutions to tackle fuel poverty and youth unemployment. It was easy to tell that they had put a lot of thought into the needs and wants of the local community in Hackney and had tailored their solutions so. The amount of creativity, thought, and empathy that went into designing these solutions was apparent and made each of their presentations highly engaging and connected in with the purpose of supporting vulnerable communities. Each group worked together well as a team and the delivery was clear and the graphics engaging. The solutions ranged from applications, to organising initiatives, but all remained true to the idea of solutions local communities in Hackney could use and operate themselves to better their own situation”.

INTRODUCING THE TOOLS

This section will introduce seven different visual tools and reflect on their value in the context of the ‘educational activities’ outlined above (refer to: Table 9.2 for a summary). Their role in supporting the uptake of innovation skills and knowledge in
**cross-disciplinary** student projects will be considered and the benefits and challenges will be reflected upon.

<table>
<thead>
<tr>
<th>Tools</th>
<th>Visual planning template</th>
<th>Persona profiles</th>
<th>Stakeholder maps</th>
<th>Social issues cards</th>
<th>Customer journey mapping</th>
<th>Project blogs</th>
<th>Prototyping</th>
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*Table 9.2: Visualisation of the different tools and the projects in which they have been used.*

**Visual Planning Templates**

In industry, adaptations of the visual planning templates such as those designed by The Grove Consultants International (2003), have been seen to be a very effective method for encouraging innovation in cross-disciplinary teams (Lofthouse, Bhamra, & Burrow, 2005; Young, Lettuce, & Leslie, 2003). In light of this observation it was decided that they would be introduced at the start of the ‘Group Project’ to encourage a high degree of team working, facilitate project management and celebrate the different expertise available across team members.

The ‘Journey Diagram’ was adapted from the ‘Your Company’s Gameplan’ template designed by The Grove Consultants International (2003) was introduced to the students. It is eight feet (2438mm) by four feet (1219mm) in size and consists of four main areas (refer to: Figure 9.8). A section on the left-hand side of the diagram entitled ‘Resources’ records the team members’ names along with any external resources that can be drawn upon. The main section illustrated by a large arrow outline which is used to record the deliverables and tasks which needed to be completed. A large yellow target on the right-hand side of the diagram reminds the team of the ultimate aim of the project and helped to reduce deviation from the goal. At the bottom of the diagram green hills provided the team with an area in which to record the challenges that they face during the project.
The expectation was that once created, the template would be referred to at each team meeting and used to direct the project. Tasks can be recorded on individual Post-it Notes and stuck onto the plan and progress can be monitored at each meeting. Future activities can be identified and assigned an owner and a completion date. However, the students did not use the template in the manner that was anticipated. To start with the students chose to interpret the basic template in several creative different ways (refer to: Figure 9.9).
Though unexpected, this was seen as a very positive start. They clearly enjoyed creating the planning template within their teams and it proved to be a very effective team building activity. They used it as a mechanism to get to know each other and to identify their strengths. In this initial session they also began to map out some of the key activities that they needed to accomplish to successfully complete the project.
However, despite its effectiveness in industry, beyond this first session the students did not refer back to the planning template very much and as such did not use the tool as effectively as we would have liked. One possible reason for this could have been the lack of permanent space available for the Masters students in LDS. If they had had a project area where they could have stuck up the template, they might have been more likely to use it. Encouraging one of the students to take ownership of the plan
and to bring it to each meeting as a way of directing activities, may have also made a difference. In a previous industry project with suit manufacturer HE & FJ Browns, the project manager brought the template to each meeting to facilitate conversation. It helped ensure each team member was aware of the activities that needed to be carried out, when they needed to be done and who was responsible for them. The template provided an effective way of making everyone accountable for their tasks in a non-confrontational and supportive way. This approach made the project more transparent and helped to reduce the level of misunderstandings within the team, and enabled each team member to have a high level of project ownership. Finally, the visual nature of the template meant that the team could easily see the project progressing and celebrate success when the milestones were reached. So, on balance they were a beneficially tool for the groups, however further investigation is needed to understand how to encourage the student groups to engage in using them more in the future.

### Persona Profiles

Personas are an effective way of visualising representative profiles of target user groups which help to humanise the focus of the project and aid design communication (Cooper, 2004). Typically, a persona profile is limited to one page and will include a culturally appropriate name, an illustrative photograph (which is ideally not from stock photography) to provide visual clues as to the identity of the persona and a number of interesting and relevant attributes such as their demographics, needs and goals (refer to: Figure 9.11). Additional information such as brands and other influences can also be added if appropriate to the brief that the persona is intended to inform.

It is interesting to note that the students consistently found it difficult to find non-stock images for their personas, also illustrated by Figure 9.11.

![Persona Profile](image.png)

**Figure 9.11**: A sample person’s profile developed by a cross-disciplinary group of students.
There is a considerable risk of stereotyping when using persona profiles, so to mitigate against this, personas should be built from the outputs of detailed user research, such as user centred observations and interviews with target groups members. “Once you have enough information collected to describe several users, look for behaviour patterns and themes that constitute commonalities” (Martin & Hanington, 2012). Affinity diagrams (such as the one illustrated in Figure 9.12) can be a useful way of downloading a consolidating understanding.

![Figure 9.12: Design thinking students downloading user data.](image)

Within our teaching, in conjunction with detailed user centred research, personas are used widely in the Collaborative project and Design Thinking modules as a way of encouraging the student groups to better understand their target user, so that by extension they can generate more suitable solutions to their problems and needs. The following section will consider how personas are used by the students in these modules and then reflect on the low fidelity approach that has been observed in the Service Design Jam.

**Usage in the Collaborative Project and Design Thinking**

It is recognised that personas can be a useful way of providing a common language for discussing design decisions and in helping to keep the solution centred on users (Cooper, 2014). This has proven to be especially useful in cross-disciplinary student groups. By visualising attributes associated with the user e.g. they buy Mamia baby...
wipes from Aldi, shop by bus, the weekly shop is the only time they get any time to themselves etc., the students can begin to understand how their solutions need to be tailored to meet the needs of a group of users. As personas resemble ‘real’ people, they are easier to relate to and create for, than feature lists and flowcharts (Cooper, 2014). Despite the risks of stereotyping, the authors have observed that there is a lot of value in teaching students to create and use personas, even if they are not perfect. One key advantage that they bring is that they help to discourage students from creating solutions aimed at their own interests and requirements e.g. housing solutions for Chinese postgraduates – a common problem widely observed when they are given a free rein. Figure 9.13 shows an example of a persona profile developed by a cross-disciplinary group of students, who were responding to a transportation brief set by Hackney Wick Borough Council.

![Figure 9.13: Example persona developed by a student group engaged in the Design Thinking module.](image)

*Source: Canik, Huang, Lu, Sun and Vaz (2015)*

Students report that they find personas to be a useful way of relating to the consumer and understanding their interests and dislikes, which in turn helps them to develop a solution which is better tailored to their specific needs.

Cooper (2014) reports that personas can be used to test initial ideas and that although this doesn’t replace the need to test with real users, this can be a useful reality-check which enables iteration to occur rapidly. Our observations with the students have also seen this to be the case but typically only when led by the tutor. For example, the persona profile can be used as the focus for the discussion to investigate the viability of the design direction being pursued by the group. Having this type of ready reckoner helps to quickly get the group back on target.
Examples from Service Design Jam

In contrast to the examples outlined above, the student teams involved in the Service Jam were limited by the time constraint of 48 hours which meant students were limited to several hours of user research. As such they took to take a low fidelity approach to the persona tool as illustrated in Figure 9.14 and Figure 9.15. In Figure 9.14, the persona is represented as a stick drawing, but despite being visually under developed the text captures persona’s lifestyle choices, behaviours, and needs. Doing this at the beginning of the Jam helped students to collectively develop empathy towards the user for the duration of the whole design process, which informed the innovative design of their service concepts.

![Image of a hand-drawn persona named Alison](image)

*Figure 9.14: Persona examples from the Lufbra Service Design Jam, 2016, team Fluid.*

Figure 9.15, presents two out of five personas developed by the team AquaPoint. Both personas were visually more advanced than an example in Figure 9.14, yet the textual information provided about each persona is limited and generic, making it difficult to relate to the character. Each persona does however have a statement around its need in relation to the service solution. Unlike the previous example these personas were developed after the service has been created to communicate a final solution in a presentation. While the personas themselves are generic, by having several personas rather than one, the team presented how their solution addresses the need of each individual character providing the more insightful view of the service.
The noted time constraints meant that teams were unable to carry out an extended user research, and as such students drew on their own experiences, collaboratively constructing persona’s attributes, supplemented by general quantitative data found on internet. This process was highly collaborative but potentially led to the finite user insights and thus limited solution innovation. In each case however the use of persona profiles encouraged teams to develop a human-centred approach to their work which helps facilitate innovation.

**Stakeholder Maps**

Stakeholder map is a ‘mapping tool’ that is used to visualise a network of actors in a system (Sangiorgi, 2009). In particular, within a service design context, it visualises stakeholders involved in the service system and their respective interrelations (Stickdorn, & Schwarzenberger, 2016). Stakeholder map allows designers to explore,
analyse and understand the ecosystem within which services takes place (Sangiorgi, 2009; Stickdorn, & Schwarzenberger, 2016) and can be used both for generating insight into the existing system as well as for the development of a new system. Cardoso et al (2015) define two steps to create a stakeholder map: identify stakeholders and draw relations. Both higher level, primary stakeholders, without which service will not work, and more detailed, secondary stakeholders, non-critical to the service actors, may be identified and placed onto the map. Stakeholders may be organised into groups and named on the map, for example, customer, supplier, etc. The relations between the stakeholders also need to be identified and visualised using arrows, labelling them in a natural language.

**Using Stakeholder Maps in the Lufbra Service Design Jam**

In order to support a systematic approach, some groups choose Stakeholder mapping as a way of identifying and simplifying a complex set of actors and relations in their services. In Figure 9.16 a Stakeholder map was used by Lufbra Jam 2016 team, H2FLO, to represent a new set of relations between three primary stakeholders of their service. As students developed the map, they first focused on identifying their primary stakeholders (agency, student and charity) and then sought to clarify the needs and characteristics of each stakeholder. Through the process, they engaged with the knowledge from their expertise fields (design, business and marketing) and undertook collaborative research, which led them to visualise a new network system. Students used the Stakeholder map to communicate the new system to the design industry mentor and other students at the event, thus testing their concept and further clarifying on the relations, characteristics and needs of the stakeholders. Whilst the Stakeholder map allowed for a wide array of stakeholders to be included, students chose to focus only on the three primary actors within their system. This was done mainly due to the time constraints. However, what students successfully focused on, was undertaking an in depth exploration of the relationships between the three actors, based on their characteristics and needs, thus slightly adapting the tool. The simple representation of the new actor network helped students to initiate discussions with their mentors and other students which led to collaborative development of the service ecosystem.
Using Stakeholder Maps for the Sense of Place Brief in the Collaborative Project

The Stakeholder map generated by the students in the Collaborative Project (refer to: Figure 9.17) was created during their user research phase for the ‘Sense of Place’ brief. The team had to identify users and their needs for the digital platform provided by City Insights, in order to develop the platform and the content that met users’ needs. In this example, students chose to use the stakeholder map for the purpose of exploring a social system in the local area of Hackney Wick.

They used the map to visualise their research, which helped them to record and clarify the findings. For example, they mapped out the complexity of issues by noting a variety of stakeholders, locals and newcomers, individuals and organisations, as well as stakeholders’ needs and interrelationships. This allowed the students to clarify the users of their platform and to recognise an opportunity to develop a platform for both immediate and future users. Once the map was designed students reframed their project brief adding multi-temporal and multi-user perspectives, which led to an innovative solution proposition.
The example shown in Figure 9.17 is the only stakeholder map that students produced during the project. They hesitated to make changes to it as the project moved along, nor did they consider creating several stakeholder maps. It is visually appealing and enabled students to capture an insight into the community dynamics that otherwise could have been missed. However, students found it challenging to show an array of identities one stakeholder may have in the community. For this they would have to add more information onto the map, possibly layer it, which they felt would complicate it. Thus, students had to collaboratively choose the identity of each stakeholder that is and isn’t represented on the map. Engaging in the dialogue meant students discussed their research findings, analysed them and came to a consensus which then were visualised on the map. Stakeholder map therefore helped the students to collaboratively and critically explore the constraints for their project, making the constraints concrete and thus enabling innovation in their project solution. Overall, it became an important stage in the process that helped the team to move towards a solution generation stage. Asking students to develop several stakeholder maps, further visualising and concretising their research findings could enable students to deepen the innovation process that they were involved in during the project.

**Social Issues Cards**

The Social Issues Cards (refer to: Figure 9.18) are a set of 31 hand held cards which have been designed to help users to consider relevant social issues in their design
work. The cards feature a series of relevant questions about the types of social issues that one might consider during an innovation project. The back of the card presents an illustrated case study to demonstrate how others have addressed the question posed.

Although the Social Issues cards were specifically designed to help Design students to consider social issues which are relevant to their field of influence (Lofthouse, 2013), they have proven to have a useful role in cross-disciplinary teams who are tackling wicked problems (Kolko, 2012). They have been useful within both the Group Project and Design Thinking modules. It is felt that the cards were successful because of the diverse range of case study examples that they incorporate, drawing from a wide variety of disciplines. It appears that this diversity helps to support inclusivity, as students can find examples that they specifically relate to (helping to make it relevant to them), whilst at the same time introducing them to new ideas through case studies which may broaden their horizons and challenge them. It has been seen in the past that inclusivity builds confidence and belonging which is more likely to lead to innovation (Prime & Salib, 2014; Swiegers & Toohey, 2013).

**Customer Journey Mapping**

Customer journey mapping originated as a technique to help teams in organisations move away from an operational, system-centred view towards a user-centred view of their product and/or service use. Using the insights around customer experience of their product and/or service to innovate.

Customer journey mapping can be defined as a visualisation of the experiences people have when interacting with a product or service, so that each moment can be individually evaluated and improved (Hanington & Martin, 2012). These moments or touch points may consist of the interaction between human-to-human or human-machine and may be both direct and indirect, such as receiving a message from a third
party (Stickdorn & Schneider, 2011). The Customer journey map supports visualisation of the service taking place in time, within variety of contexts and attending to user’s behaviour and emotions as well as visualisation of the whole customer experience at an individual level while capturing individual’s breakdowns and successes during the use of the service.

The use of Customer Journey Mapping in Lufbra Service Design Jam

In a service design context, customer journey mapping has been used widely both to redesign services and design new ones, as such there are a variety of templates available to use. At Lufbra Service Design Jam, students were introduced to one of the more structured Customer Journey Map (CJM) developed by the Design Thinkers Group (CDRI & Design Thinkers Group, 2014) (refer to: Figure 9.19). The map is divided vertically to indicate a sequence of steps that can be grouped into the stages within a service: pre-service, during service and after service (Stickdorn, & Schwarzenberger, 2016). Each step represents a customer interaction with the service as they seek to reach their goal. The horizontal structure of the template includes various ‘swimlanes’ that may make up that interaction: emotional experience, context, touch point and actions undertaken and experienced by the user. It also provides a lane to record insights and opportunities for innovation and improvement for each step.

Figure 9.19: DT group Customer journey template used at Lufbra Service Design Jam, team Emineo.
While CJM has been created to be used in the research stage of the service re-design projects (CDRI & Design Thinkers Group, 2014) at the Jam students usually use it at the development/iteration stage of their new service development. It is a tool that teams pick up once they have an idea or a concept for a service to help them develop it further and communicate it to mentors for opportunities to iterate (refer to: Figure 9.19). They choose to use the tool not only for its support in structuring their ideas, but for the opportunity to work collaboratively, with various ways for an individual to contribute. For example, for each step teams discuss and agree a variety of information about the user experience, the context of use, the service touchpoints (non-relational and relational), and user’s emotional journey. For this to happen the template requires different types of knowledge (Technical, psychological, managerial) and skills (analytical, systemic thinking, visual) that students within the team input into the final solution. The CJM also enables students to think about the service both in detail and holistically. This in turn supports teams to recognise insights and opportunities for improvement and innovation of the service both at a detailed level (touchpoint interaction) and systemic level (how all three service stages integrate).

The challenge of using CJM at Lufbra Jam is the time that the students need to fully develop it. Teams can spend considerable amount of time debating a particular touchpoint or context rather than considering the wider service experience. Further some information may not be available to the students, leaving CJM under developed. The detailed view of the service that CJM presupposes therefore can be both beneficial to the service development as well as restrictive in the context of a very short design exercise, such as the Jam.

**Project Blogs**

Project blogs which were developed to support the Global Studio (Bohemia, Harman, & Lauche, 2009). The project blogs provide a platform for the student project teams to share their progress with their collaborative industry partners. Project blogs have been used in the Group Project (LDS) and the Design Innovation Project (LU London). Each of the student project teams are provided with an online project site to curate their weekly progress including meeting minutes. These project sites also provided access to external project collaborators to view the students’ teams weekly progress. The project blogs also enable the collaborative industry partners and the academic supervisors to comment and provide online feedback to students’ teams. Thus, the project blogs over the duration of the project form a digital log-book (refer to: Figure 9.20).
At the start of the project each of the teams developed a project blog banner consisting of team’s name, members’ photos, and logo (refer to: Figure 21). Similarly, as with the visual planning templates, this initial team’s activity provided the team members with an opportunity to get to know each other and to identify their strengths.
The project blogs provided student project teams with number of benefits. First, the process of formulating and contributing a post on the project blog helps students to externalise their own knowledge (Cress & Kimmerle, 2008) and thus externalising their knowledge and sharing it with their team members. It has been recognised that the process of making tacit knowledge explicit is an important part of the innovation process within teams (Nonaka & Takeuchi, 1995).

In addition, all the student teams can access the other teams’ project blogs. This provides students with opportunity to observe diverse design practices across the overall student cohort. The openness of the blogs promotes a peer learning not only with the specific teams but across the whole class. This is evidenced by students incorporating new practices they have observed from the other project teams. Incorporation of new practices indicates that the students have internalised a new knowledge. This in turn enables students to make a contribution to collaborative multidisciplinary teams’ project work.

**Prototyping**

Prototyping ‘is the tangible creation of artefacts at various levels of resolution, for development and testing of ideas within design teams and with clients and users’ (Martin & Hanington, 2012, p.138). Prototyping helps to make things real and brings ideas to life (Allan, Kingdon, Murrin, & Rudkin, 1999) which enhances communication in groups and beyond. An extreme demonstration of this can be seen in the ideation pitch for ‘Animal Kingdom’ in Florida when a 400-pound Bengal tiger was brought into the meeting to convince a sceptical CEO of Disney that live animals are exciting (Allan et al., 1999). The physical nature of a prototype, as something that you can literally weigh up, put in your pocket; play with in your hands is where the value lies. Prototypes can be used; to establish empathy, to see if an idea works, to find out what doesn’t work – to refine and try again, to sell and ideas, to test early ideas on people, to refine ideas and to test developed ideas on people.

Prototyping can take many different forms, including sketching, storyboarding, paper prototyping, video prototyping, and role play. They can be physical, virtual or a hybrid. Prototypes are often referred to as low or high fidelity i.e. the degree to which the model resembles the final solution (refer to: Figure 9.22).

*Figure 9.22: Low fidelity prototyping (LHS) vs high fidelity prototyping (RHS).*
Initial solutions are often evaluated using low fidelity prototypes, then more rigorous usability testing is carried out with high-fidelity prototypes (typically within the remit of industrial designers). As we are not reporting on the activities of designers in this chapter, the focus will predominately be on low fidelity prototypes.

**Early Stage Prototyping**

Paper prototypes are very quick and cost effective to construct and are an excellent mechanism for introducing non-design students to prototyping. They have proven to a useful way of evaluating attributes such as scale, form and tactility, as well as to demonstrate and test sequencing (Hinman, 2012). Similarly, plasticine prototypes are typically not very refined as the material is difficult to work with. But it can be a very useful and cost-effective way of quickly getting a feel for sizes and crude button layout.

In the early stages of the Design Thinking module, the students are required to create a low fidelity models to communicate their initial ideas to the rest of the group (refer to: Figure 9.23). They are provided with a wide range of materials including: plasticine, corrugated card, pipe cleaners, post it notes, stickers and pens, from which to create their vision. Once created the students present their work to each other in order to gain feedback.

![Figure 9.23: Initial prototypes for concept development, Group J.](image)

This session has repeatedly proven to be great fun and the students enjoy bringing their early ideas life. In turn, this has been seen to help with team building and cross disciplinary engagement. The element of this exercise that students do struggle with, is the act of gaining feedback on their ideas. Often the ‘audience’ are not accustomed to criticizing the work of others in public and the group presenting their work are
often not very skilled in encouraging the type of criticism from which early prototyping often benefits.

Creating Prototypes for User Testing

To be most effective, prototyping should be cyclical. Idea are generated, concepts are prototyped, then tested, then refined, adapted & retested. Initial ideas are often evaluated using low fidelity prototypes, then as the development progresses, more rigorous testing is carried out with high-fidelity prototypes.

Later on in the Design Thinking module the students are required to create a prototype of their refined idea and test this on their identified target user. At this stage mock ups in programmes such as PowerPoint can be a useful way of getting ‘quick & dirty’ feedback. Simple interfaces can be created to simulate content & navigation. Images can be imported & multiple hyperlinks added between pages, text & simulation controls.

For app development, POP app is currently a very popular and accessible application which allows students to prototype apps, for testing with users (https://popapp.in/, accessed November 2016). Figure 9.24 illustrates a mock-up of an app that one group of students created to test the service touch points of a bigger food delivery service that they had designed.

Figure 9.24: More refined digital prototype for user testing, Group J.

In the Collaborative project the student groups also developed prototypes of user testing. These took on a variety of forms, including video prototyping, physical prototypes and apps made in POP app (refer to: Figure 9.25 & Figure 9.26).
Within the Design Thinking, Collaborative project and Group project modules the prototypes that are created for user testing are useful for communicating their ideas within the group as well as to the client in their final presentation.
Although it has been observed that the majority of the non-design students in cross-disciplinary project groups are unfamiliar with the creation and development of prototyping, they pick it up quickly and are generally very engaged in prototyping workshops. As such it often works effectively as a team building activity as well as an ideation activity. One area where further work is required, is how to encourage them to test their prototypes with target users, rather than their peers. Although many student groups do approach friendly target users, this is not universal and as such needs some consideration. Over all we feel that enabling multidisciplinary groups of students to develop the skills to create and utilise prototypes as well as helping them to understand their value as a communication tool provides them with a range of new skills which will be very useful in their future careers.

CONCLUSIONS

This chapter has set out to introduce a diverse range of visual tools that have been utilised to enhance the acquisition of cross-disciplinary innovation skills and knowledge with various levels of success. We do not propose that any specific tool is more effective than another, instead, we conclude that the value lies in the range of tools available. These can be selected from a ‘tool box’ to best suit the situation. In some instances, it is effective to use several tools to achieve the most comprehensive set of innovation skills and knowledge, such as using stakeholder map and personas in the research stage of a project, to inform the development of a customer journey map.

Many of the tools presented in the chapter are paper based, through this they benefit from being low cost, interactive and quick to manipulate. However, this transient form creates challenges for long-term projects, and those which are taking place at co-located locations. Digital approaches may provide a solution to this dilemma in the future. For example, either through the use of video streaming or through digital development platforms such as virtual prototyping. However, currently software does not provide the same level of flexibility and manipulation which considerably slows down the creative process.

It has been our experience that all of the tools presented can encourage inclusivity and help to develop a common vision within cross-disciplinary teams which can in turn clarify intentions and facilitate innovative solutions which benefit from everyone’s input. The development of this common vision can also be extremely useful when it comes to communicating with external project champions.

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Pedagogy for Visually Supported Acquisition of Cross-Disciplinary Innovation Skills and Knowledge


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CHAPTER 10

Visualising Empathy: A Framework to Teach User-Based Innovation in Design

Dr. Christopher Kueh and Russell Thom (Edith Cowan University)

Empathy-based course content is critical to expand the roles of design from focusing on artefacts to contributing to social, health, environmental, and economic innovations. Visualisation techniques play an important role in teaching empathy in design education. This chapter offers the Integrated Visual Empathic Design Process (IVEDP) as a theoretical framework to teach empathy to design students at university level. The framework is developed based on design thinking processes, empathy processes, and experiential learning processes. Based on visual ethnography, the framework encourages students to learn about empathy through both thinking and doing.

INTRODUCTION

Design as a practice and discipline has expanded from solving discrete problems of style and decoration to addressing complex challenges in multi- and trans-disciplinary environments (Muratovski, 2016, p.13; Kueh, Medley & Price, 2013, p. 3). This shift requires designers to not just understand people’s needs, but to also shift from top-down design approaches to bottom-up empathic thinking processes. Due to the complex situations that face the contemporary world, the design process needs to be an experimental process that requires designers and design students to think holistically while having empathy with people (Medley & Kueh, 2015, pp. 173-175). Visualisation techniques such as empathy mapping and storyboarding allow designers to experience the situational complexity that people are facing. This chapter offers the Integrated Visual Empathic Design Process (IVEDP) as a theoretical framework to teach empathy, through visualisation, and based on experiential learning process, to design students at university level. The framework aims to scaffold collaborative innovation in design education. Design students are encouraged to consider design process as a collaborative practice that engages stakeholders that are directly and indirectly involved in the design challenge. This theoretical framework is developed as a reaction to the need for empathy to assist in the development of innovative solutions for complex design problems. In this chapter, the theoretical framework of teaching empathic design through visual techniques are organised in this sequence.
and logic: discussion on the need of teaching empathy in the shifting design profession as a collaborative practice; review of skills and knowledge in design thinking as an innovative practice; discussion of empathic design teaching methods and frameworks; discussion of experiential learning framework to teach empathic design through action; visual ethnography as a visual practice that contributes to the teaching of empathic design process; and, general discussions of the proposed framework and its application to teaching.

**TEACHING EMPATHY IN DESIGN: A THEORETICAL FOUNDATION**

**Design: From Artefact to Strategy**

Before launching into the discussion of empathic design, it is important to understand the need for design practice and education to expand from the artefact-based practice to experience- and strategy-based practice. This section explores the roles of design through examining design models and processes. The complexity found in contemporary society, economy and environment requires designers to be able to analyse, and visualise, multifaceted situations and to develop systemic solutions to explain and tackle the challenges at hand. This way of designing is being referred to as ‘Design Thinking’. The idea of design thinking is not new. However, it became increasingly popular from the beginning of the 21st century with a dramatic increase in literature in 2009 (Johansson & Sköldberg et al, 2013). Designers like Brown (2009) play a significant role in advocating design practice as no longer being restricted to the world of the artefact. Instead, designers should engage in the design of new experiences such as services, interactions, entertainment forms and ways of communicating and collaborating. Brown (2009), Buchanan (1992), and Johansson & Sköldberg et al (2013) acknowledged the role and application of design and designers working in non-traditional design contexts. Norman (2010), Moggridge (2008), Kelly (2001) and Cross (2011) also advocated for and promote an expanded concept of design thinking and the designer’s role. These directions position design practice and education as strategic innovative process rather than object-based creative process.

Brown (2009) considered that in a traditional design process the designer was driving the creative solution, which was usually aesthetic, but having little concern for the end user. Instead, Brown believed that designers should create products and services that would improve the lives of others. Brown encouraged designers to be accountable and aware of their contribution to the lives of others. Brown (2009) proposed that design thinking created an opportunity and process for designers and their clients to work together to explore possibilities. As a team they would work to refine the problem statement, build empathy and understanding of the stakeholders and therefore develop a people-focused solution.

There are many design thinking models that have been published and applied by various design philosophers, design companies and councils. For example the Human Centred Design Toolkit (IDEO, n.d.), Acumen HCD Workshop (Acumen Fund, n.d.), Design Thinking Business Innovation (Vianna, Vianna, Adler, Lucena, & Russo, 2012), Design Thinking (Cross, 2011), Design Thinking for Educators (IDEO, 2011),
Basic Design 08 Design Thinking (Ambrose, 2010), Double Diamond (Design Council, 2015), IDEO (Myerson, 2001), Leading Public Sector Innovation (Bason, 2010), Service Design (Stickdorn & Schneider, 2011), Collective Action Toolkit (Frog, 2013), Bootleg Bootcamp (dschool, n.d.), Business Model Generation (Osterwalder, Pigneur, & Clark, 2010) and Design For Growth (Liedtka & Ogilvie, 2011). These models were developed to tackle different challenges and needs in varying situations. Table 10.1 shows a pattern and similarities among the design thinking processes of the 15 models reviewed when the processes are grouped into the researcher’s five design thinking phases.
<table>
<thead>
<tr>
<th>Model</th>
<th>Steps in the process</th>
</tr>
</thead>
<tbody>
<tr>
<td>Human Centred Design Toolkit (IDEO, n.d.)</td>
<td>Hear, Create, Deliver</td>
</tr>
<tr>
<td>Acumen HCD Workshop (Acumen Fund, n.d.)</td>
<td>Discover, Ideate, Prototype</td>
</tr>
<tr>
<td>Design thinking - Business Innovation (Vianna, Vianna, Adler, Lucena, &amp; Russo, 2012)</td>
<td>Immersion, In-depth Immersion, Analysis and synthesis, Ideation, Prototyping</td>
</tr>
<tr>
<td>Design thinking (Cross, 2011)</td>
<td>Quantify problem, Generate concepts, Refine concepts, Select a concept, Design, Present</td>
</tr>
<tr>
<td>Design thinking for Educators (IDEO, 2012)</td>
<td>Discover, Interpretation, Ideation, Experimentations, Evolution</td>
</tr>
<tr>
<td>Basics Design 08 Design Thinking (Ambrose, 2010)</td>
<td>Define, Research, Ideate, Prototype, Select</td>
</tr>
<tr>
<td>Double Diamond (Design Council, 2015)</td>
<td>Discover, Define, Develop, Deliver</td>
</tr>
<tr>
<td>IDEO (Myerson, 2001)</td>
<td>Observations, Brainstorming, Rapid Prototyping, Refining, Implementation</td>
</tr>
<tr>
<td>Leading Public Sector Innovation (Bason, 2010)</td>
<td>Knowing, Analysing, Synthesising, Creating</td>
</tr>
<tr>
<td>Service Design (Stickdorn &amp; Schneider, 2011)</td>
<td>Exploration, Creation, Reflection, Implementation</td>
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<tr>
<td>Model</td>
<td>Context Framing Phase</td>
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<td>--------------------------------------------</td>
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<td>Collective Action toolkit</td>
<td>Seek</td>
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<td>Bootleg Bootcamp</td>
<td>Empathise</td>
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<tr>
<td>(dschool, n.d.)</td>
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<td>dSchool</td>
<td>Understand</td>
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<td>(dSchool, 2009)</td>
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<tr>
<td>Designing for growth</td>
<td>What is?</td>
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<tr>
<td>(Liedtka &amp; Ogilvie, 2011)</td>
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<tr>
<td>Business Model Generation</td>
<td>Mobilise</td>
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<tr>
<td>(Osterwalder, Pigneur, &amp; Clark, 2010)</td>
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While these models have a different number of phases, there are similarities across them all. The following describes the concept of each of the five phases:

- **Context or problem framing phase:** The framing phase investigates and develops an understanding of the context and the problem;
- **Ideation generation phase:** The ideation phase develops and documents ideas that can assist in providing a solution or lessens the impact of the context or problem;
- **Prototyping phase:** The prototyping phase creates an example or prototype of the solution to enable experimentation and further development of the solution;
- **Implementation phase:** The implementation phase is about planning for and implementing the solution to enable testing and collecting of feedback by the users about the proposed solution;
- **The reframing phases:** The reframing phases is used to check the validity of or changes in thinking, identify shifts or changes in focus, monitor changes in the context or problem and ascertain learning progress or needs.

In higher education context, the first four phases are appropriate to be taught through visual tools and techniques as the means to understand the context of design and
prototype possible solutions. As the final phase is the evaluation and validation of the applied design system, it is only feasible in a real-world environment through time. This phase might not be able to be taught in an educational environment.

The diversity of design thinking phases and models reflect the broad application of design in various situations. However, methods and processes cannot counteract a lack of empathy for stakeholders in the practitioner’s thinking. The application of design as an innovation tool and process can only be possible when practitioners understand stakeholders’ needs.

**Complexity in Design and the Need of Empathic Practice**

The new roles of design involve complexity in practice. Design that addresses challenges in social and organisational change requires designers to have empathy for the stakeholders. According to Jones (2013, pp 23-28) and Jones and VanPatter (2009), there are four levels of design practice:

- **Design 1.0 Traditional craft design processes:** This process relies on individual designers creating effective communication artefacts such as websites, logos, and posters. Skills involved are mainly form-giving;
- **Design 2.0 Industrial and interactive product design:** This level involves design and research activities that see collaboration between designers and stakeholders. Design outcomes include IT, interactive services, and service design;
- **Design 3.0 [Organisational] level transformation design:** This level sees the application of design methods to assist organisations to become more innovative and competitive. Challenges that are facing designers here are bounded by systems and strategies. Co-creation is the focus to achieve change-making processes in organisations;
- **Design 4.0 Social transformation:** This level intends to designing social systems to achieve innovations in policy-making processes for communities. Designers are faced with complex and unframed challenges. Projects in this stage involve social innovation, health policy, and facilitation in social transformational processes.

According to the levels of design practice presented above, Design 2.0, 3.0 and 4.0 are dealing with increasingly complex situations, especially in social and organisational transformation. The level of complexity involved in design processes requires various ways of thinking and working. According to Muratovski (2016, pp. 19-20), design research and practice can be categorised as:

- **Interdisciplinary Design:** This type of practice involves designers collaborating across specialised areas of design. For example, a branding project requires product designers, graphic designers,
interface designers and interior designers to work together to develop effective brand strategies and touchpoints. Each design discipline contributes their expertise to deliver the touchpoints but the group remains as team and their outputs support each other, as a system;

- **Multidisciplinary Design:** This type of practice sees two or more disciplines working towards a mutual goal. An example is where User Experience (UX) designers work with engineers, city planners and architects to deliver new public services to people. This way of collaborating requires designers to work with non-design disciplines.

- **Transdisciplinary Design:** This type of practice requires designers to be able to ‘transcend’ from the design discipline that they are familiar with, into non-design disciplines while adapting ways of working from these disciplines. This is common in projects dealing with complex challenges that require the designer to have experience and skill outside of design that serves to enhance their ability have empathy for the multitude of stakeholders involved.

It is important to note that the four levels of design and the categories of design research and practice are not hierarchical. However, Design 3.0 and Design 4.0, and transdisciplinary design are the arena of complex and wicked problems. To prepare students to function in these areas, curriculum needs to allow students to think in transdisciplinary manner while understand the complexity of systemic design approaches. This calls for empathetic methods to help students to see challenges from various points of view.

Brown (2009), Bason (2010), and Vianna et al. (2012) identified a key element of design is having empathy and understanding for those affected by the problem. To tackle complex challenges, designers must identify, understand, reflect upon, challenge and possibly change their frame of reference, and habits of thinking. Marino (2013) suggested if people are unable to connect with another person within the affective arena, to share their emotional state, then the process moves to the cognitive arena. According to Marino (2013) cognitive dimension is “the ability to understand another’s emotional state without necessarily sharing their feelings” (p. 11). This knowledge is important for design in complex situations, like those in Design 3.0 and 4.0, and in trans-disciplinary design environment. Otherwise, designers are likely to design outcomes based on what they think are appropriate, based upon their worldview. Instead they need to see, hear, and experience the complexity from the stakeholders’ perspectives throughout the process of exploring, designing and refining possibilities based on this knowledge. In this dimension, the emphasis is on creating experience that can develop an understanding and a perspective of the other person’s experience. Visualisation techniques, such as empathy mapping, photo ethnography and storyboarding, allow designers to infer someone’s emotional state.
Empathy and Design Process

While the previous sections reviewed the expanding roles of design and the design models commonly used for innovation in complex situations, this section focuses on design models that are specifically developed to emphasise empathy in design education. Design’s focus on empathy is a response to the rapidly changing scene of design, from a ‘design for people’ paradigm to a complex and collaborative design environment of ‘design with people’. Empathy is a core approach in design to tackle complex challenges (see Koskinen et al., 2003; Mattelmaki & Battarbee, 2002). However, due to the multi-dimensional application and difficulty measuring, empathy can be a difficult concept to understand (Pike, 1990). The quest to understand empathy itself is a multi-disciplinary effort. Researchers and philosophers from various disciplines have contributed perspectives in the roles of empathy in the society. For example, Derntl et al. (2010), with the aids of MRI, found that there are gender differences in three types of empathy: emotion recognition, perspective taking, and affective responsiveness. In philosophy, Stein (1989) conceptualised that when an individual empathises with another person or group of people, they would: emerge on the experience, achieve clarification, and comprehend with the explained experience. Empathic design is therefore a holistic approach to innovate possibilities that are relevant to social, health, economic and environmental needs.

Empathic design is a recent movement that was introduced in the 1990s (Battarbee & Koskinen, 2005). Marino’s (2013) research Empathy in design concluded that empathy is a ‘complex system with different sub-components, some measurable in a quantitative way’ and included the dimensions of affective and cognitive. The “affective dimension is the ability to share another’s feelings or emotional state” (p. 10). A person can feel empathy for someone who has lost something, for example his or her ability to walk. To create empathy, the person does not have to have experienced the “actual” loss; rather they can connect with an event of loss in their life that enables them to empathise with the other person’s situation and feelings of loss. Barnes & Thagard (1996) explained that this process uses the semantic markers connected to events of their previous experience. These semantic markers have associated emotional experience, so the feeling of loss can be generated by recalling an event of loss. Marino (2013) suggested that people search through their personal archives for similar feelings and activities. The larger the person’s archive the greater the likelihood they can connect with the other person. Marino considers this to be shared representations.

Kouprie & Visser (2009) related empathy to design by developing an empathic design framework consisting of four phases:

- **Discovery**: Designer explores the worlds and experiences of the users of an intended design. It is important that designers need to be willing to conduct this first step of making contact with the users;

- **Immersion**: Designer takes on an active role to be immersed in the users’ day-to-day lives. Designer at this stage would need to be
open-minded and genuinely be interested in wanting to understand users’ experience;

- **Connection:** Designer connects with the users through sharing stories and experiences. Designer would require the affective component of empathy to understand feelings and the cognitive to understand meaning;

- **Detachment:** Designer steps away from the situation to allow for space to make sense of users’ worlds, and also to be able to design from an objective view.

These phases emphasise the importance of designers stepping out from the design studio, and into users’ and broader stakeholders’ experiences, in order to innovate meaningful products, interfaces, services, organisations and even social systems. The IVEDP proposed in this chapter adapts these phases of empathic design process.

Empathy in design education is starting to be recognised as an important step to shift the ways designers function, from top-down approaches to engagement approaches. Lam and Suen (2015) developed the 3Ems framework to teach socially conscious design. Adapted from IDEO’s (Brown, 2009; Kelley *et al.*, 2000) design thinking approach and the British Design Council’s double diamond model (Design Council, 2015), the 3Ems framework consists of these sections (refer to: Figure 10.1):

- **Empathy:** Students are encouraged to observe and be involved in the daily practice of users and other stakeholders who are directly or indirectly involved in the design problem. This is to reduce students’ reliance on market research;

- **Embrace:** Students are to immerse themselves in the target group and to see the challenges from their perspectives;

- **Empowerment:** Students generate ideas that enable the target group to practice their rights as community members (Lam & Suen, 2015).
The 3Ems Framework is a comprehensive process to enable students to understand users’ needs and to design based on these needs, rather than designing based on students’ preferences and styles. The IVEDP introduced in this chapter is inspired by this framework. It is expanded to include the empathy process, visual ethnography, and experiential learning, as a way to explore details in teaching and learning about empathy, through visuals, in design.

**Expirential Learning and Empathy**

This chapter takes on the view that empathy can be developed and refined if it is supported by other abilities like being a good listener and respect for others points of view. Empathy requires learning that is embedded in transformation, experience and action. The development of empathy must provide value to learners, and must have relevance for them and their lives. Dewey (cited in Merriam et al., 2012, pp. 163-163) observed that learning should link current experience with past learning and relate that to possibilities within the future. Within an educational setting, the environment and context of learning is important. The educator should ensure that learning takes place in an environment that is supportive and that materials are linked to the learners past knowledge and are conducive to learning (Merriam et al., 2012, pp. 162-163). Kolb and Kolb (2005) identified experiential learning as having six propositions:

- That learning should be viewed as a process not an outcome
- That ideas should be created, questioned, and refined
- Thinking and feeling should be opposed with doing and reflecting
- Learning is a holistic activity
Learning occurs when the learner interacts with the environment.
Learning is constructivist.

Under these propositions, experiential learning requires the learner to have the ability to be open to new experiences, be able to view experience from different viewpoints, be able to generate ideas and concepts from their observations, and be able to take ideas to implementation. These abilities are linked as a cycle of phases from concrete experience, reflective observation, abstract conceptualisation, and to active experimentation. This cycle allows learners to continually build on their learning (Merriam et al., 2007, pp. 163-164). Experiential learning theory defines learning as “the process whereby knowledge is created through the transformation of experience. Knowledge results from the combination of grasping and transforming experience” (Kolb, 1984, p. 41 as cited in Kolb & Kolb, 2005). The experiential learning modes are aligned with the design thinking phases (refer to: Table 10.2) to illustrate commonalities, the framing phase consists of the concrete and reflective phase, the Abstract phase aligns to ideation and the active phase aligns to prototyping and implementation (Kolb & Kolb, 2005). In the context of design education, it is important to view experiential learning and design thinking phases as cyclical, rather than linear processes that run only once.

Table 10.2: The experiential learning modes aligned with the design thinking phases.

<table>
<thead>
<tr>
<th>Experiential Learning</th>
<th>Design Thinking</th>
</tr>
</thead>
<tbody>
<tr>
<td>Concrete Experience</td>
<td>Framing / Reframing Phase</td>
</tr>
<tr>
<td>Reflective Observations</td>
<td>Framing / Reframing Phase</td>
</tr>
<tr>
<td>Abstract conceptualisation</td>
<td>Ideation</td>
</tr>
<tr>
<td>Active Experimentation</td>
<td>Prototyping Phase &amp; Implementation Phase</td>
</tr>
</tbody>
</table>

Supporting this observation are researchers Beckman & Barry (2007) who investigated design thinking, experiential learning and learning styles. They argued, using Owen’s suggestion that design thinking has both an analytic and synthetic element and that it operated in an the abstract (theoretical) and the concrete (practical) realms, that it could be overlayed onto Kolb and Kolb’s experiential learning modes. They further developed this to consider that Kolb’s reflective conceptualisation and active experimentation phases could be interpreted as an analysis and synthesis phases respectively. They articulated this concept to different learning styles that would operate optimally in each quadrant; diverging, assimilating, converging and accommodating (refer to: Table 10.3). This formed the concept of their innovation process, which is a cyclic process of learning through experiencing, reflecting, thinking and acting. This is the moving from observations to framework (problem...
finding), frameworks to imperative (problem selecting), imperatives to solutions (solution finding) and back to observations (solution selecting).

Table 10.3: Kolb and Kolb’s experiential learning modes are reflected in Beckman and Barry Innovation Process

<table>
<thead>
<tr>
<th>Experiential Learning</th>
<th>Innovation Process</th>
<th>Learning Styles</th>
<th>Learning Cycle</th>
</tr>
</thead>
<tbody>
<tr>
<td>Concrete Experience</td>
<td>Concrete</td>
<td>Diverging</td>
<td>Observations</td>
</tr>
<tr>
<td>Reflective Observations</td>
<td>Analysis</td>
<td>Assimilating</td>
<td>Frameworks</td>
</tr>
<tr>
<td>Abstract conceptualisation</td>
<td>Abstract</td>
<td>Converging</td>
<td>Imperatives</td>
</tr>
<tr>
<td>Active Experimentation</td>
<td>Synthesis</td>
<td>Accommodating.</td>
<td>Solutions</td>
</tr>
</tbody>
</table>

Experiential learning can be integrated into the phases of design process through the framing and reframing phase providing opportunities for concrete experience and reflective observations, the ideation phase providing opportunities for abstract conceptualisation and the prototyping and implementation phase providing opportunities for active experimentation. The IVEDP introduced in this chapter (refer to: Table 10.4) adapts the four phases of experiential learning to scaffold empathic design through visual techniques.

Visualisation to Experience Others’ Needs

This chapter proposes visual ethnography as the research approach to teach empathy in design. To understand what people experience, designers need to immerse themselves in their lives. In university setting, sometimes there are limitations on the level of engagement that students could have, to enable them to fully immerse themselves in empathising with the users. These limitations could be for the reasons of safety, ethical and timeframe concerns. Visual ethnography offers students with broader, but yet still rigorous and effective, ways to visualise stakeholders’ lives and needs.

While many visual methods are about collecting visuals as data and to analyse the data objectively, visual ethnography used as empathic design focuses on allowing designers to ‘move’ in and out of the stakeholders’ experiences through visuals. This ethnographic approach allows designers to build empathy towards the stakeholders of any given design problem. According to visual ethnographer Sarah Pink (2007), ethnography is:

…an approach to experiencing, interpreting and representing culture and society that informs and is informed by sets of different disciplinary agendas and theoretical principles. Rather than a method for the collection of data, ethnography is a process of creating and representing knowledge (about
society, culture and individuals) that is based on ethnographers’ own experiences. It does not claim to produce an objective or truthful account of reality, but should aim to offer versions of ethnographers’ experiences of reality that are as loyal as possible to the context, negotiations and intersubjectivities through which the knowledge was produced (p. 22).

This definition offers empathic design process with the appropriate paradigm to move in and out of people’s lives. It is important to note that empathic design process is rarely about collecting data and objectively analyse them – it is more of the concern of experiencing and immersing designers’ thinking process into the daily practices of stakeholders. This does not mean that designers cannot collect images from stakeholders. Designers could, for example, collect photographs taken by stakeholders (public transport users, bus drivers, cyclists, and drivers) while engaging with public transport. Together with field notes such as annotations on emotions and experiences, designers could then map these images in journey maps that would allow designers to immerse themselves in stakeholders’ experiences with public transport. These collective experiences would portray insightful understanding, hence building empathy, for designers to develop better experiences in public transport services. This way of conducting visual ethnography aligns with Kouprie and Visser’s (2009) proposal that the empathy process ends with ‘detachment’ that allows designers the space to ‘move’ back to the design realm.

Photography and film are two of the most common visual ethnographic methods. Drawings, drawn by designers or collected from stakeholders, are also effective medium to help designers to empathise with stakeholders. Drawings can provide an opportunity for participants and designer to ‘discuss’ insights that other verbal methods might not be able to capture. This is especially true with certain target groups. For example, visual methods used in understanding children’s needs have been recognised as valuable in medical research. Many researchers agree that drawings as a visual method could maximise children’s involvement in voicing their thoughts (see Luttrell, 2010; Vindrola-Padros, 2012). Johnson, Pfister and Vindrola-Padros (2012) regarded drawings collected from children, could supplement traditional ethnographic methods and add ‘voice’ to children who participated in research. Relating these insights to empathic design process, designers could maximise use of drawings and photographs taken by designers and stakeholders, to access stakeholders’ thoughts and experiences.

THE INTEGRATED VISUAL EMPATHIC DESIGN PROCESS (IVEDP)

This section introduces the IVEDP as a theoretical framework for teaching empathic design process through visual techniques. This framework (refer to: Table 10.4) synthesizes insights from experiential learning, design thinking, and empathy processes, and the importance of visualisation. The visual tools in this framework are selected to suit visual ethnographic approach and help make the experiential learning, design thinking and empathy development more concrete for the students.
Table 10.4: The Integrated Visual Empathic Design Process (IVEDP) merges experiential learning, design thinking process, and empathy process as the means to teach empathy to design students.

<table>
<thead>
<tr>
<th>Experiential Learning to teach Empathy</th>
<th>Concrete Experience</th>
<th>Reflective Experience</th>
<th>Abstract Conceptualisation</th>
<th>Active Experimentation</th>
</tr>
</thead>
<tbody>
<tr>
<td>Design (Thinking) Process</td>
<td>Context Framing</td>
<td>Ideation</td>
<td>Prototyping</td>
<td>Implementation</td>
</tr>
<tr>
<td>Empathy Process</td>
<td>Empathy to Frame Context</td>
<td>Empathy for User-Centred Design</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>Discovery Immersion Connection Detachment</td>
<td>Discovery Immersion Connection Detachment</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Visual Tools</td>
<td>Empathy Map Photo Ethnography Visual Diary</td>
<td>Storyboarding Forth point mapping through persona</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

Experiential Learning and Empathy

Using the IVEDP framework, students learn about innovative design process actively through experience. The four stages of experiential learning provide a thinking and doing structure to help students to scaffold the learning of the design process. Concrete experience and reflective experience stages are where students are guided and encouraged to understand, frame and re-frame the given design situation. This is where students contextualise the design problem by immersing themselves into the daily practice of stakeholders. Students will learn about divergent and convergent thinking as part of the design process through concrete experience of the design problem while reflecting on their observations.

The abstract conceptualisation and active experimentation stages of the experiential learning set the scene for students to learn about ideation, prototyping and implementation phases in design. Students are encouraged to make mistakes while experimenting and prototyping with possibilities.

Adapted from Kouprie and Visser (2009) and inspired by Lam and Suen (2015), the empathy process aligns with the design process. However, the IVEDP proposes two rounds of empathy process. The first round of empathy process is to allow students to empathise with the stakeholders in order to experience the challenges and context surrounding a design problem or design brief. The second round of empathy process aligns with the design phases of ideation, prototyping, and implementation. The two rounds of the empathy process align with the experiential learning framework, concrete experience and reflective experience phases which involve different thinking and doing patterns from abstract conceptualising and active experimenting phases. Immersing in people’s lives to understand their experiences and prototyping ideas while building empathy are separate stages of the design process. There is therefore a need for students to detach themselves from the stakeholders, from the affective to the cognitive, to re-frame the design problem before they can progress into ideation, prototyping, and implementation phases. The
thinking and doing patterns involved in the two cycles of the empathy process are as follows:

*Empathy to frame design context:*

- **Discovery:** Students identify stakeholders who are involved in the given design problem. Students would visit the environment or situation where the design problem exists. This allows students to map the general daily activities of stakeholders;

- **Immersion:** Depending on the size and timeframe of the project, students can draw the parameters of the stakeholders to be involved in the context framing stage of design process. Students then immerse themselves as the selected stakeholders to understand the obvious and covert challenges that are related to the design problem;

- **Connection:** Students share perspectives through stories among stakeholders. This could be done through conversations with stakeholders, or through persona workshops in class;

- **Detachment:** Students step away from the environment to re-frame the design problem, from stakeholders’ needs and daily activities.

*Empathy for user-centred design:*

- **Discovery:** Students re-enter the design problem, but with the intention of developing possibilities to tackle the identified challenge from context frame stage. Students can investigate avenues, from stakeholders’ daily activities, where innovation could take place;

- **Immersion:** Students immerse themselves as selected stakeholders to actively engage with materials, opportunities, social practices, and community’s willingness and abilities to innovate. This phase allows students to also explore vernacular design, that emphasises innovation is to be from the community and for the community;

- **Connection:** Students connect with stakeholders by sharing ideas and prototypes. This is where feedback and co-creative aspects contribute to the working empathic design;

- **Detachment:** Students step back to a designer’s perspective to frame the prototyped possibilities into desirable and practical solutions.
Visual Tools

Visualisation, as the means to embed empathy in a design process, includes drawings, photographs and diagrams. Tools to do so are suggested in, but not limited to, the list below:

- **Empathy Map:** This method allows designer students to sort drawings and photographs into what the stakeholder says, does, thinks, hears, sees, feels and thinks. It can also include the pain and gain associated with the need or context. This may help to understand behaviour, concerns and goals of users (see Stickdorn & Schneider, 2011; Osterwalder, Pigneur, & Clark, 2010). Students can do this with their own photographs and drawings, and/or those done by stakeholders. This method allows students to attach emotions to the design problem through visuals. Figure 10.2 is an example of visual based empathy map used for the first cycle of empathy process;

- **Photo Ethnography:** Students could take photographs of settings that are relevant to the given design problem. In this way, students immerse themselves in the situation as one of the community members and visually record things and events that they would encounter. Another way of conducting photo ethnography is to assign participants, who are stakeholders of the design problem, to take photographs of things and events that meant something to them. Students could choose to be broad or specific in collecting photographs from participants. For example, in a project to re-design travelling experience, students could give participants an open and broad question such as ‘what does your daily journey to work look like?’ Making sense of photographs taken under broader questions would allow students to immerse themselves in the holistic experience encountered by the stakeholders. Students could then look for certain information in this collective experience in the ‘detachment’ phase of the empathy process. Students could also give participants more specific question such as ‘what are the problems that you could see on your daily journey to work?’ This way, students would be experiencing the specific aspect of the experience and be able to immerse themselves and experience only the problems in the journeys to work;

- **Visual Essay:** This method is best suited in the ‘detachment’ stage of the empathy process. The visual essay could be seen as parallel to the written report created from a traditional verbal research technique like an interview. The essay is a collection and organisation of images (photographs and drawings) to illustrate
student’s ‘conclusion’ of experiences from the stakeholders. In this context, the visual essay needs to tell a story that communicates insights of the stakeholders’ experience as a narrative;

- **Storyboarding**: This method allows student to understand stakeholders’ lives through a visual story. The focus is on identifying areas where innovation could take place in stakeholders’ daily activities. There is no fixed format, but the comic framing technique is commonly used. Students might want to experiment with drawing from the third person’s views (where the frames see stakeholders conducting activities) or drawing from first person’s views (where frames show the world seen from the stakeholders’ eyes);

- **Touch point mapping**: This visualisation allows students to understand and consider the systemic complexity of proposed solutions. The purpose is not to over-complicate possibilities to innovate, but to test the practicality of possibilities. The map details the user experience of the frontstage and backstage activities provided by the service.

It is important to realise that visuals used in the teaching and learning process of empathic design are to investigate and understand a given challenge from different stakeholders’ experiences. The quality of the visuals therefore should focus on the representation of experiences and exploration of events and things that the students might not have previously encounter, but not the aesthetic value.
Class Structure

This framework is suitable for university undergraduate units that allow one semester (10-12 sessions of in-class and studio workshops) for students to progress on one project. The framework is also suitable for postgraduate coursework projects. Students could work as individuals or in small groups of 2-4 people. Weekly class activities would involve short lectures and in-class workshops. Field trips to the environment where the design problem is situated would be useful. Assessment criteria for the unit could be developed based on the four stages of experiential learning that scaffold the learning of the design process with empathy as the focus.

CONCLUSION

The growing complexity challenges in the social, economic, and environmental sectors require people-centred innovation. A people-centred design process is a holistic innovation approach that focuses on people’s needs which engages empathy as the means to improve people’s lifestyle. Visual techniques such as storyboarding, empathy maps, and photo-ethnography are commonly employed to allow designers to empathise with stakeholders. However, teaching empathy requires both thinking and doing. The above discussions offer the IVEDP as a theoretical framework to teach empathy to design students through visuals. The theoretical framework recommends...
visual ethnographic approaches that allow students to actively immerse themselves in the stakeholders’ daily activities while leaving space for students to detach and reflect on the identified problems and design solution from designer’s perspectives.

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Scaffolding Innovation with Design Artefacts that Enable Others to Do their Work

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Organisations globally are turning to design-driven approaches to support their shift towards customer-centricity and to accomplish their innovation objectives. Design approaches are now applied within wicked and diverse domains such as health, government, sustainability, planning, social innovation and business. Irrespective of its domain, innovation occurs within complex social environments. Visual design artefacts provide valuable inputs into innovation processes providing instruments that support the social and interlinked demands of innovation. Especially in complex environments, designers need to consider how to best steward their designs towards implementation. Results from the collective work of many, requiring collaboration and broad sense making, often over long periods of time. Consideration of the social context empowers designers to provide organisations with useful visual tools that support innovation processes. There is a significant opportunity for designers to support innovation and it is therefore critical that today’s graduates understand the important mediatory and enabling possibilities of well-crafted visual artefacts. In this chapter current practices and roles of design artefacts within innovation contexts are explored. Some specific examples of design artefacts that are being used in the innovation practices of design professionals are presented, and a pedagogical framework that helps designers consider the social context of innovation initiatives is introduced, enabling them to deliver useful visual tools that scaffold innovation through supporting others to do their work. Well-crafted design artefacts, can support innovation processes, by helping organisational members to do their work of facilitating innovation outcomes. Like scaffolding supports construction workers, design artefacts are enabling tools to deliver collective outcomes.

INTRODUCTION

Innovation is as old as humanity, because it is about changing the way that we do things. Its requirement for implementation is what distinguishes it from both invention (Schumpeter 1989) and design. The differences between innovation and design include; (1) *innovation is broader in scope than design*. Design may form part of
innovation, but innovation includes much more, such as the management of regulatory issues. (2) *Innovation is seen as an economic activity whose basic unit of analysis is the innovation system.* Management sees design as a part of the innovation system. (3) *Innovation can include initiatives that are technology-led rather than design-led* i.e. when a new technology leads to an innovation rather than the identification of a gap which leads to a solution (Ulrich, 2011). While the process of design can stop with the delivery of ideas and specifications, innovation requires implementation and adoption.

Within design discourse, there is much enthusiasm for the value of design approaches within innovation; however, the majority of texts focus on the role of design at the beginning phases of the innovation life cycle (Kelley *et al.* 2001, Brown 2009), rather than the role of supporting design tools such as design artefacts within innovation processes. Innovation is a collective outcome, often requiring change to processes, products, services, culture, and organisational structure. On a fundamental level, artefacts can enable organisational members to think and (hopefully) act in a more person-centred way. This role within human-centred design is well established. However, the reuse of these design artefacts outside the bounds of the design project less so. In this chapter we argue that there is a significant opportunity for design (artefacts) to support innovation and its associated processes.

Design artefacts are created as both outcomes of as well as inputs into the design process. We are not concerned about the role of design artefacts as outcomes (e.g. products and services) but rather the role of design artefacts (e.g. sketches, personas, visualisations, and specifications) that inform the design and delivery of services or things, such as web-sites, buildings, products, and government services. Artefacts, quite simply help people get things done; they mediate work activities, facilitating conversation, collaboration, sense-making, knowledge transfer, documentation, alignment, co-operation, co-ordination and communication. In these ways, artefacts play significant mediatory and enabling roles within organisations. Innovation demands cross-disciplinary collaboration, communication and knowledge building. Artefacts play significant roles as cross-disciplinary mediators within organisations. Some example artefacts used within organisational activities include GANTT charts, spreadsheets, presentations, texts, documents, visual representations and drawings. Design artefacts refer to those that have a visual component, including animations, videos, sketches, drawings, and info-graphics.

**LITERATURE**

The enabling role of artefacts within collaborative work is widely discussed within the organisational literature (e.g. Knorr & Cetina 1997; Wagner, 2000; Carlile, 2002; 2004; Ewenstein & Whyte, 2007, 2009; Pratt & Rafaeli, 2006). Two of the most useful constructs put forward for this discussion are *boundary objects* (Star & Griesemer 1989) and *mediating artefacts/Activity Theory* (Engeström, 1999).

In studying collaborative work practices, Star & Griesemer (1989) defined ‘boundary objects’ as tools which organisational members act with and towards. Boundary objects provide organisational members with flexible frameworks,
facilitating both local meaning within distinct organisational communities as well as shared meanings between organisational communities. Boundary objects establish a shared language for individuals to represent their knowledge and provide a concrete means for individuals to specify and learn about differences, dependencies and what is new across a given boundary. Twenty years after coining the term, Star (2010) clarifies that ‘boundary objects’ offer more than interpretive flexibility. They are active tools, which she describes as “the stuff of action” (p.10).

Engeström studies artefacts as input devices, active languages, processes and frameworks that individuals and groups themselves utilise and adapt to affect collective outcomes (1999, 2005, 2006a). Engeström in his work on Activity Theory (1999) (See Figure 11.1) stresses the mediatory nature of artefacts and their significance for achieving collective outcomes. Where objects are the focus of subjects’ activity, activity is influenced by mediating artefacts and social factors, such as division of labour, community or other actors and social rules. Organisational outcomes result from the combined activities of many working on different ‘objects’. Engeström, in his notion of ‘expansive design’ (2006), discusses the notion of ‘mediating artefacts’ as ‘tool-constellations’ and ‘instrumentalities’ (2006, 2006a, 2007) that facilitate knowledge sharing and learning. In light of the social nature of design practice, design is a boundary spanning profession (Engeström, 2006a).

Innovation requires people to work on inter-related components and to collaborate across organisational boundaries. Design artefacts might be considered a type of boundary object for innovation, if their role is to assist organisational members to cooperate and facilitate a collective innovation outcome.

![Figure 11.1: Third generation of Activity Theory (Engeström, 1999).](image)

Design artefacts contribute both outcomes of, as well as inputs into, design processes. They are constructed in and through the process of design. Design practice necessitates the transformation of artefacts (sketches and prototypes) that capture and
represent, embody ideas, inspire, communicate, shape and that define and refine iteratively. Designers rely on artefacts to transform and externalise their thinking, making their mental representations available to others (Schön, 1983, Bucciarelli, 1988, 1994). Schön (1983) describes this internal process as ‘reflection-in action’, constituting a process of iterative back talk between designers and their representations. For example, sketches provide designers with things to think and talk with throughout the design process (Arnheim, 1993; Goldschmidt, 2003; Buxton 2007).

Artefacts are central to designers’ ‘reframing’ processes (Dorst, 2011; 2015). They provide frameworks in collaborative contexts, mediating thinking about complex problems in new ways, in order to innovate (Bucciarelli, 1994). Considering the social nature of design practice, design artefacts function as both tangible representatives of the evolving object of design and at the same time as objects supporting communication and participation (Henderson, 1995; Bechky 2003). To examine artefacts’ roles, consideration of their social practice context is hence critical.

Within design practice specifically, many artefact roles have been identified. For example, their roles as prototypes and visualisations assisting to transform abstract concepts understood by few to more tangible models available to many (Schrage 2006, 2013, Oster 2009), as mechanisms for knowledge sharing and transformation (Zimmerman et al. 2004, Dasgupta & Gupta, 2009), as facilitators of empathy and customer-centric thinking (Junginger 2007; McGinley & Dong 2011), as probes for innovation and idea generation (Gaver et al. 1999; Kelley et al. 2001) as well as conversation and collaboration enablers (Perry & Sanderson 1998, Brandt 2007). The role of artefacts varies throughout the design process (Carlile 2004; Ewenstein & Whyte 2009) and this dynamic nature is pronounced within innovation contexts, where artefacts perform flexible roles for numerous stakeholders during both design and implementation phases (Oster 2009; Nicolini et al. 2012). Despite their central role in design, the translation of the role of design artefacts into business and organisational contexts is still poorly understood.

If innovation is essentially about improving products, services and/or processes in organisations, what role might artefacts have as enabling instruments for shaping innovation goals and cooperative integration? The instrumentality of an artefact refers to the level to which the artefact supports or impedes the execution of individual or organisational goals (Pratt & Rafaeli, 2006). As innovation necessitates organisational transformation including changes to culture, structure and processes what role do design artefacts play in facilitating change? What role do they play once they are released from the designer into the company? How does the social context affect the role of artefacts within design-based innovation processes? These are some questions that motivate the thinking behind this chapter.

**Artefact Examples, Contexts, and Roles**

As has been discussed, design artefacts can play mediatory and enabling roles within innovation contexts, supporting organisational members to work together and get things done. In this section, some examples of design artefacts from the professional
practice of the author are discussed. Information about the context in which these artefacts have been used is described in support of the premise that design artefacts scaffold innovation by supporting organisational members to do their work. By no means is this list of artefacts exhaustive, there are plenty of other types of design artefacts that are used within human-centred design and design-led innovation contexts.

**Research Reports**

Research reports are artefacts that are commonly delivered at the end of design research projects. These reports are usually delivered in PDF format which makes them easily printable and sharable. They can function to communicate the key insights about research conducted about specific stakeholder groups mapped to associated findings and recommendations. Insights consist of broad generalisations. Findings provide evidence for the insights and have more specific information and recommendations that contribute suggestions of things to change or do to address the insights and findings. These documents commonly communicate the research process and describe the sample of people included in the research. Within projects, these reports can function to document the findings and to substantiate design recommendations, providing evidence for design recommendations in a format common to many organisations. Research reports can help to persuade that there is a need for change. They commonly function as communicators of knowledge about various customer/stakeholder groups supporting organisational learning and can include data visualisation.

**Research Videos**

Research videos are short videos that communicate information from qualitative research conducted as part of a human-centred design process. They can function to create empathy for customers/service recipients, and communicate issues encountered when using existing or associated services simply and persuasively. They can communicate that current processes and systems need to be updated, providing evidence for the need for change in compelling and sharable ways. Video artefacts are accessible to broad groups of internal stakeholders as limited domain knowledge is required to understand human experience. It is easy for broad audiences to relate to stories about experiences. The image below (Figure 11.2) shows a quote from a project conducted with a government agency considering barriers to adoption of online government services. This video artefact was used to substantiate and share some of the comments that citizens had about digital transactions and barriers to adoption.
Within another project for a large telecommunications company, research videos were used to persuade the senior executive team that there was a need for change substantiating the need for the recommended costly IT upgrades. Within these videos, verbatim quotes from customers and organisational members establishing that the current service was extremely onerous to use, and was leading to lack of efficiency and profit loss. This organisation did not have a very collaborative culture and the design team were having problems getting some teams to participate in their workshops. These videos were additionally used to persuade managers that the design initiative was important, so that they would mandate that their busy staff participated in the project workshops. The same videos were shown to call centre staff so that they had a greater understanding of the customers on the other end of the phone, as well as to staff who work with this customer group in a national road show. Within this project it was interesting to see that staff re-used the video for their own purposes, pointing to the supporting role design artefacts can play. Research videos can provide persuasive, accessible and sharable objects that can be used to create empathy, encourage participation in programs of work, and persuade change. They can function to communicate knowledge about the customer, supporting customer-centred organisational learning, empathy and change.

**Journey Maps**

Journey maps (Shostack 1984; Wechsler 2012) are visual representations of the various interactions a customer has with an organisation through various touch-points. They are commonly used within human-centred design practices, providing useful frameworks for understanding and discussing customer experiences. Journey maps always communicate the journey a customer has with an organisation over time, yet what is included depends on its use context. They can include direct customer interactions as well as interactions that organisational members conduct in support of these customer interactions. An example of a journey map’s components includes; tasks, artefacts, systems and tools used, customer needs, pain-points/challenges and opportunities mapped along the different stages of the customer journey. For example,
if the journey map was exploring the ordering and activation of a mobile phone service, the journey stages might be awareness, research, purchase, activate, contract expiry, and renewal. Journey maps provide useful frameworks for organisational members to re-consider processes and systems with. They provide a unitary referent, the journey of the customer, as a framework for different teams to consider their work in relation to each other with. They help organisational members and partners understand how their work contributes to the holistic experience of the customer (Wechsler, 2012).

The journey map below (Figure: 11.3) visually depicts the experience of a research student getting a higher research degree (Masters or PhD) with an education provider. The students tasks (what they are doing) during the different phases of the journey (i.e. considering a research degree, researching options, applying, being accepted, writing a thesis, submitting progress reports, attending conferences, undergoing thesis examination, graduation and being an alumni), what they are asking (i.e. the information they want at different stages of their journey), their pain-points (i.e. things they found challenging during the different phases), and improvement opportunities, mapped along the different phases of the customer journey. Within this project, a few different maps were created for different student pathways. They were printed out and stuck to the wall within co-design workshops with internal staff to help them conceptualise how to improve their service for the different student cohorts. The maps invite different stakeholders to consider their work in relation to each other and in relation to the experience of the student. They help staff see what needs to change. Additional maps were also provided to communicate internal staff processes in service of the different student pathways and scenarios (such as gaining approval for new courses etc.).

Figure 11.3: Example of a journey map visually depicting the journey of a research student working toward a higher research degree (e.g. PhD).

Journey maps can be used in flexible ways. Another map was created by the author for a government agency exploring how they could better support people involved in the child protection system (i.e. children/young people who were in foster care, workers, carers, families, teachers etc.). A series of maps were initially created, looking at the different scenarios and interactions that government and non-government case managers had in relation to their work protecting children and young people. These maps, however, did not communicate children’s experience of the system. Out of this program a series of requirements for new IT tools to support children/young people, workers, carers and families were delivered. These
requirements went out to IT vendors who tendered to develop the IT tools. The IT vendors would be unfamiliar with the child protection context and another journey map was developed to communicate the child experience so that they could understand the context in which the services would exist. A ‘child journey map’ was created from qualitative research conducted with children/young people and case workers involved in the child protection system. Figure 11.4 shows part of this map depicting the experience of children/young people being assessed to determine whether they need to be removed from their birth families (i.e. this phase was known as ‘assessment’). The map was printed and used within various co-design workshops so that participants could understand the perspective of young people during the different phases of their journey within child protection (e.g. early intervention, assessment, intake, placement, adoption, leaving care etc.). Its primary role was as an empathy enabler and an educational tool, enabling different project stakeholders to have a greater understanding of the experiences of children/young people within the system.

Figure 11.4: A part of a larger journey map used to communicate the child experience of the child protection system.
**Personas**

A persona (Cooper, 1999) communicates the goals, needs and behaviours of a hypothesised group of service recipients. Personas should synthesise and represent data collected from actual interviews with people. Usually a few different personas are delivered to communicate the differing needs of different service users, representing differing customer segments. Personas bring research to life and provide useful tools to help organisations design services that align to the needs, behaviours and expectations of service users. They can be used as an educational device, educating staff about the different needs of service recipients. They help design teams design services by supporting them to consider how different people may want to interact with a product or service in different ways. Personas should represent real people having names, using verbatim quotes and photographs. Figure 11.5 shows a persona delivered to a medical organisation who were designing an app to help support health related behaviour change for patients who have had a cardiovascular episode (heart attack) or are at risk of having one. Within personas, it can be useful to create little info-graphic objects to highlight the key differences in user behaviour. For example, within the medical project it was evident that there were two key criteria that influenced people’s motivation to use a health app; (1) technical literacy, and (2) their motivation to improve their health. These two criteria would influence their adoption of the app and we needed to consider both factors. The persona helped to communicate knowledge about different user needs and contexts to inform design of the app so that it would be usable for different groups.

Another example of a persona delivered to support a government project looking at supporting young people with disabilities to leave the child protection system when they turn 18 can be seen in Figure 11.6. This persona includes a high-level journey map to illustrate the young person’s experience over a few years before her 18th birthday, when she needs to leave care. Personas can be derived from synthesised data from lots of data sources, but this particular artefact was used to communicate the actual experience of a specific young person and her journey preparing to leave the child protection system. This story provided a valuable example of how things can go terribly wrong. Three related personas were delivered to illustrate the experiences of the young person, her primary carer and her case manager. These three inter-linked stories showed the different experiences and needs of these three people, explaining how things can go wrong. These artefacts were designed to be persuasive tools to show that there is a need for change. They provided interesting and accessible objects which were shared with senior management to convey stories of real experience. Personas can function as objects to communicate information about specific user groups and the need for change. They can provide useful ‘boundary objects’ (Star & Griesemer 1989) to foster collaboration and conversation between different organisational groups and create shared understanding of customers/service recipient needs and life contexts.
Figure 11.5: Example persona from a project looking at health-related behaviour change to inform the design of a mobile phone app.
Figure 11.6: Example of a persona used on a government project looking at the experience of young people with disabilities who are in foster care preparing to leave care (i.e. becoming independent adults).

Info-graphics

Info-graphics visually translate complex quantitative data to broad audience groups in an accessible way. An example info-graphic delivered to a telecommunications organisation who were looking at improving the experience for customers ordering their products, included the number of incoming support calls to the call-centre in service of these customers, information about the revenue this group brought into the organisation per product and the number of members of this customer group per state (Figure 11.7 shows an element of this artefact). This artefact visually illustrated statistics showing that the customer group; a) contributed a significant amount of revenue to the organisation, and b) if the organisation could improve their ordering services, there would be significant efficiencies gained in relation to call-centre calls and subsequently increased net revenue. This artefact illustrated the potential value of investing in a revised online ordering service in an accessible way. It was used as a persuasive artefact as it showed that investment in services that support this customer group would yield increased profit for the organisation. It also provided an educational tool as it communicated information about the customer group such as their number and in what state they work from. It was reported that this artefact was shared broadly internally as it looked good and the content was related to the work of many different staff.
**Functional Overview**

A functional overview is a summary of the functions for a recommended service. It can correlate with opportunities identified in journey maps. It can give an easily digestible overview of a proposed service’s capabilities. It provides a short, sharp elevator pitch that describes what a proposed service does at a high level. As it is a high-level description of service capabilities it provides accessible understanding of the proposed service, helping to facilitate a shared vision of the future.

**Wireframes**

Wireframes communicate how online services work in more detail. They are sometimes clickable prototypes and other times static screens. The static version often includes descriptions about how the screens behave. An example wireframe for an online service for a courier company is included in Figure 11.8. This wireframe depicts a screen within the ordering process. These artefacts are very common when designing online services. They are useful for communicating how a proposed service should work and are used by graphic designers and developers when developing and designing the proposed service. They are usually provided in black and white and shades of grey as they need to go to a visual designer to be designed. They function as objects that mediate conversation and collaboration between different job functions. Wireframes communicate specifications and create alignment by facilitating a shared vision of a proposed future state. Not everyone is good at reading wireframes which is why it is useful to have additional artefacts that communicate visions of the proposed product or service.
Video Prototypes

Video prototypes can be used to communicate design solutions in easily understandable ways. Not everyone understands wireframes or specification documents and video can be used to bring service ideas to life. An example video prototype delivered to a corporate client is one where a fictitious customer (Simone) talks the audience through an animation of wire-frames for a proposed online service, describing the online service in terms of its benefits. These discussed benefits addressed many of the pain-points expressed by other artefacts, for example research reports, research videos, journey maps and personas. Video can be used to communicate designs in accessible ways appropriate for a broad group of stakeholders. The artefact mentioned above was shown to the CEO and executive team when pitching for funding for the proposed service. They function as communication objects helping to bring understanding about a future state supporting a shared vision for the future for diverse audiences.

User Stories

Services can be specified using agile user stories (e.g. as a <user type> I can <do something> so that <benefit>). They should correspond with the features in the wireframes, explaining how the system needs to support the design. User stories function to communicate the scope of the design and required technical integration.
effort, enabling communication of the proposed scope of work to development and project management staff. They provide boundary objects that facilitate collaboration and conversation, as well as shared understanding of a proposed future state.

**Quick Wins**

During the research process when customers are consulted about their interactions with an organisation, what is not working will become clear. It’s a good idea to deliver clients an account of things that they can do quickly and easily that will result in an improved experience for the customer. Quick wins communicate what could be executed immediately without funding. They can be delivered in a spreadsheet or a report.

**Future Storyboards**

Future storyboards depict possible future scenarios in use (Carroll 1995). Figure 11.9 shows use of a tracking feature and mobile ordering function using a tablet. These artefacts facilitate the communication of service concepts in relation to their use context. They are easy to create and are easy to understand. These artefacts are useful to communicate a proposed service concept and provide a vision of a possible future service. They function as communication devices, communicating easily actionable recommendations for implementation.

![Figure 11.9: Example future-story storyboard artefact.](image-url)
Summary of Artefact Roles

Different examples of design artefacts that support others to do their work, scaffolding innovation have been described above. Discussion of the roles they played within the different project contexts has been included. The following six roles for design artefacts within human-centred innovation contexts have been derived from the author’s practice, and can be seen in the examples provided;

- Customer empathy enablers
- Persuasive and political tools
- Sense-making tools
- Collaboration and conversation enablers
- Communication devices (supporting organisational learning)
- Communication devices (shared visions for the future and implementation).

These roles are helpful when considering how to support organisations to deliver on their designs, and what tools to deliver to scaffold human-centred innovation within organisations.

The following section describes a pedagogical framework that can be used to create design artefacts that scaffold innovation, supporting diverse organisational members to enact collective innovation outcomes.

A PEDAGOGICAL FRAMEWORK FOR DESIGNING INNOVATION SCAFFOLDS (MEDIATORY AND ENABLING DESIGN ARTEFACTS)

As design becomes more strategic and designers more distanced from the execution of their designs, there is an opportunity for designers to help organisations deliver on their design recommendations and support its associated initiatives and processes. The following framework is intended to assist designers to consider the social context of the innovation initiative so that they can deliver those involved with useful tools to do their work. It can help designers and design managers to deliver useful and usable design artefacts that scaffold innovation and its associated processes. In this way designers can support the innovation processes and activities that fall out of the conceptual design phase. The framework is detailed below using the case project as an example.

This framework provides a pedagogical tool as it helps designers and design managers to understand the organisational context surrounding innovation initiatives and how design artefacts can function to support both innovation design and implementation. The framework can be used in educational contexts to teach design students and practitioners about the important social context and organisational processes surrounding innovation design and implementation. The framework prompts designers to consider: What activities relate to the initiative? Who is involved? How are they involved? What artefacts could mediate understanding, conversation and collaboration between these stakeholders? Essentially, what
artefacts can designers craft to support the organisation to reach the collective innovation outcome? Where innovation relies on a variety of inter-linked activities and deliverables produced by various actors, what artefacts could enable this work? What tools can support the associated actors to do their work?

**Using the Framework**

The framework illustrated below (Figure 11.10) has five components; (1) What: the innovation outcome, (2) With: components and dependencies, (3) Who: people who can affect or are affected by the initiative, (4) Considerations: risks, potential hurdles and barriers, and (5) Innovation scaffolds: Artefacts/tools that enable others to do their work (i.e. what, who might use them and why). It can be completed in any order, but it is useful to make sure that step 1 is completed first. The framework provides a thinking tool that can be used and added to throughout the project as understanding of the project context deepens. It can contribute to understanding of the social context surrounding design projects, and is useful for designers, design managers and design educators. It provides educators with a pedagogical tool that supports design students to consider the social context of innovation projects, training them to support organisations to deliver on their designs, supporting innovation implementation.

**Figure 11.10:** Pedagogical framework for understanding the innovation context, to inform design artefact creation.

The framework is described in the step-by-step guide below (Table 11.1) using examples from a project looking at how a telecommunications organisation may improve ordering capability of a specific suite of products by third party resellers. There is a cheat sheet (Table 11.2) articulating different roles for design artefacts,
which may be useful during Step 5. First use the step-by-step guide to think through
the different parts of the framework and then consolidate this data by completing the
template (Figure 11.2). You can use butchers paper and PostIt notes to complete the
template. As your understanding of the organisation and initiative changes, so will
your ability to complete the template. Remember, this is a working tool that can be
revisited at different phases of your project.

Table 11.1: Step by step guide to using the framework (including example data from the case).

<table>
<thead>
<tr>
<th>Step 1</th>
<th>WHAT: What is the outcome you are working on?</th>
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<tbody>
<tr>
<td></td>
<td>“Improve the ordering capability of CustomerX reselling CompanyX products.”</td>
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<table>
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<tr>
<th>Step 2</th>
<th>WITH: Identify the innovation components and dependencies at a high level. What needs to happen to get there? What needs to be created to support getting to this innovation outcome?</th>
</tr>
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<tbody>
<tr>
<td></td>
<td>For this project, these include:</td>
</tr>
<tr>
<td></td>
<td>(1) business case to support next phases of the program</td>
</tr>
<tr>
<td></td>
<td>(2) detailed design including wire-frames and technical specifications</td>
</tr>
<tr>
<td></td>
<td>(3) the development and deployment of a new online service</td>
</tr>
<tr>
<td></td>
<td>(4) integration of technical legacy solutions</td>
</tr>
<tr>
<td></td>
<td>(5) modified processes for ordering</td>
</tr>
<tr>
<td></td>
<td>(6) education/training about the new service and processes</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Step 3</th>
<th>WHO: Who needs to be involved? Who can affect or can be affected by this innovation outcome? Consider how?</th>
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</thead>
<tbody>
<tr>
<td></td>
<td>For the case project, these include:</td>
</tr>
<tr>
<td></td>
<td>(1) <strong>The IT team:</strong> Need to build and deploy the new solution. They are also responsible for</td>
</tr>
<tr>
<td></td>
<td>adapting legacy systems.</td>
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<tr>
<td></td>
<td>(2) <strong>Product teams:</strong> The teams responsible for the different products CompanyX sell will need</td>
</tr>
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<td></td>
<td>to feed into this program for the design team to understand the current state and design an</td>
</tr>
<tr>
<td></td>
<td>improved ordering process and system.</td>
</tr>
<tr>
<td></td>
<td>(3) <strong>Contact centre:</strong> They are a wealth of knowledge about current challenges. They will also</td>
</tr>
<tr>
<td></td>
<td>need to support customers to move over to the new service.</td>
</tr>
<tr>
<td></td>
<td>(4) <strong>Executive leadership team:</strong> Will need to be persuaded to fund the next stages and delivery</td>
</tr>
<tr>
<td></td>
<td>of the proposed service.</td>
</tr>
<tr>
<td></td>
<td>(5) <strong>Detailed design team</strong> including user experience designers, business analysts and</td>
</tr>
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<td></td>
<td>development/technical staff. These teams need to understand the intent of the designed service. They</td>
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<td></td>
<td>may need tools to persuade to retain functionality that delights the customer. They need to</td>
</tr>
<tr>
<td></td>
<td>understand the design recommendations as well as rationale for the design decisions made.</td>
</tr>
<tr>
<td></td>
<td>(6) <strong>CustomerX (Third party resellers):</strong> will get a better experience of CompanyX as the ordering</td>
</tr>
<tr>
<td></td>
<td>process will be easier and more streamlined. A better service will hopefully yield greater</td>
</tr>
<tr>
<td></td>
<td>efficiency and profits.</td>
</tr>
</tbody>
</table>
### Step 4
**CONSIDERATIONS: What are the potential risks, hurdles and barriers?**

For this project, these may include:
- The executive team do not fund the next stage of the initiative.
- The platform and associated changes to legacy systems are deemed too expensive, the value proposition and return on investment is not understood.
- Features that are important for the customer are not included in what is delivered yielding a system that does not meet customer needs.

### Step 5
**INNOVATION SCAFFOLDS: What innovation scaffolds (design artefacts) can be delivered to support these stakeholders do their work? Use the cheat sheet for inspiration.**

- **Persuasive and political tools** - To support next stage funding, we need to show that the current state needs improvement in ways that is understandable by diverse audiences with different technical understanding. Also, in order to understand the current state, different internal stakeholders will need to be consulted. It will be important to activate their participation in the initiative. Example artefacts include videos showing that the current state is onerous and journey maps depicting the frustrating existing process.

- **Communication devices** - Artefacts outlining the capabilities of the proposed service. There will need to be artefacts to communicate the capabilities of the proposed design and its benefits to stakeholders with diverse technical understanding. To determine the scope of work for development of the idea, some artefacts will be needed to inform specifications. The organisation will need to be able to quantify the scope of this project to inform next phase funding. For example, concept videos discuss the different features in relation to benefits, providing rationale for the design as well as an artefact that is easy to understand for non-technical audiences. User stories and feature overview could fulfil this communication need for those tasks with next stage design and development.

- **Sense-making tools** - New processes will need to be created, and legacy systems will need to be updated/replaced. Artefacts communicating the current state can help the organisation understand what legacy systems may need to be amended. A journey map showing all the systems and artefacts customers currently use to order and activate products, and pain-points and opportunities would provide a useful artefact for others to use. Further such an artefact could also support the design of new processes. Additional sense-making artefacts such as personas can provide thinking frameworks to communicate customer research.

- **Customer empathy enablers** – These can potentially help the organisation understand the needs and current challenges of the customer group. Info-graphics can show the economic value of this group and the return on investment on service updates. Research videos can communicate that current processes are arduous and there is a need for change.

Think about what tools you will provide. Who are their audiences and what is their purpose? Your answers will change as you learn more about the project.

### Step 6
Look through your responses and complete the map (Figure 12). You can use butchers paper and PostIt notes to do this. Remember that this framework is a map you can revisit throughout your project. It should evolve over time as your understanding of the project context deepens.
Table 11.2: Cheat sheet for inspiration when designing artefacts (Step 5 of Table 11.2). Download at http://jaxwechsler.com/scaffoldinginnovation.

<table>
<thead>
<tr>
<th>CHEAT SHEET</th>
<th>Inspiration for crafting scaffolding artefacts (step 4)</th>
</tr>
</thead>
</table>

**Customer empathy enablers:** What did you learn that may help teams gain a better understanding of customer needs and their life context. Is there an opportunity to educate staff about the stakeholders you have researched? For example, new call centre staff may benefit from a better understanding of customer challenges.

**Persuasive and political tools:** Consider who might need to be persuaded to support the initiative. Do people need to make changes to their work behaviours? How could they be persuaded to change? Who do you need to persuade to collaborate with you on this initiative?

**Sense-making tools:** Design artefacts can support innovation processes by making the abstract more concrete, assisting communication and knowledge building, assisting staff to make sense of complexity and the non-tangible. What artefacts may your team need to make sense of the problem and the research? What related activities could these sense-making tools support? Visual frameworks such as personas and journey maps can support non-design staff with models for thinking about the customer and the problem space.

**Collaboration and conversation enablers:** Innovation often requires cross-functional teams to work together. What artefacts can support groups from different teams to talk and collaborate? Are there groups that are hard to engage? How can you sell in this work to activate their participation?

**Communication devices (supporting organisational learning):** Design artefacts support collaboration and knowledge building, facilitating a customer-centric perspective amongst diverse staff. What have you learnt that could be useful for others in the organisation working with these same customers? Who could benefit from greater empathy?

**Communication devices (shared visions for the future and implementation):** A shared vision is vital for innovation. Artefacts can provide staff with things to talk through, with and about. Who needs to be involved with the implementation of this innovation? What can you provide that can help them carry out related work? Think about who needs to be informed about this initiative. What is the best way to communicate with these different groups?

**DISCUSSION**

For design practices and, by extension, design artefacts, to effectively support innovation within the organisation, it needs to be recognised by other core functions and advocated by senior leadership (Aftab, 2012; Aftab et al. 2013). Executive support for the use of design artefacts supports their widespread use and impact (Bailey 2012). Following, for design artefacts to have maximum impact, organisations need to move to not only become human-centred or customer-centric, but also design-led. If this is achieved, design artefacts can have more impact on the culture and innovation capability of the organisation. There is opportunity for customer-centric design artefacts to provide useful tools for staff working on innovation-related work.
activities, improving organisational human-centred innovation capability; however, organisations need to build capability around the use of design artefacts as mediatory and enabling tools. Further, there is an opportunity for engaging customer-centric design artefacts to support an organisations’ movement towards customer-centric organisational change.

There are some other critical affective factors influencing the mediatory potential for design artefacts, such as organisational knowledge management capabilities, organisational culture and the absorptive capacity of the organisation (Cohen & Levinthal, 1990). For design artefacts to be used by staff to mediate work activities, they must be easy to share and find. An effective knowledge management approach would assist to prevent loss of knowledge between projects (du Plessis 2007, Quintane et al. 2011). This would enable improved absorption and the sustained currency of customer-centric knowledge and mediating artefacts. There is reason to suggest that customer-centric design artefacts can affect organisational culture; however, for design artefacts to be effectively shared, a sharing and participatory culture is required (Hargadon & Sutton, 2000; Rezgui, 2007).

CONCLUSION

The chapter argues that design artefacts can play valuable enabling roles within innovation contexts, providing organisations with things to think, talk and persuade with. A pedagogical framework is provided to help designers and design managers to consider the social context, risks and dependencies that can influence innovation implementation, enabling designers to think about their artefacts as being potentially useful outside the bounds of their design projects. In an educational context, this pedagogical tool can support students to become aware of the social context of innovation programs and the breadth of its associated activities. The idea of design artefacts enabling others to do their work and the notion of ‘scaffolding artefacts’ is an instructive construct for design practitioners and organisations as it broadens the applicability of design tools.

The research points to the strategic relevance of design practice within contemporary organisations and their important role as change-agents and enablers. Through the provision of useful and usable tools that augment the activities of staff and mediate the social context of human-centred innovation, designers and design artefacts can have more innovation impact, scaffolding human-centred innovation within the organisation. It is hoped that the pedagogical framework supports both educators and practitioners to consider the social contexts surrounding innovation initiatives, guiding the crafting of useful artefacts that scaffold innovation and enable others to do their work. Through the delivery of well-crafted design artefacts, design practitioners are well placed to empower organisations to implement their designs.

ACKNOWLEDGEMENTS

I would like to thank my supervisors Dr. Jochen Schweitzer and Dr. Joanne Jakovich for their support, as well as all the staff at the organisation where the research was...
located who participated in the research. Additionally, I would like to thank my colleagues who have enabled me to experiment with this framework and supported me to develop it further.

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Section 3: Visual Tools for Entrepreneurship
Visual Tools for Developing Cross-Disciplinary Collaboration...
Chapter 12

An Entrepreneur in a Scramble Crossing: An Exploratory Case Study

Gerard Anthony Reed (The University of Adelaide, Entrepreneurship, Commercialisation and Innovation Centre (ECIC,) Australian Institute of Business (AIB), and the Australian Film Television and Radio School (AFTRS))

This chapter is motivated by a need for an adaptive and anticipatory model of opportunity seeking by entrepreneurial firms. An exploratory case study is utilised to examine the applicability of an emergent framework. The framework, entitled *parabolic scramble*, demonstrates a flexibility and application found to be well suited to entrepreneurs and the entrepreneurial experience.

Developed from a study of an independent screen production company (the exploratory company) this entrepreneurship research is based upon the theoretical foundations of the resource-based-view of the firm, as adjunct to Edith Penrose’s pioneering investigations of tangible and intangible assets of the firm. Inspirationally Edith Penrose (1914-1996)’s examination of a firm from within provides the theoretical basis upon which the *parabolic scramble* emerges from an embedded research study of a company to demonstrate how the exploratory company develops from a regional start-up position to engage with markets nationally and internationally.

From the methodology of action learning action research assisted by grounded theory, and the researcher’s interaction with a pedestrian *scramble crossing* in the city of Adelaide, South Australia emerges a framework from the study which is conceptual and practical. The *parabolic scramble* translates easily as a visual tool that can potentially be utilised by entrepreneurs to contextualise ‘uncertainty’ or ‘the unknown’ as well as ‘path dependency’. For teachers of entrepreneurship education, the use of the *parabolic scramble* can visually demonstrate the means by which entrepreneurs address the tangible and intangibilities of being in the market; and how to prepare for a myriad of variables and unexpected phenomena that are inevitably encountered on the entrepreneurial journey.

The benefit of the *parabolic scramble* framework and its visual representation for the entrepreneur, entrepreneur in training or yet-to-be, is that it provides a context for ‘risk’ and frames it as necessary for entrepreneurship and entrepreneurial process. It is through the depiction of the *parabolic scramble* that a conceptual understanding and
an instantaneous plan-in-action can be established. This is particularly important for those yet to encounter the entrepreneurial arena where agility, anticipation of variables, and ultimately an acceptance of the lack of certainty is a norm; because for the entrepreneur or entrepreneurial practitioner, adapting to these ‘unknown’ factors is the new normal.

INTRODUCTION

This chapter provides an overview of a research project that is inspired by the author’s experience as a practitioner in the independent screen production sector in Australia. Through the methodology of action learning action research (ALAR) assisted by grounded theory (Dick, 2003), the research project identifies a need for an adaptive and anticipatory model as entrepreneurial firms seek opportunities. An exploratory case study is utilised to examine the applicability of an emergent framework resultant from the research. The framework, entitled parabolic scramble, is derived from my experience in a pedestrian scramble crossing in central Adelaide, South Australia. Relatively early in the study, and after several cycles of ALAR, I introduced grounded theory as prescribed by its co-founder Barney Glaser (1999) to assist the ALAR, and almost miraculously the parabolic scramble became evident to me. I learnt a valuable lesson at this point of the research that is to trust in the process, which ultimately extends to everything that we actively do. What would become a framework for the research study, and not foreseen at the commencement of the research investigation, is an alternate way to engage with a pedestrian scramble crossing; which had recently been introduced to Adelaide as the research commenced. The parabolic scramble framework takes its inspiration from a ‘Diagonal Crossing’ and originates with Henry A. Barnes (1906-1968) (1965) who further developed the concept, whilst Traffic Commissioner of New York in the late 1940s in America, of a diagonal pedestrian crossing after watching his daughter, and her friends, avoiding vehicles as they crossed the street in front of their school (pp. 103 - 117).

Discovering the Framework

As I engaged to cross the intersection just outside the former News headquarters, opposite The Adelaide Town Hall, the revelation for this chapter became apparent. What I discovered in the scramble crossing is that, although there are many variables, there is an alternative way to engage with them. This alternative way is achieved essentially by not adhering to the prescribed pathway that the other pedestrians follow but through an alternative interpretation and physical engagement. If I adopted a curvature rather than a straight line I avoided all other pedestrians in the area of the crossing, and importantly avoided its epicentre of semi-ordered confusion. I had found another way to understand the space and this revelation was transformational for the course of the research, and the exploratory company I was seeking to establish in the market. While the parabolic scramble framework was at first metaphorical and analogous to an entrepreneur, or entrepreneurial organisation seeking to do things differently, it became much more. As I worked on the framework and moved the
exploratory company through cycles of ALAR I discovered that the *parabolic scramble* demonstrated a flexibility and application that I found to be exceptionally well suited to entrepreneurs and the entrepreneurial experience. Beyond the immediate application as an assistance with strategy and re-strategising to deal with obstacles, the greatest revelation was that the *parabolic scramble* framework grew in tandem with the exploratory company. True to Edith Penrose and especially her embedded research of intangibles of the firm, as the exploratory company developed so did the *parabolic scramble* to the point where it began to populate every aspect of the company from within - which was the most impressive aspect of all revelation to this point.

I further developed the concept and characterised its inherent variables and seemingly randomly chaotic composition. The *parabolic scramble* framework developed into a visual tool with which an entrepreneur could interpret his or her environs, and I thereafter used it every day. As the company transitioned from start-up to the survival phase (O'Connor & Reed, 2015), the assistance of the *parabolic scramble* in a metaphoric mode enabled me to comprehend and mentally prepare for the challenges of the unknown (or unforeseen events and obstacles) which began to emerge with an over-taxing rapidity. The *parabolic scramble* it transpires is perfectly suited to attain clarity and determine objectives within the context of business and its research. I then extended and applied the framework successfully to assist the conceptualising process, the formation of corporate culture, instantaneous strategising and strategic planning for the future objectives of the exploratory company. Additionally, in terms of a visual tool, the *parabolic scramble* demonstrates its dynamic qualities and flexibility when applied to seeking innovative outcomes, with a consistency born out of its genesis in the exploratory research endeavour. Although the research is firmly based in entrepreneurship, the *parabolic scramble* is able to be utilised across disciplines and industries, as would transpire on a number of occasions.

Commencing from the position of a documentary producer proactively operating as an entrepreneur, I developed the research from its intellectual and practical investigation that clearly identifies a need for further examination and a reinterpretation of the marketplace. I deliberately chose to conduct the research as a live project over an extended period and importantly adopt a regional perspective and entry position based at the city of Adelaide, South Australia. Through the vehicle of the exploratory case study of Reed Films Pty Ltd, a company formed on 19th May 2008 at the commencement of the research, as the exploratory company, the long-term study is embarked upon with an openness to all possibilities. By constructing its operation and monitoring interactions with regional, national, and international organisations, institutions, and individuals, over an extended period, this research documents the emergence of a producer of programming for dissemination to local, national, and international markets. The value chain for independent film and documentary production, later termed screen, is established and the research provides an alternative operational and strategic method.

By documenting a dynamic period of technological growth and diversification in the screen sector, through the exploratory case study, the research develops through the framework of the *parabolic scramble* a unique theoretical understanding of the
entrepreneurial experience. In the dual roles of researcher and co-founder, and as a
practising entrepreneur, the *parabolic scramble* is transformational and proved to be
versatile and relevant beyond expectation.

Firmly based in the Resource-Based View (RBV) of the firm (Barney, 1986a,
investigation of tangible and intangible assets of the firm (Penrose, 1955, 1959, 1960),
the *parabolic scramble* performs theoretically and practically as the exploratory
company develops from a regional start-up position to engage nationally and
internationally with markets.

**Importance for Entrepreneurs**

Positioned in the context of a value chain for independent film and documentary
production, the research initially used the exploratory case study to address a gap in
the literature that exists between the producer of visual products, programs and the
consumer. The exploratory company was established in the Australian independent
screen production sector (Office for the Arts, DPC, 2011) and it is anticipated that the
outcomes will provide an example of transformative benefit to entrepreneurs and
researchers wishing to establish or investigate enterprises in this industry, with the
potential to assist other industries if it were to become the subject of future research in
those other areas. Recently reviewing the flexible potential of the *parabolic scramble*,
I considered the framework in relation to adaptability and obsolescence, in terms of
contemporary conflict resolution (e.g., Kilcullen, 2006) and its requirement for an
instantaneous response *on the ground or in situ* in real time. What I discovered is that
the elastic nature of the framework enables its applications to be far reaching and of
multiple facets not necessarily located in the area of entrepreneurship *per se*. That is
to say that not all entrepreneurs are necessarily restricted by the parameters of new
market creation via a new venture or entrepreneurial enterprise. In the context of
‘uncertainty’ (Hawking & Penrose, 1996; Penrose, 2011) or more accurately
‘volatility’ that extends beyond the dynamic scenario of the entrepreneur and the
entrepreneurial firm, as it progresses from a start-up position through survival to
growth (O’Connor & Reed, 2015), the *parabolic scramble* framework excels in its
utility. This, impressively, is beyond the expectation of what is initially perceived
probable or possible (by the researcher or within the bounds of the research project).
In order to develop my understanding, I needed to clearly appreciate the point of
difference between a ‘dynamic’ scenario as it moves to ‘volatility’. Essentially, as
with much of the research, I was able to use literature as data (Pine, 2009) to observe
when there was a crossing over to a ‘critical state’ as defined in relation to
quantum/string theoretical positions (*Laws of Nature*, 2000). The reason for
borrowing from such a seemingly unrelated and potentially extreme area of science is
because it enabled me to look beyond the three dimensions of length, breadth and
width. When contemplating variables it is also essential to appreciate when the critical
point is reached and there is a move from the dynamic to the volatile which assists to
further explore and extend the concept of the *parabolic scramble*.
The entrepreneur, through the use of the \textit{parabolic scramble}, is able to enlist elements of value to interpret and distinguish different solutions \textit{in real time} to multi-faceted applications. It is important for an entrepreneur to act and react, as the situation and circumstances emerge or change, and this adaptability is the feature of the framework. As an entrepreneur engaging with the \textit{unknown} or elements outside of his or her experience the \textit{parabolic scramble} alleviates this if the entrepreneur views the space they are engaging with from the point of view of the framework.

Importantly, and in consideration of the entrepreneur’s perspectives the (Sarasvathy, 2001, 2010) determined realisation of value may not necessarily or always be monetarily based or profit motivated (Connor, Karmokar & Walker, 2014). The entrepreneur may place value in opportunities that arise from a range of situations and responses. And a tool, such as the framework of the \textit{parabolic scramble}, possesses a versatility of application that is diverse especially when referenced against chaos and game theory for example. The notion of chaos (Burns, 2002, pp. 42-44; Frederick, O’Connor & Kuratko, 2016; Gleick, 1987; Levy, 1994, pp. 167-178) being relatable to variables that form patterns and game theory which relates to an anticipation of competition that those involved in a \textit{competitive} scenario consciously render such behaviour redundant due to their co-operation (Nash, 1950a, 1950b, 1951) not to be competitive with one another. The \textit{parabolic scramble} is able to be flexible and adaptive in relation to innovation, and its derivation, which is often non-linear and may exist in a chaotic environment where variables are numerous or potentially ‘unknown’ or representative of the \textit{unknown}.

**Contributing to the Work of Edith Penrose**

The exploratory company builds upon the foundations of the RBV of the firm and its genesis. The methodology of ALAR (Reason & Bradbury, 2008; Revans, 1980, 1983; Shank, 2006), assisted by a grounded approach (Glaser & Straus, 1967) produced the \textit{parabolic scramble} framework which proved to be versatile and elastically suited to a range of theoretical and applied applications. Although the \textit{parabolic scramble} is derived from a \textit{diagonal} or \textit{scramble crossing} and emerged from the investigative nature of the explorative case study, it is importantly not the only revelation of the research. However, the framework is central to discoveries that could only have been attained through its organically embedded qualities contextualised by an immersive experience true to the RBV’s pioneering antecedent, Edith Penrose (1914-1996), (1955, 1959, 1960).

It is interesting to now have the opportunity to illustrate the practical nature of the \textit{parabolic scramble} because, as with Edith Penrose and her seminal revelations to the RBV, this framework develops and extends \textit{intangibles} in relation to the firm. This is, and was, a transformational revelation of the research study, and like the lived experience, is not always easy to quantify. What can be said, and explained, is that as the exploratory company was founded in tandem with the research study, the two became almost infused with each other. It is somewhat difficult to explain that there was an exponential organic quality to these seemingly separate endeavours that were
not at any stage truly independent of one another. So, as the combination of ALAR, grounded theoretical positions, the RBV and the entrepreneurial foundations of Edith Penrose derived the *parabolic scramble* framework, so too did the exploratory company develop the *parabolic scramble*, from within.

As the exploratory company grew, it did so with the *parabolic scramble* framework embedded in its very ‘cell’ structure, as though it was its DNA. This enabled the framework to move from a theoretical, metaphorical concept, to something that was real and its progression documented in the thesis of the research and its accompanying journal.

From a practical perspective, the revelation of the *parabolic scramble* is the genesis from which the framework can be further developed to determine if it is transferable. I envisage that there is the potential for the *parabolic scramble* to assist entrepreneurs beyond the screen production sector, as it could be utilised by consultants, policy makers and entrepreneurs involved in other industries engaging with diverse and divergent markets.

**Theoretical Foundations of the Research**

This enquiry’s genesis was based in the creative industries with the research initially involving the independent screen production sector in Australia. The endeavour was undertaken from a regional perspective centred at the city of Adelaide, South Australia to look across industries, locally, nationally, and internationally. However, the research quickly extended beyond the screen sector and the bounds of a regional environment as it incorporated examples of transformational (Mezirow, 1991, 1995, 1996, 2000) relevance, and comparison for the exploratory company. The forerunner of such organisations was that led by Rupert Murdoch as he commenced his global media organisation or *empire* at The News in Adelaide, curiously close to where the *parabolic scramble* emerged. Other inspirational organisations, in the spirit of *creative entrepreneurs*, were those led by Richard Branson, George Lucas, Steve Jobs (1955-2011), Walt Disney (1901-1966) and Peter Jackson. From the outset these examples, as is the benefit of such biography (Sambrook, Henley, Jones, & Norbury, 2011), provided a guiding assistance to the progression of the endeavour as would other factors also emerge to play a part.

**Identifying Intangibles**

I was forever conscious of Edith Penrose’s profound contribution of identifying *intangibles* from within a firm and wished to always remain faithful to this history. To provide background, and the Penrosian genesis of the RBV, this understanding of intangible assets of a firm commenced with the economist’s evaluation of The Hercules Powder Company in the 1950s (Penrose E., 1960). Penrose’s genesis of the RBV involved a revolutionary assessment of a firm importantly from within rather than an external or clinical appraisal of the assets and liabilities of a commercial
organisation. Edith Penrose’s study clearly identified tangible and intangible assets as distinct from the generalised contemporary mid-twentieth century appreciation and understanding of a firm being receipts, payments, and means of production or delivery of a good or service, and the building that housed or contained the commercial undertaking or concern (1955, 1959). This genesis eventually developed into what is now termed the RBV of the firm.

However, Edith Penrose (1960) chose to explain it as follows, “If the growth of the firm has been restrained … this … reflects the lack of entrepreneurial confidence … for Hercules of areas of activity with which the officials of the firm are insufficiently familiar …” To which Penrose then offers the separation of tangible and intangible, “Since a ‘technological base’ consists not of buildings, kettles, and tubes, but of experience and know-how of personnel, the basic restriction comes down to the services available from existing personnel; the problem of entrepreneurial confidence is fundamentally a problem of building up an experienced managerial and technical team in new fields of activity” (p. 22). Using this form of the RBV, this study sought to subjectively understand a firm from within its structure to focus upon all elements of its creation and construction (Berger & Luckmann, 1967, 1991). As such when I began using the RBV, especially in a Penrosian format, I soon discovered that it was essential to go back to the inception of the research with regard to methodology, industry, positional perspectives and the entrepreneurial foundation, and importantly the firm itself, which I constructed as a live project. As with any subjective position it is necessary to objectify as much as is possible, so the exploratory company was deliberately removed from the screen sector, as its basis of operations, and alternative industries sought to provide alternative perspectives.

METHODS OF THE RESEARCH

Developing the Parabolic Scramble Framework

The parabolic scramble developed profoundly through the course of the research and at first I only expected it to be an expression or at best a metaphor (Flood & Jackson, 1991, p. 32) of action research in action, and perhaps the market and its forces. However, the metaphor soon revealed itself as a versatile tool with inherent flexibility and became a framework that could be drawn into operational and strategic usage by the exploratory company. From the perspective of an almost internally developing engine of the exploratory company the parabolic scramble provided a means of interpreting a variety of applications extending metaphorically to chaos (Burns, 2002, pp. 42 – 44; Frederick, O’Connor & Kuratko, 2016; Gleick, 1987; Levy, 1994, pp. 167 - 178; ‘The secret life of chaos’, 2010), and game theory (Nash, 1950a, 1950b, 1951). The parabolic scramble developed, as the research progressed, and it became evident that it could also encapsulate aspects and some characteristics of the entrepreneurial experience, as a way of interpreting the unknown, which an entrepreneur must encounter and deal with in real time and react accordingly. As well as, and importantly, the entrepreneur must negotiate variables in this arena of unknown quantities and be responsive to change as quickly and as flexibly as it is
possible (in order to be successful in his, her or its endeavour/s or effect change). In essence, the entrepreneur is required to react almost in the moment of dynamic change, which can also be volatile, and this was the remarkable application I noted regarding the parabolic scramble (in relation to the exploratory company) as the framework had this almost organic development through the research and its exploration.

To place the parabolic scramble in its context, and explain its genesis, it is necessary to go back to the methodology of action research assisted by action learning.

The importance of transformation or a transformational moment is something I now seek out, as the research taught me its value for change. Change in terms of a course of action or importantly to update our processes and perspectives.

The transformational moment for the research can be seen illustrated in Figure: 12.1 as it relates to my interpretation of the pedestrian scramble crossing (Barnes, 1965, pp. 103 - 117; Jaffe, 2012) and I would later interpret in the framework of the parabolic scramble. Throughout the research, this moment is the transitional point of ALAR (Reason & Bradbury, 2008; Revans, 1980, 1983; Shank, 2006) when it gained its grounded theoretical understanding (Glaser & Straus, 1967) from the methodology. This was especially assisted and influenced by participatory action research (Shank, 2006, pp. 68 – 69), which directed the study to the genesis of the parabolic scramble framework, to be developed, adopted and ultimately used diversely as a tool of interpretation for the exploratory company.

![Figure 12.1: ‘Scramble Crossing’ – King William Street intersecting Waymouth and Pirie Streets in the city of Adelaide. Source: Photograph by the author.](image-url)
Following is the transitional moment of the research recorded as my journal entry (Reed, 2016) that reads:

As I walked across a new intersection known as a ‘Scramble Crossing’ I began to develop different ways of interacting with it and the people who entered it with me. The pedestrian intersection works with everyone walking at the same time from the four corners of the intersection with the result that the centre is often very busy especially in peak periods. I adopted a few ways of using it, the best being to determine my course and walk keeping an eye out for others moving into my path. I worked out new ways of crossing the intersection by avoiding the centre of confusion, it is to walk in an arc that parabolically (Block, Dejong & Ochsendorf, 2006; Galilei, 1914; Hooke, 1675) skirts the centre and avoids the need to stop and start or simply move through expecting others to get out of the way.

The lesson learnt is that there is adaption to new things and always a different way to engage, a slight modification may be all that is needed. Hubbard, Samuel, Cocks, and Heap (2007) provide a summation of the most successful companies and state importantly that there needs to be flexibility in the mode of operation in order to take up opportunities (pp. 88 - 93). It is the same here, I developed a single technique by learning how to interpret the pedestrian intersection and interact with it however there may be occasions when it is more logical to move through the apex of the square rather than parabolically (Osserman, 2010, pp. 220 - 229) deal with it. The interpretation is a single tool and adds to my interaction with the ‘Scramble Crossing’ however does not define every involvement with it.

The proposed framework I called the parabolic scramble as my interaction with the scramble crossing was dealt with in a parabolic curve and this transpired as the most accurate description.

I consider the parabolic scramble is a method of engaging with ‘semi-structured’ chaos (Gleick, 1987; ‘The secret life of chaos’, 2010) in that there is purpose and direction evident but is largely unorganised. To simplify the idea of the parabolic scramble it can be seen as relying upon a central point of engagement by actors except those dealing parabolically with it or performing an alternative interaction. Importantly the parabolic scramble will not be successful if all actors adopt a parabolic curvature as a mode of operation, akin to a pathway that is dependent or shows elements of dependency on previous experience that then becomes locked-in (Liebowitz & Margolis, 1995a, 1995b). It is also important to note that if the actor is presented with a scramble crossing (Barnes, 1965, pp. 103 - 117) devoid of pedestrians then the most logical, and unencumbered, mode of interaction is through the centre. The perception of the chaotic (Gleick, 1987) crossing may not present itself or be relevant in such a case.

For an entrepreneur using the parabolic scramble, as I experienced it, through the vehicle of the exploratory company, the greatest benefit I foresee is in terms of
framing ‘uncertainty’, and what is ‘unknown’. The metaphorical nature of the framework very quickly became integrated into the pitching of projects, at a highly competitive national and international broadcast screen market, where ‘rejection’ or ‘failure’ typically represented considerable losses financially and with regard to resources of time, labour and intellectual property (IP). The work has to be at the highest of presentation standards, with associated costs for visual material, and the variables involved in terms of the broadcast screen market is vast. The independent screen production market notably is itself undergoing fragmentation in terms of technological disruption. Whilst changes in the screen market present opportunity in some respects, it overall results in a loss of opportunity for producers as executives seek to limit their exposure, unprepared to invest in original programming. As the exploratory company entered an intense period, of what is colloquially referred to by producers as development hell, the parabolic scramble developed in its own right to alleviate the precariousness of dealing with what often amounted to seemingly indeterminate variables and unknown factors. As the exploratory company entered the survival phase of a start-up or as is otherwise referred to as the Valley of Death (Barr, Baker, Markham, & Kingon, 2009; O’Connor & Reed, 2015), the framework emerged moving from strength to strength ultimately influencing the strategy devised by the exploratory company to deal with this vast, fragmenting, fickle or volatile market. The intangibles of developing a firm were assisted by an intangible framework that was of practical and physiological benefit as intense periods of struggle and stress were encountered and the ‘unknown’ and ‘uncertainty’ of being an entrepreneur were normalised. This new norm, after a period of time, became quite comfortable as it was understood and, with the assistance of the parabolic scramble framework, lessons could be easily learned and those lessons absorbed into a new strategy. Hence the agility and nimbleness necessary, that I understood early in the research to be essential in a flexible and adaptive framework, was provided and utilised effectively.

![Figure 12.2: Image of a basic scramble crossing or pedestrian scramble. Source: Photograph by the author.](image-url)
Figure 12.3: The parabolic scramble framework is illustrated here by the combination of circles and lines, including the wide, mauve dashed line in the shape of a parabola. The parabolic shape emerges when an individual agent decides to move differently from everyone else. Since the concept is temporal as well as physical, changes in direction or unusual movements must be compensated for in the temporal plane.

Source: Concept and preparation by the author.

Contextualising the Framework in Entrepreneurship

It is interesting to reflect upon the documented experience in the scramble crossing which generated the parabolic scramble framework as depicted in Figure: 12.2 and illustrated in Figure: 12.3. To elaborate further upon what was mentioned earlier the scramble crossing that inspired the parabolic scramble is located where The News was situated on the corner of King William Street and Waymouth Street in the central area of the city of Adelaide, as seen in Figure: 12.1. It is from this location that Rupert Murdoch began his career and ultimately a company with unparalleled global success in a contemporary media context. This may be coincidence or perhaps it is a convenient entrée to chaos and game theory (Levy, 1994, pp. 167 - 178), Rupert Murdoch epitomises both in his actions and the expansion of his businesses and is worthy of further discussion and development as a point of study in his own context (Munster, 1987; Page & Potter, 2003). News Corporation is a leading example of transformational change and a company’s ability to embrace variables, the unknown and on occasion risk it all (Murdoch, 2013) on a theoretical venture that at the point of commitment remains unproven (Spar, 2001, pp. 190 - 243).

As detailed somewhat earlier functionally, with the advent of the parabolic scramble framework, the exploratory company began to now utilise the device in its
interactions with local, and national firms, in the screen production sector and by association international co-developers, co-producers and broadcasters.

Throughout an extended development period of three and a half to four years, during which the creation of original material in the form of IP was the focus for the exploratory company, the parabolic scramble’s application facilitated a faster and ever-refined presentation to screen production markets. As the exploratory company emerged from its development hell, especially as it moved from a start-up position through survival towards achieving growth (O’Connor & Reed, 2015) in the market; the response time to the market was reduced considerably as the device and its operators gained commercial knowledge and intelligence. The commercial necessities required, when presenting IP to the market, to be so instantaneous and robust that the need for an adaptive and anticipatory tool became acute. The parabolic scramble was by this stage so integrated throughout the exploratory company that it was enough to accommodate the diversity of eventualities, whether process or strategic. The device also enabled the exploratory company to react with greater frequency to the massing challenges of an intense period of operations that was exponential in its demands on resources. With reference to the integration of the parabolic scramble in the DNA of the exploratory company, I have likened it to the tendrils of a grapevine or perhaps a root structure as to the way in which it was entwined throughout every aspect of the company.

So involved was this period of development for the exploratory company, and its co-founders, that the parabolic scramble was often the only solace across a market that consistently demonstrated its impenetrability by rebuffing all advances. To these rebuffs, the parabolic scramble redefined for a renewed approach that in turn proved to be equally unrelenting by necessities in its flexibility and adaptive qualities. The parabolic scramble was so integrated into the processes and operations of the exploratory company by this advanced stage developed over years that we, as the co-founders, responded to almost all situations with it as much a part of us as we were of it. This was the essence of intangibility as I could comprehend it: in the scramble crossing the pedestrians were symbolic of the customers, and the area of the intersection was symbolic of the market. In this market seemingly any movement is possible, and yet there are the factors of time and negotiated variables that entrepreneurs must learn to deal with.

The parabolic scramble enables reinterpreting the space of the market and its customers and to effectively do it differently, not follow the crowd but interpret its course and choose an alternate pathway. Although the alternate pathway curvature makes it seemingly longer, it can ultimately enable a faster arrival at the destination. For the entrepreneur and his or her venture, the destination can be considered to be the opportunity presented by the market, that is fleeting and fickle, with its myriad of variables and yet ultimately attainable with the right means and method at hand. The increased frequency of financial and market obstacles seemed to ultimately be measured by the parabolic scramble and through its use, their interpretation was easily rationalised and reframed to enable us, as the co-founders, to adjust to new situations and environments. Whether commercial or otherwise, instantaneously we
were able to engage with the market demonstrating our commitment and rectitude that was empowered by the framework and its application in an entrepreneurial context.

Additionally, and importantly, the combination of the parabolic scramble and an awareness of path dependency (Puffert, 2000, 2002, 2003) through the examination of successful eclectic organisations outside of the screen industry; prompted our partnering strategically with other companies. These companies are interstate in Australia and for the exploratory company this has assisted integration into the market in a local, national and global operational context.

APPLICATION IN ENTREPRENEURSHIP

The parabolic scramble continues to be utilised by the exploratory company and its diversity is ever increasing as the exploratory company grows and it extends from cultural development to operations, strategy and the everyday eventualities that often stray into what the researcher terms the unknown. It is the flexibility, I believe in terms of intangibilities, of the device that gives it such diverse applications and, as is revealed consistently in the research, the parabolic scramble is in the very DNA of the exploratory company as a core constituent that it emerged from it.

It must be noted that this experience and study was unique in many of its contributing factors and elements and there may not be a similar outcome for others who utilise this concept in any of its various formats. However, for the individual or those who seek an answer, or answers, such an apparatus or device may be specific to their needs and as such potentially transferrable. It is also conceivable that the framework could be further developed into a theory, if a theory is indeed relevant or warranted (Suddaby, 2006).

APPLICATION IN TEACHING

The use of the parabolic scramble as a visual tool for teaching purposes is achieved through creating an interactive and integrated experience of the framework for students in-class and potentially via online applications. This is achieved through demonstrating practical ways of dealing with notions of ‘uncertainty’ and ‘risk’, as determined by Joseph Schumpeter (1883-1950) early last century (Scarborough & Cornwall, 2016, p. 21) and as is further developed through the research, in relation to ‘the unknown’, and ‘path dependency’ for the entrepreneur. Practically this is a suggested method to demonstrate the flexibility of a responsively adaptive device or tool to be presented by educators or instructors (Cranton, 1994, 1996) to course participants in the following format of ten designated steps:

1. Discuss (in-class) a traffic intersection with course participants, and then through a verbal description, the pedestrian scramble crossing, as distinct from a conventional linear pedestrian crossing.

2. Ask course participants to describe themselves in the metaphor of a pedestrian intersection. How will they proceed to cross the bounded area of the intersection?
3. Engage course participants in a visual exercise where they discuss an aerial perspective of a *scramble crossing* (which is projected or distributed via hard or soft copy) and the alternatives of its interaction with pedestrians. Discuss the options of crossing from its four corners (diagonally) identified as A, B, C, and D in the time allocation of 10 seconds.

4. Relocate to an area external to the classroom to perform an exercise with course participants in an open space (indoor or outdoor – sport’s court or sport’s field). Rediscuss *in situ* the options of crossing from the four corners of the *scramble crossing* identified previously as A, B, C, and D diagonally in the time allocation of 10 seconds. The corners should be established physically at a distance of 10 x 10 metres approximately with markers (such as traffic cones) being used to indicate the four corners. Initiate a series of games with the course participants who must cross the open area to achieve their destination in the most efficient time (walking only), importantly without making physical contact with any other participant, within a 10-second timeframe initially used to then be reduced to record the most efficient crossing time possible. The players of the game should be evenly dispersed to each of the four corners of the square and may be organised in groups for this purpose. Their designated corner will then become their home location for the duration of the game (and a round can be reset to the home location of the participants/groups as required). Upon reaching the diagonally opposite traffic cone the participants should indicate arrival with the raising of soft flags that will be positioned at each of the four points – the educator or instructor should be the adjudicator – with the stated understanding pre-game that a fair and sporting ethos be followed throughout the exercise. In the event of a tie, the session should be run again or a participant/group can nominate to allow the other participant to assume the winning position.

5. Ask the student who has the fastest time to re-engage with restricted vision, glasses or a cloth used to block vision, or maintain closure of their eyes, when entering the bounded area of the simulated intersection, with all other participants re-engaging with the timed exercise of crossing from A, B, C, and D in the most efficient time possible without running or making contact with any other participant (especially the participant with restricted vision). Once a course participant has had the fastest crossing, restricted vision and interacted parabolically with the bounded area they should be asked to cross the bounded area diagonally in 10 seconds precisely without an increase or decrease of time.

6. After each interaction ask the next (newest) fastest participant to replace the vision restricted participant to interact with the bounded
area without making contact with any other member of the course participating in the space.

7. Repeat the exercise now asking the next (newest) fastest participant, who has not been vision restricted previously in the game, to interact with the bounded area where they assume a parabolic arc when entering the bounded area at the same time that all other participants commence the crossing from their respective position of A, B, C, and D.

8. Repeat until there have been several participants who have interacted parabolically with the bounded area (with a new vision restricted participant nominated each cycle of the game).

9. Run through cycles of the game appropriate to the number of course participants until each member has had an experience dealing with the bounded area in all roles of fastest, vision restricted, and parabolically engaged, to then be time accurate to a 10- second precise crossing of the bounded area.

10. The final run through of the exercise should have all participants interacting for 27 seconds precisely within the bounded area from A, B, C, and D to arrive at the destination alternate to where they commenced as the seconds are counted down to zero (all participants arriving on zero or as near to zero as possible).

The educator or instructor can initiate a discussion regarding the experience of this exercise at the outdoor/indoor area to then be discussed further in-class at another (home) location. It is important to ask the participants to reflect upon all aspects of the experience that can then develop into a class-based discussion. It is suggested that this be a documented exercise where participants in groups discuss the potentiality of their derived insight with the role of an entrepreneur, and as an actor in the market, with all its constituent elements. The educator, or instructor, should enable an intuitive and exploratory exercise whereby the experience is documented (visually being preferred) by individuals and then in groupings possibly as A, B, C, and D or a mix. What are the outcomes and recommendations for the entrepreneur in terms of his or her engagement with the market and each of its factors whether known or not, tangible or intangible? As there is an increasing move to online or virtual reality (VR) applications this can also be a consideration if the technology and its infrastructure is accessible or becomes increasingly available to educators, or instructors.

**GENERAL DISCUSSION**

Importantly, and as an extension of what was initially examined through the research, alternative interpretations of entrepreneurial practice can be revealed. This includes a specific understanding of entrepreneurship and its experiential qualities relevant to an entrepreneur’s quest into areas that embrace, what is at an early stage of an endeavour or enterprise, usually defined as the unknown. The research’s intuitive achievements and its revelations were profound for the study itself and I found akin to the
enlightenment that any such intensive exercise inevitably produces, especially with immediate applications that deliver instantaneous results. Additional to this in the case study, and its use of an exploratory company, was that it was lived by its co-founders as an embedded experience. The experiential intuitive nature of this live project was embodied by the *parabolic scramble* in all ways which proved to encompass importantly elements of the entrepreneurial condition in all its formats, whether tangible or not.

**CONCLUSION**

The *parabolic scramble* will always have its place in the very make-up of the exploratory company and the related research, and I hope that it will have applications elsewhere. It is desirous to me, and as a future direction of the study, to determine if this is the case either through an extension of this research endeavour or through the experiences of those who wish to explore and develop the concept further for their own uses and application/s. One proposition is to see whether the *parabolic scramble* is able to be implemented and practised in an organisation such as *Google*, as an environment of industry for instance, which could potentially be used as a case study to extend the understanding of the framework. Whether formal or informal it is hoped that the *parabolic scramble* will continue a conceptual and practical journey where it has a place to assist discovery and possibly offer a range of improvements to entrepreneurship, entrepreneurs and their endeavours, and any other applications that the framework is appropriate for, whether known or unknown.

In terms of the research project, it provided all that was required of it at all stages of its application and deployment which was beyond what could have been conceived or expected at the commencement of the study. The discussion presented in this paper is an exposé of the research endeavour that revealed the *parabolic scramble* through an immersive exploratory case study of a company removed from its industrial basis and free to range across theoretical and practical bounds, perceived or otherwise. For the entrepreneur, it is possible that the *parabolic scramble* is able to assist with an approach to new experiences and environs as he or she embrace an alternate or *new paradigm*, with the array of factors that can be considered for the entrepreneur as the *new normal*.

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CHAPTER 13

Visualising Intellectual Capital Transformations for Strategic Design of Entrepreneurial Business Models

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This chapter discusses the use of a kit of Intellectual Capital Visual Tools for entrepreneurial strategy. Grounded upon the theoretical model of strategic entrepreneurship developed by Ireland, Hitt and Sirmon (2003) we approach the entrepreneurial strategy subject from a practical vantage point and offer a demonstration of the strategy visualisation design tools for entrepreneurial ventures as used in a classroom setting. The approach uses an adaptation of the business model canvas (Osterwalder, 2004) and includes resource transformation grids, resource effectiveness plotting techniques and an Intellectual Capital (IC) Navigator (Roos et al., 2005), purposefully conceived as an Intellectual Capital Visual Tool (ICVT) kit for students of entrepreneurship. The visual tools used in the design context of entrepreneurial strategy and business model have two main objectives. The first is to model a design of resources in use for a practical and profitable business and the second is to design a sustainable business model that has the potential to deliver extraordinary performance grounded on a superior competitive advantage. In this chapter, we will mainly focus on the design process to achieve the first objective.

INTRODUCTION

Strategy for new and small entrepreneurial firms currently relies heavily on models and tools developed in the field of strategic management. However, it should be reasonably obvious that the strategic management of either a new or small firm with growth ambitions (hereafter referred to as an entrepreneurial firm) will not have the same benefits of the resource base and capabilities of its larger corporate relative (Rumelt, 2005). Schendel and Hitt (2007) argue that “the strategic management field has contributed substantial knowledge on the subject of balancing value creation with potential opportunity (p. 1). On the other hand, research interest in the process of entrepreneurship is centrally concerned with opportunity, its recognition, discovery and/or creation (Alvarez & Barney, 2004; Schendel & Hitt, 2007; Shane & Venkataraman, 2000). We argue that the focus on the opportunity process has somewhat obscured the notion of research that practically benefits strategic design of value creation within the entrepreneurial context. However, recognition of a symbiotic
relationship between strategic management and entrepreneurship has been emerging as convergence between the two fields is thought to facilitate understanding of a firm’s wealth-creating ability (Ireland, 2007).

From the perspective of teaching entrepreneurship Neck and Greene (2011) suggest that entrepreneurs tend to think and act like designers. Design, they argue is “a process of divergence and convergence requiring skills in observation, synthesis, searching and generating alternatives, critical thinking, feedback, visual representation, creativity, problem-solving, and value creation” (p. 65). A design lens, they add, uses “a toolkit of observation, fieldwork, and understanding value creation across multiple stakeholder groups” (p. 65). Grounding entrepreneurship education with fundamental design principles requires students to be equipped with tools (Neck & Greene, 2011) to aid finding and creating opportunities (Sarasvathy, 2008) but furthermore, drawing from the strategic management field, those opportunities must offer value for some segment of society (Schendel & Hitt, 2007) and, let’s not forget, the entrepreneur themselves.

Our chapter is presented in two parts. First, a brief literature review establishes the differences in strategic approaches between the entrepreneurial and corporate contexts and introduces the design thinking approach. Next, the elements of the ICVT kit (the business model, and specifically the aspects of the business model that relates to resource transformations, effector plot and IC Navigator (for a more detailed discussion around the role of intellectual capital in business model innovation, see: Roos, 2013 & Roos, 2014) are elaborated as a set of visual design tools for entrepreneurial application. The elements of the toolkit have different relevance and impact on venture design but within its entirety, each element provides context for understanding and applying the other. Overall, as a set of strategic design tools, the ICVT kit benefits students through the conceptual challenge of designing a business model and the IC Navigator. It particularly provides a meaningful way to ‘sketch and experiment’ with the firm business model design of resource configuration. The toolkit assists students to discover new ways and means to maximise the value-creating potential of entrepreneurial firms.

**STRATEGY IN THE ENTREPRENEURSHIP EDUCATION CONTEXT**

Within the entrepreneurial sphere of resource management and asset orchestration (Sirmon Hitt, Ireland, & Gilbert, 2011), there are a number of elements within the activities of structuring, bundling and leveraging resources and assets which will be unique to individual ventures. Whether the use of strategy and other design tools is effective in entrepreneurship education context provides a fertile area for future research. In addition, as entrepreneurship education develops, the need for design-based tools that are adapted and suitable for the entrepreneurial venture will also be increasingly in demand. Neck and Green (2011) argue that entrepreneurship education should be more akin to method teaching employing techniques such as starting a business, serious games and simulations, design-based learning and reflective practice. The fundamental principles of design-based tools can be illustrated by innovative approaches such as ‘Serious Play’ developed by Imagination Lab (Roos & Victor,
1999; Roos, Roos, Victor, & Statler, 2004; Bürgi, Jacobs, & Roos, 2005; Oliver & Roos, 2007; Roos, 2008; Statler, Roos, & Victor, 2009). This effective approach combines various perspectives on play including the psychological, sociological, anthropological and philosophical. These combined perspectives frame an interaction between the mind and the world of the player, practically implemented through a constructionist approach where the students are provided with appropriate materials, in a relevant context, and are given tasks directly related to the learning outcome sought (Piaget, 1958; Harel & Papert, 1991).

Resource orchestration differs between the entrepreneurial and the mature firm contexts (Sirmon et al., 2011). While resource orchestration for established firms is heavily influenced by the means already at the firm’s disposal, its dominant logic, and the ends to which the firm is oriented, the entrepreneurial firm can be far more flexible and able to experiment with different orchestrations without sacrificing value that may be captured within a portfolio of fixed resources and/or fixed means (Sarasvathy, 2005). The incorporation of visual tools into an entrepreneurship strategy course provides the entrepreneur or the entrepreneurial team scope to experiment and reconfigure the resource transformations in theory before committing to any particular strategy for resource recruitment or acquisition. While established businesses seek to make the best use of their resources, young entrepreneurial firms are working toward the acquisition and conceptual orchestration of resources that can best fulfil the pursuit of a perceived opportunity and optimise performance. It is in this domain that the ICVT kit provides students with an opportunity to examine deeply the interactions among resources and how they relate to competitive advantage, value creation and value capture within a new firm’s business model design.

THE INTEGRATION OF VISUAL TOOLS INTO A STRATEGY AND BUSINESS MODEL DESIGN COURSE

The ICVT approach to strategic design has been employed within a course called Managing Strategy and Growth since 2010 at the University of Adelaide. The course commences with a broad approach to contextualise strategy to new venture creation, highlighting the contrast between the corporate view of strategic planning and the entrepreneurial setting. In pre- and early venture formation the emergent approach to strategy making (Mintzberg, 1987) has recently become a dominant discourse in entrepreneurial strategy that is characterised by practice-based lean start-up approaches such as espoused by Ries (2011) and theoretical appreciation of effectuation (Sarasvathy, 2001). However, growth and life cycle theories suggest that the continually adaptive behaviour of emergent strategy transitions to a planning approach as the opportunity and the resources needed to capitalise on the opportunity become refined (Churchill & Lewis, 1983) although thereafter the planning and emergent strategy approaches are not mutually exclusive and emergent strategy is hence still a powerful force and fundamental to firms that continue to innovate. Firms, as they transition through stages, become qualitatively different (Lichtenstein & Lyons, 2008) and things like organisational structure, formalised procedures and
managerial hierarchy become necessary (Sirmon et al., 2011). Strategic planning and coordination increasingly become a feature of the organisation's management.

The course next deals with the character of the entrepreneur and the behavioural blueprint their character creates for managing the new firm. An entrepreneur’s character plays a significant role in creating an internally consistent blueprint for the firm in response to the opportunity (or opportunities) identified (Barron & Hannon, 2002). The influences of strategy, the entrepreneur and the dynamics of firm growth provide the contextual setting for business model design and the visual tools employed within the course. At the conclusion of the course, the cyclic nature of strategy making is reinforced stressing that strategic planning and emergent strategy are both integrated and continually evolving the firm through its life-cycle development.

The design tools contained within the ICVT kit are each presented to the course participants, first through a group assignment and second through a subsequent team analytical design process. This stepped approach is thought to enable a context for rigorous student debate and sharing of perspectives and learning. The first assessment item requires the team to select a fast growth firm from the most recent Deloitte’s Fast 50 report (see https://www2.deloitte.com/au/en/pages/technology-media-and-telecommunications/topics/tech-fast-50.html) and make a reasoned assessment of the market and internal drivers of the firm’s growth. In this assignment, the team, through research, becomes familiar with the firm, the market context, the entrepreneur and the resource base of the firm (Barney & Hesterly, 2010). The assignment is assessed on the team’s evaluation of the market and internal resource drivers for competitive advantage and growth but equally importantly it prepares the team with a case that they are all sufficiently familiar to which the ICVT kit can be applied as a learning device. In the final assignment, individuals are required to work with a young (less than three years old) ‘live’ firm, corporate spin-out or business unit, to apply the ICVT kit to a real case.

**The Business Model Design Process**

The ICVT kit facilitates the design of a business model for a new or an evolving/growing firm. The term ‘design’ is frequently used with limited precision and can tend to have many potential meanings. It can be a noun or a verb, it can relate to the engineering domain or the art domain, etc. Here we define design as the process that contributes to the creation of an artefact, in our case a business model, that best accommodates the behaviour of the customer in a predictable, desirable and possibly new way and the entrepreneur’s behavioural blueprint, objectives and ambitions in a profitable way.

This definition most closely aligns with the innovative-design theory (Sriram et al., 1989) which sets out four elements of the design problem. The first element is the a priori decomposition of the problem specifying a set of levels that represent component or object hierarchy choices for the solution of the problem. For an entrepreneur, the levels and components of a business model which are the context of the problem are known – for instance see Figure 13.1 that represents the business
model components and the different levels of hierarchy indicated by shading (discussed in detail later). The second element of the design problem is that the alternatives for the different established hierarchies do not exist. For an entrepreneur how the business model will be assembled, packaged and operated through its resource base is not known. The third design problem element is that the approach will employ fundamental domain principles to develop alternatives for the different established hierarchies. For an entrepreneur, each element of the business model has well-developed but varied fundamental principles of good business practice, e.g. the customer is always right is one principle but they may not always know what they want or need can be equally true and a paradoxical principle, hence providing two alternatives. Fourth, the key design element will be novel combinations of existing/known component strategies. For an entrepreneur, orchestrating the novel combination of strategies that reflect the whole business model design from the variety of business model component strategies can differentiate the business model from potential or existing competitors.

Design-based innovation plays an important role in both the value creating and value appropriating areas of the innovation process. The general design process is articulated by Brown (2008) as a system of spaces that is iteratively passed through in an episodic way, rather than a series of orderly steps. This iterative process draws on and combines abductive, inductive, and deductive reasoning (Martin, 2009). A generic process for design thinking tends to include the following steps (Australian Design Integration Network, 2014; Ideo, 2009; Stanford d.school, 2010):

- Understand the prerequisites of the problem – e.g. the market, the customer, technology, perceived constraints, etc.;
- Observe users in real life situations using a variety of ethnography techniques to develop empathy for users;
- Define insights–create a point of view for reframing the problem;
- Ideate and prototype multiple alternatives in short iterations;
- Test by getting feedback, then modify and reiterate solutions, and if necessary, the problem formulation. This stage is frequently summarised as an iteration of the circular process: Observation → Analysis → Genesis → Test, until the solutions criteria are fulfilled.

For our purposes, we describe the process through an analogy drawn from the design process used by one of the world’s leading product design companies, Ideo. This can be illustrated through a video of the design process employed in re-designing a shopping cart (see YouTube AU (2009) ABC Nightline, http://www.youtube.com/watch?v=M66ZU2PCiCm) and is portrayed through an iterative cycle of activities as presented in Figure 13.1.
<table>
<thead>
<tr>
<th></th>
<th></th>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Target segments of customers you want to offer value to</td>
<td>The kind of links you create for the company to maintain value</td>
<td>The means of getting your value offering to customers</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th></th>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>The ways a company makes money and appropriates value</td>
<td>The presentation of the firm's value offering</td>
<td>Representation in money of the means used to create value</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th></th>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>Everything that can be deployed by the company to create value</td>
<td>Those companies you choose to cooperate with to create value</td>
<td>The things you do to that creates value</td>
</tr>
</tbody>
</table>

**Figure 13.1:** A layout of business model components.  
*Source: Adapted from Osterwalder, 2004.*

![Diagram](https://via.placeholder.com/200)

**Figure 13.2:** Ideo design process  
*Source: Chia, 2013*
There is one major trap and one set of requirements that become critical when design is used as a tool in firms. The trap is confusing the use and definition of art with design – something seen quite frequently in architectural education for example whereby designs may have aesthetic appeal or abstract conceptual function but serve no practical value in use or may be impractical in purpose. The requirements are instead for every participant in the value-creating process that represents a paradigm of one hierarchical level, in our case of the business model hierarchical levels, to have enough understanding of the paradigms of the other levels to both contribute to them and make use of them in a synergistic way. This is particularly critical for entrepreneurs who may be educated in a singular or narrow paradigmatic view, e.g. either marketing, economics or operations, but who are expected to orchestrate the practical implementation of business model solutions across multiple paradigms. For business model designers, this means understanding the distinction between three specific perspectives (Morris, Schindehutte, & Allen, 2005). First, the paradigm of the customer embedded in future-oriented strategic views in terms of customer acquisition prospects, growth and expansion opportunities, interpreting customer intelligence, deriving insight and negotiating promises of future delivered value. Second, the operational paradigm, a view of the reality of the present and satisfying stakeholders including suppliers, equity holders, family and of course the customers by delivering the promised value in practical ways and means that are consistent with the capabilities of the firm and satisfying multiple stakeholder demands. Third, the paradigm of financial outcomes derived from past performances encapsulated in the view of residual profits and/or surpluses earned (or not earned, e.g. losses) through the sum of past strategic and operational decisions.

The three paradigmatic representations are conveyed through the shaded coding of the business model (refer to Figure 13.1) to enable a visualisation of the various hierarchical and relational components and how they are bound within paradigmatic views of the firm and its function. The light shading, at the top, represents the future-oriented strategic view about where revenue will come from and how it is planned to be maintained and delivered. The darker shading, at the bottom, represents the present paradigmatic viewpoint of operations and the means employed in delivering to expectations in practical and manageable ways, and the black shading across the centre extremes represents the paradigm of the past or the costs forgone in operations and the evidence of strategy in revenues attained. At the heart of the business model is the value proposition, in white, which serves the purpose of evaluating the business model design decisions through questioning whether value is maintained or destroyed for the various stakeholders through analysis of each of the paradigmatic lenses.

While entrepreneurs are developing conceptual positions and designing a business model from a future standpoint, key questions also need to be addressed from a managerial and operational point of view to determine whether the proposed firm's resources, when put to use, will maximise the firm's value creating potential and generate profitable performance that evidences the coherence of, by then, past decisions. The business model, despite the terminology suggesting a dynamic representation, is a static device that does not represent the resources in action. To move beyond the static view of the business model the ICVT kit has particular
relevance and application. The application of the ICVT kit is intended to drive internal strategic discussion and modelling of the resources in proposed use with respect to operationally meeting the strategic and market determined opportunities and doing so in a profitable way.

THE INTELLECTUAL CAPITAL VISUAL TOOL KIT

In an entrepreneurial context, the purpose of the Intellectual Capital Visual Tool is to be able to answer the question: Will the organisation be deploying its resources in the most effective way possible? The ICVT uses the intellectual capital lens (Dragonetti & Roos, 1998) – an extension of the resource-based view of the firm (Wernerfelt, 1984) and the associated dynamic capability view (Nelson & Winter, 1982), core competence based view (Hamel & Heene, 1994) and knowledge based view (Kogut & Zander, 1992). The ICVT, within the business model framework, is made up of resource transformation grids, an Intellectual Capital Navigator and an Effector Plot. The ICVT views the firm as a bundle of five categories of resources:

**Physical:** All resources that hold a physical form and mass e.g. machines, bricks, tools, etc.

**Monetary:** All resources of a monetary or monetarily equivalent nature e.g. cash, bonds, shares, debtors, etc.

**Relational:** All outside relationships that the organisation holds or that members of the organisation holds on behalf of the organisation with, e.g., customers, consumers, intermediaries, representatives, suppliers, partners, owners, lenders, and the like.

**Organisational:** This includes resources like brands, intellectual property, processes, systems, organisational structures, information (on paper or in databases), and all other results of human endeavour that takes this form.

**Human:** All the attributes that relate to individuals as resources for the company and under the requirement that it cannot be replaced by machines or written down on a piece of paper. This includes resources such as competence, attitude, skill, tacit knowledge, personal networks, and the like.

The ICVT captures the dynamics of the firm by viewing value creation as a system of transformations where one form of resource is transformed into other forms of resources (Roos & Roos 1997). The resource transformation view accounts for the discrepancies between tangibility and intangibility of various resources by dealing specifically with the stock and flow of value. In this way, we move past the resource value-adding ‘service’ debate (Penrose 1959) to account for the variety of capability transformations that may take place. For example, transformation capabilities that
occur as software-driven automated machines that bend or shape metal sheets into usable parts (an organisational resource (software) enabling a physical resource (machine) to act on another physical resource (raw material) to create a new physical resource (usable part)) or the use of customer relationship management systems to gain insight into customer behaviour and preferences to increase customer loyalty (an organisational resource (collected customer data) on which another organisational resource (software) operates to identify a third organisational resource (patterns) enabling the extraction by a human resource (competence) of an organisational resource (preference attributes in informational form) that can drive the change in an organisational resource (business process) resulting in a strengthened relational resource (customer loyalty). Neither of these examples is strictly an intangible service function that value-adds to a tangible resource but both are capabilities that are distinct and highly relevant to the overall firm’s value creation. This is a useful perspective since any given organisation is made up of a unique resource portfolio deployed in a unique transformation structure – no two organisations are the same.

When visualising this resource transformation structure, it is not possible to use a lens of what actually happens since transformations take different forms: some are physical flow, some are monetary flow, some knowledge transfer, some are reputation or trust transformation, etc. Most transformations are actually made up of several of these different types of sub-transformations and become for practical purposes difficult, if not impossible, to identify and map. In response to this, the ICVT uses a trick from system dynamics and moves to consider the influence space (In order to describe a system, you need to know two things: Firstly, what actually happens and secondly which of the things that happens actually matter for the outcome or behaviour of the system). By using an influence view of a system (i.e. what transformations matter and to what extent) we get the added benefit from the fact that influence can be treated as additive. This means that we now have the means of identifying, sizing and mapping the components of the resource transformation system that makes up the organisation (Roos, Roos, Edvinsson, & Dragonetti, 1997/1998; Roos, Pike, Fernström & Burgman, 2005; Roos, 2014).

The ICVT is a numeric and visual representation of how the entrepreneurial team views the way in which resources are deployed to create value in the organisation. In effect, the perceptions of the team become their objective reality that governs their management behaviour and style which fits our understanding of sensemaking in managerial teams (Taylor & Lerner, 1996).

The visual language of the ICVT is unmatched in its ability to make the complex organisational design of a resource base understandable and thereby provides an excellent tool for strategic discussions and decision making. The ICVT achieves this by reducing the cognitive load and the load on the short-term memory and thereby facilitates comparisons and inference making (Shneiderman, 1996; Tufte, 1997) leading to the journey from data via information to knowledge being facilitated (Masud, Valsecchi, Ciuccarelli, Ricci, & Caviglia, 2010). The ICVT is actually providing a very useful bridge between strategy crafting and strategy implementation by assisting both the strategic thinking and the strategic analysis. In a recent survey
(Roos, 2013) it was ranked as the tool or framework that provided the third most valuable insight when involved in business model innovation.

The process used to create the visual representations used in the ICVT is a consensus process among the entrepreneurial team that aims to capture the tacit knowledge of the team as it relates to how value is perceived to be created within the organisational resource design configuration. The necessary steps in this process are:

1. Identification and classification of the resources that are intended to be deployed in the new organisation;

2. Weighting of the resources as relates to their ability to influence value creation in the new organisation;

3. Evaluation of the identified resources as relates to their suitability to form the basis for competitive advantage;

4. Weighting of the resource transformations within a resource transformation matrix by distributing 100 points across each row in the matrix asking the question: “How relatively influential is this transformation when it comes to contributing to the organisation's value creation?” The result of this step is a matrix where every row adds up to 100 and where each transformation that has been assigned a weight greater than zero is defined. An example of the resulting matrix is shown in Figure 13.3.

<table>
<thead>
<tr>
<th>Starting Resource</th>
<th>Resource Weighting</th>
<th>Monetary</th>
<th>Physical</th>
<th>Relational</th>
<th>Organisational</th>
<th>Human</th>
<th>Row Sum</th>
</tr>
</thead>
<tbody>
<tr>
<td>Monetay</td>
<td>0</td>
<td>10</td>
<td>40</td>
<td>30</td>
<td>20</td>
<td></td>
<td>100</td>
</tr>
<tr>
<td>Physical</td>
<td>80</td>
<td>10</td>
<td>10</td>
<td>0</td>
<td>0</td>
<td>100</td>
<td></td>
</tr>
<tr>
<td>Relational</td>
<td>30</td>
<td>0</td>
<td>70</td>
<td>0</td>
<td>0</td>
<td>100</td>
<td></td>
</tr>
<tr>
<td>Organisational</td>
<td>30</td>
<td>0</td>
<td>60</td>
<td>0</td>
<td>10</td>
<td>100</td>
<td></td>
</tr>
<tr>
<td>Human</td>
<td>0</td>
<td>20</td>
<td>40</td>
<td>10</td>
<td>30</td>
<td>100</td>
<td></td>
</tr>
</tbody>
</table>

*Figure 13.3: Example of Resulting Matrix after finishing Step 4.*

5. Normalising the resulting Matrix by viewing the resource weightings for each given resource as a percentage and multiplying the resource transformations from that starting process with this percentage. Figure 13.4 illustrates the resulting matrix for the matrix illustrated in Figure 13.3.
<table>
<thead>
<tr>
<th>Resource Weighting</th>
<th>Resource Category</th>
<th>Monetary</th>
<th>Physical</th>
<th>Relational</th>
<th>Organisational</th>
<th>Human</th>
<th>Row Sum</th>
</tr>
</thead>
<tbody>
<tr>
<td>5</td>
<td>Monetary</td>
<td>0</td>
<td>0.5</td>
<td>2</td>
<td>1.5</td>
<td>1</td>
<td>5</td>
</tr>
<tr>
<td>10</td>
<td>Physical</td>
<td>8</td>
<td>1</td>
<td>1</td>
<td>0</td>
<td>0</td>
<td>10</td>
</tr>
<tr>
<td>30</td>
<td>Relational</td>
<td>9</td>
<td>0</td>
<td>21</td>
<td>0</td>
<td>0</td>
<td>30</td>
</tr>
<tr>
<td>35</td>
<td>Organisational</td>
<td>10.5</td>
<td>0</td>
<td>21</td>
<td>0</td>
<td>3.5</td>
<td>35</td>
</tr>
<tr>
<td>20</td>
<td>Human</td>
<td>0</td>
<td>4</td>
<td>8</td>
<td>2</td>
<td>6</td>
<td>20</td>
</tr>
<tr>
<td>100</td>
<td>Column Sum</td>
<td>27.5</td>
<td>5.5</td>
<td>53</td>
<td>3.5</td>
<td>10.5</td>
<td>100</td>
</tr>
</tbody>
</table>

*Figure 13.4: Normalised Figure 13.3 matrix*

6. Convert the matrix to a visual representation of the matrix by illustrating resources as circles and transformations as arrows. To further enhance the key visual patterns a Pareto lens is taken to the transformations whereby roughly 20% of the potential transformation activity is assumed to convey 80% of the influence in terms of value creation. The resulting figure, where the size of the surface area of the circles is proportionate to the assigned resource weights and the width of the arrows is proportionate to their assigned transformation weights, is shown in Figure 13.5.

*Figure 13.5: Visual representation of the normalised matrix illustrated in Figure 13.4 using a Pareto lens for the transformations*
7. The visual representation (shown in Figure 13.5) is evaluated using four key questions (a to d).
   a) Are there any free-floating resources (i.e. resources where there are no transformation arrows either in or out) and if so, then what purpose do they serve?
   b) Are there any resources with only resources going in (i.e. value sinks) that raises the further question of whether the allocation of resources is warranted if nothing is being transformed from it?
   c) Are there any resources with only resources going out (i.e. value sources) that raises the issue of whether the resource is being replenished and if it is sustainable;
   d) Are there any resource transformation loops involving at least two resources that require optimised management attention?

8. Convert the Normalised matrix (shown in figure 13.4) to an effector table. This is done by identifying an x-coordinate (which is the resource weighting) and a y-coordinate (which is the resource transformation total out of the resource divided by the resource transformation into the same resource) for each Resource. The result for the matrix shown in figure 13.4 is shown in figure 13.6.

<table>
<thead>
<tr>
<th>Resource Weighting</th>
<th>Effector Ratio</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>0.18</td>
</tr>
<tr>
<td>Monetary</td>
<td></td>
</tr>
<tr>
<td>Physical</td>
<td></td>
</tr>
<tr>
<td>Relational</td>
<td></td>
</tr>
<tr>
<td>Organisational</td>
<td></td>
</tr>
<tr>
<td>Human</td>
<td></td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Resource Category</th>
<th>Monetary</th>
<th>Physical</th>
<th>Relational</th>
<th>Organisational</th>
<th>Human</th>
<th>Row Sum</th>
</tr>
</thead>
<tbody>
<tr>
<td>5</td>
<td>0</td>
<td>0.5</td>
<td>2</td>
<td>1.5</td>
<td>1</td>
<td>5</td>
</tr>
<tr>
<td>10</td>
<td>8</td>
<td>1</td>
<td>1</td>
<td>0</td>
<td>0</td>
<td>10</td>
</tr>
<tr>
<td>30</td>
<td>9</td>
<td>0</td>
<td>21</td>
<td>0</td>
<td>0</td>
<td>30</td>
</tr>
<tr>
<td>35</td>
<td>10.5</td>
<td>0</td>
<td>21</td>
<td>0</td>
<td>3.5</td>
<td>35</td>
</tr>
<tr>
<td>20</td>
<td>0</td>
<td>4</td>
<td>8</td>
<td>2</td>
<td>6</td>
<td>20</td>
</tr>
<tr>
<td>100</td>
<td>27.5</td>
<td>5.5</td>
<td>53</td>
<td>3.5</td>
<td>10.5</td>
<td>100</td>
</tr>
</tbody>
</table>

Figure 13.6: Normalised Figure 13.3 matrix

9. Convert the effector table to a plot (this conversion of the effector table shown in Figure 13.6 is shown as a plot in Figure 13.7) and add a line showing the best fit line to the plot points and the two curves to which this best fit line and the y-axis are an oblique asymptot. This can be done in the more intuitive direct way as illustrated in the left-hand side of Figure 13.7 or in the mathematically more correct way as illustrated by the right-hand side of Figure 13.7. The right-hand approach involves plotting the 10-base logarithm of the effector number compensating for the fact that the y-axis is not mathematically independent of the x-axis. In real business applications
the right hand approach should be used but in conceptual and understanding oriented applications, like education, the left hand side is preferable.

10. Evaluate the effector plot in Figure 13.7:
   a. The first evaluation is to identify the economic logic underpinning the business. If the physical resource is furthest to the right the logic is based on economies of scale i.e. a value chain logic (Porter, 1985); if the human resource is furthest to the right the logic is based on economies of scope i.e. a value shop logic (Stabell & Fjeldstad, 1998); if either the organisational or the relational resource is furthest to the right the logic is based on network economics i.e. a value network logic (Stabell & Fjeldstad, 1998).
   b. The second evaluation is the direction and angle of the least square line fit (best fit). If the slope of the curve is positive (as shown in figure 13.7) the value creation of the analysed organisation is likely to increase over time and the steeper the slope the sharper the increase.
   c. The third evaluation is to divide the plotted area into three subareas delineated by the two curves and the best fit line by making the least square line fit and the y-axis oblique asymptots to two curves as illustrated in Figure 13.8 (see e.g. Roos et al., 2005; Roos, 2014). The logic behind this is that the less important a resource is the less it matters what level of return-on-influence it gives. The two theoretical problems are automatically handled by this curve:
      i. What if a resource is further to the left (i.e. is less important) than the monetary resource and has a very high or low y-coordinate value. This circumstance distorts the line fit and may induce an erroneous perception of the value-creating potential of the organisation. In any firm that is in the business of making money, this cannot happen as the monetary resource is the object of value capture and therefore will by definition be the least important in the value creation cycle. In other words, all other resources must contribute to value creation for the firm which is measured and captured in monetary terms. Hence, the fact that another resource may be less important than money would require a rethink of the firm’s value creation structure. An analogous reasoning can be made with firms that are looking at money as an input resource and are in the “business” of creating a non-monetary output value e.g. defence forces, charities, religious organisations, interest organisations, some cooperatives, etc.
      ii. What if a resource is to the left generally but is to the right of the monetary resource and have a very high or low y-
coordinate value? This circumstance will also distort the line fit and may induce an erroneous perception of the value-creating potential of the organisation. Again, this would be evident in the diagram since the potential for such distortion would be picked up by the resource appearing outside (i.e. above the upper curve or below the lower curve) and hence would require discussion leading to a re-thinking of the firm’s value creation structure.

![Figure 13.7](image)

**Figure 13.7:** Effector plot with curves making the y-axis and the least square line fit into oblique asymptotes (left-hand side is a “more intuitive” linear plot and right-hand side is a “more mathematically correct” logarithmic plot).

Any resource appearing between or near the two asymptotic curves are reasonably deployed (in Figure 13.7 this would cover Monetary, Physical and Human resources). Any resources appearing above the upper asymptotic curve would raise the question: Is this a sustainable position given that a lot of value is extracted while little is invested into this resource, i.e. is it a sustainable value source? This would refer to the Organisational resource in Figure 13.7. Any resource appearing below the lower curve would attract the question: Is this a sufficiently sustainable position given that the resource absorbs more than it provides to value creation – i.e. is it a sustainable value sink? This would refer to Relational resource in Figure 13.7.

Based on the above analysis it is now possible for the entrepreneurial team to re-evaluate their assumptions and re-focus the team efforts on the resource acquisition and development of the priority resources and transformation processes that create and capture value. The process can be repeated to question key assumptions until the team comes to a common understanding and view of the new organisation’s value creating potential through the business model and resource configuration the team intends to build and adopt.

**CONCLUSION**

The strategy process for an entrepreneur and/or the entrepreneurial team has a strong resemblance to the design process. From the perspective of entrepreneurial opportunity, the entrepreneurial team can be guided by such concepts as the lean start-up (Ries, 2011) that in essence develops a hypothesis of customer value that is
subsequently market tested. The concept suggests developing a minimum viable product that satisfies or possibly even delights the customer. In this way, the market strategy is emergent and the team trials different offerings using different means. This approach, however, risks developing a singular paradigmatic view of the business model that is customer centric. While marketing theorists would certainly declare the supremacy of this approach and without doubt the customer is key to new venture creation, a business model also has embedded within it potentially conflicting paradigmatic views that ultimately must be reconciled by the entrepreneurial team.

An alternate approach (and primary to the ICVT kit application) for students to learn the design principles of a business model relies on the representation of the business model such as that developed by Osterwalder (2004). This approach highlights nine components that offers a useful start to the principles of business model design by alluding to the multiple perspectives embedded in the concept (Morris, Schindehutte, & Allen, 2005). However, the business model adopts a relatively static view providing a categorical framework for descriptive representations of the different elements comprising the business model. When adopting the resource base of view of the firm (Barney & Hesterly, 2010) to configure or orchestrate a competitive advantage, the approach misses the dynamic portrayal of precise resources and the ways and means that these contribute to competitive advantage. This is a weakness pointed out by Sanchez (2008) and the ICTV kit addresses this weakness.

Using a static approach to business model design also obscures the linkage between the business model and financial performance as the language of value proposition biases a customer view. There is no suggestion that the value proposition is not an important concept in designing a business model however the value proposition from a customer perspective does not necessarily reflect the harsh realities in monetary terms of decisions made that influence the operational and economic perspectives embedded in the business model. Ultimately, the objective of a commercially operated venture is to make money although the financial perspective only becomes apparent in accounting for historical performance. Overly confident entrepreneurs with optimistic customer forecasts regrettably does little to assist in
alignment of the business model around the three competing paradigms—strategic, operational and financial—co-existing within a business model.

Through the use of the ICVT kit students engage with the multiple paradigmatic perspectives, the dynamic relationships between resources and prediction of financial performance generated by resource orchestration. The method relies on the strategic perspective of customer value, provides a means for modelling the resources in a dynamic state to ascertain resource and competitive advantage effectiveness, and accounts for firm-level value creation strategies that pre-empt financial outcomes. In effect, it integrates the three paradigmatic perspectives embedded within a business model and creates a visual model that represents the perceptual reality of the entrepreneurial team and the likelihood of that perception generating positive financial outcomes. As a strategic tool, it allows in-depth and specific discussion of the value of resources, both tangible and intangible, among the entrepreneurial team and brings about a common and shared understanding of the capacities and priorities in resource management that are critical to the long-term firm success.

REFERENCES


The study investigates the effectiveness of using design mock-ups by business learners as part of their innovation journeys. It draws on learners’ experiences in a final year elective module (Managing Strategic Design) delivered on an undergraduate management degree. This module has been designed to challenge learners to develop truly innovative business opportunities, utilising design and strategic thinking.

The design mock-ups are examined for their capacity to help learners to traverse disciplinary and conceptual boundaries in order to seek out innovative solutions. In design, reliance on mock-ups as teaching tools informs critical aspects of learning about the design concepts and processes, but this is not the case in business. We investigate the impact of creating such artefacts by teams as a means of mediating collaborative interaction within innovation process and for the ways learners encounter the unfamiliar and incorporate it into their learning experiences.

The methodology underpinning the investigation is that of participatory action research, where the analysis draws on the observed processes of making the mock-ups, assessment feedback on the mock-up submissions and learners’ reflection on creating the mock-ups.

The current literature on innovation already acknowledges that artefacts play an important role in the innovation process. However, our study indicates that the purposeful process of making such artefacts as a way to make sense of the innovation has added value. The physical act of making combines the emotional response to the collaboration with managing the uncertainty of the innovation process. As the artefacts become conduits of the social interactions within the teams, they reveal the role they play in reframing the encountered learning boundaries into a ‘new familiar’. We conclude that the process of making sense of the unfamiliar and re-creating it into the ‘new familiar’ takes place at metacognitive level. Thus, the exploration of the ways in which the creation of design mock-up assists this process of metacognitive reframing has implication for the learning environments in which it takes place.
INTRODUCTION

Buur & Larsen (2010) propose a way of understanding innovation as the emergence of new meaning in conversations. They recognised the value in collaboration, where the different participants with different viewpoints are brought together leading to the creation of new insights. From a design perspective, Curedale (2012) argues that although “[t]raditional design education has cast a designer as a type of artist who essentially works alone and places personal self-expression above all else…” (p. III), in reality, design methods and processes are very much a part of the complexity of the innovation projects they contribute to. Moreover, “[t]he methods stress design as a collaborative activity where designers respect and have empathy for the other development team members and where design is informed by an understanding of the perspectives of the people who will eventually use the finished design” (p. III).

Drawing on these recent debates exploring the role of design collaborations in innovation processes, we study the impact of creating design mock-ups by business management undergraduate teams as a means of mediating collaborative interaction within innovation process. We examine these emergent collaborations grounded by the mock-ups, for the ways learners encounter the unfamiliar and incorporate it into their learning experiences. We draw on learners’ experiences in a final year elective module focused on management of strategic design delivered on an undergraduate management degree, at a business school in London, UK.

Framework Underpinning the Collaborative Learning Process

The module in question has been designed to challenge learners to develop truly innovative business opportunities, utilising design and strategic thinking. From its inception, it has been based on a single project, which follows a design process consisting of formulating, representing, moving, evaluating and reflecting as defined by seminal works of Nelson & Stolterman (2003), Cross (2006) and Lawson (2006). Moreover, it also acknowledges that this “process consists of distinct yet interacting mental acts in which [learners] establish relationships with the real world with a view to creating … [particular] outcomes” (Cassim, 2013, p. 196).

In the initial iterations of the module, learners began their innovation process by defining a possible offering and then moved on to identifying the customers. However, this approach has not proven very successful as learners never could get to grips with their customers and maintained their focus on the offering making the customers very abstract. Hence, it has been adjusted, where learners have been required to define their customer first and then identify a need to shape their proposal. Thus, the module was underpinned by two pedagogical approaches: (1) learners were given free rein to choose who the customer was, and (2) learners were given a broad archetype to offer a starting point for their development. The first approach was used by the first five cohorts to embark on their innovation journey, whereas the second approach was implemented from Spring 2014 onwards.
The design and construction of the mock-ups are theorised by aspects of the classic work by Krippendorff (1995) considering “… the aim of making something new and different from what was there before, and the desire to have it make sense, to be recognised and understandable. The former calls for innovation, while the latter calls for the reproduction of historical continuities” (p. 156). In our context, the mock-up acts as a platform for not only testing new ideas, but also as a means to foster collaborative interactions, offer critique and further dialogue on tackling the unfamiliar. As our module combines a mix of design management students, business students or finance and marketing students this design method is “…particularly effective in communicating design ideas to diverse groups of stakeholders” (Design Council, 2012). In addition, by creating such mock-ups learners have the opportunity to explore diverse dimensions of their proposed innovations from multiple perspectives. Moreover, we argue that mock-ups are particularly well suited as a tool of mediation while learners transition from ‘unfamiliar’ to ‘new familiar’ learning environments within the innovation journey. In this case, the educational environments that learners engage with, we termed as ‘unfamiliar’, which is the unknown, uncomfortable, unexpected, and perceived different - it is the other. On the other hand, the ‘new familiar’ is the educational environment, which learners have reshaped through their collaborative process, and now they perceive it as known, comfortable and meeting their expectations, thus they shaped it into a new norm. The above thus provides a context for our questioning of the impact of creating such artefacts by teams as a means of mediating cross-disciplinary collaborative interaction within innovation process, whilst encountering the unfamiliar and incorporating it into their learning experiences.

**LITERATURE REVIEW**

There is a range of approaches to dealing with innovation. These include the integration of users and external knowledge (Cohen & Levinthal, 1990), team constellations and processes (West 2002), knowledge and innovation management process (Basadur & Gelade, 2006), and design and modelling methods (Sanders & Stappers, 2008), which is where the use of mock-ups would be located. Moreover, Schulz et al. (2015) maintain that playful modelling with simple-to-use toolkits could
provide an important contribution to creativity, where the toolkit helps to generate ideas and inspire through ‘thinking with the hands’ (Roos & Victor, 1999).

In addition, we draw on recent debates shaping the role of mock-ups as representations of artefacts used within the innovation journeys. Stigliani (2008) presents preliminary findings emerging from an ethnographic study based on the participant-observation techniques. She argues that a wide array of artefacts can support, influence, help generate, develop, and refine ideas. The four main functions that are seen as being performed by artefacts in innovation process are: (1) inspiration, (2) individual evaluation and refinement, (3) internal sharing, and (4) external alignment. On the other hand, Schulz et al. (2015) argue that particularly representational methods [like mock-ups], which apply manual toolkit-based modelling in a goal-oriented but playful way foster the emergence of innovation in heterogeneous groups.

Our investigation also draws on an argument for the process of design prototyping as a means of creating a transformative learning environment and ‘problem-posing’ education (Friere, 1986) within higher education business studies. We argue that the use of design mock-ups enables learners to create and reconstruct new boundaries, at an individual or collaborative level, in order to define ‘new familiar’ environments; a meta-space where they are open to cross-disciplinary collaborations.

The unfamiliar (design) environment places value and emphasis on the learner experiencing design process in practice by providing opportunity for the management learner to cross boundaries (Klein, 1996) from their native, known, familiar environment into a non-native, unknown, unfamiliar environment, which they can reshape into a ‘new familiar’ through learning. Referencing Freire’s (1986) ‘Gnosiological Cycle – the cycle of knowing’ we observe two distinct moments in the process of learning: 1) the production of new knowledge, and 2) the perceived knowing of existing knowledge. Freire and Shor (1986) maintain that all learners are creating and re-creating boundaries to their conscious knowledge as part of their metacognitive processes. This cycle of knowing leads to curiosity and critical reasoning, in turn, triggering positive emotions (Fredrickson, 2001) which, with repetition and over time, broaden, build, and stimulate more interest in the unfamiliar environments. The learners become able to create and reconstruct new boundaries in order to define new familiar environments; a space in which learners now have the “ability to solve problems in a given context” (Gardner, cited by Robinson, 2011, p. 118), feel empowered, generate knowledge, and happily occupy a new familiar environment to deepen and broaden the subject in practice and theory.

Many scholars agreed that artefacts have a role in facilitating group innovation processes (Jacobs & Heracleous, 2007; Schrage, 2000). These artefacts can be ‘mundane office objects to plasticine, to construction toy materials’ (Jacobs & Heracleous, 2007, p. 80), but can also be templates and sketches, which are considered helpful tools to structure and focus teams whilst they are immersed in innovation process (Suthers, 2001). Eppler et al. (2011) argue that such artefacts can have considerable power in shaping team’s interactions and idea generation in the context of business model innovation. They shed light on the phenomenon of artefact-
mediated interactions, showing that an interactive template, increased perceived collaboration while decreasing perceived creativity. Whilst presenting these somewhat surprising results Eppler et al. (2011) point toward the need to investigate the role of artefacts on knowledge work and innovation in organisations in more detail and this is where our study can contribute further.

**METHODOLOGY**

The study is underpinned by participatory action research methodology. Reason and Bradbury (2001) define it as “…a participatory, democratic process concerned with developing practical knowing in the pursuit of worthwhile human purposes” (p. 1). Thus, it is a systematic approach that seeks knowledge for social action (Fals-Borda & Rahman, 1991). “Action researchers reject the theory/practice divide and believe that applied research can both build theories and solve problems” (Brinberg & Hirschman, 1986). Ozanne and Saatcioglu (2008) argue that: “…action research is demanding because researchers are expected to both develop knowledge and work toward social change” (p. 424). It is an appropriate methodological choice as the research question focuses on solving a practical problem, namely helping learners to reframe the boundaries of the ‘unfamiliar’ learning experiences to create ‘new familiar’. It also contributes to the development of knowledge around the integration of design and strategic thinking into a business education as a means of enabling cross-disciplinary collaborations within innovation process. The research project pursues “... a spiral [of] self-contained cycles of planning, acting and observing, and reflecting” (Kemmis & McTaggart, 2000, p. 595), which aligns with participatory action research design. The underpinning research design is applied through reflection on module delivery, which delves into issues identified in teaching. The analysis and insights are then fed back into the next round of teaching, followed by further post-teaching reflection. This process began in summer 2009 and has continued until now.

Over the duration of the study 134 learners have undertaken the Managing Strategic Design module and became participants in the research project. All of the participating learners were in their final year of undergraduate study on a BA (Hons) Global Management degree. They were all in their early 20s and represented a wide selection of cultural, social and national backgrounds. The module is an elective, (hence not compulsory) and the participants’ reasons for choosing it varied from wanting to learn more about innovation to simply finding a module that fits with their timetable and has no exams. To our knowledge, none of the learners chose it because it gave them the opportunity to collaborate and work in teams. On the contrary, they tended to be quite concerned how the team work would affect their final grade.

Data informing this study was collected during each module delivery once a year in Spring term. The data was collected from three stages of mock-up development: its creation, its evaluation and post-mock-up reflection. For stage one the data was obtained from observed processes of making the mock-ups. The observations took place where teams were given time in the classroom to develop their mock-ups. Data for stage two was collected from team assessment feedback on the mock-up submissions. This stage immediately followed the making process hence as with the
data collected for stage one there is a level of immediacy to both data sets. For stage three, the data was extracted from learners’ reflection on creating the mock-ups. These were obtained from learner’s individual reflective reports submitted toward the end of the module delivery. Here the data has the benefit of hindsight where learners themselves had the opportunity to evaluate their effectiveness of the processes of creating their mock-ups and the collaborative experiences, in the context of the whole module. Thus, all three stages enable a more holistic data set combined with the longitudinal element of the module being delivered once a year for eight years, leading to a robust data collection and analysis.

THE MOCK-UP

Over these eight years of module delivery, we have observed the critical role the mock-up can play for teams in: (1) impacting the innovation process and influencing their broader understanding; (2) mediating group dynamics; and (3) establishing emotional connections. All of these patterns emerge from the way teams perceive a given brief and engage with the assigned task. The mock-up was the second piece of assessment in the overall project for this module. The task at this stage was to create a three-dimensional mock-up of the physical space in which the club business was to be housed. This allowed learners to explore trade-offs between function, capacity, offering, affordability, and their creative ideas. The key take-out from this part of the brief for learners was the ability to balance their creative proposals and aims to deliver innovative solutions with the practicalities of implementing these into actual deliverables in form of a running business. The following sections explore each of the impacts in turn and its relation to the way the mock-up shapes the collaborative engagement of teams in the problem-solving learning through the innovation journey.

Impacting the Innovation Process

The observations of team’s creation of the mock-ups, supported by conversations around the process, reveal that the teams have found the development of their initial ideas into a three-dimensional object quite valuable experience of balancing the imagination and practical application. In particular, the process of embodiment has enabled the members of the team to see their ideas externalised and shared as a common picture by all. This process in most cases led to a better project engagement and a far greater collaboration through the process of shared understanding, as exemplified by feedback they received.

“In the Part 1 of this project [B] you had developed quite a ‘daring’ proposition. It was a good response to Project A where your Blue Ocean proposal had some issues. The enthusiasm and creative flare has allowed you to rethink the whole approach and opened up new doors for the Blue Ocean opportunity that you have captured well in the design model. It is also to your credit that you did not abandon your creative input and used it as a
strong element to drive your business case” (Group 3 feedback, Spring 2009).

In cases where the initial project proposals are not strong, often the process of creating a mock-up provides learners with new insights and enables them to expand their knowledge by doing. In such cases, teams are able to more readily comprehend the more practical elements of setting up and running a business, which until that point often is measured only in abstract terms. Such questions as space capacity, staff requirement or opening hours come to life when teams are prompted to design the space in which their business would take place. Thus by generating additional understanding the teams are able to reinvigorate their projects resulting in new enthusiasm for the tasks. This is evident in the staff feedback offered on how students utilised the mock-up to develop the final part of the project:

“It is to your credit that you went back to the idea and used design to strengthen the offering. Moreover, it is to your credit that you took the time to create a model since the previous presentation, and this process seemed to have helped you in fleshing out your business offering” (Group 1 feedback, Spring 2009).

When commenting on the role the mock-up plays in the innovation process, the learners observe that the learning they undergo in the module could be seen in two phases: that of information gathering and information production, where the creation of the mock-up is the pivotal point triggering the change (Learner comment, Spring 2016). Indeed, from classroom observations it has been evident that teams which have immersed themselves in the process of creating the mock-up tended to gain much more confidence in generating responses to the latter stages of the brief, as one of the learners observes:

“The process allowed me to re-evaluate the basics of our concept and realise a creative visualisation. This element was a highlight for my personal journey, as for the first time it made me ‘feel’ that our ideas became reality, although the feedback demonstrated the vast possibilities that remained” (Learner comment, Spring 2016).
Mediating Team Dynamics

Over the year, we note that the size of the team can have quite an influence on how the group engages with the mock-up stage of the process. The larger the team, the more of a challenge it is for learners to manage the team dynamics; which seems quite obvious. We also observed that when a team was too small pressure of creating an outcome in a short time influenced the team dynamics. Although with small teams the practical operational issues were not as much of a challenge than in large teams, the dynamics of who does what could adversely influence the need for the team to allow itself to be creative and experimental.

In teams of three or four the sense of responsibility, we have observed, seems to be managed a lot more smoothly in this collaborative endeavour as there is the pressure of having to complete all the necessary tasks to make the mock-up happen. However, in teams of five or six (our largest teams in the delivery) the perceived number of many hands for getting the job done seems to offer a licence for learners to abdicate their responsibility, by assuming another member of the team will get it done. In larger teams, we also noted that often there is a greater reliance on lecturers to offer any required intervention when the team runs into trouble. The smaller teams tend to be much more agile and often resolve the internal issues on their own not relying so much on the external influence.
Observing the way, the teams manage their social interaction when they encounter the mock-up stage of the process has made us recognise how much the collaborative creation of the artefact influences the social dynamics of this process. As one of the learners observes:

“I wasn’t very sure about how this physical resolution of the club would provide me an actual reflection of the key elements regarding our Blue Ocean strategy. However, it was a matter of time (once we started and finished the construction of the mock-up) that my doubts started to go away. I then realized I wasn’t pushing myself to take more risks (neither pushing my group), although I knew how important breaking our boundaries and leaving our comfort zone was. Maybe in this case, what was missing was the division of the member roles, in order to ensure a better balance between the main aims, objectives and constraints from the project and the needs and desires from our customers” (Learner comment, Spring 2016).

Not only size can be a factor but also the overall motivation around success that each member of the team brings with them. This is particularly evident at the mock-up stage since in order to generate an outcome the response has to be truly collaborative. As expected, the mock-up had a role in allowing some of the quieter members of the group to have the courage to express themselves more and put forward their ideas:

“Week 6 was the time when we started to think and designing mock-up of our club. I think at that period I found myself more confident within the group. I started to be more confident with expressing my ideas to the group and my team mates now are more considered of my ideas. Also during week 7 the
But we also observed that at this stage, where teams have too many ‘achieving’ learners despite the common goal of creating a mock-up they struggle to not impose their own view on the team. Although such behaviour is not uncommon in collaborative situations, what is interesting about it is the fact that creating a mock-up is the second stage of the process thus learners are already familiar with each other’s working styles. Moreover, as none of the learners are designers, all learners start from the same position of uncertainty but their response is to bring in their problem-solving habits from other areas of the degree as those have already served them well. For example, in one of the teams in 2015 module delivery, a number of members wanted to come up with the perfect answer right away, rather than iterate to get there.

‘The biggest challenge for me has been in handling my perfectionism. I want things to be right and they must be right the first time. As a result, I found it very difficult and tough to start over several times with a new business proposal idea. I felt that my group and I wanted to ‘give up’ several times and I could feel that my group’s frustrations influenced me to think negatively’ (Learner comment, Spring 2015).

Hence how the mock-up mediates the social interaction links with the already mentioned observation that learners not always perceive the mock-up as part of a larger ongoing process, but tend to approach it as a new stage where social interactions need to be defined anew. Thus, again here is an area which opens itself up for teaching intervention as a means to help learners managed those social interactions in a positive manner even if they include conflicts amongst individuals within the teams.

**Establishing Emotional Connections**

The final element we have identified in our research focuses on how the mock-up as an artefact has the capacity to provide a platform for the learners to establish an emotional connection either with each other or the project or the customers they are designing for. We note that learners imbue the process of creating the mock-up with a number of different emotions on an individual basis, from excitement to feeling of uncertainty as they tend to project their emotional states onto the mock-up as they create it. There are feelings of pleasure at being able to create something and there is also an acknowledgement of fun and play. But there is also frustration when things do not go according to plan and concern whether the work ‘will be good enough’ and disappointment when the feedback offers too critical a view.
When teams struggle from the onset with finding truly innovative ideas, the concept of developing something new becomes uncomfortable for them and often teams seem to make decisions in the hope to please us as lecturers as a way to mitigate risk of failure.

“I think it was at this point we realized that some of our initial ideas really were not suited for this project, and when you notice that weeks go by without being confident that we have a very strong idea, you can easily get wary and frustrated” (Learner comment, Spring 2011).

The diversity of emotional engagement that learners develop with the creation of the mock-up confirms that this is quite a vital stage of the innovation process, which the learners recognise as such through their wish to ‘get it right’.

Although the teams invest the time to research into their potential customers, the information they tend to accumulate seem to permit learners to keep the customers quite abstract often shaped by the learners’ own assumptions about that particular social group. The mock-up stage with its very practical and embodied nature forces the teams to begin empathising with their customers. Moreover as the creation is a collaborative process, the process of developing that empathy is shared within the team further enabling a shared understanding of who the potential customer might be. It also means that the team can externalise the feeling of not knowing and discover that individuals within the team have different perceptions of the same customer. All these elements lead the team to extrapolate who the customer is and how they make sense of them in the context of their innovation process.

The mock up often enables students to manage their emotional responses to the previous stages and the resulting feedback. In such cases, we have observed that the playfulness of the process and the ‘we are all in it together’ sense of collaboration enables teams to more positively tackled the need of the project development and helps them challenge possible feelings of disappointment. In 2011 module delivery, there was a general feeling of low confidence amongst the teams around creative decision making, often evident in the conversations during tutorials and the (in)ability of the learners to respond to the given feedback. The process of designing a mock-up led to a set of different innovative outcomes. For two teams the process resulted in an infusion of new perspectives, new energy and momentum to go on with the
development, and some new insights that then could be taken to the final stage of the journey.

For one team the design implementation stage was a complete disaster. The initial idea was never really narrowed down, but the team chose to take a risk and develop a mock-up which failed spectacularly. The failure was not in the execution itself and on the day of presentation their peers saw the mock-up as the most impressive submission. The failure was conceptual as the team lacked the ability to commit to an idea and didn't develop a relationship between the business proposal and the audience it was meant to attract. Thus the mock-up, although a conceptual failure, became a significant experience for the whole cohort as it provided an occasion for all learn to learn from a mistake. Nonetheless, the teams experienced the emotional turmoil of this process as one of the learners’ comments:

“Of course, I was very disappointed with the mark we got for Project B, but it has taught us something very valuable for our business, if we had not done it and experimented with the idea, then we would have never known if it would work or not. I believe that we gained a high learning curve from this unsuccessful project” (Learner comment, Spring, 2011).

It also highlighted to us, as lecturers, the value of learners making mistakes as part of their overall journey and the need for such times and spaces within that journey. Moreover, it brought to the fore the strong impression that many business learners see making mistakes in this learning environment as too risky, thus generating discomfort which prevents them from exploring alternative options or taking chances, key aspects of innovation. However, from learners’ reactions through the process, it was evident that the experience of designing mock-ups facilitated a ‘reality check’ and provided insight as to how their ideas could be developed further. Thus through the process of creating, the teams are able to tackle their responses to the learning experience in a collaborative manner. But in particular, they can ‘get lost’ in the pleasure of doing and making which injects energy into the whole process and can pull them through any potential downs, making the sense of enthusiasm the biggest takeout from the mock-up.

“I came up with a new entrepreneur club concept, which triggered a wave of enthusiasm and motivation within the group. Restarting from the scratch with the lessons learned from our failure was a great opportunity” (Learner comment, Spring 2015).

**DISCUSSION**

**Offering Coping Mechanisms in Light of Arising Innovation Challenges**

Although the mock-up can create a common sense of knowing and as artefact provide a platform for abstraction becoming an embodiment of visual representation, there are some challenges that the mock-up cannot resolve. The most common issue has to do
with the team members themselves and how they relate to each other whilst addressing the brief. If the team does not ‘gel’ together well, irrespective of the positive attributes of the process of developing mock-up, the team will not resolve its problems and will continue to struggle. Thus for the mock-up to generate a common platform for all, the team in itself has to be willing to collaborate and they have to gather around the mock-up making it a central goal of their collaboration. Such focus then has a much more unifying impact on the collaboration as it challenges the issues that the team is experiencing by creating a sense of distance and common ownership through the creation of the mock-up, which bears out the importance and potential role of artefacts outlined by Eppler et al. (2011).

How teams approach the process of making the mock-ups can also be a challenge. Here we argue that it is the making ‘from scratch’ of the mock-ups that enables learners to cope with the unfamiliar and the resulting boundaries, whilst reframing them through the cross-disciplinary collaboration with a particular focus on two of the functions outlined by Stigliani (2008) in terms of individual evaluation/refinement and internal sharing. Such an approach also aligns with Krippendorff (1995) classical definition of design as making leading to innovation.

However, our study also reveals contrary to Krippendorff (1995) that our learners are far more drawn to reproducing the historical continuities rather than in the creation of new artefacts. The analysis indicates that event when learners have shaped the ‘new familiar’ environments these often emerge from new understandings of the familiar aspects of the unfamiliar context they encounter. For example, occasionally learners used pre-fabricated elements in the construction of their mock-ups, precisely as this would enable them to reproduce the familiar and act as a safety net. This approach has an impact on the overall cohort’s team dynamics. In the presentations, the rest of the class tends to be always impressed by the execution and the look and feel of the mock-up, but do not challenge the conceptual framework underpinning the choices. The learners who opt to make such particular mock-ups tend to be drawn to the ‘cool’ look and feel of their outcome and do not truly consider the audience which was meant to interact with the environment they create. They fall down particularly on the 4th of Stigliani (2008) functions of artefacts – i.e. the external alignment. We argue that when teams opt to use pre-fabricated elements for their mock-ups it is because they do not really engage with the process of reframing their boundaries but rather look for shortcuts and familiarity. We note that such approaches become coping mechanisms in response to the unknown and management of possible risk of getting the idea wrong by making the mock-up appear pleasant looking and well designed.
On the other hand, teams often can perceive the mock-up as an outcome in itself because its embodied nature allows them to arrive at a physical visually appealing object. Although the mock-up is meant to help the teams to inject new ideas and refresh their creativity, this sense of achieving a finish can impact on how teams perceive the mock-up as part of a larger innovation process where the end goal is in fact to generate a proposal for a truly innovative outcome. Thus the study reveals that from the perspective of educators, when teams do not intuitively gain an overview that there is a larger underpinning goal, the learning experience rather misses the point of the problem-posing education approach outlined by Friere (1986). Therefore, there is a need on the part of those who deliver the module to develop stronger intervention mechanisms to ensure that teams do not get seduced by the physically and visual appeal of their mock-ups and perceive them as the final outcome.

To build on the previous insight, this process of being involved in building the mock-up and resolving the challenges inherent in creating a physical object from abstract concepts and ideas, can also mean that teams dismiss the need to utilise the mock-up as another tool to resolve the issues they have faced in the previous stages of the process. Thus teams who are not familiar with design processes that include mock-ups as a means of testing their ideas, often will perceive the process of creating one as yet another challenge and will not position it as a tool to check their experimenting or a way to cope with the challenges of the innovation process, even when the exercise is formative in nature.

**Excitement of Making, Mediation of Interactions and Emotional Engagement**

One of the beneficial impacts of the mock-up has been to allow groups to coalesce around a shared idea of the offering, externalising the individuals’ views and
combining into a consensual one as outlined by Eppler et al. (2011). The practical questions of what will ‘happen in the room’, and the implications for critical elements of the business model that result, help learners iterate towards a more practicable offering. It also encourages learners to make a decision one way or the other rather than ‘sit on the fence’ with compromise offerings. Moreover, the process of making further supports any collaborative bonds between the team members, due to mock-up often being completed during non-class time positioning it as a fun activity with significant playful undertones. Thus our study contributes to Schulz et al. (2015) work highlighting how playful use of tool-kit modelling elicits creative outcomes in heterogeneous teams. The emergence of a physical outcome from a common goal of making the mock-up lends itself to an immediate gratifying result for the team. Thus, the study indicates that the mock-ups can become a framing mechanism for the collaborative endeavours, whilst grounding internal team interactions.

The mock-up can bring the project ‘alive’ for learners, and allow them to get more connected to it than other forms of intervention. It can help members connect with each other, and help manage feelings of uncertainty or disappointment from earlier stages of the project, or see where the proposal doesn’t ‘gel’ appropriately. It can also enable them to manage the crossing of the boundaries (Klein, 1996) as they move into unfamiliar territory on their own unique learning journey. The shared goal of making the mock-up can give voice to these feeling and behaviours. In particular, the use of the mock-up as an artefact imbued with meaning and representation of a common goal can be a very useful way to separate the personalities from the objective of the process to remind learners about the shared and collaborative nature of the experience. Thus, being sensitised to these possibilities, the teams may be better placed to surface these issues themselves and thereby manage them better. Hence, the analysis indicates that mock-ups are very useful in helping learners mediate their own emotional investment in the collaborative process of innovation. Thus we argue, the study contributes to the current literature by unpacking the dynamics that emerge around the mock-up as an artefact used in an innovation process, whilst becoming a learning tool and a means to mediate human interactions.

CONCLUSION

Our analysis has provided us with three particularly interesting insights into how a design mock-up helps learners reframe the unfamiliar into a ‘new familiar’ learning experiences whilst fostering cross-disciplinary collaborations amongst team members engaged in innovation journey. These are: 1) the value of the tactile experience of making as the framing mechanism for the collaborative endeavour; 2) the capacity for facilitating, through a common goal, the management of internal team relations and interactions; and 3) the capacity for externalising and framing the emotional investment of the learners in the collaborative process. However, we also argue that the mock-up has enabled learners in an embodied manner to reframe the ‘unfamiliar’ of the innovation process into ‘new familiar’. Although the process of making sense of the unfamiliar and re-creating it into ‘new familiar’ takes place at a metacognitive level, the making of the mock-up helps shape it into deep learning precisely because
of the embodied nature of making supported by the mediation of social interactions and emotional investment. The current literature on innovation already acknowledges that artefacts play an important role in the innovation process. However, our study indicates that the purposeful process of making such artefacts as a way to make sense of the innovation has added value. The physical act of making combines the emotional response to the collaboration with managing the uncertainty of the innovation process.

We conclude that the exploration of the ways in which the creation of design mock-up assists this process of metacognitive reframing has implication for the learning environments in which it takes place. It enables learners to fast-track their self-motivation and self-belief as active contributors in collaborative teams. While at the same time it equips them with adaptability and resilience to cope with the uncertainty of such cross-disciplinary collaborative environments. Such insights inform teaching practice by positioning the reframing process as one of the pre-requisite skills for cross-disciplinary collaborations.

REFERENCES


Section 4: Visual Tools for Integrated Practice
Visual Tools for Developing Cross-Disciplinary Collaboration...
A New Approach to Help Students Develop Practical and Collaborative Skills with Visuals Methods Applied as a Key Tool

Elwin Dong (董天田) and Lenovo

In this chapter, we shall discuss and illustrate a new approach that is able to help students develop practical and collaborative skills. By combining User Experience Design Award (UXDA) into university curriculum, we provided students a platform to develop a tangible product in collaborating with peers from different disciplines, working closely as a team with assistance of tutors from both universities and enterprises. Based on the practice of rapid-product development, selected visuals tools from the basic hand drawings to rapid prototyping by Flash CS6 were explored and utilised in this approach, where several key issues were emphasised and focused.

It is expected that selected methods and visual tools can help students quickly develop the capabilities of coping with problems from key aspects such as user experience, commercial prospect, practicality, timeline and stakeholders’ concerns as in the real business. To complete required tasks and get promoted, it is essential for students to adapt to a multi-disciplinary work project environment and learn when & how to insist - and how to find compromises in order to reach a more balanced result in given time. To articulate this approach more clearly, a case study is included in later section of this chapter where all key methods and related practices will be detailed visually.

INTRODUCTION

In recent years, since the majority of Chinese consumers are moving from level 2 to level 3 in Maslow’s hierarchy of human needs (Justice, 2012), product design now needs to fulfil a greater expectation of consumers than it was traditionally defined. Since the quality and pricing issues are no longer the only key concerns in product development, the integrity of product user experience has been highlighted. As a result, a sense in product development has been raised from pursuing improvement in respective profession to developing critical abilities for the general user experience of products. With the help of new technologies and advanced methodologies, software and hardware also become smarter and more accessible to make teamwork and collaboration efficiently and seamlessly, in achieving an optimal result.
However, it is not easy to bring the updated cognitions and practical methodologies to universities as there is a gap between enterprises and campus. Since China’s academic has been deeply influenced by planned economy and a variety of historical factors (Peng, 2007), the end results normally come out unsatisfactory or just fulfils the basic academic requirements. On one side, although universities have implemented and adopted a range of methods such as assigning design projects, organising class workshops and visiting enterprises, most of those actions still remain on theoretical and aesthetical level. On the other side, students are requested to mimic completing assignments and projects in a simulated enterprise environment, but it is generally hard to give a valid evaluation to the outcome due to the missing of actual participation from enterprises.

To fill the gap and solve these problems, it has been proved effective and applicable by merging UXDA into universities. As one of the most influential design competitions, UXDA covers the majority of big enterprises in China and has a judge board consisting of over 70 senior designers, business managers and IT experts from associated enterprises and universities.

![Flow chart of UXDA 2015.](image)

Figure 15.1: Flow chart of UXDA 2015.

With a professional review for each of the 5 phases in the competition, the ultimate goal of UXDA is to bring students a platform to experience and conduct a complete process of product design through teamwork. After 11 years’ development, the annual UXDA now attracts more than 6000 students in 1500 teams from over 200 universities in China including Hong Kong region and Taiwan province.

**LITERATURE REVIEW**

**From Traditional Product Development to Rapid Product Development**

It has been mentioned and realised that user experience can add huge value to products, so designers are required to extend own profession by addressing all aspects
of a product as perceived by users (IBM Design, 2015) beyond any single concerns. Therefore, it is not sufficient to focus on a specific discipline anymore in product development. As Anderson, McRee and Wilson (2010) stated in *Effective UI: The Art of Building Great User Experience in Software* that product designers need to take time to see things from the view of a project manager or leader, not just act as limited contributors as traditionally defined. Besides the expansion of own professions, it is also critical and necessary to know how to design and produce products in an inter-disciplinary environment with professional management and teamwork skills (Justice, 2012). Unlike most of the traditional product development process where people based in different disciplines are essentially separated and follow a linear order, in *Sketching User Experiences: The Workbook*, Greenberg et al (2012) explored new development models by positioning all disciplines to work together, right in the beginning rather than place specific disciplines in an one after another order in product development. To minimise the problems and increase the effectiveness of teamwork, rapid product development has been largely adopted by enterprises and it has been proved efficacious (Lewisa, Teratanavata, Beckleyb & Jeltema, 2010).

**An Approach to Fill the Gap Between Universities and Enterprises**

Since the definitions, technologies and methodologies are rapidly refreshed in enterprises, it brings a problem to university education on how to get aligned and updated. To fill the gap, direct collaboration between universities and enterprises or developing a tangible product with assistance and guide from enterprises has been experimented and proved a positive and applicable approach (Artiles &Wallace, 2014). It is also a mutual beneficial approach to enterprises besides helping students get valuable experience and develop practical skills, as Press and Cooper (2003) stated in *The design experience: The role of design and designers in the twenty-first century* where supported research and examples provide cues for design interventions that resolve asymmetries of creation inside the cycles of product development and consumption. Carnegie Mellon University once collaborated with New Balance by assigning 6 student teams to work closely with the enterprise and 6 successful product concepts were created in 16 weeks, according to *The Design of Things to Come: How ordinary people create extraordinary products* by Vogel, Cagan and Boatwright (2005).

**Using Visuals as Key Tools**

As visual objects comprise rich and meaningful functions (Kress & Leeuwen, 2006), the rational use of visual tools not only helps achieve a better product design, but it also keeps a concept or idea clear, avoiding members from different disciplines getting off the right track in a thousand ways (Streng, 2016). In most of products development, it is common to adopt visual methods such as creating story boards, personas, scenarios, information architect, interaction & visual designs, especially in rapid product development where a closer and tighter relationship is requested. Thanks to the maturity and accessibility of new technologies, visual methods have...
been extended and applied through smarter software and hardware that greatly enhanced the efficiency and effectiveness. In *Visual and Interactive Tool for Product Development Process Enhancement: Towards Intuitive Support of Co-located Project Review* (Sadeghi, Masclet & Noël, 2012), a multi-touch table was introduced to facilitate and support reviews in different phases of product development. Airbnb also created a software tool for designers to quickly create instant results on devices of various screen sizes and resolutions, which has provided a nice user experience and minimised misunderstandings to a large degree (Brownlee, 2016).

Visual tools have played an important role in usability test in certain phases of product development as well. In *Sketching User Experiences: The Workbook*, Greenberg et al (2012) illustrated a variety of visual methods that successfully completed the tasks. Specific visual tools also empower test users to actively feedback how they feel about the experience of a given product. According to the experiments and analysis in *UX Curve: A method for evaluating long-term user experience* (Kujala, Roto, Mattila, Karapanos & Sinnelä, 2011), product designers got a comprehensive and holistic view on how to apply the improvement by asking users to draw a curve on a designated template.

**METHODOLOGY**

Our approach is built on the platform provided by UXDA. The annual UXDA sets a broad theme calling for entries. To obey the fundamental requirement of UXDA, only teams made of students are allowed to participate and the final outcomes are not limited in the form of software or hardware or a combination. Ideally, a team is consisted of at least 5 students, functioning as product manager, user researcher(s), interaction designer(s), visual designer(s), programmer(s), marketing or sales consultant(s) to conduct ethnographic study, contextual inquiry, prototype testing, usability testing and other tasks as required by a typical User Centred Design (UCD) process (UXPA, 2016). It is required that team members’ roles and duties need to be defined and clarified in the application to UXDA.

In phase 1, each team is required to discuss and identify the problems then work out a conceptual solution with the help of tutors in both universities and enterprises. Once a primary product concept is approved and decided, each team needs to prepare a presentation illustrating selected technologies, competitor audits, marketing researches and analysis of target user groups to the judge board in the end of phase 1. Results and feedback will be given based on multiple concerns including user experience, business prospect, practicality, aesthetics and design. In phase 2, normally over 70% teams are able to get promoted, as a high ratio of promotion is to encourage students to proceed in this stage.

Visual methods are heavily applied and utilized as phase 2 commences. In this phase, sketching, hand drawing, computer drawing and a wide range of visual methods are allowed to describe how the product shall look like, how it will interact with users and what are the right places. As the most important outcomes for phase review, story boards, personas, scenarios and an information structure framework of...
chosen product are required to submit to judge board. Results and feedback will be
given and normally less than half of teams are promoted.

After getting promoted in phase 3, each team launches the product development.
In order to achieve a better and more balanced result in given time, team members
need to stay closer and get centralized on core principles such as user experience and
business concerns of a product. Although there are a number of available methods of
developing a product, students are encouraged and guided to think out of the
traditional and regular notions, exploring and applying new technologies and new
methodologies to increase the efficiency and facilitate collaboration to reach an
optimised product. Since the evolution of the capacities of the actual rapid product
development technologies enlarges the scope of collaboration inside the team and
interaction with the end users (Bernard, Taillard & Karunakaran, 2009), a stronger
partnership is required between the product researchers and product development,
business people also gain a deeper understanding of consumer language and key
design elements that feeds back into future product development projects. By
adopting rapid product development and getting end users involved, the period of
development had been cut from 18-24 months to only 6 months in using a consumer-
driven rapid product navigation process to develop an optimal product (Lewisa, et al.,
2010).

In a typical product development, only minor modifications and adjusts are
allowed once a baseline version comes out and all team members need to be aware of
that. Therefore, a strong and united teamwork is required to make things happen. With
Flash CS6 as a pivotal tool in this phase, our tutored team stayed close to rapidly
produce prototypes with the latest available designs and the development cycle was
largely shortened and iterated easily and consistently by comparison with the
traditional ways. In each iteration, designers worked with programmers to quickly
develop conceptual designs, coded in AS and published a primary version of
prototype in the form of Android Package (APK, standard format of Android
application installation file). Once the APK was installed on target devices, an instant
prototype testing was conducted. Feedback from users and suggestions from
marketing or sales aspect were analysed and considered to contribute to next version.
Meanwhile, members acting as marketing consultant also needed to conduct business
promotion plans and tried to find possible opportunities to get sponsorship or letter of
intent with available APKs. As expected, the requirements and expectations from
possible investors and potential commercial partners were also evaluated and
accounted to the ongoing product development iterations. Ideally, the iteration should
be repeated for no less than five rounds until a baseline version is formed. As the
main outcome from this phase, the baseline version (an APK or at least a demo in any
format) and all supplementary materials will be assessed by the judge board. The
dimensions of criteria highlight the usability, effect, design, practicality and
commercial potential.

As a result of phase 4, TOP30 are selected from several divisions.

Promoted teams prepare for the final that is held in the last phase where 30 teams
shall contest in front of the judge board in the annual conference of user experience
professional association (UXPA China). Although having hardware and relevant
appliances may add more credit to the team, those are not compulsory due to the manufacturer and cost limitations. By giving a presentation one by one, each team needs to answer questions from any judges on the board. The questions are based on assessment criteria including a wide range of concerns on the general user experience, product concepts, benefits to target users, available technologies, design solutions, visual effect, practicality, integrity of the whole product system and expansibility potentials. Top10 are announced in the end and certificates, prizes and credits are awarded to the winning teams.

**PARTICIPANTS**

Students: Only students are permitted to participate in this competition and ideally a team shall consist of 5 members including one from each of recommended disciplines. It is allowed to establish a team with peers in different regions through online or video communication. Although there is no restriction for disciplines or regions, participants should possess basic skills to visualise the presentation, produce design resources and create a prototype in proper forms. The most suitable and closely related students are in:

1. art, design, media, psychology or other similar majors
2. information technology, programming, computer science or other similar majors
3. marketing, sales, business or other similar majors

Tutors: Each student team is allowed to find two tutors, one from enterprise and the other one from university to acquire assistance and suggestions. Tutors provide continuous support during the whole process of UXDA but are prohibited to offer design solutions or any direct contributions to tutored team. Similarly, there is no restriction for disciplines or regions but tutors are required to have no less than 5 years work experience, working in:

1. design, user experience, user research, product, research & development centre or other disciplines closely related with product development in enterprises, especially those who had successful product development experiences
2. art, design, information technology, programming, computer science, marketing, sales, business or other similar majors in universities, especially those who had successful project experiences with enterprises

Judge board: the judge board of UXDA has 60-70 seniors and professionals from more than 50 big enterprises and universities such as Alibaba, Huawei, Tencent, Baidu, Nelson, Tang, ZTE, China Unicom, China mobile, Chine telecom and etc. in China. The general requirement for judges is 6+ years work experience or of position as director or higher.
Users: target user groups, user representatives and test users, depending on the nature of chosen product and available resources.

Miscellaneous: professionals in target disciplines, product managers, hardware manufacturers, marketing consultants, sales, etc.

MATERIALS

1. Questionnaires in paper and online forms
   - in both paper and online forms, used for conducting user research and data analysis.

2. Communication tools
   - video cameras, mobile phones, digital recorders, QQ, WeChat, Emails to record and communicate.

3. Office stationery
   - Pins, notepapers, markers, notebooks etc to facilitate discussions, meetings, interactions and workshops.

4. Software
   - Flash CS6, CorelDraw, Photoshop, Visio, Microsoft suite, VideoStudio, VS, Eclipse to conduct user researches, story boards & scenarios, design resources, prototypes and demos

5. Tools
   - PVC, plaster, glues and related tools for creating mock-ups

CASE STUDY TO ILLUSTRATE APPLIED METHODOLOGY

Tutored team: Fisssh (5 members, all from Ocean University of China)
Chosen product: Peter Shut-up (an app and related wearable that cures kids stutter)
Key methods: Selected visual tools and the practice of rapid product development

The original motivation of ‘Peter Shut-up’ was triggered by the personal experience of the product manager who suffered stutter in childhood. As she grew up, she overcame stutter with a great difficulty and she had witnessed the pain of a huge number of other kids who had the same problem. She had tried many applications and tools that are supposed to cure stutter but not many of them were effective. Taking UXDA 2015 as an opportunity and platform, she quickly organised a team consisting
of 5 members respectively playing as user researcher, interaction designer, visual designer, marketing consultant and product manager. Designed to guide and train kids to complete certain tasks to shut up Peter the lovely but wordy little bird, this product was aimed to cure kids’ stutter in playing games (Luo, Chu, Chen, 2015).

Since the biggest advantage of rapid product development, all team members can be synchronized efficiently with a better understanding and respect to each other, which has been commonly used in internet enterprises such as Tencent Inc (T.J. Liu, personal communication, April 27, 2015). A practice of rapid product development was adopted by Fisssh throughout the whole process recommended and assisted by tutors. Due to the core principle of UXDA, holding user experience as one of the Top concerns, Fisssh placed a special emphasis on users’ participation and feedback. Based on rapid product development model, Fisssh completed key tasks by experimenting and utilising several visual methods through a closer and successful collaboration.

**Story Boarding and Persona**

In the early phase of product development, it is important to decide the principle and theme of the product and find the typical user.
Based on the collected data from user research and plans from marketing consultants’ perspective, story boarding is the typical method to explore and visualise a logical and convincing story where a persona is displayed to help guide decisions about product features, navigation, interactions, and even visual designs (Cooper, 2016). Story boarding can be taken in various forms such as comics, plot graphics or even simple line drawings, as long as it conveys a clear sense to all team members that how the target users are related with the product and sets a foundation for further development. As a complete story board is the result of agreed opinions and aligned concepts of all team members, it normally takes several rounds of modification and revisions to become complete.

Based on the field user research in hospital and cure centres, Fisssh created the story board with hand drawing on a sketch pad. Meanwhile, marketing consultants also started to consider business strategy as story board were getting complete and decided.

Figure 15.3: Persona in story boarding.
As an indispensable component to a complete development process, scenario is another typical visual method to clarify the attributes of product and pave the ground for designs in the next step. In order to make a vivid depiction as in the real world, Fisssh brainstormed and figured out the scenarios by combing silhouetted figures with several chosen circumstances in Photoshop. In adopting this method, the images of user using the product were simplified but highlighted in the form of a two-colour silhouette, which could be easily placed anywhere on the backgrounds – that was easy to modify for adjustment, for instances, user using product on sofa, on bed or on the carpet in different poses.

![Figure 15.5: Combined scenarios of ‘Peter Shut-up’](image)

**Information Structure of ‘Peter Shut-up’**

Once the scenarios became clear and accurate, a product information structure was created to systematically map the product by listing out the key functions of software, the hardware and the relation between them. To make the structure valid and practical, Fisssh’s programmers and marketing consultants not only contributed the building
work but they also evaluated the concrete workload and timeline afterwards. When the information structure came close to completion, programmers started to code the app through using JAVA and C++ with replaceable images and graphics. Meanwhile, marketing consultants started to conduct researches on hardware manufactures and factories that might be able to provide support or collaborate.

**Rapid Prototyping Centred with User Experience**

Aiming at an optimal result through an efficient teamwork, Flash CS6 was utilised by Fisssh as a strong weapon to increase the efficiency and enhance the effectiveness in product prototyping. As a powerful visual tool, Flash CS6 is capable of rapid-creating software prototypes and transferring them to APKs with one touch. Although Flash CS6 was not completely new to Fisssh’s designers, it was a little difficult for them to code in Action script in Flash. However, they overcame the problem by self-studying and assistance from the tutors and the programmer and successfully created the prototypes as they expected.
Rapid prototyping had brought a much closer and denser collaboration to Fisssh, as team members needed to discuss and review over prototypes iteratively in this stage: once a prototype was exported to an APK, user researcher immediately installed on devices, tested it among target users, collected feedback and formed suggestions for improvement; programmer assisted coding the prototype and adjusting the formal product (app) at the same time; marketing consultant kept evaluating every new prototype from business perspective, ensuring the outcome would not just be an artwork or a pure application for pleasing users; designers kept producing design resources and took opinions from all aspects into consideration in next iteration.

It was observed and proved that team members experienced and learnt how to understand and implement own duties in respective disciplines during iterations. Functioning as different parts of a body, each team member needed to make compromises in achieving a same goal: as the programmer, the sole mission was to guarantee the result to look as much as original design, so he only argued back when there was a technical problem or difficulty, otherwise he compromised when it referred to user experience and commercial issues; as the user researcher, she was empowered to stand for the benefits of users but had to give in on aesthetic and design issues; as the marketing consultant, he might point out how to make the product more eye-catching or stylish to make business investors and partners interested and convinced; as the product manager, the responsibility was much heavier than any team members as she needed to give considerations to a wide range of factors. Although the self-awareness of each team member was important to form a close teamwork, it wouldn’t be successful without product manager’s control and management. It was a huge challenge for Fisssh’s product manager: a girl majored in design to make decisions among various factors on timeline, user experience and business aspects. To ensure enough time for designing and programming, she also had to act timely and neatly as it was inevitable to lose something in judging which suggestions and recommendations should be taken to achieve a more balanced result.

In this stage, tutors were involved via phone call, online communication and face-to-face meetings in a high frequency to share their knowledge and opinions, guiding and directing the future improvement.
RESULTS AND DATA ANALYSIS

Phased Performance Evaluation

The purpose of setting iterations inside the workflow was to improve the product gradually. Therefore, it became necessary to conduct a review on the overall performance of the prototype in iteration in case the development process went astray. To make the evaluation more holistic and accurate, Fisssh adopted a simple but effective method - using radar chart to score selected variables: look & feel, user satisfaction, commercial prospect, tutors opinions and program practicality. Each variable was set for score from 0 – 10, 0 for the worst and 10 for the best. A weighted average score was calculated if there was more than one person to score on one variable. These 5 variables were in turn graded by interaction designer and visual designer, user representatives, marketing consultant, tutors and the programmer. As it was clearly shown, the overall performance of prototype had made progress through iterative evaluation and improvement, despite the difficulty for programming had increased due to difficulty of achieving a better result.
Final Usability Test

The final usability test of Peter Shut-up was conducted among 5 target users. Scores were calculated according to the effectiveness and efficiency in completing the tasks by users, 0 as the lowest and 10 as the highest.
Table 15.1: Final usability test and scores.

<table>
<thead>
<tr>
<th>No.</th>
<th>Test users</th>
<th>Observation and description</th>
<th>Score</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>A 3-year boy</td>
<td>Impatient to follow the audio instructions and he kept touching on the screen. It was a little difficult for him to compose a complete description as the fifth game required</td>
<td>7</td>
</tr>
<tr>
<td>2</td>
<td>A 6-year boy</td>
<td>Able to complete all tasks without any difficulties</td>
<td>10</td>
</tr>
<tr>
<td>3</td>
<td>A 5-year girl</td>
<td>Gave a satisfactory performance but she started to mimic the voices from the game before the audio instructions completed</td>
<td>9</td>
</tr>
<tr>
<td>4</td>
<td>A 4-year girl</td>
<td>Put her face closer to screen and repeated when the internet connection was down</td>
<td>8</td>
</tr>
<tr>
<td>5</td>
<td>A 5-year boy</td>
<td>Shy when adults were present. His voice was low and he was reluctant to follow the song in fourth game</td>
<td>6</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Average score:</td>
<td>8</td>
</tr>
</tbody>
</table>

Team Performance in UXDA

Despite of the actual problems on efficacy and integrity, Fisssh had achieved:

1) In the third phase, Fisssh was successfully promoted to the Top30 and ranked number 1 in north China division.
2) In the final, Fisssh was promoted to the Top10 among almost 400 teams over the nation and ranked number 7 eventually.
3) Peter Shut-up was shortlisted in Red Dot Award in 2016, now waiting for the next round review.

Figure 15.10: App designs of ‘Peter Shut-up’ and a kid testing the app.
**DISCUSSION**

Based on the commonly defined rapid product development, Fisssh achieved an optimal result in iterations by taking comprehensive feedback including both inside and outside stakeholders into consideration. As the prototype was always given the most effective and pertinent feedback in each iteration, the problems and bugs had been minimized to a great extent through iterative improvements. Centred with rapid prototyping by using Flash CS6, Fisssh’s teamwork had been greatly facilitated as all team members were connected closely and frequently. Students realised the importance of aligning own thought towards one direction instead of insisting on a personally biased or idealized conception. For the girl functioning as product manager, she also experienced and learnt it was not always black and white in team management and maintenance, but compromises and blurs were allowed to happen in certain situations (Ma, 2012).

By placing the end users on top of concerns, students recognised the significance of users’ participation and quickly developed the capability of interacting and communicating with the end users with different background, as users’ feedback was not only a critical guidance for adjustment and modification, but also helped avoiding the product become a self-imagination or assumption of designers’. Moreover, users’ approval and positive feedback can also be a strong back-up to make the product more convincing and plausible when it came to various stakeholders in certain circumstances, as it would do when facing managers or leaders in real business.

**GENERAL DISCUSSION**

As this approach is built on the platform of UXDA, enough time and motivation is a paramount premise for students to further development. As a rational encouragement and reward, students who participated and completed the tasks to certain degrees can get designated credits as same as they get from regular assignments. Alternatively, there are various ways of utilising UXDA depending on the realistic situations and conditions. It has been proved applicable and successful that some universities took UXDA as a form of internship for students with local enterprises that are associated with UXDA. To make it more applicable and reduce the workload, students are allowed to build UXDA projects on their graduation projects or other available projects. The experience of participating UXDA and achievement is also a useful support to graduates’ portfolios when they seek jobs or advanced studies, as all associated enterprises or universities give priority to those who participated and got good results in UXDA.

Getting involved in UXDA creates an excellent opportunity for students to get social exposure and expand social networking in an early stage as the relevant media, news and reports are spread via multiple channels such as UXPA official websites, blogs, WeChat accounts, sponsored channels, universities and colleges. Product designs of Top10 are chanced to be submitted to the world leading design awards such as Red Dot and IF design award. For instance, the winning team of UXDA 2014 was not only ranked number one in the final, but their product design ‘Hear Me’ was...
also submitted to the Red Dot and awarded ‘best of the best’ in the same year (Red Dot Communication Design Award, 2014). It is also possible that any student teams’ product designs or concepts are chanced to get investment or even be purchased by interested enterprises in stage of UXDA.

LIMITATIONS

Availability Issues

Since rapid product development normally requires closer and more frequent meet-ups, it inevitably causes time conflicts among team members especially in rapid-prototyping period. Although UXDA has been merged to some universities’ curriculum and given priority as much as possible, it may still be difficult for all team members to sit down and work together consecutively, due to the time conflicts caused by timetable of different majors.

Instability of Team Members

Some teams suffered losing members during the process. We noticed that there was a team progressed to the third phase with only 2 members left, as the other 3 members quit due to personal reasons. It was hard to assess teams without enough members, according to the rules of UXDA that any team with less than 3 members is not allowed to proceed.

Software Capability

To keep UXDA a fair competition, student teams need to complete all tasks in their own effort and tutors are only allowed to give suggestions but not direct contributions or solutions. Therefore, mostly due to the insufficiency and incompetency of software capabilities, the final product app was inevitably impacted and this problem was commonly seen in a number of teams.

Hardware Limitation

Although most of teams especially the Top10 were able to create a decent product prototype or even a complete app by C++ & JAVA, it was generally difficult for them to produce concrete products on hardware level, due to the realistic requirements of manufacture and cost issues.
Regional Inequality

Affected by academic atmosphere, resources, teaching levels and development of local cities, the general performance of teams from the south part of China was better than the north.

RECOMMENDATIONS

For Universities and Colleges

In order to make the platform larger and stronger, it is recommended to develop a longer and closer relationship with enterprises. This can be applied in various models such as a joint laboratory or students involved pre-research projects in enterprises. For instance, the College of Engineering of Ocean University of China (where all Fissh’s team members are from) had maintained a long-term collaboration with Haier the biggest local enterprise in Qingdao. According to the agreement, the college annually takes part in a range of products development and gets specific budget and necessary resources allocated from Haier. By doing so, it creates actual opportunities for tutors and selected students to get involved in real business and enterprise projects, as working closely with enterprises is also a motivation for students to get involved and further the practices beyond theoretical level.

With the help and support from collaborative enterprises, it becomes easier to create a decent hardware demo or prototype, since enterprises normally have the capability of manufacturing or at least are able to coordinate resources for producing. Similarly, Sunswift the solar racing team in UNSW also collaborated with Boeing in Sydney. Supported by professional equipment and advanced technique, the key components of the car were successfully and efficiently constructed in Boeing’s workshop during 2009-2010.

For Students

As the world is becoming an internet connected community, it has become more and more convenient to obtain knowledge and information. Therefore, a practical and effective way is to join online communities such as forums, websites and blogs in...
specific disciplines. For instance, LinkedIn, one of the largest professional network websites where students are encouraged and recommended to maintain own professional accounts and select some influencers and well-known companies to follow, then check up and look for useful articles and columns that are frequently updated and posted on. Due to the popularity of mobile devices and maturity of technologies, new possibilities of collecting and analysing useful information and data have been created. For instance, it is free that SoJump.com enables anyone to create professional questionnaires instantly and provides a complete set of functions including tracking and analysing data to a final visual report. Many apps also pre-installed a huge number of templates and effects and those empower users to easily edit footages and export visual reports and graphic charts even impressive videos. For instance, Frame.io the app, one of the 12 best apps announced in Worldwide Developers Conference 2016(WWDC), allows users to upload footages, clips and shots to private workspaces where anyone can be invited to collaborate to create videos (Apple Inc, 2016). Moreover, a number of software for rapid prototyping are also available, such as Framer, Principle, Origami and etc., although some of them can only be used on iOS platform.

Taking UXDA as a platform is not the only way to develop practical skills and cognitions, it is also possible and beneficial for young people to keep a long-term conversation with experts and seniors in related disciplines. There are also a number of associations and organisations calling for members, papers, academic researches and practical studies, providing opportunities for students to get involved and exposure in public in an early stage.

**FUTURE RESEARCH**

As it was described and analysed in an early paper Cybercampuses: design issues and future directions by Førland, Sourin and Sourina (2006) that a virtual cyber-campus would bring an immersive experience to online education and communities. New software technologies can provide us a wide range of possibilities and opportunities. Visuals will be reached to deeper potential and extended in creating a much more immersive and exciting experience in many cases. With the application of augmented reality and virtual reality, collaboration and interaction will become more natural, comfortable and multidisciplinary as the boundary will disappear among regions, races and spaces.

Besides the significant progress made on software, advanced hardware technologies also empower the application and presentation of visuals via multiple terminals including but not limited in PCs, smart phones, tablets and VR glasses even smart watches. For instance, ‘Project Soli’ the pre-research project has enabled manipulating and controlling electronic devices without any physical touch. It is expected that the user experience, efficiency and effectiveness of teamwork and interaction will be significantly increased once this technology becomes accessible to the public.
CONCLUSION

New technologies and pervasive internet has enabled the creation of new methodologies and powerful tools. Centred with the end users, user experience issues are considered a key concern in most product development in enterprises. As a response to this change, product designers need to develop a sense of coordinating all stakeholders and the capability of utilising the right tools to enhance the efficiency and effectiveness in product development. To get universities aligned with enterprises in a practical way, bridging them through UXDA has been proved effective and positive to bring an excellent opportunity to students to develop a series of practical skills and teamwork cognition, through a creative use of visuals including traditional and the latest applications in a multi-disciplinary environment. It can be expected that visuals will play an even pivotal role with the rise of AR and VR applications in the near future.

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Visual Tools for Developing Cross-Disciplinary Collaboration...
Chapter 16

Practice Case Study for Visually Supported Acquisition of Cross-Disciplinary Innovation Skills and Knowledge

Janine Cahill, Future Journeys

This paper explores Visual Tools and behaviours that help build collaboration and team engagement that enable opportunities for innovation in complex uncertain environments. Over twenty years of action research in collaborative innovation, strategy and change has resulted in a range of practices and tools that assist successful outcomes. This has been applied and examined particularly in the area of wicked problems – systemic, intractable, uncertain and complex. Research has led to structuring processes in ways that build collaborative intelligence and ensure that diverse views are heard while minimising the negative impacts of groupthink (individuals in groups thinking similarly). Diverse models from Intentional change theory, neuroscience and cognitive psychology, strategic foresight and management literature and practice also inform the methodology and are presented here.

Design/Methodology/Approach

This chapter will describe how to structure processes and activities that engage participants/students to solve real world problems. The processes encourage students to draw on their own skills and experience to assist solutions. Rules for innovation labs are described and the reasoning behind this – for building stronger collaborations, trust and engagement in the process and outcomes.

Visual Tools are essential for communicating complex systems and solving complex intractable “wicked” problems characterised by uncertainty. Presented are processes for and images of systems mapping – with a range of Visual Tools. These tools can also be used to represent systemic solutions. Other visual tools include Sensory Metaphors, Collaborative Sketching, Deep Impact Analysis, Trend Analysis and Speed Scenarios. Visual Tools improve cross-disciplinary and cross-cultural collaborations through enhanced communication of ideas.

Findings

These processes and structured model for innovation has been developed over two decades since first exploring how best to teach Strategic Foresight as part of
postgraduate and undergraduate Strategic Management courses in London in 1998. The model has been applied in a range of contexts – for addressing corporate strategy, Cities infrastructure, Youth engagement, Community Planning, Climate Change systemic solutions, and Building Collaborative Sustainable Business models.

The model has evolved during this time to suit different contexts and while applying responsive feedback loops from participants/students. The chapter also discusses feedback in determining evolution of the InnoLab processes.

Evolution of the practice will be described and analysed since the introduction of Futures Thinking workshops and Strategic Leadership simulations in London in 1998, FISH@6 (Foresight Innovation and Sustainability Hothouses) in 2006, Live Futures 2020: A world of Opportunity 2007 - 2011, Youth Futures Dreaming in 2008, and Creating Climate Wealth InnoLab in 2011 to continued application and review of InnoLab in different settings and contexts. A number of visual tools within this context will be provided.

**Research/Practice Implications**

InnoLab processes have proven useful in applications from Corporate Business Challenges to Infrastructure engagement, Visioning for disadvantaged communities to co-create cycles of health and advantage, and Global Futures.

The unique combination of Foresight and Innovation within the InnoLab methodology starts Strategy Implementation at the beginning. There are psychological processes built in that assist individuals and the group to thrive; increasing engagement, participation and positive outcomes for the individual, increasing collective intelligence for the group and greater success for projects. It adds an effective Toolkit for designers interested in working with complex wicked problems. Feedback from other researchers and practitioners will assist future development and practical outcomes of the methodology.

**INTRODUCTION**

This chapter will describe how to structure processes and activities that engage participants to solve real world problems. The processes encourage participants to draw on their own skills and experience to facilitate solutions. The purpose is to build strong collaborations, trust and engagement, and engage both divergent (creative, opportunistic) and convergent (analytical) thinking in the process and outcomes. Rules or guidelines for innovation labs are described to achieve this.

The Boyatzis deep learning methodology is presented to enable facilitators to observe their preferred learning model and optimise interaction with participants. Boyatzis model also underpins the InnoLab methodology. (Boyatzis, 2006). Other cognitive and neuroscience learning models (Davachi, 2010, 2014) and a model for Strategic Foresight skills (Collins 1994, James 1997, Liedtka 1998) also underpin the methodology.

“A picture tells a thousand words.” Images are more effective at sharing meaning than verbal or written communication alone. Visual Tools are essential for
communicating complex systems and solving complex intractable “wicked” problems characterised by uncertainty. I describe processes for and provide images of systems mapping – with drawings, words, blocks and other Visual Tools. These tools can also be used to represent systemic solutions. Other visual tools include sensory metaphors, collaborative sketching, deep impact analysis, trend analysis and speed scenarios. Visual Tools also improve cross-disciplinary multi-generational and cross-cultural collaborations through enhanced communication.

The need for complex visual tools and Collaborative Innovation processes is a result of the rapid change and therefore uncertainties arising around the world. A wide range of possible futures is accelerating towards us due to the exponential growth in technology development, (across all sciences and technologies) and the interconnectedness of the world. This creates increasingly complex and uncertain business and work environments and throws up wicked problems – complex, systemic, intractable, uncertain.

**PURPOSE**

- To develop capacity of facilitators/students to learn behaviours that help build collaboration and team engagement and enable innovation opportunities in groups
- To describe structures and processes in which innovation occurs
- To describe visual tools which aid collaborative cross-disciplinary innovation and purposeful engagement
- To shift mindsets to value cross disciplinary collaboration to create new insights and innovations

**METHODOLOGY**

**InnoLab Collaborative Innovation**

InnoLab is a space designed for collaborative innovation. Using powerful evidence-based processes for managing complex, changing environments, InnoLab draws people together and engages them, sharing their expertise to create specific outcomes, new products and services, new insights, new business models, new solutions to systemic “wicked” problems. InnoLab uses evidence-based methodologies and process experts, to engage content experts in developing a shared knowledge space humming with new ideas. Resilient and robust collaborative innovation occurs at the edge between different knowledge bases, across organisational, professional intergenerational and industry silos. InnoLabs use a range of evidence-based methods from areas as diverse as strategy, foresight, organisational transformation, creativity and innovation, design thinking, systems thinking, motivational psychology, neurolearning and neuroleadership to gather diverse and multiple insights into complex systemic challenges.

InnoLabs operate under a number of evidence-based principles:
• A lab is a learning process – We learn from each other and build ideas together
• Systems Thinking and Systems Mapping are necessary to solve “wicked” problems (intractable, complex, ambiguous, systemic)
• Collaboration and Co-creation are essential as no one person or professional group can have all the answers
• Strengths-based Approaches and Appreciative Inquiry focus on what works and motivate people to act
• The room is flat – we are all equally important to solving the problem
• Process and Content are equally important
• Synthesis of Ideas is as Important as Analysis
• Visualisation of ideas improves understanding and collaboration

Wicked Problems

Wicked problems are complex, difficult to resolve, uncertain. Research shows that traditional methods of critique and analysis (convergent thinking) are insufficient to resolve complex problems. What is also required is synthesis, creativity, foresight, design thinking: working around the problem, using many tools and processes to increase the map of opportunity in which solutions occur.

Figure 16.1: InnoLab

Measuring Success

Most of our Labs are about long-term interventions into complex systems. So, measurement is difficult in the early stages. We use self-reporting methods to assess
the solutions. We also understand that a solution is only as good as its implementation— which is why the InnoLabs are designed to be part of the implementation—to motivate each participant to want to reach the solution state. We assess this using a very simple tool that assesses on four dimensions.

We also gather qualitative information to assess and improve the processes. Self-assessment and team assessment is also key – implementation is only possible if participants believe their outcomes are strategic, doable, visionary and engaging. Simple questions on a scale of 1 - 4 include:

- The solution makes good strategic sense
- The plan is doable in practice
- The solution is visionary and farsighted
- People will feel enthusiastic about it

In the long run, the success of processes can be measured (new income streams, new services, cost reductions etc.) and individual projects experiments/prototypes should always be measured, with success criteria established early.

Creating Optimal Collaborative Innovation Conditions

It is not just about choosing some tools to explore a problem. It is imperative that success be designed by ensuring optimal conditions.

Examining Context—of Who

Consider three contexts for Innovation – Personal Cultural and Future

It helps to organise the key contexts for innovation:

Personal

Who are the participants? What level of knowledge do they bring to the space? What experiences?

Cultural External

How is their workplace innovative? Their industry? Their profession? What are they rewarded for?

Future

How is their context changing? What is the group’s understanding of the future? How do they engage with the future? (if at all?) Innovating requires an understanding of the future – whether one year, two years or ten years. What access do they have to Strategic Foresight tools to help frame thinking.
Choosing Group Members

Many organisations come to you with a specific group to work with. Find out the composition of the group and request to add more people to it. The more complex the problem the greater the need for diversity – in demographics, age, gender, ethnicity, profession, industry, experience, etc. Bring in “extras” to add diversity. Complex problems involve society so it should reflect society – and now we are global – so global society. I often add designers, artists and educators to business groups to increase the strategic success of the outcome. Diversity is key – MIT Colab Lab research found that to increase the IQ of a group – add women. Although you may expect differently there is little correlation between a group’s collective intelligence and the IQ of its members. Collaborative intelligence is correlated with social sensitivity, equal airtime and the proportion of females in the group. Groups with dominant individuals (no matter how intelligent) perform less well. (Malone, 2011).

Participant Experience Design

Types of Thinking and Choice of Tools

When designing the participant experience, it is key to consider Convergent and Divergent Tools and Processes. Both Divergence and convergence are essential. They have different purposes. Divergence is about creativity, diversity, possibilities, many ideas. Convergence about analytical and critical thinking – integral for considering options, considering data and pulling together detail. Divergent thinking is absolutely essential to addressing complex problems. Use divergent tools for as long as possible before commencing convergent thinking. Consider the group when choosing tools. There are analytical tools within the divergent toolkit. If a group is very analytical – most of corporate management, technical roles, engineering and computer science, then choose some of the tools like Deep Impact Analysis that really engage analytical thinkers and broadens the thinking beyond what they would normally consider. There is no right and wrong in choice of tool. Consider the participants, the questions to be asked, the problem to be solved, and the amount of time available.

The Warm-Up The people in the room that you are about to work with have arrived with things on their mind, (what they had for breakfast, the person they just spoke to, the problem they are having at work).

It is your job as facilitator to design processes that put participants in the best frame of mind to address the wicked problem/develop an answer or insights to a client’s question. InnoLab addresses this by establishing rules of engagement, and warming the group up to successful solutions and possibilities.

As an experience designer, consider the participant experience all along the way. Bring them with you on the journey to a solution or solution state. (With wicked problems a solution state (broad) is a better focus that a solution (narrow)). A solution state is when the problem is no longer a problem – a solution is narrower.
Socrates Updated – Rules of Engagement for InnoLab

Socrates first developed Koinona – a spirit of fellowship to enable real dialogue to take place. Adopted by Einstein, Heisenberg and Bohr during their conversations, researchers believe that the processes adopted of sharing and holding others’ ideas in their heads without criticism helped create the amazing work of these three and the foundations for modern physics. (Michalko, 2001)

Experimentation in large group work and further research leads to Koinona updated, particularly from the collective intelligence research at MIT, (Malone, 2011) and research in positive psychology and Appreciative Inquiry (Cooperrider, 2005).

Dialog not debate - Listen carefully

Equal Air Time

We are all Experts AND there are no Experts

Uncertainty is ok

Yes and....

Strengths-based

Think in correlations and probabilities (not cause and effect)
There is not one right answer

The Context of Change – from Certainty to Uncertainty

Table 16.1: Working from Uncertainty.

<table>
<thead>
<tr>
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<th>Uncertain</th>
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<tr>
<td>Learned</td>
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<td>Strategic Planning</td>
<td>Scenario Development</td>
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<td>Scanning</td>
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<td>Cause and Effect</td>
<td>Correlational, Systems Thinking</td>
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<tr>
<td>Analysis, Critique</td>
<td>Synthesis, Appreciative Inquiry</td>
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<td>Competition</td>
<td>Collaboration and Co-Creation</td>
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<td>Silos</td>
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<td>Time as Photo</td>
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The Context of Change – Futures Thinking

Adapted from (Collins 1994, Hamel 1994, James 1997, Liedtka 1998) models:

1. Systems Thinking – including Thinking in Time
2. Experimental/Hypothesis Thinking
3. Purposeful Intent – involving a shared sense of Direction, Discovery and Destiny – enabling Collaborative Opportunistic Strategy

The Context of Change – Purposeful Intent

Purposeful intent is key to establishing strong connections within the group and for individuals to connect to their personal and professional values – their purpose.

Design a process that starts with setting a personal Vision with Purpose. Ask two questions to be answered by individuals on paper (we want diversity of views and the individual’s expression of those views not groupthink). Groupthink is the tendency of a group to think similarly.
1. What will the world be like when this is no longer a problem – when the opposite is true (e.g., If you are addressing the challenge of homelessness – What will our world/city/community look like when Homefulness exists?)

2. What skills and passions do you bring that can help create this Vision? (What are you good at and like to do?)

Focus on each individual designing and sharing their vision with their team. This creates close relationships between participants. There is no critique. We take their vision exactly as they explain it.

This is not about creating a shared vision. This is about creating an understanding of others’ diverse Visions and Purpose. This creates very big picture context (broadens the Map of Opportunity in which solutions occur) and a shared sense of Purposeful Intent (a Futures Thinking Skill), (Collins 1990, Hamel 1994, Liedtka, 1997).

If there is not enough time to bring people to their largest vision, share it and still reach the outcomes required by the workshop, then just ask Question 2. That will still create a strong sense of collaboration and engagement in solving the problem together.

The following areas of practice and research inform InnoLab processes and the skills being developed to build collaborative innovation capability.

**The Context of Change – Neuroplasticity**

Our brains are plastic and to some extent we can choose how we change our brains over time. Learning and memory create brain changes. Appreciative (positive) focus enhances learning and development of solutions.

**The Context of Change – Learning**

*Boyatzis Deep Learning Model*

![Boyatzis Model of Deep Learning (Intentional Change)](image_url)

*Figure 16.3: Boyatzis Model of Deep Learning (Intentional Change).*
Boyatzis model informs InnoLab processes. It is proven for self-directed learning and for you to consider in your facilitator journey and career development. It is a model of intentional change used for professional and personal development and also for planning and designing systems change. The most important aspects to consider when designing an Innovation Lab is that most often what you are asking people to do is new. They have to want to do it – you can’t make them or if you do they may sabotage the process. So the environment has to be completely safe and supported for them to make mistakes. They need to be supported to experiment and to practice. And they must be supported not just by you but by all group members – the InnoLab rules of engagement assist this. Group focus on the shared desired outcome helps. Focusing on participant’s strengths helps. And repeating that there are no wrong answers – knowing the “right answer” does not lead to newer better answers.

MAGESSS Model – Neuroscience of Learning

This model has been adapted from Neuroleadership Institute research (Davachi 2010, 2014) that identified the principles that increase retention of learning over time. Utilising these principles in workshops increases the impact of that work by strengthening the memories of the experience. This assists both in the room at the time (better understanding between group members) and later during implementation/execution drawing on stronger and more accurate memories from the design phase.

- Meta-Learning (help people understand how we learn),
- Attention (establish motivation),
- Generation of Ideas by the Individual,
- Emotion (create emotive responses),
- Sequencing (Re-engage with the content at specific times),
- Social (people learn more from each other than the “teacher”),
- Self-Directed.

Evolution of InnoLAB Technology

These processes and structured model for innovation has been developed over two decades since first exploring how best to teach Strategic Foresight as part of postgraduate and undergraduate Strategic Management courses in London in 1998. The model has been applied in a range of contexts – for addressing corporate strategy, cities infrastructure, youth engagement, community planning, homelessness, climate change systemic solutions, mental health collaborative research and building collaborative sustainable business models.

The model has evolved during this time to suit different contexts and while applying responsive feedback loops from participants. A brief evolution of the practice will be described since the introduction of Futures Thinking workshops and Strategic Leadership simulations in London in 1998, FISH@6 (Foresight Innovation

1. Introduction of Strategy Toolkit to Strategic Management students in final year of 4 and 5 year undergraduate program 1998. Focus altered from content knowledge to practice through to mastery (Boyatzis) and experiential learning simulations. 

   Learnings: Students understanding of the whole Strategy course improved by receiving the toolkit on Day One to be used every week until and including final exams. The tools helped them to understand the structure of strategy and to begin to trust in their own ability to use the tools and processes in real examples. The toolkit gave confidence to all students and encouraged collaboration.

2. Introduction of 48 hour Strategic Leadership Simulations (taking the practical aspects of Strategy into simulated strategy projects 1998 - a. to give students a real world experience of strategy making, scenario planning, and strategic change. Simulations are based on real companies in significant change (identities hidden until after simulation).

   Learnings: Simulations provide opportunities for ALL students to excel. Even the normally least motivated students engage deeply in simulations. (In fact students will not leave the simulations despite operating with little sleep). The simulations improved working relationships with other students as well as students understanding of the chaos of strategy in the real world. Simulations are an excellent way to demonstrate that hothouse environments engage participants deeply and create multiple opportunities for incidental learning.

3. FISH@6 – Foresight Innovation Sustainability Hothouses are short innovation workshops experimenting with lightning talks, deep learning, creativity and foresight toolkits addressing wicked problems.

   Learnings: Allowing people time to apply what they learn from speakers immediately improves learning outcomes, collaborative problem-solving and connections between people. Avoid cognitive overload and improve retention.
4. Live Futures 2020 was the world’s first annual futures festival 2007 – 2011, a Collaboration with UNSW from 2008-2012, and both a Science Week and Sydney Design festival event. It brought together people from the worlds of science, design, technology, art, engineering, sustainability, social change, architecture, games and cities planning. From this sparking of ideas and conversations came a range of initiatives in social enterprise and innovation, games, and cross-disciplinary collaborative projects. Learnings: Cross-disciplinary collaborations work well with encouragement and support. Design students are very open to collaborations and assist the process. Impactful discussions of the future and projects inspired by them require cross-disciplinary and cross-generational collaborations to succeed.

5. Futures Dreaming Weekends 2006 – 2008 were opportunities for the general public to engage in teams of four in deep future scenarios, using futurist tools and techniques and experiential processes to engage deeply with the future. We employ scenarios that are possible but not probable. Initially focused on 20 years ahead participants most often addressed scenarios between 40 and 80 years ahead. Learnings: The general public engage easily with futurist tools and techniques. The key challenge as facilitator is to help participants understand how to take the motivation to change forward post-workshop. Using scenarios, teams have developed profound new systems to deal with the enormous challenges of climate change, outdated systems of government, global governance and inadequate economic systems. This has informed InnoLab practices by bringing Systems Maps, Speed Scenarios, Implications Wheel Analysis and future timelines tools into our innovation Labs.

6. Foresight Simulations as part of Corporate Innovation workshops and postgraduate degrees 2000 – 2011 One day simulations that enable participants to explore the future in a safe environment and develop Futures Thinking Skills and Emotional Intelligence Skills that underpin Strategy Making. Learnings: Simulations are more effective when designed to challenge participants and still be within their content area. Our first simulations for bankers were set 15 years ahead and looking at the space where art and engineering converge to create sustainable tools for the developing and developed world. This was too challenging as the participants had to deal both with new tools and processes and new content areas. We set the revised simulations five years ahead and in participants’ own industry (though looking vastly different and extending their content area). This gave a better
result and it was still very challenging for most participants. The focus was designed to be challenging – developing finance technology innovations partnering with the developing world to address services for those living on less than $2 per day at the Base of the Pyramid. We took away two major insights – challenge is good if participants have support and collaborate well as team. Over time people become more and more accepting of simulated futures and accept the challenge – the simulation gathers a mythology of its own as a challenge to be excited by.

7. Creating Climate Wealth InnoLab Sydney (with Sir Richard Branson’s Carbon War Room) and London 2011 the first design to use all the major elements of the Foresight and Creativity Toolkits with psychological processes underpinning. Two days with 300 people broken into groups up to 45. Fifteen process facilitators trained in the method in both Sydney and London.

Learnings: InnoLab very engaging even with large numbers. Participants deeply motivated to act. Outcomes highly supported. Again, there is an issue with motivating people to act and then not providing an avenue for that to occur. InnoLab particularly well suited to ongoing projects rather than one off. Adding a Road Map exercise at end gives an avenue for action. Other learnings relate to the composition of the groups – adding designers and digital media people to the mix resulted in better outcomes. Climate Change is a social problem not a technical one – so the more diverse the group addressing it the better the solutions. Giving people an opportunity to connect on the big issues connects people deeply.

8. Ongoing development of InnoLAB processes to optimise its method for workshops of varying duration.

Learnings: Enabling people to connect on their purpose and passions rather than the kind of work they do builds trust and leads to better workshop outcomes in collaborative innovation. Two hours is enough to allow this connection to purpose, some systems mapping, individual inputs and team deliberations, and a rough Road Map ahead. (all completed at speed.) Collaborative Agile Innovation is possible. More time is preferred and argued for – to evaluate and embed implementation of solutions.

The Context of Change – Creative Skills

Creativity skills can be learned. When young we all had creativity drivers – curiosity and experimentation - when we are born we start to create our world. There are very few connections in the brain of a newborn compared to an adult. As a child each individual’s experiences create those brain connections in which our perceptions and
our memories occur. Neuroplasticity research has proven that people of all ages can learn new ways of thinking about and perceiving the world.

One of the purposes of InnoLab workshops is to build creative capability and futures thinking skills and encourage ongoing practice. Applying the Boyatzis Intentional Change and Learning model, this means giving others the tools and encouraging peer support to continue to learn and practice through to mastery.

**The InnoLab Process**

The process is designed to build engagement and deliver an outcome. Additional insights may be gathered along the way, both personal and group shared insights.

**InnoLab Tools**

**Systems Mapping**

1. Invite teams of 4-5 people to write elements of a system they wish to examine on sticky notes (that can stick to large sheets of paper on a wall). 15 items one minute (+- is ok)
2. Participants place on wall chart – they can explain as they do it or do it quietly – teams intuitively set their own norms.
3. Cluster elements into groups or categories. Best done with discussion of elements and categories.
4. Ask what is missing? So people can add as they work
5. Once clustered people can start to draw arrows for relationships between elements in the system
6. Start to look for leverage points in the system – where could resources or influence be added to shift the system? What is strange or interesting about the system?
7. Is there a metaphor for the system? What is it? What new insights arise?
8. Systems mapping is best layered over time – just give further instructions as the maps start to develop. People may say they wish they had all information in advance but practice shows that this doesn’t work – it becomes too complex and overwhelms.
1. Place the situation you are trying to resolve in few words at middle of mind map.
2. Walk outside or to a window.
3. Stop close eyes and take three deep slow breaths.
4. Open eyes and notice three things/features in the environment – use all your senses – examples could be wind in your hair, bright green shining leaves.

5. Return to workspace and write/draw one of the three features on the mind map extending out from the situation in the middle.

6. Each person describes how their feature applies to the situation e.g., “the leaves are green and living but the situation is one of stagnation. They were really shining. I think the solution has to survive the spotlight”. The initiator shares first to avoid groupthink. Then capture any thoughts from others.

7. Repeat for each person in the team and if there is time repeat with second features.

8. Spend time discussing which of the insights and solutions are important.

9. Highlight key insights and solutions on the mind map visually – circles, stars, colours to visually communicate what is most important to the team. Highlight strange or interesting insights or features. These often lead to breakthrough ideas.

10. Stop here if you plan to use additional tools.

11. If this is your last tool, then look at results of all tools and then start work on putting detail to the solutions for evaluation and planning.

**Collaborative Sketching**

*Figure 16.6: Collaborative Sketching for eliciting broad insights*
1. Draw attention of the group to the problem they are solving or the solutions they are wanting
2. Form tables of 4 - 6 people.
3. Each person takes a large sheet of paper and draws boxes on it to divide it into the number of people at the table (4 - 6).
4. Use timer to allow one minute for each drawing
5. Each person draws a solution or insight into the problem. At one minute they must pass their paper to the person on their left who now draws their insights or solutions in a new box
6. At the end there will be many insights into the problem/solution
7. Share around the table what each drawing means

Deep Impact Analysis

1. Place solution problem or insight into centre of a mind map
2. Remember this is brainstorming – no judgement – place the ideas as they come up – in fact you get better solutions giving each person a pen so there is no controller of ideas
3. Ask what impact will this have? – at least one negative and one positive

Figure 16.7: Deep Impact Analysis
4. Go to the next level – what impact will this have? – at least one negative and one positive – this can be challenging finding a negative from a positive impact and a positive from a negative impact
5. Go to next level - again at least one positive and one negative
6. Discuss key insights and solutions that arise – visually highlight key and interesting ones

Trend analysis and Speed Scenarios – this requires specialised training however the process is given for understanding and possible practice with friends rather than clients

1. Place six sheets around the room. Mark top of each sheet with Trends – Social, Scientific, Technological (can be broken further into areas eg. artificial intelligence, data, robotics, etc.), Economic, Environmental, Political, Legal, Demographic.
2. Give each participant a pen so they can add to the lists
3. Give each person ten dots to place on the highest impact trends – they can place any way they like
4. Of the high impact trends give each person three (different coloured) dots to place on the trends of least probability
5. As facilitator choose these high impact low probability trends and give two or three to each group of 4 – 6 people with a random scattering of three other trends
6. Each group now has 5 – 6 trends that are occurring in their new world of the future 20 or 30 years from today
7. The group works together to create a plausible story with internal consistency – this is a scenario. It should not be probable. It should be possible however. Teams should use building tools (blocks and props) to represent their scenario. Visual tools are key to this process as discussions cannot handle the complexity adequately. This is challenging and experimentation should be encouraged. Speed scenarios are completed in one to two hours including the trends.
All or None

Figure 16.8: All or None Road Map – Construction Innovation Creating Climate Wealth Australia

1. Ask teams to prepare a roadmap backwards from the desired future state to now. They have all resources needed to achieve this.
2. After half the time allocated to this task announce that all resources have been allocated elsewhere and they are still expected to complete the task successfully with no resources. (You may remind them of trends like crowdsourcing and increasing digital capability. Who else is passionate about achieving the desired outcomes?)
3. Share roadmaps of activities and high-level milestones with rest of group.

An Example of a Day Workshop using InnoLab Process

1. Desired future for the wicked problem
   This enables personal engagement with the solution state. Sharing it with others creates a shared sense of purpose.

1a. Skills and abilities and passions to co-create
   Deepening engagement with capabilities of themselves and their colleagues, creates trust that together Vision is achievable.

2a. Current System - and other tools
   Mapping the current system enables systems thinking and avoids the problem of simplistic answers to complex problems. Engages correlational probabilistic thinking rather than cause and effect. Other creative tools are used to engage whole-brain thinking and enable intuitive connection of ideas.

2b. Deep Impact Analysis
   Broadens and deepens thinking, shifts out of current modes of thinking, by forcing finding negative in positive and vice versa
3. Prototype - the desired solution state and its elements/features

Road Mapping - How to get from the future to now? all or none exercise....
* Enables systems thinking to be applied to finding pathways forward. Avoids simplistic thinking. Taps into creative thinking. Allows exaggeration of solutions and enables more ambitious pathways.*

3b. All or None - giving resources (for half of the time) then taking away the resources for the rest of the allocated time

*The purpose of this tool is twofold: 1. To enable generative and creative thinking when budgets are totally unconstrained and 2. To avoid reliance on “throwing money at the problem”. If you have no budget then innovative ways have to be found to co-create the desired futures. This always delivers new insights into the system to better influence others to be part of joint solutions. Enables teams to use the opportunities that exist within complexity by seeking to motivate elements within the whole system.*

4. Share and reflect on roadmaps - looking for patterns.
*To see if there are patterns within patterns, develop a more systemic view of the challenges.*

**Experimentation and Prototyping**

Part of the reason for using three dimensional modelling tools – tangible items is so that they can be moved – is to explore how the system might shift with different interventions and “experiments” in the system. This is not possible with solely visual tools and sketches. Being able to pick up elements in the system and move them around for new perspectives or experiments adds a whole new capability for systems thinking. New conversations can take place that were previously impossible. Verbal discussion does not serve well for the layering and connections in complex issues and wicked problems. Anchoring discussions with three dimensional modelling tools and visuals works brilliantly.

**CONCLUSION**

Design leaders and students will find the InnoLab processes of benefit in their work, particularly in working with groups. Research into collaborative intelligence has profound impacts on finding sustainable solutions to the challenges we face globally today. As design infiltrates every aspect of how we live design thinking can also accommodate the latest in psychological and sociological research to improve design practice. Feedback loops into the InnoLab system will benefit the process and tools and improve success of design projects addressing wicked problems.
REFERENCES


Visual Tools for Developing Cross-Disciplinary Collaboration...
Purpose of the Manuscript

This chapter describes the use of a ‘flipped classroom’ environment by students of multiple disciplines in an entrepreneurship course, such that they can see each other’s use of various tools throughout the course.

Methodology the Teach Using the “Flipped Classroom”

This is a reflective summary based on 3 years of teaching in ‘The PLACE’. The PLACE (an acronym for Peer Learning and Creative Exchange) is a pedagogical tool known as the ‘flipped classroom’ which enables students to have the freedom for unencumbered movement within the physical learning and teaching space. This allows them to see oral presentations by their peers, including work-in-progress on their (personal or pod’s) screens. This transparency in the classroom is mirrored with the transparency of each team’s weekly progress in the online Learning Management System. This transparency leads to improved learning of how to use a variety of visual tools by individual students, within their cross-disciplinary teams, and across teams.

Impact on Development of Student Capacity

For students, the ability to see anyone else’s use of various tools in the classroom is a major contributor to their own learning. It is also a more authentic preparation for what their (open plan) office environment may be like upon graduation. As a result, graduates from this course are well prepared to collaborate across disciplines toward entrepreneurial outcomes. This is evidenced by the ability of numerous teams to win pitch competitions outside of class and who perform well in entrepreneurial ventures after graduation.
Practical Implications

By understanding what students (and lecturers) do and see in the PLACE, we gain a better sense for what the right balance is between focussing on ICT technologies versus teaching methods to help students authentically develop a capacity for cross-disciplinary collaboration and entrepreneurship. This chapter is also relevant to students, desiring to understand how to leverage their learning spaces to improve their learning. This might even mean selecting courses for where they are taught over what is taught or by whom.

Social Implications

Beyond transmission of knowledge, universities are committed to improving the professional skills of students towards desirable graduate attributes or program learning outcomes. By focussing on these softer, social skills in the classroom, students are better prepared to confidently and effectively function in the professional environment upon graduation.

Contribution

This chapter contributes to advocating for a holistic approach to using online technologies and physical space. This balances out the recent over-emphasis in the ‘flipped classroom’ discourse on online technologies and addresses anxieties about creating lecture podcasts and losing control of the classroom.

INTRODUCTION

Universities exist for several reasons. One of the most common reasons is the creation and dissemination of knowledge. In the earliest of days, the founders of universities were interested in knowledge dissemination in terms of educating the local population in the hopes that that will bolster the local economy. The purpose remains, but times have changed. Modern information and communications technology (ICT) also excel at dissemination of knowledge. In particular, most subject matter is now available online, anytime, for free, thus challenging the value proposition of universities. Meanwhile students often travel internationally for their education, challenging the notion of education the local population if this population is transient.

If dissemination of (codified) knowledge were removed from universities’ value proposition, what else is there that universities offer students? Is attaining an education becoming a public utility? What about the purpose of the education? I.e., becoming a contributing member of the economy? Learning and economic contributions are not entirely different classes of questions. Learning and economic impact are both highly social activities. Students learn individually by absorbing, thinking, and doing, but also socially by questioning, interacting, and engaging with others. Likewise, work can involve working in isolation, but its value is realized through the interactions with other people, especially for entrepreneurship. So,
becoming accustomed to the social dynamics in the classroom can prepare students for their occupations upon graduation, and in particular for entrepreneurship.

This chapter focuses on the importance of physical learning spaces in amplifying the ability to prepare entrepreneurship students for life after graduation, with emphasis on improving their ability to collaborate in cross-disciplinary teams. This is a departure from focusing almost exclusively on the subject matter (e.g. Maritz et al., 2015) to include the relevant skills and attitudes (Lackéus, 2015) as well as graduate attributes (Bliemel, 2016). The emphasis on collaboration in cross-disciplinary teams addresses the recurring shortage in related skills (WEF, 2016) and is particularly reflective of entrepreneurship.

Context

When studying the impact of space on cross-disciplinary collaboration in entrepreneurship, there are two important contexts to consider, each compounding the other. One context is the demographic shift in students, who are often (and sometimes mistakenly) referred to as digital natives or millennials. The other context to consider is the recent trend by universities to figure out how to adopt blended learning and flipped learning practices (Bergmann & Sams, 2012, 2014; Bliemel, 2014a, 2014b; Sepasgozar et al., 2016; Balan et al., 2015).

Blended and Flipped Learning

The trend towards blended and flipped learning may have been brought about by the emergence of MOOCs and other forms of online education, including the opportunities and threats they pose to universities. Early MOOCs were little more than video recordings of in-class lectures, along with readings and quizzes, made available to the public. Universities are increasingly competing in this online environment, while attempting to simultaneously add value in the in-class environment. In an ideal world, the best of both the online and in-class worlds is blended together under the umbrella term of ‘blended learning’.

Blended learning is perfectly complementary to the flipped learning method that pushes conventional learning activities online with podcasts and quizzes. Flipped learning emphasises the online environment as a means to enable individual learning and testing to occur at any time. Doing so frees up the in-class time for more engaging learning experiences that focus on “the One Question [for flipped learning]: What is the best use of face-to-face time with students?” (Bergmann & Sams, 2014, p. 3).

“Universities are under increased pressure to deliver to their students and other constituencies expanded services and greater value with reduced expenditure of capital and human resources. Second, the capabilities and economics of information and telecommunication technologies are rapidly improving” (Alavi, Yoo, & Vogel, 1997, p.1311).

MOOCs, blended and flipped learning both emphasise and debate the merits of online technologies (Whitaker et al., 2016). This emphasis (and in some cases obsession)
with online technology comes at the expense of overlooking the role of actual learning and experience. Even when the in-class environment is discussed, technology receives a disproportionate level of attention in comparison to learning (e.g., Salter et al., 2013). Most of the discussion about in-class technology focuses on the ICT hardware and software in the classroom, not the physical classroom itself (as done in this chapter).

**Millenials**

This technological emphasis is compounded by the demographic composition of students in universities. The Millennial or “Net Generation” students do not know a world without the Internet. For many, the only internet they know is broadband mobile internet with virtually unlimited cloud-based storage; not dial-up modems and 1.4” floppy disks. While some call them ‘digital natives’ or ‘digitally literate’ (e.g., Oblinger et al., 2005), this applies mainly to their consumption, and not a universal ability to create digital technologies. This generation of students are prolific consumers of online media, including their more conventional form as well as newer forms of social media. This makes them more connected to what’s immediately happening around them and more social in their communications (ibid.).

This permanently connected and social aspect is reflected in how they learn: “Rather than being told, Net Geners would rather construct their own learning, assembling information, tools, and frameworks from a variety of sources” (Oblinger & Oblinger, 2005, p. 2.12). This includes online resources (like MOOCs) as well as in-person communication (aka talking) and offline resources (aka books).

This desire to ‘construct their own learning’ may sound like overconfidence, when in fact it might be a survival mechanism to future-proof their own careers. Estimates show that “65% of children entering primary school today will ultimately end up working in completely new job types that don’t yet exist” (WEF, 2016, p. 3). Specialized skills and technical knowledge seems to have transient value. WEF’s “The Future of Jobs” report found that “by 2020, more than a third of the desired core skill sets of most occupations will be comprised of skills that are not yet considered crucial to the job today” (WEF, 2016, p. 20). Of the top 10 job skills in demand today or in 2020, the vast majority deal with uncertainties, whether related to solving complex problem, coordinating or managing other people, or process and systems skills (ibid., p. 21). It seems each of these is relevant to entrepreneurship. Similarly, a new report by the Australian Council of Learned Academies (ACOLA) concludes that business and innovation require more than either technical or entrepreneurial skills, but a mix of them.

By far, the primary demographic and socio-economic driver of change in in the future of jobs is the rise of “remote working, co-working spaces and teleconferencing” (WEF, 2016, p. 6). This too is highly relevant to entrepreneurship, as co-working spaces and accelerators (Bliemel & Flores, 2015; Bliemel et al., 2016) are increasingly popular options. This driver reinforces the need or moral responsibility of educators to explore the importance of space in the classroom, to support student learning as well as to prepare students for their future careers.
**Space versus Technology**

By almost any account, most reports on trends in education focus on new technologies, with ICT technologies dominating the conversation. True, physical spaces have not changed as dramatically as ICT technology. However, they remain a critical factor in education, and have almost completely been taken for granted (Oblinger et al., 2005; Keppell et al., 2012; Peris-Ortiz, et al., 2016). The overemphasis on technology is questionable too. What kind of learning does it improve? By how much? From the perspective of graduate attributes, do educational technologies prepare students to use similar technology in their careers? A case in point is Clayphan et al.’s (2016) study of cards, touch tabletops and touch wall displays. Are these cool tools for schools (each with their own benefits and drawbacks) or are they also preparation for the real world upon graduation?

In particular, the emergence of the flipped classroom has resulted in disproportionate emphasis on online tools to in-class practices (Balan et al, 2015; Little, 2015). At our own university virtually all discussions and presentations about the flipped classroom revolve around online content delivery and online assessment, and distract from what occurs in the classroom and how to make use of that space and time. Meanwhile, surveys of students indicate clearly that they prefer moderate levels of ICT in the classroom (Kvavik, 2005, p. 7.9):

> “Information technology is just a tool. Like all tools, if used properly it can be an asset. If it is used improperly, it can become an obstacle to achieving its intended purpose. Never is it a panacea.”

Unfortunately, Kvavik’s chapter almost exclusively mentions benefits, not drawbacks or alternatives, and doesn’t mention physical space. The subsequent chapter in the same book suffers the same limitation, but offers an insightful quote from another faculty member:

> “[Technology] also sheds light on how we interact with our students and how they respond to our courses, and [it] forces us to think about the real meaning of community and what it is that a group of people assembled in a single physical space experience and how that compares to what a group of people in cyberspace might experience” (Ramaley & Zia, 2005, p. 8.15).

**So, Why is Physical Space Important?**

Space, in particular open plan classrooms, is important for several reasons. The two I focus on in this chapter are that open spaces are especially complementary to the millennial learning style and that there is no room to hide (for students or teachers). The first reason is more incidental since teachers have less control over students’ learning styles than how to activate the classroom’s space. The second reason forces actively engaging with the space and those in it.
Regarding learning styles, as mentioned earlier, Millennials favour constructing their own learning “and assembling information, tools, and frameworks from a variety of sources” (Oblinger & Oblinger, 2005, p. 212). This means they place great importance on freely navigating and discovering their environment. A conventional tiered theatre would add physical constraints to their freedom to navigate and discover, while open plan spaces enable this freedom. Commensurate with a change in learning styles and spaces that enable them to flourish, there has been a shift in ‘teaching and learning paradigms’ (Brown, 2005, p. 126), from transmission and memorization by students to (co-)construction and (shared) understanding, as summarized in Table 17.1.

Table 17.1: Differences in the Teaching and Learning Paradigms.

<table>
<thead>
<tr>
<th>Traditional Paradigm “Teaching”</th>
<th>Constructivist Paradigm “Learning”</th>
</tr>
</thead>
<tbody>
<tr>
<td>Fixed classrooms</td>
<td>Mobile, convertible classrooms</td>
</tr>
<tr>
<td>Teacher = master and commander</td>
<td>Teacher = expert and mentor</td>
</tr>
<tr>
<td>Transmission</td>
<td>Construction</td>
</tr>
<tr>
<td>Isolated facts</td>
<td>Organized conceptual schemas</td>
</tr>
<tr>
<td>Acquisition of facts</td>
<td>Facts + conceptual framework</td>
</tr>
<tr>
<td>Recall</td>
<td>Discovery</td>
</tr>
<tr>
<td>Repetition</td>
<td>Transfer and construction</td>
</tr>
<tr>
<td>Memorization</td>
<td>Understanding</td>
</tr>
<tr>
<td>One size fits all</td>
<td>Tailored; option rich</td>
</tr>
<tr>
<td>Summative assessment</td>
<td>Summative and formative assessment</td>
</tr>
<tr>
<td>Talent via weeding out</td>
<td>Talent cultivated and sought out</td>
</tr>
<tr>
<td>Fixed roles</td>
<td>Mobile roles</td>
</tr>
<tr>
<td>Single location</td>
<td>Plurality of locations and space types</td>
</tr>
</tbody>
</table>

(Source: adapted from Brown, 2005, Table 1)
Brown aptly spells out the implications for learning spaces, as a consequence of adopting a constructivist lens:

“One important implication is that the vocabulary we use to describe what learners do in these spaces must become active. We must go beyond describing ways to help the instructor to be active; we must include students as well. The vision and design principles should emphasize the options students have as active participants in the learning process. Design principles should include terms such as analyze, create, criticize, debate, present, and classify—all directed at what the space enables the students to do” (Brown, 2005, p. 12.7).

These design principles are complementary to the most important job skills of today and 2020 (WEF 2016), and therefore relevant to career development. However, the Brown’s list is imprecise regarding the social component emphasized in the WEF report. The emphasis on everyone in the classroom being ‘active’ nonetheless draws attention to the second reason space is important: no room to hide. In open spaces, students are welcome to use their devices and sit in corners, but they cannot hide there and make themselves unreachable or invisible to their peers, teacher or guests; they have to engage with the space.

As with other chapters and articles about modern education, IT is an almost inescapable central theme in Brown (2005). To his credit, he concludes:

“No single magic formula will guarantee successful learning spaces on every campus. It is clear, however, that it will not be enough if we simply place projectors, computers, and DVD players in the classrooms. Nor will it be adequate just to provide scores of publicly available computers. Such tactics, in isolation, may have little impact. Learning space design is a large-scale, long-term project, involving building and maintaining consensus, curricular vision, emerging technology, and layout and furniture options, as well as intracampus organizational collaboration. Learning space design requires a collaborative, integrated approach, with an overarching vision that informs and supports specific projects” (Brown, 2005, p. 12.20).

Because so many others (like Brown, 2005 and aforementioned citations) have provided such extensive reviews of the IT or ICT technology that powers modern classrooms, we focus on the opposite to explore and elaborate on the importance of the physical space itself. In context of entrepreneurship education, experiential learning is an emerging theme (e.g, Bliemel 2014b; Lackéus et al., 2015; Mason & Arshed, 2013; Dhliwayo, 2008). Experiential learning is “the process whereby knowledge is created through the transformation of experience. Knowledge results from the combination of grasping and transforming experience” (Kolb, 1984, p. 41). Experience is a by-product of actions and iteratively engaging with the physical and social environment, thus bringing the physical classroom space and its occupants into the foreground. “The difference between classroom learning and experiential learning
[.] is like the difference between learning about roller coasters by watching one from across the street and learning about them while gripping the front handrail during the ride” (McKormick, 1993, p. 261).Acknowledging the need for universities to prepare students for their future careers, this chapter focuses on how entrepreneurship students and teachers actively and authentically experience the space in a way that prepares them for a future career as an entrepreneur or related to entrepreneurship.

**Authenticity**

Analysing how students engage in learning spaces through the lens of authenticity reframes the discussion from the content being taught, to the practices, attitudes, skills and other attributes that graduates are expected to develop and their ability to re-apply what they have learned. Embracing authenticity is the crux to exploiting the potential of modern teaching spaces to prepare students for their careers, because it addresses the problem that:

“**much of the abstract knowledge taught in schools and universities is not retrievable in real-life, problem solving contexts, because [the conventional] approach ignores the interdependence of situation and cognition. When learning and context are separated, knowledge itself is seen by learners as the final product of education rather than a tool to be used dynamically to solve problems**” (Herrington & Oliver, 2000, p. 23).

If the classroom space, the activities and interactions in that space and the assessments are all authentic, then students should be able to overcome this problem. This section reviews the literature in relation to authentic learning, authentic learning spaces, authentic activities and authentic assessment.

**Authentic Teaching or Learning**

To enrich the discussion about how students learn within spaces, we first review Barr and Tagg’s seminal (1995) article about thinking about student’s learning above teacher’s teaching. This was presented as a ‘new paradigm’ in 1996 wherein the shift was from ‘providing instruction’ to ‘producing learning.’ The article immediately generated further impactful publications, as measured by the top 100 most relevant citations in Google Scholar, including Oblinger et al. (2005) in 5th place (cited extensively here). However, the real impact of this paradigm and its early citations was not felt until the late 2000’s, as measured by the proportion of citations reported by Taylor and Francis (out of 404 via CrossRef) or ProQuest (out of 820). Figure 17.1 illustrates the emergence and late popularity of focussing on students’ learning instead of teacher’s teaching. One could speculate that the lag is due to “difference between our espoused theory and our theory-in-use” (Barr & Tagg, 1995), where the later articles are biased towards assessing the implementation of the paradigm, not just its theoretical merits. This lag is indicated by recent reviews of entrepreneurship education methods that conclude “It is also necessary to move away from entrepreneurship education as being teacher led to being more student-centred and
focused on experiential and existential lifelong learning practices” (Robinson et al., 2016). It is concerning that this move is taking as long, especially in an area as conducive to experiential learning as entrepreneurship. To help overcome this lag, new books (e.g., Peris-Ortiz, et al., 2016) and journals are emerging that are dedicated to experiential learning in entrepreneurship, such as the Entrepreneurship Education and Pedagogy Journal.

The Learning Paradigms includes six dimensions, of which we only discuss ‘Structures’ here, which are “those features of an organization that are stable over time and that form the framework within which activities and processes occur” (ibid., p. 18), including facilities and equipment. As with the aforementioned authenticity criteria, the teaching environment is vague and not specified in concrete (physical) terms. Where it is clear, is that the Learning Paradigm fosters collaboration and flexibility to reshape the environment in order to discover ‘what works’ best for learning to occur.

Leveraging and shaping such amorphous environments requires new skills for ‘teachers’. As with the flipped learning paradigm, teachers are no longer the ‘sage on the stage’ (there is no longer a stage!), and instead are the ‘guide by your side’ (Bliemel, 2014a, p. 126). This shift then also presents the need to completely change how academic professional development happens (Steel & Andrews, 2012), with an emphasis on developing ‘soft skills’ of teachers. These skills are essential in teachers if they are to cultivate similar personal and professional skills in their students (Biggs, 1999; Macht & Ball, 2016).

Authenticity of Space

Barr and Tagg’s (1995) article pre-dates most active learning spaces, so a brief review of learning spaces is required to contextualize their article’s espoused practices in
those spaces. Combining the effects of an active learning curriculum and active
learning spaces has been shown to improve failure rates and learning (Brooks, 2012).
While space and curriculum delivery are almost inextricably linked, Brooks (2012)
Attempts to isolate the effects of space, to show that active learning spaces influence
the delivery of the curriculum, and thereby having a significant indirect effect on the
learning. In particular group activity and discussion increases in active learning spaces,
implying greater opportunities to develop collaboration skills.

But are these spaces authentic? Authentic environments are environments where
“students are motivated to learn in rich, relevant and real-world contexts”
(Herrington & Herrington, 2007, p. 68). The same article argues that “it is the
Cognitive authenticity rather than the physical authenticity that is of prime importance
in the design of authentic learning environments” (p. 70). For our purposes of
focusing on space, ‘environment’ or ‘contexts’ is too broad a term. Therefore, we
interpret these statements that, from the perspective of the students, the space
becomes authentic when they treat it as a genuine work place and it resembles their
future workplace.

On the note of work, Fox and Lam’s (2012) review of learning space designs
notes that “Students need places where they can work collaboratively, on their own, in
quiet and noisy areas and in multiple settings” (p. 73), including formal and informal
learning spaces. This involves paying attention to the ability to reconfigure furniture,
adjust chairs, ventilation, lighting and sound, and access utilities and internet, or even
amenities like cafés. Their review provides photos of spaces where students are too
far apart to collaborate or too cramped to comfortably work. Of the four spatial types
reviewed, the classical tiered theatre enabled the least interaction, followed by the
horseshoe shaped tiered theatre and double-row theatres (where some students can
face each other). The open plan spaces with movable tables rated highest for their
ability to facilitate all forms of interaction, with the caveat that capacity should be
capped at 70. Because of the ability to rearrange the seats and tables, they give a sense
of ownership to whoever rearranges them. A challenge noted with these spaces, and
evident to most co-working spaces, is the need to provide electricity to each table,
thereby limiting the mid- to longer-term rearrangement of the tables.

The resemblance to co-working spaces is particularly relevant to entrepreneurship
courses in which students work as teams on their own business ideas, and are
mentored and guided following a semi-structured program similar to business
accelerators (Bliemel, 2014a, 2014b, 2016). When students graduate, their familiarity
with working as groups in these spaces enables a more fluid transition into the
exploding phenomenon of co-working spaces (WEF, 2016) and accelerators (Bliemel
& Flores, 2015; Bliemel et al., 2016).

Authentic Collaboration and Entrepreneurship Activities

Active learning and collaboration is certainly not a completely novel topic, but one of
increasing interest to educators in entrepreneurship. For example, a new book by
Peris-Oritz et al. (2016) provides several tools and techniques to engage entrepreneurship students in the classroom. However, as with the previous critique that the physical space is taken for granted in publications about educational tools,
this volume rarely explicitly considers the physical environment. Space is mentioned briefly in context of an on-campus incubator (ibid., p. 78), but largely taken for granted for coursework. Nonetheless, educational practices in entrepreneurship education have come a long way towards being experiential and hopefully retrievable after graduation.

One experiential learning technique is to conduct experiments or simulations, where students are given a series of decisions. The assessment of the experiment is usually in the form of a report afterward why they made the decisions the way they did. As such, “classroom experiments in the economics and entrepreneurial field tend to rely more on introspection, and as such students are not merely spectators but active participants in the investigation themselves” (Perote et al., 2016, p. 4). While the experiments have the potential to be authentic, they are often reduced forms of complex situations that focus on a single lesson. “The experiment does not need to represent reality with great fidelity; it just has to capture the relation and the subject incentives that we pretend to study. The simpler the experiment the better” (ibid., p.5). While this active participation in the experiment can engrain a lesson into the student’s attitudes and skill sets, the simplicity of the experiment may limit their ability to retrieve the lesson in the complex reality after graduation. However, dealing with a succession of decisions in each experiment helps students actually learn how running a business is not a collection of disparate case studies, but an ongoing flow of interdependent actions and decisions.

More specifically to collaboration, another technique is the jigsaw technique (Aronson et al., 1978), wherein one student in each (usually cross-disciplinary) team is an expert on a specific topic and ‘teaches’ their expertise to the rest of the group. The technique “requires a series of social capabilities and skills to bring it to a successful outcome. The great advantages of this methodology are particularly based on the cooperation between the students” (Babiloni et al., 2016, p. 18). This can be done within teams, or to facilitate cooperation and collaboration across teams, it can be done across teams. When used across teams, it can be combined with peer assessment, wherein each team reviews another team’s assignment against a rubric. One person from each reviewing team then visits the other team to explain how their assignment was assessed. Because teams are given similar assignments, they can use this method to learn directly from each other, instead of only indirectly observing what other teams are doing. This technique is relatively authentic in the sense that it resembles how start-ups in co-working spaces interact when they see each other’s pitches (often on a Friday, over beer and pizza).

Another peer learning technique that can be adapted to learning collaboration is for students to learn by teaching (Apetrei et al., 2016). Students can collaborate to teach a specific topic in the course to the other students. The authenticity of the lesson for the rest of the cohort is vastly increased if the teaching students are instructed not to teach in the classic sense, but to devise an interactive workshop or experiment through which others learn the key lessons, thereby also increasing the collaborative experiences of the cohort. A critical enabler of this technique is a clear rubric that articulates and emphasizes the level of interaction desired in the workshop.
Like the jigsaw technique, this technique can include peer evaluation, whereby the student teachers are evaluated by the rest of the cohort against the rubric. Involving peers means more sources of learning, but also “learning to help others to improve their performance” (Rodríguez-Gómez & Ibarra-Sáiz, 2016, p. 63). Constructively learning to help others improve their performance is arguable highly important for aspiring entrepreneurs, who ultimately will aim to get the best efforts out of their employees.

Being able to collaborate and constructively deal with conflict is particularly evident in the classroom, versus online environments (Batista-Canino et al., 2016). Online collaboration and conflict resolution has some advantages in terms of the conversations being auditable and searchable. However, the benefits of in-class collaboration and conflict resolution are more immediate. In comparison to the online environment, in-class collaboration involves fewer temporal delays and easier interpersonal connections. Interestingly, people feel more compelled to write something, anything, in an online environment (especially if there are marks for online participation), and in-class environments can include more passive aggressiveness and withholding oral expression. As speculated by Batista-Canino et al. (2016), “In the classroom environment, the competences of the interpersonal type of conflict resolution are most evident. This is perhaps because non-verbal communication leads to students experiencing a larger number of conflict situations” (p. 95). Increasing the number of conflicts is not necessarily a bad thing either: “In many cases, this forces the tutor to arbitrate and mediate. In classroom teaching, the mediating role of the teacher encourages some students to launch proposals that would not have been made in another environment” (ibid., p. 96).

**Authentic Activities Beyond the Classroom**

Students don’t just collaborate within classrooms or for coursework. They (authentically) collaborate on their own entrepreneurial initiatives. Learning about entrepreneurship at university can start with coursework (Maritz et al., 2015). However, the real ‘magic’ happens with students cultivate their interest for reasons not including course credit. Extra-curricular activities and incubators develop soft skills and “the spirit of entrepreneurship” (Shepherd & Douglas, 1996, in Woolfolk-Ruiz & Acosta-Alvarado, 2016). In recent years, there has been an explosion of university-wide extracurricular entrepreneurship programs (Fayolle & Redford 2014; Crispin et al., 2013; Morris et al., 2012; Fetters et al., 2010).

By observing what extra-curricular work students do and which spaces they choose to do that work has great potential to inform the design of the spaces that universities assign them for course-work. In their study of student journals, Beckers et al. (2016) identified that open plan rooms and ‘open learning centres’ were the dominant choice of location for collaborative learning activities outside lessons (e.g., group home work or extra-curricular work) as well as for social activities. Their study confirmed that comfort, technology and proximity to catering services mattered. However, this overlapping dominance indicates that one of the main drivers for using these spaces was because of how they physically enabled learning as a social process. A similar combination of studying and socializing in the same spaces was also
observed in an earlier study employing a small number of semi-structured interviews (Cox, 2012).

**Authentic Assessment**

Tying each of the above subtopics together, we arrive at the crux of this chapter. This is not simply about teaching students how to use technology for its own sake. It is not about teaching the concept of collaboration or entrepreneurship, per se. It is not even really about teaching, in the sense of instruction, transmitting information or imparting understanding (see most dictionaries for definitions that echo the traditional paradigm). This chapter is about experiencing a space, and using the physical space as a platform to authentically learn cross-disciplinary collaboration and entrepreneurship, as it would occur in industry.

To answer the question of whether the authentic spaces and authentic activities genuinely improve students’ capabilities in collaboration and entrepreneurship, there is one more plot twist. Can the assessments of their capabilities be conducted in a way that builds on this authenticity? Among the authenticity criteria for activities, is that they are seamlessly integrated with their assessment (Herrington & Herrington, 2007; Cheers et al., 2012). This means that there is little to no separation between the teaching space, the learning space, and the assessment space (Crisp, 2012), and that assessment involves multiple stakeholders who are qualified or trained to perform the assessment in a way that would occur in industry.

**METHOD**

This study uses a self-reflective process (Hayward, 2000), “where the teacher becomes a researcher who assesses his or her practice and applies what is learned to future practice. Reflection and learning from experience promote professional development that is meaningful and relevant for the individual” (p. 22). This method is common for studies in entrepreneurship education (e.g., Jones, 2010; Jones, Penaluna, 2013), and involves comparing one’s own practices and observations against practices that might be expected according to the literature, conversations with colleagues or other sources. Because of its origins in experiential learning (Kolb, 1984), it is directly analogous to how students in many entrepreneurship courses learn. Aside, by employing self-reflection, I also gain a better understanding of the process of keeping reflective journals that students do in my course.

Building on these four authenticity themes above–authentic learning, authentic learning spaces, authentic activities and authentic assessment–this section reflects on how a new active learning space was used at UNSW Australia in an undergraduate entrepreneurship course. The space was a $3.5M refurbishment of the ground floor of the business school, involving four classrooms and two informal study areas. The name for the combined spaces was ‘The PLACE’ (short for Peer Learning And Creative Exchange). Because of the emphasis on space and its interdependence with curriculum, I first review the course design (teaching/learning, activities and assessment) to then focus on how space enables or constrains learning.
Course Design

The course reviewed here is a ‘flipped’ entrepreneurship course (Bliemel, 2014a, 2014b) and designed to create authentic learning experiences (Bliemel, 2015, 2016). It adopts activities that reflect the operating model of business accelerators (Bliemel et al., 2016), thus blurring the distinction between entrepreneurship education and entrepreneurship as practice (Lackéus et al., 2015).

University courses and accelerators both operate on a cohort model with a strong emphasis on learning how to find opportunities in the form of product-market fit. Both can be designed to accommodate for iterative learning (mastering a lesson through repetition) as well as punctuated learning (discovering something new or one-off assignments). The role of the accelerator operator is analogous to the lecturer in that “to facilitate learning, the teacher’s role moves from being directive to coaching, encouraging and questioning” (Draycott et al., 2011). Likewise, accelerator operators primarily play the role of mentor or broker to external mentors (Bliemel et al., 2016). The most significant difference is that the performance of accelerator programs is usually measured by follow-on investment and exits of ventures, while educational program performance is usually measured by the progression of students through the rest of their degree program and subsequently career.

With this accelerator-course analogy in mind, the purpose of the “inside-out flip” is to facilitate “interactions with industry [which] provides a more realistic experiential learning opportunity than in the conventional flipped classroom” (Bliemel, 2014a, p. 120). In other words, the course is still primarily a university course, not a real accelerator, and the authenticity of experience offered over the duration of the course is gradually shifted from vicarious to virtual to real (Bliemel, 2014b). Through this scaffolded process, students learn what it is like to be an entrepreneur and learn how to apply different course concepts (and their interactions) in actual complex situations.

Activities

The in-class time generally follows the same structure every week:

- Weekly update pitches: Verbal weekly updates by each team briefly (1-2 minutes) summarize what evidence each team collected and how their business model evolved.
- A brief lecture, reinforcing only the key concept(s) for the week
- A ~1 hour-long hands-on workshop and/or guest speaker
- Teams reflecting on the feedback they received from those stakeholders, and planning next steps in consultation with the lecturer

Ensuring coverage and critically discussion of subject matter is required as a university. Therefore, some form of mini-lecture is required in case students to not keep up with course materials and online quizzes related to the readings. Beyond
content, the course emphasizes working in the classroom as a team, as if the teams were in the same co-working space or accelerator.

Assessments

Most of the assessable activities directly involve engaging with external stakeholders to complete the assignment, with the stakeholder contact usually falling outside scheduled classroom hours. For one of the final assignments, external stakeholders are also involved in the assessment.

- The first assignment is for students to find an entrepreneur to conduct a brief semi-structured survey by the second week of class. Based on the interview, students are also asked to reflect the process of having contacted the entrepreneur and asked to identify the top three insights they learned, which are sharable in-class. Through this process, students learn vicariously about entrepreneurship from the interviewee, while also learning how prevalent entrepreneurs are in society and building some basic market research skills.
- The second assignment is to form inter-disciplinary teams and find a mentor for the team by the fourth week of class. In most cases, one of the entrepreneurs interviewed for the first assignment agrees to become the team’s mentor. Through this process students learn the process of assembling a board of advisors.
- There are two weekly assignments. The first is a weekly update of progress made by testing business hypotheses outside the classroom. To complete the assignment, teams submit an auditable 1-page online form and provide a verbal summary. Both forms are visible to the rest of the class, thus enabling teams to be inspired by each other’s weekly tests and how they have incorporated topics from the readings. Through these tests and reports, students learn to delegate tasks and systematically and consistently make progress on their ideas.
- The other weekly assignment is an online Readiness Assurance Test (RAT). These tests assist in ensuring students have pre-read the core course materials and are prepared to apply them in-class and in their field tests.
- The first major group assignment, near the midpoint of the course is the creation of a website and explainer video. The URLs are shared with the whole class and alumni in a Facebook group. These assignments are peer assessed in-class using the jigsaw technique and by the lecturer. Through this assignment, students also authentically gain the feedback of perfect strangers and actual potential customers who are unbiased towards the team.
- In the final week, students present the latest version of their business idea, and supporting evidence to a live panel of actual
investors and entrepreneurs whose scores are used for assessment. To further increase the authenticity of this activity and exercise, the event is held off-site in a co-working space or incubator in the city.

- At the end of the final week, students can take feedback from the live pitch on board before submitting a written 4-page business plan.

**Space**

By “flipping the classroom” (i.e., moving the core course materials and their direct assessment online) and shifting most of the assignments outside the classroom, this creates the temporal space to make the most of the physical space. Having started teaching this course in tiered classrooms with 90 minute lectures, it quickly became apparent that students struggled to work effectively as a team for two reasons. First, the only time their schedules permitted being in the same place was in-class. Second, the physical layout of the tiered classroom was poorly suited for group work.

The physical space is an open plan layout with 10 tables, each associated with a computer and screen, as shown in Figure 17.2.

Instead of a lectern, there is a small table attached to a structural column near the centre of the classroom, which has basic computer and other A/V inputs. To accommodate for conventional or centralized presentations, there is a projector and screen on one wall. Slides from the central computer or any of the other 10 computers can be rebroadcast to the all of the 11 screens. Most of the vertical wall space is usable as whiteboard space, as shown in Figure 17.3. While tables are usually parked at one of the screens, they can be moved around freely, thus enabling creating larger boardroom tables, or pulling them away from the walls to enable local presentation spaces in front of each screen. Likewise, chairs can be moved around to accommodate arrangements like horseshoe shapes for a ‘fireside chat’ or ‘ask-my-anything’ session with a guest entrepreneur.
Altogether, the space has all the non-negotiable criteria for active learning spaces [10]:

- An abundance of writing surfaces
- Basic presentation technology
• Excellent wireless internet coverage (and several power points)
• Flexible furniture

In a 2014 interview, Professor Nick Wailes, Associate Dean (Digital and Innovation) speaks out about the design and use of The Place. In the interview he notes that by design, “When you sit down at a table, you’re actually in a group, facing each other. You’re not facing towards the lecturer”. As a result, “[Students] have told us [...] two things. One is that they feel like they get to know their classmates a lot better. Because, rather than sitting passively back, with someone right beside of you, you’re actually working with others. And, just enhancing their cross cultural competence”. When asked about the technology, he notes the computers and screens at each table, along with: “There’s a huge amount of technology in these rooms. But, a funny thing is, I think that it’s not the technology. Technology enhances the experience and enables it, and those type of things. But, it’s actually the physical space and the orientation of learners to each other that really makes a difference.” Even after hours, the space is used for group work: “They’re open 24-7. If there’s not a formal class in here, they’ll come in and work as a group”.

Collectively, these comments reinforce that the online technology and the technology in the classroom are important, but mainly as a supporting role to the curriculum design and use of physical space. The space enables easy visual, auditory and physical access to anyone in the same space, while the course design encourages it.

**Use of Classroom Space as a Visual Tool to Develop Capacity in Cross- disciplinary Collaboration in Entrepreneurship**

The defining characteristics of these active learning spaces in relation to cross-disciplinary collaboration in entrepreneurship are direct line of sight to almost anyone in the classroom, as well as few obstacles between people, to enable free movement of people (and furniture). This section reviews how these two critical elements come into play in the course mentioned above.

**Forming teams:** Prior to forming teams, students are given an icebreaker exercise to get to know each other. In this exercise, temporary teams of 2-3 people are formed for 5 minutes, and all teams are provided three randomly generated words to use as the basis of a business idea. The words can be used for any aspect of the business and often have multiple meanings. Silly ideas are not discouraged. With this trivial business idea in their mind, all the tables and chairs are moved to create a large open space for students to practice networking, introducing themselves, and pitching their idea to at least 10 other students in 20 minutes. The open space enables the free flow of people in the room and gives no one a place to hide, thereby enabling the lecturer to intervene to encourage shyer students to engage. By seeing and hearing each other’s performance, students can also recognize the importance of gestures and animation when explaining ideas.
**Weekly updates:** For the in-class verbal updates, students are effectively teaching other students what they learned about their own business tests. All students can see each other’s updates without having to re-arrange the entire room. Students are encouraged to use this as an opportunity to practice their presentation skills. By telling the whole class about their progress, they are planting ideas with the other teams about how their respective ideas could be tested, while simultaneously opening themselves up for suggestions on how to improve their own team’s idea. With a tiered classroom, there would have been significant delays as each team sends a member to the front or everyone shuffles in their seats to turn towards the presenter.

**Themed workshops:** One of the more popular workshops is the design thinking workshop, wherein each team uses the whiteboard spaces to sketch personas of their envisioned customers. These are immediately visible by anyone in the room, so students can quickly see what other teams are doing if they get stuck. Another popular workshop is the seed fund simulator. In this simulation teams end up competing against each other to invest in a limited portfolio of start-ups to try and make the most money (or lose the least money). Investment choices are centrally coordinated in a Google Doc that is visible on all screens, including personal devices. The openness of the space enables significant levels of ‘espionage’ to see which teams are quickly scrambling to be the first investors, while others are more methodical in their approach, but might miss out on the better deals. The simulation is played over two rounds, and it is not uncommon in the second round, for teams to imitate (as fast followers) the investment choices of the higher performing teams from the first round. For the midterm website and explainer video, the jigsaw method is employed. Even before the due date, teams can see each other’s progress on the sites and videos due to the transparency of the room and some early sharing of URLs in the weekly update uploads. This transparency creates peer pressure across teams to ‘up their game’ and create more visually appealing sites and videos, including sharing of which tools they used to get them done. The jigsaw peer assessment exercise provides live and constructive feedback between teams. During this activity, students can communicate verbally, while also employing non-verbal cues to indicate enthusiasm, (dis)approval, (dis)comfort, (mis)understanding, etc. This turns the exercise into a dialogue wherein students learn to give and receive constructive critique in a manner not possible with purely written peer assessments. Physically, the exercise is simple to execute because one student from each team only needs to roll their chair over to the adjacent table to communicate their team’s review of the other team’s site and video. This is easy enough to repeat twice; once clockwise, once counter-clockwise.

**Guests:** Guest speakers are often initially thrown off by the space, because there is no clear ‘front’ and walking around the middle would mean that their back is turned to someone. Because of the flexibility of the space and the mobility of the chairs, the students can very quickly roll their chairs into a more conventional horseshoe layout for the guest talk and Q&A. After guest talks, students return their chairs to their tables, and guests are often curious to move around the room and consult with each team about their own ideas while the lecturer does the same.
Group work and general use: By far, the most useful aspect of The Place (in combination with the flipped curriculum design) is that each multidisciplinary team can comfortably collaborate at the same table. Team members can freely choose to sit on the same side of the table to share what they have on their personal screens. They can also separately focus on delegated tasks while sitting opposite each other. They can also easily use the shared computer and screen for their table so everyone within the team (and classroom) can see the same thing.

Because of the long time slot, students are free to enter and leave whenever they need to, assuming they have coordinated their responsibilities within their team. Breaks include grabbing coffee, washroom breaks, or impromptu surveys of students as customers. The open plan layout makes entering and leaving the room less intrusive than when the exit is near a central presentation screen, and more welcoming than when the entrance is in the remote depths of a tiered theatre. So, while the atmosphere is relaxed, students are generally working hard to make the most of their time as a team, particularly if scheduling team meetings outside of class times is difficult across majors. An additional mechanism to encourage students to feel comfortable for longer and make more continuous progress is to stream music in the background, like at most cafés or many co-working spaces.

CHALLENGES AND LIMITATIONS

The above review and personal observations and reflections are largely positive. However, there are always some limitations and challenges. In this particular space, there is arguably too much open space in the middle of the room. This makes it a little more difficult for teams to see and hear teams on the opposite side of the room. This issue is compounded by the high levels of sound attenuation and baffling in the space. The sound attenuation is required so that students can actively discuss within their team, without each conversation being drowned out by the general din in the room.

There are two workarounds for the sound attenuation: technological and human. The technological solution is to use a lapel mic or handheld microphone (mic). These mics are useful for lecturers or guest speakers if they need to be audible by everyone for longer periods of time. Then students are providing short updates or quickly answering questions, ‘passing the mic’ can cause delays that demotivate students from participating in addition to being uncomfortable with using a mic. The alternative solution is to ask students to learn to project their voice, thus also helping develop their professional public speaking skills and confidence.

Educational software vendors are promoting sophisticated means to capture the video, audio and textual comments in the classroom. However, capturing anything at the classroom scale is often pointless for each team, except for maybe the guest talks. The (limited) slides can easily be shared with the whole class. But, because of the high emphasis on group work only the discussions within the group would be worth capturing for each separate group. Even if the technology were installed to automate this, recording each group discussion would not authentically represent how
teamwork in industry. Students thus have to learn to become responsible for watching, listening, keeping notes and communicating effectively within their teams.

An additional, but minor challenge with the space is its non-permanence. At the end of each class, anything on the whiteboards or walls and local files on the computers need to be copied so they are not lost. This does not authentically represent workspaces where employees can keep their notes and drawings on white boards and easily revise them over time or easily refer others to them. At best, students can take a snapshot of the drawings and notes to retain and share them, albeit usually not with the same level of transparency or public accountability as the original.

Lastly, there is the challenge of scalability. These classrooms are designed for up to 10 tables of 6 people. Even if larger classrooms were available, their effectiveness may drop dramatically because students would become unable to see and hear what is happening across the room, and there may not be enough time for lecturers to consult with every team about their progress. This constraint can be mitigated by employing teaching assistance to help provide the guidance and consultations, and by being more selective in picking students or teams to present their progress to the rest of the class.

CONCLUSIONS

Curriculum and space are almost inextricably intertwined. By focussing on the physical attributes and affordances of the space and depending less on the technology, this chapter has explained how close physical proximity and immediate visual and auditory access to other students enables them to collaborate in an entrepreneurship course. Taken to extremes, the methods discussed here mean that the space can still be used if there is a complete failure of the ICT (e.g. a computer failure, power failure, or internet disruption).

The flexibility of spaces like The Place is well suited to how students learn and collaborate, even outside of class hours. Such open spaces are increasingly used in workplaces in industry. So, students are more certainly being prepared to join industry in these spaces than in conventional tiered classrooms.

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Visual Tools for Developing Cross-Disciplinary Collaboration...


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There are few professions that don’t require individuals to collaborate with people outside their own field. When collaborating outside your discipline, innovative ideas are often found at the nexus of the collaborators’ interests. Innovations are most readily brought to life through entrepreneurial or intrapreneurial actions. Developing collaboration, innovation, and entrepreneurship skills in newly formed teams, especially cross disciplinary ones, can be a challenge in both teaching and industry contexts. In this chapter the ‘Nexus’ model is described. It uses visual tools and techniques developed, and iterated for application in, undergraduate and post graduate courses and industry contexts to facilitate collaboration, innovation and entrepreneurship, in disciplinary diverse teams. Some of these tools have been drawn from design thinking, service design, business, psychology and education practice and iterated to suit the context. Others have been developed by the author and some in collaboration with students. This chapter will be of interest to practitioners looking to develop a toolbox for their students or clients that is flexible and adaptable and supports an integrated practice.

INTRODUCTION

The Nexus Model, described in this chapter, was originally developed to support cross-disciplinary, engaged learning, and action learning opportunities for students at UNSW Art and Design (formerly COFA). It has been iterated over a number years and courses, and used in a variety of contexts including work integrated learning (WIL), academic, professional and extracurricular programs. Focused on developing and delivering creative, innovative projects over relatively short time periods via entrepreneurial mechanisms, it acknowledges that most professions require individuals to collaborate with people outside their own field. When doing this you often find innovative solutions or ideas at the nexus of you and your collaborators’ interests. Innovations are most readily brought to life through entrepreneurial or intrapreneurial actions. Often in the context of studying at a university or working in a specific context, you are artificially siloed as you are taught or reside within disciplinary based cohorts. This can make it difficult to find opportunities to
experience cross disciplinary collaboration. Developing, collaboration, innovation and entrepreneurship skills in newly formed teams, especially cross disciplinary ones, can be a challenge in both teaching and industry contexts. In this chapter the ‘Nexus’ model is described. It uses visual tools and techniques, developed through iteration, for application in, undergraduate and post graduate courses and industry contexts to facilitate collaboration, innovation and entrepreneurship in disciplinary diverse teams.

Some of these tools have been drawn from design thinking, service design, business, psychology and education practice and iterated to suit the context. Others have been developed by the author and some in collaboration with students. This chapter will be of interest to practitioners looking to develop a toolbox for their students or clients that is flexible and adaptable and supports an integrated collaborative practice with a view to continued or further practice.

**NEXUS MODEL**

The NEXUS model (Refer to Figure 18.1) describes the process through which a team of collaborators will progress from the start to the finish of a project and the possible continuation of collaboration through successive future projects. This process does not start at the point of NEXUS. It begins before that point with a courting process. It also does not always end at one collaboration. If it is successful it should lead to successive future collaboration(s) of the team or a subset of the team.

![Figure 18.1: The Nexus Model](image)

The challenge for an educator or practitioner is to guide a group of individuals, based on a common goal, problem, theme or a topic, through a courting period, to find a point of nexus, to form teams, to collaborate, to innovate and to be entrepreneurial in delivery of the project. This is often under the demands of a short time period. It is also worth noting that not all collaborations will go through an innovation and / or an entrepreneurship phase. As indicated in Figure 18.1 the collaboration can continue on its own to the end, through an innovation phase to its end or through an innovation and entrepreneurship phase to the end.

The expanded NEXUS model (Refer to Figure 18.2) acknowledges that there are many points across the continuum of the process of courting, collaboration,
innovation and entrepreneurship that can be supported through the use of visual tools. A number of these tools have been indicated in the figure and will be described in further detail in this chapter.

![Figure 18.2: The Nexus Model expanded to include examples of visual tools.](image)

**COURTING**

Working in a team requires relationships to be built. Just like any relationship there is the need to meet, connect, then get to know each other. The ‘courting’ phase is one of discovery where potential collaborators or team members meet and learn about each other. It is desirable in a learning or work context to facilitate, and fast track, this process to ensure the formation of effective teams, across interests and skills, and also maximise use of time. In the Nexus Model, a number of visual exercises are leveraged to this extent. Two are described below.

**Positioning**

Positioning is an important exercise to fast track connections between potential collaborators. It allows them to quickly showcase their areas of interest, disciplinary specialities and overall skill and knowledge sets as well as to identify potential collaborators. It comes in two parts:

1. A visual/verbal presentation to the whole cohort designed to quickly introduce themselves as potential collaborators through indicating their area of interest, disciplinary expertise and experience, framed by a common theme.

2. An illustrated research report providing a formal opportunity for all potential collaborators to introduce themselves more deeply. In the report they identify key theories and theorists and aspects of their topic of choice along with their interests. These reports are shared
among the cohort the week before they leave for the program. They are asked to read through the reports, which become a peer-led learning opportunity.

An example of a brief for these comes from the Island Innovation Lab (Palau 2016) course outline. Island Innovation Labs are 7 to 10-day immersive, residential, experiential, cross disciplinary, WIL, action learning courses at UNSW Sydney. The Island Innovation Lab focuses on addressing global sustainability issues in local and regional contexts in cross disciplinary collaborative teams using innovation and entrepreneurship.

Task 1: 20%

There are many topical, global sustainability issues. These may be environmental, social, economic or governance. Select an issue you are passionate about and research it in a local (Palau), regional (Asia Pacific) and global context. Identify the kinds of people with whom you may be able to collaborate to address / find a solution to the issue. Articulate the skills you can contribute through your current disciplinary knowledge and practice context.

Prepare a 2000 - 3000 word, Harvard referenced, illustrated research report on above. Email to your course convenor 1 week before departure.

Prepare a 5 minute visual presentation for our first day of the lab as an introduction to you, your skills, knowledge, and interests.

Having read through the reports prior to the start of the course, participants broaden their knowledge related to the course and start to get to know their collaborators even before they have met them. The presentations allow participants to physically identify the report authors, ask them questions and work out potential collaborations.
Figure 18.3: UNSW Island Innovation Lab student Neelam Gopalani delivers a visual presentation to position herself as a collaborator at the Island Innovation Lab Palau (2016).

**Interest Mapping**

Interest Mapping is a simple exercise where participants identify topics they are interested in exploring in their collaborations. They identify these after the positioning exercises which tend to change and broaden their original perspectives. The students and facilitator first identify topics of interest (Refer to Figure 18.4).

These topics are rationalised and negotiated into key themes, which are then recorded in a list on one side of a sheet of paper. Participant names are listed on the other side. Participants then draw a line from their name to the topics they are interested in (Refer to Figure 18.5).
Figure 18.4: Students working on interest mapping, identifying topics at the Island Innovation Lab Vanuatu, 2014 cohort.

Figure 18.5: Interest mapping output of the Island Innovation Lab Vanuatu 2014 cohort.
Once the exercise is completed, the Interest Map can be used across the duration of the project to identify potential collaborators or partners in activities around participant interests for either collaboration or knowledge exchange.

**NEXUS**

Nexus is the point at which the courting phase ends and the collaboration phase begins. Collaborators form their collaboration teams based on shared interests, experience, knowledge and skills through a bidding process. This bidding process can be formal or informal. I have managed it online via forums or chat groups, face to face as speed dating exercises and also allowed the teams to form naturally over longer periods of time. I have found speed dating to be the best. Once in teams, collaborators then begin to define their project(s) through negotiation. They reach, through consensus, a common goal for their project(s). The collaborators will form a mission statement at this time for their projects to help guide them as they progress towards brief writing. This is flexible and can evolve as the project does but provides a starting focus.

**COLLABORATION**

**Mind Maps**

A very useful visual tool to explore a topic of interest is the Mind Map. When used early in a collaboration, just after a team forms, it can be a great way to get the team quickly mobilised and working productively together around a specific topic. It can easily be recorded by team members with their mobile phones and taken away to work on the individual components between team meetings. The idea of a mind map is to start with the key issue for discussion at the centre and to add considerations and ideas linked to it in a radial pattern. Each of these can be extended in the same way. It is a very effective way to quickly map out the possible scope of a collaboration.
Figure 18.6 illustrates a Mind Map used by student collaborators from the Nexus, Collaboration, Innovation elective at UNSW Art & Design in 2015. The Mind Map explores their partnership on a project with retailers from Oxford St Paddington, Sydney, Australia, students and Place Partners, a local place-making consultancy, to re-engage community and pedestrian commuters to reinvigorate a once thriving and busy retail strip. The project was to create a ‘gallery’ (Refer to: Figure: 18.7) along the street in retail windows where UNSW Sydney Art & Design students could show and sell their work, and that activity and associated events would attract more people to the local area to shop, drink and dine. The #OXFORDSTGALLERY project was started by this student / retailer collaboration in 2015 and has continued to run openings, fair days and other events on a regular basis. It is still running at the time of printing of this book.

Figure 18.7: Student works on exhibit in #OXFORDSTGALLERY shop windows 2015.

CROSS-DISCIPLINARY COLLABORATION

Complex projects or problems can require larger and more diverse teams to collaborate. When planning these projects, it is often useful to identify who will be
collaborating, what skills, knowledge and resources they bring to the project, the roles they play and when they will be needed.

**Stakeholder Maps**

Stakeholder maps are a very flexible visual tool that can help to quickly document the various internal project collaborators, the external project partners, end users, and any other stakeholders who need to be considered in the project planning, solution forming or delivery. These can be developed and iterated at different times across the running of the project as it progresses and changes. In general, the key issue being explored, or the product being developed will be placed at the centre of the map. This may be followed by a problem statement or current activities. The first tier of information will be the various stakeholders. The second tier of information will be their needs. This format can be played with as you will see, in the examples below. The flexibility of this tool makes it useful in any scenario and particularly useful in co-design situations.

*Figure 18.8:* UNSW Outreach Librarian, Amy Allenspach, presenting a stakeholder map she has developed for understanding the common and unique needs of library users.

An example of an early stage Stakeholder Map can be seen in Figure 18.8. It was developed by UNSW Outreach Librarian, Amy Barker, during a Design Led Tuesday Design Thinking Workshop, led by the author in 2015 at the Michael Crouch Innovation Centre UNSW Sydney. Amy was exploring how different stakeholders utilise library resources in order to understand how to develop strategies for delivering more targeted internal client experiences. From the picture, you can see that she has placed the product offering (library resources) at the centre of the map.

The first tier of the map documents the primary stakeholders for Library resources. The second tier of the map documents what the stakeholders use the
resources for and how they access them. This can help to identify common and unique stakeholder needs and or gaps in delivery so that the services provided can be designed more effectively to deliver them.

As projects develop, and more information becomes available, more detailed or refined project maps can be very useful. In Figure 18.9 you will see an example of a very detailed stakeholder map developed in 2013 as part of a series of community co-design sessions run by the author for Pittwater Council. The participants in these sessions were community and resident group leaders, Local Government Councillors, and senior council staff. It was uncommon for all three to collaborate formally. A series of issues were identified for deeper, more specific co-design sessions. The issue for this session, ‘Tree canopy loss’, is at the centre. The map is divided into quadrants each representing a stakeholder category. The third tier (outside ring) specifies concerns specific to each of the four stakeholder categories. Tiers one and two document possible actions all parties could take.

This visual artefact was used to identify a number of actions that the different stakeholder groups could undertake to respond to tree canopy loss and ways in which policy and actions of council could promote or support these.

Figure 18.9: Stakeholder Map to explore key stakeholders with respect to the issue of tree canopy loss in the Local Government Area of Pittwater, Sydney 2013.
INNOVATION

The process of innovating can be supported with many different visual tools. This section of the chapter will describe a number which have proven successful in the Nexus model.

Ideation

Ideation is a process where ideas or concepts are formed. Under the Nexus model, Ideation is encouraged at all stages of decision making for teams.

Team members are encouraged to develop a toolbox of techniques they are comfortable to use in ideation sessions. Figure 18.10 shows some GSOE9220 students, in their teams, using white boards in the UNSW Engineering Design Studio to ideate their minimum viable products for their start-ups. All ideation sessions have the goal of getting as many ideas, options, possibilities or solutions recorded as possible. Methods and tools encouraged include word clouds, images, video, role play, photography, sketching, drawing and making models.
Sketching and Drawing

Sketching and annotated drawings are very useful in the innovation stages of a project. When sketching, problem solving and design resolution occurs. Sketches can be done collaboratively or by individuals and used to share information, document ideas, track progress, delineate tasks and assign responsibilities.

Figure 18.11: An annotated sketch used by students to design an animatronic lion mascot for UNSW Sydney Marketing.

Figure 18.11 shows an annotated sketch model created by UNSW Engineering students when designing an animatronic, interactive mascot lion for the UNSW marketing team. Whilst the drawing of the lion is not to scale or indicative of the end visual outcome, it does clearly communicate features and functions. Colour has been used to demote functions (black) and technology (red). The students made a number of sketch models as they resolved the design to a production stage.
Prototyping

Whilst sketches are invaluable to identify and resolve many aspects of a project, developing prototypes facilitates testing. Prototypes can be virtual, such as a ‘wire frame’ model of a smartphone application or a web landing page which can test a concept. They can also be tangible, either two dimensional such as a storyboard, or three dimensional, such as a scale or working model. Figure 18.12 shows a team of UNSW GSOE9220 Starting a Start-up students developing a physical prototype for a book translation application. They are using simple materials to do this, and once finished it was used to test the Minimum Viable Product (MVP) their start-up plans to bring to market.
The team then used the feedback from testing this rough prototype to iterate a more refined visual prototype closer to the final end product. Figure 18.13 shows the same team using the prototype to pitch for project support from collaborators and investors.

Prototypes are very useful as projects switch from a development to entrepreneurial phase. They generally mimic or emulate the end functions or features of a product or service and are used to test technology, usability, efficacy, consumer perceptions, aesthetics or establish proof of concept. Prototypes can be used very effectively within the team context to aid in visually and functionally communicating in order to collaborate on iterating a product, or to collaborate with project partners to refine aspects such as design, manufacturing or delivery. From an end-user perspective, they can also be very useful to test traction, design, functionality and usability.

ENTREPRENEURSHIP

The entrepreneurship phase of the Nexus Model concentrates on using tools which assist collaborators to find opportunities, engage with end users, establish markets and secure resources.

Service Design Tools

Many of the tools used come from the field of service design as they are user centred, readily available and usable. Students are directed to http://www.servicedesigntools.org/ as a common resource, a number of tools are also taught in...
class in an action learning context. The three most used at Personas where students develop:

Figure 18.14: Vox Pop conducted as part of a Human Centred Design exercise to establish student expectations of the facilities and services provided by The Michael Crouch Innovation Centre at UNSW.

Figure 18.15: Co-Design conducted as part of a Human Centred Design exercise to establish student expectations of the facilities and services provided by The Michael Crouch Innovation Centre at UNSW. Creating the collaborative response.
Figure 18.16: Co-Design conducted as part of a Human Centred Design exercise to establish student expectations of the facilities and services provided by The Michael Crouch Innovation Centre at UNSW. Negotiating outcomes.

Figure 18.17: Prompted Verbal Statements as part of Human Centred Design exercise to establish student expectations of the facilities and services provided by The Michael Crouch Innovation Centre at UNSW. Creating the collaborative response.
Figure 18.18: Prompted Visual Statements as part of Human Centred Design exercise to establish student expectations of the facilities and services provided by The Michael Crouch Innovation Centre at UNSW. Creating the collaborative response.

**Story Boards**

Figure 18.19: UNSW Business School student services team story boarding a student onboarding strategy at MCIC as part of Design Led Tuesdays Design Thinking workshops 2015.
Figure 18.20: Business Model Canvas produced by a student start up working from the UNSW Engineering Computer Science and Engineering Catapult Co Working Space 2017.

MVP

Figure 18.21: Minimum Viable Product prototype from Island Innovation Lab Vanuatu 2014 student Miriam Grundy.
Reflective Writing in Form of Visual Diary or Blog

Data Visualisation

**Figure 18.22:** Data Visualisations prepared by Island Innovation Lab Palau 2016 Student Martina Calvi as part of her visual diary.

**USING/ADAPTING THE NEXUS MODEL**

The NEXUS model is flexible and versatile. It has been used in many contexts. Short courses, intensive learning programs, start up and innovation weekends, at University with students and with staff, and in community and commercial contexts. A good example of a project delivered under a Nexus model is the I LOVE YOU installation for Vivid Lights 2016.
Figure 18.23: Images for ‘I Love You’ installation for Vivid Lights Sydney 2016. A cross disciplinary UNSW student-led project.

Figure 18.24: Nexus Model for Vivid Lights Collaboration 2015 / 2016.
REFERENCES


Visual Tools for Developing Cross-Disciplinary Collaboration...
Multiple Measures: A Tool for Supporting Interdisciplinary Assessment Design

Dr. Kate Tregloan (The University of Melbourne), Kit Wise (Royal Melbourne Institute of Technology), and Dr. Wendy Fountain (Linneaus University)

Multiple Measures is an Innovation & Discovery research project funded by the Australian Office for Learning and Teaching, and forms the basis of this chapter. (Final report at https://ltr.edu.au/resources/ID14-3909_Monash_Tregloan_Final%20report_2017.pdf). Formally titled Benchmarking Interdisciplinary Assessment tasks in the Creative Arts and Humanities, this project has sought assessment practices that frame, elicit and inform students’ interdisciplinary (ID) understanding, enabling collaboration and innovation. The project draws on Boix Mansilla & Dawes Duraising’s (2007) analysis of quality ID work, including the degree to which it is “grounded in disciplinary insights, advances student understanding through integration, and exhibits critical awareness” (p.222).

The project collected and analysed case studies and has presented these as a library that can be searched via six filters of a bespoke tool. The simple design of coloured search filters provides users with a simple means to translate these complex ideas to other forms of interaction with the resource. The coding of library content, using the same six themes, allows search results to similarly make use of the same visual language. The benchmarking approach again reinforces this approach for evaluation and design development.

The first part of this chapter will outline the six themes defined through the Multiple Measures project, and will describe the operation of the tool and the central role graphic elements play in its effective operation. Identified themes have been arranged as 3 interrelated pairs of questions and focus on: Students, Pedagogy and Learning Outcomes. These act as means to explore and refine engagement with the library of case studies and inform discussion of ID pedagogy and assessment. Multiple learning outcomes were evident in the case studies identified, and were explored through the second pair of questions outlined above. The second half of this chapter will articulate these outcomes in terms of collaboration and innovation, including identifying examples of integrated assessment design that enable these key outcomes.
SECTION 1: MULTIPLE MEASURES OF INTERDISCIPLINARY PEDAGOGY

This chapter focuses on Multiple Measures, an Innovation and Development research project funded by the Australian Government Office for Learning and Teaching (2014-2016). The project focused on the delivery of interdisciplinary (ID) education in the creative arts and humanities. It was developed to support the enhancement of ID assessment approaches through a focus on pedagogy design and the selection of precedent references that can inform its further development. The completed project collected detailed examples from across Australia, making these available via a bespoke online tool. The project was built upon these examples to identify and develop core ID themes, and to develop benchmark parameters with guidelines for their application. (See: www.multiplemeasures.org.au)

The Multiple Measures project, formally titled Benchmarking Interdisciplinary Assessment tasks in the Creative Arts and Humanities, focused on interdisciplinary (ID) activities and learning and teaching innovations from undergraduate to Masters levels across the creative arts and humanities. The project brought together learned colleagues with strong records in education for creative disciplines and drew on the expertise from across Australia, and internationally via the Reference Group.

The project aimed to:

- identify objectives and core values of interdisciplinary approaches by reviewing current engagements, goals and ambitions;
- contribute to a shared understanding of ID assessment standards;
- enhance the ability of staff to develop, articulate and apply assessment approaches and criteria for ID tasks;
- improve the equitable comparison of ID outcomes across institutions.

The project adopted a broad definition of ‘interdisciplinarity’, acknowledging the many forms of disciplinary interaction that this term encompasses, from the multidisciplinary to the transdisciplinary (Davies & Devlin, 2010). Consequently, the project included examples of projects that may not have used the term interdisciplinary per se, but where this was the intention. (For a discussion of the many forms and terms commonly associated with the interdisciplinary, see Wise, 2013).

A comprehensive series of workshops over the two-year project formed a key forum for its development and refinement, and included events in Melbourne, Sydney, Adelaide and Canberra. This series concluded with a workshop and the Australian launch of the website at Monash University in Melbourne in June 2016. Dissemination activities have included a presentation at the Design Research Society International Conference 2016, at the University of Brighton, UK.

The Australian Council of University Art and Design Schools (ACUADS) has been an important feature of the project, offering sustained engagement with a wider community of practice during the development, testing and dissemination of the project and its findings. The first half of this chapter draws upon the paper ‘Multiple Visual Tools for Developing Cross-Disciplinary Collaboration...’

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Measures & Interdisciplinary Adventures: Benchmarking interdisciplinary assessment design in the Creative Arts and Humanities’, presented by Tregloan, Fountain and Wise at the Australian Council of University Art and Design Schools Conference in Brisbane, September 2016.

EXPLORING A LIBRARY OF APPROACHES

The Multiple Measures (MM) website, multiplemeasures.org.au, hosts the interactive visual tool developed through the project. The tool delivers a rich searchable library of ID units/courses/subjects and supports a user to identify relevant examples to inform his/her own design of ID assessment. It features a number of visual devices developed by the project team to facilitate reflective teaching, to assist aligned education design and to inform benchmarking by the user. At the time of writing, the library includes summaries of more than forty-five interdisciplinary teaching engagements collected from across Australia. These “MM Summaries” were developed on the basis of interviews, collected documents, and sample student submissions.

Users of the website can filter the MM library using the three MM themes, or search via keywords. Themes are expressed in the tool as three sets of paired questions or filters that focus on Students; Learning Outcomes; and Pedagogy. This approach aims to support educators already delivering ID content through benchmarking, as well as those who are designing new ID experiences for students.

The library is continuing to grow. A user can submit examples of his/her ID teaching with suggested coding for the six filters. The website also collects anonymous data about searches and outcomes with a view to further extension of this research focus on ID pedagogy and assessment design.

DEVELOPING THE APPROACH

Initial drafts of the MM questions were developed on the basis of literature review, and tested against practitioner surveys and interviews, and submitted materials. The Multiple Measures workshops became very valuable events in the development of project definitions and approaches, the refinement of MM themes and their application in the search approach. Participants in the workshops were engaged educators with recent experience in the delivery of ID education, and have formed a valuable community of practice able to offer considerable experience and key insights to the project.

Workshops were hosted by Australian National University (Canberra, April 2015); Victorian College of the Arts at the University of Melbourne (Melbourne, June 2015); University of South Australia as part of ACUADS (Adelaide, September 2015); University of NSW Art & Design (Sydney, Feb 2016). Early workshops sought participant responses to provocations in the form of discussion papers or unit/subject/course outlines, as well as ‘provocateurs’ with expertise in assessment. Participants in later workshops, including an ACUADS 2015 roundtable, tested drafts of themes and filter questions and early summaries of assessment approaches, and
also tested beta versions of the online tool. Testing, critique and feedback was crucial to further development of these, and included the review of content as well as the design of visual expression and user interaction. Other formal meetings assisted further development of this thinking at UNSW Art & Design; University of Tasmania; Monash University.

As the filters and approach were refined, each MM Summary was coded according to the questions by the project team, using a consensus approach. Coding was an iterative undertaking. Decisions were reviewed and refined as the questions, their conceptualization and their expression were further developed. Coding of each summary was further reviewed at the conclusion of the project and during the development of benchmarking statements.

The visual expression of the coding for each MM Summary is central to the interpretation and use of the tool, and is explored alongside the discussion of content below. Visual expression is straightforward, and aligns the six colours (in pairs) with the six paired filters to assist users in the navigation of the stages of the tool. Users find the filters are applied for various purposes, ie selection; evaluation; benchmarking; design development. The consistent graphic expression assists the connections that inform users application of these ideas.

**FILTERING THE LIBRARY**

In the final version of the Multiple Measures online tool, a series of buttons and sliders allow a user to filter the contents of the library (http://multiplemeasures.org.au/tool/). In this way, s/he can use the MM questions to identify precedent references most relevant to his/her own approach to ID teaching. The filter questions most relevant to a user’s concerns can be used as indicated in the diagram below. The search can also be made by keyword, or it can be unfiltered, accessing the entire library at once. These visual features of the tool will be discussed in further detail below.

![Figure 19.1: Using the MM Filter Questions to search the MM Library.](image-url)
It is important to note that the mode of interaction for users of the MM tool highlights the range and potential combination of responses. These paired questions are not considered mutually exclusive, e.g. educators need not choose between learning outcomes that focus on disciplinary depth or ID skill development. With the exception of Question One (which has multiple ‘radio buttons’), responses are collected via ‘sliders’ on a continuum. Question Two is a two-ended slider, allowing the user to identify both the scope and focus of an identified range.

DETAILS AND DISCUSSION

Background to the questions, framed by relevant literature, is provided for users via popups and PDFs on the tool. Together, the three themes (and six filters) outline an epistemology of interdisciplinary educational practice that can inform and extend ID pedagogy and research in its response to the global concerns of the twenty-first century. This section will provide a brief overview of all of these, while Section 2 of this chapter will explore the second pair, focussed on learning outcomes, in detail.

Students: Questions One and Two

Questions One and Two focus on the students, the levels of expertise they may bring to planned interdisciplinary engagements, and the significance of their disciplinary and cultural backgrounds to the development of new interdisciplinary studies.

Figure 19.2: Slider graphics for Questions One and Two.
Question One: What level of expertise will students bring to their learning?

Are students reliant on external resources or advice for knowledge or have they moved toward discovery and self-authorship in their studies (Hodge et al., 2008)? Although this may not take into account the individual experience of all students or differences between faculties or institutions, the year level(s) of the students can establish an approximation of expertise.

Question Two: What range of expectations will students have of the learning culture?

The student cohort may include students with different ways of engaging with content. Are students accustomed to receiving knowledge as information from educators, and is that knowledge hierarchical and cumulative (usual in ‘hard/abstract’ or ‘high consensus’ disciplines)? By contrast, are students more likely to engage in independent interpretation and construction of knowledge with tutor support (usual in ‘soft/concrete’ or ‘low consensus’ disciplines)? (Biglan, 1973a, 1973b; Kolb, 1981). This question asks users of the tool to consider the range of difference across the cohort when searching for relevant comparators.

Learning Outcomes: Questions Three and Four

This pair of questions asks the education designer to consider the emphasis between disciplinary depth and interdisciplinary breadth. Are the learning outcomes from the course going to help the students perform better in their own disciplinary practice (depth)? Or is the emphasis on gaining skills and knowledge that will enable further interdisciplinary engagement (breadth)? Most courses will be aiming to foster a mix of these outcomes (see discussion in Section 2) but will reflect a stronger desire to achieve one or the other. Independent ‘sliders’ allow educators to consider these agendas separately.
Figure 19.3: Slider graphics for Questions Three and Four.

Question Three: How important is it that each student develops his/her own disciplinary practice/s through this ID activity?

An interdisciplinary approach fostering critical thinking and practical problem solving encourages students to develop their independent practice (Mafe & Webb, 2009). Exposure to other ways of working can allow students to develop more sophisticated responses (Bhana, 2010).

Question Four: How important is it that each student develops skills and abilities to work with others from different disciplines/industries through this ID activity?

The product or outcome produced by students can be treated as the means to develop interdisciplinary engagement skills. In this approach assessment may focus on collaborative, entrepreneurial and presentation skills, or the ability of students to find a common language and deal with ambiguity (Bailey, 2010; Boix Mansilla, 2005; McPeek & Morthland, 2010).

This pair of questions will be addressed in more detail in Section 2 below: Learning Outcomes for Innovation and Collaboration.

**Pedagogy: Questions Five and Six**

These questions focus on the role of students (and educators) in setting the focus or brief for an assessment task, and in decision-making as the task is undertaken.
Question Five: How involved are students in deciding the brief, direction or aims of the assessment task/s?

Will students respond to a defined question / inquiry defined by the teacher that can be answered through the knowledge of the discipline or are they defining their own question, determining how that question might be answered and in turn contributing to/building knowledge of the discipline (Levy, 2009; Levy & Petrulis, 2012). Where will the students’ work fit between these extremes?

Question Six: Is the process for developing or delivering assessment task/s designed by the students or directed by staff?

In the early stages of learning there may be greater emphasis on the development and assessment of process, depending on discipline culture (de la Harpe & Peterson, 2008; Krukauskas & Ward-Perkins, 2014; Winters, 2011).

**Benchmarking for Design Development**

A central aim of the Multiple Measures project is provision of support for educators to develop new ID engagements, informed by current practice. Benchmarking is a formal process of establishing relative performance through the systematic comparison of some aspect of an example with that of other relevant 'partners’ and
offered a useful mechanism. This can be distinguished from the ‘absolute’ response to defined threshold standards. Benchmarking offers scope to focus on design development through reference to richly considered comparators. Recent audits of tertiary institutions have proposed benchmarking as a suitable framework for quality assurance and quality improvement activities (Henderson-Smart et al, p 146). Selection of benchmarking partners is a central concern of benchmarking. (Epper, 1999).

The six filters developed through the project form the basis for self-benchmarking and subsequent development of interdisciplinary assessment approaches in several respects. First, they assist an educator to identify benchmarking ‘partners’ that are relevant to his/her own concerns and intentions; second, they highlight these aspects of selected comparators; and third, they form reference points to consider further development of an ID assessment design.

They offer consistent touchpoints as educators consider key elements of the design of their own assessment design. The use of the colour coding is developed to provide visual consistency to complement the conceptual framing. A graphic coded ‘block’ of the coding for each of the MM Summaries stacks all of the coloured lozenges. The block enables easier interpretation for a user who has become familiar with the significance of the colours and markers of sliders, as well as quick comparison between the coding of multiple summaries.

Alongside each of the visual summaries, a graphic timeline summary is provided of the assessment tasks. These are separately colour coded to reflect the five main assessment task types identified through the review of ID education approaches as part of the project. Hatching indicates group or individual assessments, although it should be noted that many of the tasks were group tasks, but were assessed individually. The tasks on the timeline are arranged to show the length of time (as a proportion of the whole period of delivery) horizontally, and to show the % weighting of the assessment against 100% vertically. Assessment criteria are listed below, with primary criteria shown in bold.

The benchmarking of the MM Summaries, and new proposals considered the ‘constructive alignment’ (Biggs & Tang, 2007) of Learning Outcomes (Q3 & 4), Pedagogy (Q5 & 6), assessment tasks and assessment criteria. The dashed line indicates the linking of these considerations as part of the overall assessment design. The other consideration for benchmarking was the ‘tailoring’ of the assessment design, as a whole, to the Student cohort (Q1 & 2). The yellow lozenges are therefore shown separately but toward the top. An example is shown below, and accompanied by the Overview keys developed to assist users. They ‘float’ as users scroll the content, to assist interpretation.
After a user has applied filters to the library, a short-list of MM summaries allows up to three ‘benchmarking partners’ to be selected. Each summary includes a graphic summary of coding against the six filters and a timeline of assessment tasks and criteria as shown above. The outline and intentions for the unit/course/subject, with details of learning outcomes and assessment approaches are also provided for reference and information, and each summary offers commentary for readers against each of the six filters with respect to the example. These are also colour-coded to assist. In the final element of the tool, the user is presented with space to review these six aspects of his/her assessment design, alongside a graphic reminder of his/her initial slider responses. These allow the user to compare these initial intentions with the selected ‘benchmarking partners’, and to consider further development.
At the conclusion of the benchmarking template, there is space to record plans for further development of the assessment design. These notes can be downloaded as a PDF report, including a user’s notes and comments, graphic representations of his/her slider selections, and full MM summaries and supporting materials. The package brings together all of the applications of the six filters, providing a summary of the educator’s key concerns, alongside examples of others’ responses to matching concerns, and his/her review of the relevance and opportunities of these for further development of the ID assessment design.

SECTION 2: LEARNING OUTCOMES FOR INNOVATION AND COLLABORATION

In this section, we will consider the development of students’ innovation and collaboration skills through both the ‘broadening’ of students’ learning and capacity to work with those from other disciplines, and through the ‘deepening’ of their own disciplinary understanding. Questions 3 and 4 of the Multiple Measures Tool focus on these aspects of students’ learning, as outlined above. AQF Level 7 highlights the value of such activities, stating that students graduating from a Bachelor’s degree are expected to have a “broad and coherent theoretical and technical knowledge with depth in one or more disciplines or areas of practice” (Australian Qualifications Framework, 2013, p. 47).

The attainment of both breadth and depth, here understood as skills associated with collaboration and innovation, aims to value the development of the “T-shaped individual”, whereby graduates “have deep knowledge of one subject (the down stroke of the ‘T’) and broad experience and understanding of other disciplines (the cross-stroke)” (Leonard-Barton, 1995 in Bailey, 2010).

The appropriate balance between depth and breadth is contingent on the students’ stage of learning and personal development (see question 1). At the early stages of an undergraduate degree it may be more appropriate to be focusing on developing skills that will enable students to increase disciplinary depth, such as research skills, and the
use of technologies appropriate to the discipline (de la Harpe & Peterson, 2008; Mafe & Webb, 2009). Those interdisciplinary studies highlighting disciplinary depth may be more suitable at such a stage.

Interdisciplinary engagement allows students to acquire sets of skills and knowledge that can be applied to all successive learning, contributing to the development of disciplinary depth. Disciplinary depth helps to form the cognitive maps (‘paradigms’) and vocabularies necessary to both disciplinary and interdisciplinary studies (Davies & Devlin, 2010). Confidence in one’s disciplinary grounding is also important for further successful interdisciplinary engagement (Bailey, 2010; Boix Mansilla, 2005).

By Master’s level, graduates are expected to have already developed depth, or “expert, specialised cognitive and technical skills in a body of knowledge or practice” (Australian Qualifications Framework, 2013, p. 59). At this level, developing skills for interdisciplinary engagement may be motivated by goals of increasing students’ employability – skills such as communication, teamwork and problem-solving (see http://www.assuringgraduatecapabilities.com/ for examples of graduate capabilities and their support and encouragement according to discipline).

This pair of questions therefore asks the designer of an interdisciplinary course to consider the balance of emphasis between disciplinary depth and interdisciplinary breadth. Are the learning outcomes from the course going to help the students perform better in their own disciplinary practice (depth)? Or is the emphasis on gaining skills and knowledge that will enable further interdisciplinary engagement (breadth)? Most courses aimed to foster a mix of these outcomes, but many reflected a stronger desire to achieve one or the other.

**Depth**

An interdisciplinary approach fostering critical thinking and practical problem solving encourages students to develop their independent practice (Mafe & Webb, 2009). Exposure to other ways of working can allow students to develop more sophisticated responses (Bhana, 2010). Boden identifies the combination of cognitive frameworks as central to the development of innovative design approaches, including those defined as “combinatorial creativity” (Boden, 2005).

These abilities were considered in Question 3 of the Multiple Measures tool:

> How important is it for interdisciplinary activities to further the development or depth of a student’s own practice?

Students’ interdisciplinary engagements have the potential to foster skills and knowledge that contribute to the depth of their practice. This may be through experiencing greater complexity and range, and developing improved critical thinking skills, to contextualise their work. Such engagements can also demand greater independence, and flexibility in both ways of working and the application of new knowledge and skills.
For students to gain a depth of understanding adequate for approaching the complex problems of contemporary society, they must learn how to draw upon multiple sources of knowledge (Boix Mansilla, 2005). Through interdisciplinary engagements students develop a greater ability to approach, conceptualise, define and solve complex problems within their own practice and subsequently in further research or professional realms (Boix Mansilla, 2005; Garner, 2005; Mafe & Webb, 2009; Mahy & Zahedi, 2010).

The nature of interdisciplinary work means that students are required to consider their own discipline in the broader context of knowledge construction, which in turn develops critical thinking skills and self-reflexivity (Mafe & Webb, 2009).

The necessity to consider the viewpoints of other group members and/or stakeholders, prompts students to begin to locate their own point of view in a broader context. This gives students: “the ability to create an integrative framework and a more holistic understanding, (and) (t)he ability to compare and contrast (multiple sources) to reveal patterns and connections” (Klein, 2005, p. 10).

Students are generally expected to build the ability to work independently as they progress through their course of study, such that by the end of the third or fourth year of study graduates “will apply knowledge and skills to demonstrate autonomy, well-developed judgement and responsibility in contexts that require self-directed work and learning” (Australian Qualifications Framework, 2013, p. 47).

Some practitioners adopt interdisciplinary approaches to encourage students’ development of independence early in their studies. In a foundation year visual arts studio, for example, an open-ended interdisciplinary approach encouraged students to independently seek out learning opportunities from their peers who were working with different media and concerns (Mafe & Webb, 2009).

Overall, interdisciplinary engagement is valued for fostering the skills that prompt students to be more flexible in their approach to their studies. Problem-solving skills are enhanced by a need to seek answers beyond disciplinary boundaries, and the understanding of a holistic approach: “What an interdisciplinary course of action does do is compel students to be more literate, adaptable and intellectually flexible” (Bhana, 2010, p. 2).

One indicator of a successful interdisciplinary engagement is the ability of students to flexibly apply the knowledge they have gained, signalling a depth of understanding that may be re-contextualised through application (Boix Mansilla & Dawes Duraising, 2007).

The intensive third year elective, MM1, offers an example in which more flexible thinking and practices are encouraged through a unit of study. Students were exposed to multiple aspects of a new environment in the field. The landscape was explored with others and students worked with their peers to create an individual project in response to the experience.

The student cohort included a broad range of disciplinary backgrounds, from art and design to science majors; they submitted a proposal to the group, and researched and exhibited their final work. An architecture student produced a model for a flat-pack traditional aboriginal wilpy:
“She admitted to me that as an architecture student she had never, ever been taught how to build a traditional … structure that the indigenous people might have built for thousands of years. … (S)he thought outside of the area that she was (in and) … produced something using her skills but something that was really far left of what she would normally be doing as an architecture student” (MM Participant, 2015).

**BREADTH**

The product or outcome produced by students’ learning can be treated as the means to develop interdisciplinary engagement skills. In this approach assessment may focus on collaborative, entrepreneurial and presentation skills, or the ability of students to find a common language and deal with ambiguity (Bailey, 2010; Boix Mansilla, 2005; McPeek & Morthland, 2010). The development of the skills of collaboration was central to the delivery of many learning experiences collected through the Multiple Measures project.

These particular concerns, as expressed in the examples, are reflected in Question 4 of the Multiple Measures Tool:

How important is a focus on the development of students’ abilities to work with others from different disciplines/industries?

It is widely recognised that the success of interdisciplinary engagements is contingent upon students’ development of transferable skills. These include collaboration, teamwork and communication skills, and an ability to tolerate, and work with, ambiguity. Students may be supported to develop these skills during the process of the engagement, or in preparatory learning activities and assessment.

“Effective collaboration amongst students” features among the benchmarking statements that emerged from the Australian Studio Teaching Project (Zehner et al., 2010), and is a key indicator of effective practice in the studio. Interdisciplinary engagement often relies upon effective collaboration in order for the project to succeed, and may be highlighted in targeted learning outcomes.

Where students are asked to work together to solve real-world problems, there is often a need to collaborate with people working in industry and/or the community. Exposure to the working relationships beyond the studio and institution helps to prepare graduates for professional contexts. Project X, for example, introduced students to how they would be likely to collaborate as future professionals – architects, artists and engineers – working together on ‘real world’ projects with other stakeholders (Longbottom et al., 2009).

Teaching collaboration skills is arguably a core component of design pedagogy. In the approach taken by McPeek & Morthland (2010), architecture students actively observed the collaboration occurring in community projects while taking part in them. The emulation of collaborative behaviour was explicitly encouraged, along with valuing the sharing of ideas.
Effective communication of ideas is imperative to successful collaboration, especially if group members don’t share a common disciplinary language. There is real potential for miscommunications to act as a barrier to effective interdisciplinary collaboration (Bailey, 2010; Davies & Devlin, 2010; Klein, 2004). The development of a common language therefore needs explicit focus, with Davies and Devlin (2010, p. 26) suggesting terminology checklists be provided (or co-constructed) for mixed cohorts to clarify key terms and definitions. Similarly, Bailey (2010) encourages students to generate ‘a common language of practice’, as an extension of a community of practice.

Interdisciplinary engagement can work to actively improve students’ communication skills, as Corkery, et al. (2007) highlight in the case of “FBEOutThere!” - an interdisciplinary project of the Faculty of Built Environment at UNSW:

“They (the students) had to listen to what was being said (from a large variety of sources, sometimes conflicting), and then acquire new skills to re-interpret this information into their design-studio format. …The students were then required to present their design schemes back to stakeholders, in a non-academic environment and language, and demonstrate that they had both listened and understood the stakeholders” (Corkery et al., 2007, p. 4).

Students may also benefit from having their conceptions of effective communication challenged when faced with an audience other than their peers. It is critical to engage with information in authentic ways beyond PowerPoint presentations and “talking head” monologues, as Burgett et al. (2011) stress. Students should be tasked with seeking greater understanding between the presenter and audience, and more opportunity for feedback and shared knowledge production.

These authors are also in favour of students taking risks in a safe environment, advocating training in “public speaking, performance techniques, digital storytelling, (and) visual representations of quantitative data” (Burgett et al., 2011, pp. 480-482).

The exemplar, MM5, offers an example of a unit that develops transferable skills to support interdisciplinary engagement. Postgraduate students work in teams to research and conduct comparative analyses of cross-disciplinary projects, and the teams present their findings in a wiki format. The students are assessed on their effective contribution to team discussions, their ability to present information succinctly for an audience, and their contribution to peer reviews.

Ambiguity is another common feature of interdisciplinary engagements, as well as graduate life, requiring students to deal with multiple interpretations and inexactness.

“There is a need to tolerate ambiguity and paradox if they are to take grounded stands in the face of multiple and sometimes conflicting perspectives. The relational skills they gain also foster the ability to adapt knowledge in unexpected and changing contexts. The answers they seek and
the problems they will need to solve as workers, parents, and citizens are not “in the book” (Klein, 2005, p. 10).

Students also bring differing levels of tolerance of ambiguity to interdisciplinary engagements stemming from their respective disciplinary cultures. Bailey (2010) observed the contrasting ways business, design and engineering students dealt with ambiguity in defining problem-spaces and solution-spaces with industry clients. Students were increasingly challenged when faced with greater scope for open-ended exploration and given permission to disrupt through their design proposals.

Ambiguity in this methodological sense is distinct, though related, to the uncertainty posed by socially-engaged interdisciplinary projects. In bringing disparate groups together to solve an agreed-upon social problem, Quinlan et al. (2004) highlighted how the problem itself assisted participants in their tolerance of uncertainty. “In this domain, the community – academics, students and external groups – accept the challenge of uncertainty in constituting new knowledge and shared understanding for social action by moving beyond disciplinary boundaries to interact with other disciplines and their practices in context” (Quinlan et al., 2004, p. 5).

**EXPLORING EXAMPLES**

The Multiple Measures tool provides a collection of case studies that can be used to test these ideas of depth and breadth. To conclude this section, a comparison of specific examples of depth versus breadth-orientated study programs can help refine our understanding of the alignment of learning outcomes and approaches, as well as pointing towards the possibility that they may be pursued simultaneously.

**Depth**

![Image](386)

*Figure 19.8: Art and Life Manipulation (MM18)*

‘Art and Life Manipulation’ (case study MM18) was offered by SymbioticA, School of Anatomy, Physiology & Human Biology, University of Western Australia. As the visual summary indicates: this unit was offered at a Masters level of study. It was open to students from a wide range of learning backgrounds. Developing individual disciplinary expertise (depth) was strongly emphasized in the learning outcomes, with
little emphasis given to general ID skills. The unit pursued a clearly student-driven model of learning, in terms of both the studio process and the brief design.

The learning outcomes identified revolved around ‘innovation’; with additional criteria calling for outcomes that were ‘interdisciplinary, experimental, researched and conceptual’. The pedagogy developed for this unit was based exclusively on individual work and consisted of three streams of assessment tasks. These represented two stages of the project, but were primarily pursued over the full study period (80%). All assessment took place at the end of the study period.

**Breadth**

![Figure 19.9: Unravelling Complexity (MM25)](image)

‘Unravelling Complexity’ (case study MM25) was offered by the Australian National University, Canberra. Again focusing on senior year levels (Honours & above), it was intended for students from a narrower band of educational backgrounds, but favoured higher consensus disciplines (broadly understood as the sciences) as indicated by the Q2 slider.

The learning outcomes and pedagogic approach are markedly different to MM18. Outcomes are generally more open ended and process orientated, suggesting a more discursive model: ‘scholarship’ is the primary qualitative descriptor, followed by ‘effectively communicated, collaborative, insightful and researched’ (although the latter is a feature of both these specific breadth and depth examples). This discursive and collaborative approach is also found in the weighting given to group work (30%). The most striking difference however is the eight strands of the project, with four different study phases and associated progressive assessment. This suggests a carefully scaffolded approach to study; however, as may be expected of advanced students, this scaffolding is developed by the students themselves in regard to both working methods and the specific brief they address.

**The X-Shaped Individual**

A key finding of the Multiple Measures project is the high number of case studies that pursued both depth and breadth. Indeed, the project team found that these far outweighed breadth-only programs. Rather than the more familiar ‘T-shaped’ individual, in which depth and breadth are developed essentially independently, a
number of projects suggested the simultaneous development of depth and breadth through learning: a rounded or X shaped learner.

‘Cross-disciplinary Art & Design’ (case study MM5) is a good example. The first of a series of ID units offered online at, again, Masters level, this project focused on a narrow range of learning backgrounds, here low-consensus disciplines, but valued breadth and depth equally (and highly).

Learning outcomes were arguably closer to depth than breadth objectives, but featured concerns of both: ‘researched’ was the primary descriptor, followed by ‘cross disciplinary, reflective, collaborative, professional and analytical’. However unlike either of the previously examples, the pedagogic approach was strongly staff-driven on both the brief and process (possibly a result of the online mode of delivery). The project was pursued in two main phases, with assessment tasks at the midway and conclusion of the project, while solo and group work was given almost equal weighting. As such, it falls somewhere between the solo, single focus, long duration project of the depth-orientated project, and the scaffolded, multi-parted, partly collaborative approach of the breadth example.

**CONCLUSION**

This chapter has outlined the Multiple Measures project and online tool. The outcomes have been designed to assist the development of good assessment design for interdisciplinary education, and through this, graduates’ capacity for innovation and collaboration. The chapter has outlined the central role of six themes to the benchmarking and design of ID education and assessment. The themes focus on Students; Learning Outcomes; and Pedagogy in approaches to ID education, and have been informed by literature review, field research, and examples collected from across Australia as part of this Australian Government Office for Learning and Teaching funded project. Of these six themes, the chapter has focused on the learning outcomes associated with innovation and collaboration. It has explored how the tool, at multiplemeasures.org.au, supports the review and development of assessment design to this end, and the significant contribution of the design of visual aspects of the tool to support users’ effective engagement.
The Multiple Measures project brought together a number of colleagues with strong records in education for creative disciplines and a focus on interdisciplinarity, and was fortunate to draw on the significant experience offered by a community of practice brought together through workshop events, including via ACUADS. The project has investigated subtle and varied experiences of ID education, and has sought to deliver these in a form that can support and inform best practice as well as pedagogic innovation.

The identification of shared reference points has allowed a comparison that can be used for benchmarking, and expressing these in visual form has supported users to explore in the application of these ideas in multiple modes, as part of filtering; evaluation; benchmarking; and development. The Multiple Measures project offers a new approach to benchmarking and applies this to interdisciplinary education, to respond to the complex challenges of tomorrow. The tool relies for its operation on the effective communication, via text as well as visual means, of subtle ideas in a variety of applications.

The Multiple Measures project was undertaken when Tregloan was affiliated with Monash University, and Wise and Fountain were affiliated with the University of Tasmania. The authors gratefully acknowledge the support of these institutions to the project.

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CHAPTER 20

Self-Directed Experimentation and Reverse Engineering Consumer Products as a Route to Learning about Complex Fluids

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Reverse engineering offers a model of enquiry-based learning in which students can collaborate to investigate how existing, familiar products work and emulate the innovative steps that are central to product development. The reverse engineering process offers a context in which the requisite content knowledge is immediately useful, as well as teaching the relevant experimental and investigative skills required to design and troubleshoot products in industrial laboratories. In this study, final year undergraduate and postgraduate coursework students worked in teams to discover how familiar consumer, household or food products are engineered. The students drew on their backgrounds in chemical engineering and food science/technology to analyse the fluid properties, the underpinning molecular basis for these properties and how these properties were experienced by the end-user of the product. Students were challenged to develop hypotheses about the microstructures within their chosen product and then test these hypotheses by designing and performing simple experiments using only equipment that was to hand in their kitchens. Selected video-based experimental methods were demonstrated to the students who then adapted the protocols to produce and analyse their own video content. The students presented their experimental methods and communicated their findings to the class in presentations and by producing short videos. The reverse engineering activity was found to be a highly successful major assignment as part of the course on complex fluids, offering flexibility for the diverse interests and backgrounds of the students as well as opportunities to explore the field.

INTRODUCTION

Complex fluids are ubiquitous in our daily lives and include both natural and manufactured fluids in foods, drinks, pastes and household products (Hill, 2004; Larson, 1999). As part of degrees in both food science and chemical engineering, it is common to include courses on complex fluids to prepare students for the design, development, manufacture and troubleshooting of fluid formulations. Students often find complex fluids courses can be very enjoyable because they empower students to understand the ‘what’ and also the ‘why’ of the ingredients lists of their favourite
shampoo or salad dressing. An emphasis on the end-user of a product is appropriate in addressing complex fluids formulations: what product attributes does the end-user need and from a formulation point of view, how can they be delivered?

The technical aspects of describing complex fluids rests upon the physics of fluid flow, the chemistry of inter-molecular interactions, the engineering of mixing and also the psychology of sensing and perception (Cosgrove, 2010; Larson, 1999). Flow is central to manufacture of these fluid products, and can be a limiting factor in their cost-efficiency, and many of the same flow complexities seen during large-scale production also affect the perception, aesthetics, and performance of the products at the individual consumer level. A defining characteristic of complex fluids is that there is significant molecular or multiphase microstructure in the 10 nm to 100 µm length scale (Cosgrove, 2010). Multiple phases within the fluid are often used to achieve such structures, viz.: emulsions where one liquid phase is dispersed in another (salad dressing), gas is dispersed in liquid (shaving foam), or solid particles are dispersed in liquid (protein clumps in yoghurt). Large molecules or molecular assemblies including polymers, proteins, self-assembled surfactant micelles and liquid crystals also provide important structures. Analytical methods to measure the sizes and shapes of the structures within complex fluids are necessarily sophisticated and learning how to apply these tools is an important part of a course in the field. While students may enjoy the practical aspects of the course work, courses in complex fluids can be incredibly challenging for students due to the breadth of the field, its multidisciplinary nature and the significant reliance upon learning in foundational courses (Psillos, 1999).

While the components of the fluids themselves are not necessarily complex, the fluid behaviour can certainly be complicated; structures at the length scales described mean that flow behaviour has characteristic time-scales in the 0.1 ms to 1 s range which is then commensurate with our experiential interactions with the fluids (Larson, 1999). Flow properties such as viscosity will depend on how the flow experiment is performed, with the rate of deformation of the fluid (shear rate) and the pressure required to deform the fluid (shear stress) being the key parameters (Larson, 1999). The very nature of macroscopic flow makes visual analysis of the fluids a natural starting point. With suitable data analysis, relatively unsophisticated equipment can provide valuable information about the flow behaviour and from that the microstructural basis can be inferred (Psillos, 1999).

The ability to design and improve fluids for a given application is a highly prized research skill required for innovation in academic and corporate research (Hill, 2004). More often required, however, is troubleshooting of an existing formulation to deal with problems reported by users, issues in production due to changes in raw materials suppliers, regulatory changes or even just requests related to marketing. As distinct to first-principles design, troubleshooting an existing formulation is an exercise in reverse engineering (Wood, Jensen, Bezdek, & Otto, 2001), of deducing the roles of the various components and conducting experiments that can test the structural hypotheses that are developed (Wood et al., 2001). The reverse engineering process must often be undertaken quickly and with limited laboratory resources. In a corporate context, reverse engineering is not about stealing from competitors; reverse
engineering is much more likely to be undertaken on the company’s own product as part of troubleshooting, optimisation or new product innovation activities than it is to be undertaken on a competitor’s product.

The practitioner’s skills are honed through years of experience but it is also relatively easy to create authentic experiences in a teaching context. Here, a set of research-integrated learning activities are described, in which student teams worked to develop simple “Kitchen Chemistry” experiments to reverse engineer complex fluid consumer products. The emphasis of the challenge is to develop simple visual demonstrations of microstructural elements to the complex fluid along with semi-quantitative measures of the consequences of the microstructures. The assessment activities pushed the students to be very visual in their communication of the results.

**LITERATURE REVIEW**

There is considerable discussion in the literature about the benefits of laboratory-based teaching sessions (Arons, 1993; Trumper, 2003). Laboratory classes are expensive in capital expenditure for the facilities and equipment, require a relatively high staff:student ratio, and are difficult to scale with increasing student numbers. While there is significant disagreement about how students learn from laboratory activities and how experimental activities should be designed to facilitate learning, a broadly consistent set of goals for laboratory classes is apparent in the literature (Trumper, 2003). Paraphrasing previous descriptions of the objectives of laboratory-based teaching of introductory physics (AAPT, 1997), we can determine that the goals of laboratories in the complex fluids domain include developing:

1. the art of experimentation: experimental processes and designing investigations
2. experimental and analytical skills: how to handle the samples and the equipment, how to analyse the data
3. conceptual learning: support the mastery of concepts from the complex fluids course work
4. collaborative learning skills: team work is the reality for both industrial and academic research, development and commercialisation activities.

Laboratory-based teaching activities frequently make use of prescriptive laboratory manuals that provide students with experimental recipes that are known to work and are robust to the vagaries of the novice experimentalist. While this closed approach helps students build skills in using lab equipment and confidence in undertaking laboratory activities, students are able to succeed only by following the instructions point-by-point and are trained that there is one right answer to experimental investigations (Trumper, 2003). When following a lab manual, there is frequently little ability to design the investigation (Goal 1, above) and can lead to the students following the experimental procedure cook-book style with limited intellectual engagement and, therefore, often little conceptual learning takes place (Goal 3). For
more advanced level classes, structured laboratory activities can be replaced by open-ended investigations and research-integrated learning activities, with team projects being particularly effective at addressing the communication and conceptual learning goals (Gravett & Petersen, 2002; Gupta, 2004). Helping students develop the ability to design their own experiments that are good enough to obtain the desired outcome, even if not perfect, has practical benefit educationally and also as preparation for the realities of academic and industrial research.

In an interdisciplinary field such as formulated product engineering, it is feasible to undertake many experiments using quite expensive equipment in the pursuit of a clearer understanding of the microstructural basis for the observed behaviour of complex fluids. However, the reality in most academic or industrial laboratory environments is that the finite resources available will limit both the time and the methods that can be sunk into the investigation. One must usually “make do” with the resources to hand, frequently repurposing equipment to undertake different experiments or developing simple pieces of equipment oneself. Closing a line of investigation is a decision that defeats novice and experienced researchers alike, and in the context of industrial innovation, this is a source of tension between technical and business concerns. For small companies in particular, the resource implications of an unsuccessful line of enquiry can result in the failure of the company.

In the learning environment, custom-built equipment that can be disassembled, investigated or used for a purpose different from the manufacturer’s intent is often didactically better than the expensive black box (Arons, 1993). Having students involved in the design of the experimental procedure helps build experimental and investigative skills (Gilbert et al., 2001), with the design of the actual experimental equipment and protocols being a logical extension. It must be recognised that student innovation in developing experimental techniques tends to be limited by their exposure to extant instrumentation and methods, although, with suitable prompting, a team of students can independently ‘discover’ an experimental approach and improve it relatively quickly to become a workable testing protocol (Gilbert et al., 2001).

For the systems of interest to a course in formulations, direct measurement of the nano- or microstructures involved is not going to be possible for the unresourced investigator. It is simply not possible to see or probe nanoparticles directly without significant capital outlay. However, the fluid properties and end-user attributes can be directly probed using relatively simple experiments since these effects are macroscopic in size and visually observable. In both teaching and research, the properties can be easily assessed visually by eye or with a camera. The effects of microstructural elements can thus be seen and, by careful experimentation, the microstructural details can be inferred from bulk, macroscopic measurements.

Measurement of flow through time-lapse photography used to be a highly specialised technique, but tools such as ImageJ (Schindelin, Rueden, Hiner & Eliceiri, 2015) are freely and easily available to students and staff alike (Schindelin et al., 2012). In both research and teaching scenarios, ImageJ can be used to process a video file, create a time-lapse sequence and then measure the extent of flow relatively easily. It is now well within the capabilities of students to produce videos of experiments that can be performed with little equipment generally include following a
moving front of fluid or a moving tracer within the fluid. A simple visual investigation of a fluid is tracing a bead falling through a fluid by means of a time-juxtaposed reslice of the video is an easy method for measuring the sedimentation velocity and hence viscosity of the fluid (Bach, Dragicevic, Archambault, Hurter & Carpendale, 2014); a 1-pixel wide slice from each frame of the video is taken and collated side-by-side (Refer to: Figure: 20.1). Many formulated products (e.g. mayonnaise or cream) exhibit a small yield stress such that with small applied forces there is no flow and the fluids are actually solid-like (Coussot, 2014); a very simple test that demonstrates the presence of a yield stress and permits comparison of different fluids is a slump test (Refer to: Figure: 20.2), whereby a squat column of fluid is allowed to spread under gravity and the shape of the flow profile gives the flow properties (Roussel & Coussot, 2005). There are many similar visual experiments for probing the ‘firmness’ of the fluid (as it would be described by an end-user) and, with universal access to video cameras and significant computational processing power, these experiments are readily undertaken by students or practitioners alike.

Figure 20.1: (a) a series of stills from a video of a bead falling through a liquid over ~60 s; (b) a single pixel slice from each still image is combined to form a time-juxtaposition of the bead falling through the fluid that illustrates the relative viscosity of the fluid; (c) a superposition of frames showing the motion of the bead. Taken from an in-class demonstration for the students in this study and emulated by some of the teams in their reverse engineering projects.

Figure 20.2: (a)-(d) a series of stills from a video of a slump test of some mayonnaise over ~30 s; (e) a single pixel slice from each still image is combined to form a time-juxtaposition that shows the time-evolution of the fluid flow as a plot of total mayonnaise height vs time. Taken from an in-class demonstration for the students in this study and emulated by some of the teams in their reverse engineering projects.
METHODOLOGY

Developing the right combination of experimental skills and abilities to be able to apply the theoretical underpinning to analyse experimental results is clearly a challenge in a single course. With such a broad range of both applications and underpinning sciences, courses in complex fluids also need to cater to a wide range of incoming levels of experience and quite diverse interests. The approach taken here was to challenge students to build an introductory level of experimental competency in very visual analysis techniques, coupled with a suitable theoretical framework by having the students design and perform experiments as part of a reverse engineering effort. Despite the importance of formulated products across many industries there is no single textbook that adequately supports this course.

For the coursework environment in which this study is situated, learning outcomes were achieved using a team-based project that was centred around a complex fluid product of their choice. The activities undertaken by the students included:

- market research to select an appropriate product
- a short literature search to define the chemical and microstructural constituents of the chosen product
- collaboration within their team to define the problems they needed to address in reverse engineering, designing appropriate experiments and methods of analysis
- visual experimentation to test hypotheses and demonstrate the relevant flow behaviours
- communication of progress and final conclusions (in video form) to the rest of the students in regular presentations.

The key inductive steps required of the students were to make the appropriate links between:

- the known chemical constituents of the chosen product and the typical microstructures that entailed (literature based)
- the identified microstructures and the desired end-user attributes (literature and experiential)
- the hypothesised chemical/structural/end-user attributes connection and the experiments they could actually perform that would provide validation.

Self-selected teams of 4 to 5 students were formed around common interests in an individual product or class of products. Some facilitation by teaching staff was needed to help broker compromises to ensure that diverse and appropriately sized teams were formed.
Team interaction was facilitated using the institution’s electronic learning system (Moodle). Each team had a private forum for discussion and a wiki in which they could store or share notes as required.

The teams delivered:

- Presentation 1: in-person overview of the product, its components and its microstructure (5 min.). Presentation aides submitted electronically.
- Presentation 2: in-person overview of the microstructures in the product, including a short video of an experiment the students had performed to demonstrate the presence of the microstructures or the effect of the microstructures (5 min). Presentation aides submitted electronically.
- Presentation 3: video that describes the product, microstructures and shows the experimental reverse engineering of the product (6 min). Presentation aides, video file, video script, allocation of tasks all submitted electronically. Videos also uploaded to public video sharing websites such as YouTube if desired.

Further details of the activities are given in the Appendix. Each team saw half of the other team’s Presentations 1 & 2; all teams saw all videos for Presentation 3.

The three presentations from each team were assessed (15%, 20%, 20% of the final course mark, respectively) by the academic staff; students also completed a self-assessment of their own presentations and a peer assessment of one other team’s presentations with the comments and grades from the self- and peer-assessments being distributed to each team. Teams were encouraged to reflect on their performance and also on the positive attributes of the other presentations they saw. The raw marks from the self- and peer-assessments were not used in the final mark calculation.

PARTICIPANTS

The student cohort involved in this study were the 85 students enrolled in the course “Complex fluids microstructure and rheology” in the 2015 and 2016 academic years. The course is part of the Master of Engineering Science postgraduate coursework degree and is available to students in the Chemical Process Engineering, Food Process Engineering and Food Science and Technology streams. The student group is even more diverse than it may first appear, including not only the postgraduate coursework students (with first degrees in chemical engineering, industrial chemistry and food science), but also postgraduate research students (enrolled in PhD programs in chemical engineering or food science) and high achieving undergraduates (advanced disciplinary electives in their chemical engineering, industrial chemistry and food science programs). The cohort is a mixture of local and international students with the majority being international students in the M Eng Sci programs.
The course is conducted over a 13 week semester with a total of 150 hours of effort from each student expected over that time. The overall assessment for the course comprised of: 3 short tests completed individually (15% of the final course mark each) and the reverse engineering project described here (totalling 55% of the final course mark).

RESULTS AND DISCUSSION

The student engagement with the reverse engineering activities has been consistently high, with students producing high quality visual materials, developing good ideas for the experimental aspects of the project, contextualising the content knowledge of the course into their analyses and collaborating effectively within their teams. Student-produced videos, successfully connected the structures of the products across the many length scales involved. Students constructed the important links between the (invisible) molecular structures, nanoparticles, surfactants, polymers, etc., and the larger microstructures that can be observed with macroscopic measurements and are relevant to the end-user by changing the product attributes including rheology, tack, and mouth-feel.

Student satisfaction in the course is extremely high, with 100% of students agreeing that “Overall, I was satisfied with the quality of this course.” Although less often measured, staff satisfaction with the reverse engineering activity is also very high. Informal feedback from students indicated that the reverse engineering activities provided a solid platform around which the rest of the content was integrated.

While the principal goals of these activities were to develop a practical foundation for the technical content of the course, posing the investigation in the context of “Kitchen Chemistry” was designed to encourage students to think more carefully about what they were trying to illustrate and to break what can be an over-reliance on analytical equipment in the student cohort. As expected, the development of the Kitchen Chemistry experiments by the students was limited by their own experiences in measurement techniques (Gilbert et al., 2001). Throughout the course, demonstrations of simple experiments were shown to the students either live or in video form in the face-to-face meetings; that the demonstrated experiments were going to be used by the students in their own research work helped build engagement with the demonstration beyond the ‘entertainment’ value of the different activity (Crouch, Fagen, Callan & Mazur, 2004). Most of the videos were produced by the authors in their own kitchens in keeping with the spirit of the project work being undertaken by the students. Although often chemical in origin, the Kitchen Chemistry experiments probed very physical effects of flow, like spreading or suspension, enabling a wide range of experiments and visual studies using only digital imaging via phone-camera-level resolution. Significant time was spent discussing with each team the possibilities for investigating their chosen products, reviewing first cuts of videos the students had produced of their experiments, and providing guidance on the technical and visual aspects of their work. With this additional support, some teams were able to develop innovative ways of probing their products, although most teams adopted relatively minor variations of the experiments that were demonstrated to...
them. Even where the students were mimicking experiments demonstrated to them in class, the diversity of product properties they can probe enabled a significant degree of creativity in their choice of focus.

There is considerable disagreement in the literature on whether to allocate students to teams or allow teams to form through self-selection (Oakley, Felder, Brent & Elhajj, 2004); given the diversity in scientific backgrounds in this course, it was decided it was necessary to prioritise student familiarity with the products they were studying (e.g. Food science students selecting food/drink products, Chemical Engineering students selecting synthetic personal care or household products) and so we facilitated students to self-select groups based around common interests in specific products. As an initial exercise for the course, students worked individually to prepare summaries of the components and an informal description of the flow properties of three or four products. A little ‘market research’ in the local shops provided a wide variety of suitable fluid-based products that would be interesting. The students collected the key product information on sticky notes and arranged them on the wall of the room in thematic groups. Most of the time, teams self-assembled as they saw commonalities in their choices; the students were encouraged to assemble diverse teams so that there was a range of different experiences and backgrounds to tackle the interdisciplinary tasks ahead of them.

The distinction between a team and a group was also important in the functioning of the reverse engineering activities (Oakley et al., 2004); the collaborative research context being emulated in these activities is also one of team work rather than individual or group work and so the authenticity of the activities is developed by encouraging team work over group work. Very few parts of the work could be achieved in the “go away and report back” mode of group work, with students working collaboratively in twos or threes for much of the activity. This was particularly true for the experimental and video sections where the complexity of the tasks required multiple people working together. We did note, however, that the subtle difference in language between “group” and “team” was mostly lost on the student cohort.

The first deliverable for the teams is a presentation describing their chosen product and its microstructural details. The desired emphasis is on the microstructural components of the product (e.g. a network of gelated proteins, solid particles of sugar, emulsion drops); however, students from a food science background in particular tended to interpret these requirements as a list of ingredients that went into the process (e.g. eggs, sugar, oil). Successive iterations of this activity have improved the explanation of what is required but the correct language to describe the objectives of this presentation to the students is still yet to be found.

For most students in the cohort, the video produced for Presentation 2 is the first video that they have produced that has been used for assessment; if they have any previous exposure to making a video, it tends only to be the ubiquitous internet “cat video”. This course is not one in cinematography but an important learning outcome is clarity in communication, so we sought to carefully scaffold the development of the communication skills for the students. To help the students build these skills, a few points of advice were offered to help them avoid the most egregious mistakes for
novice video production (see Appendix). The teaching staff also presented a few videos of experiments that had been performed in their own kitchens and both the technical and communication aspects of the videos was discussed. Presentation 2 required the teams to produce a short video showing them doing an experiment that demonstrated something microstructural or rheological about their product. Students saw each other’s presentations and videos and were encouraged to critically analyse what worked well and what didn’t work well about both their own efforts and those of their peers. The improvement in quality of the video work and the clarity of the video presentation improved markedly between Presentations 2 and 3, with notable enhancements in the clarity of visual communication, steadiness of camera work, removal of clutter from the field of view and better control of background noise.

After each presentation, the students were asked to undertake a self-assessment of their work. Students also peer-assessed one other team’s presentations. The aims of these assessments were to develop self-awareness of the quality of their own outputs, to think critically about how to measure the quality of outputs and also to crowdsource some additional feedback to all groups in addition to comments that the teaching staff would provide (Dochy, Segers & Sluijsmans, 1999). While the marks from the peer- and self-assessments were not used in the final marks, the anonymised comments and marking rubrics were provided to the students via the electronic teaching system. The students reported that it was useful to receive this feedback although we were underwhelmed by the quality of comments and the care with which the self- and peer-assessments were prepared. While the cohort may well be experienced learners who will have been exposed to this sort of activity in the past, it has become clear that they are not yet well enough prepared to engage in peer- or self-assessment without additional training and that, in future iterations of these activities, a simpler rubric is required along with a brief discussion about the goals of the exercise (Andrade, 2005).

**PRACTICAL APPLICATION TO RESEARCH TRAINING**

The authenticity of the reverse engineering activity described here is probably its greatest strength in research training for both the future industrial and academic researcher. Students collaborate to develop visual probes to support their reverse engineering activities. In producing videos of experiments, they both measure microstructural/flow properties and also develop the means to communicate their work. The students also had an introduction to a key step to the innovation process in product engineering.

*Training for industrial researchers:* Perhaps the most obvious research tasks that a product developer undertakes when working on food, consumer or household products is the development of new products. The commercial aim is to be better, cheaper, greener, lighter, etc., and the product engineer must deliver innovation within that marketing framework. A detailed understanding of the relationships between molecular, microstructural, fluid and end-user properties is largely beyond what the field can provide at this stage; however, a set of design rules are learnt by
practitioners and employed as part of their design work. The reverse engineering activity described here starts to build an understanding of these design rules for the students and helps them understand the approaches that can be followed in product design or optimisation.

In addition to the development of new products, industrial research activities in complex fluids include a significant amount of troubleshooting of products or production issues. The activities described here very closely match the industrial reality of reverse engineering for troubleshooting, viz what are the characteristics of the product, what is defining these characteristics, what is changing the microstructures and hence properties away from what is desired.

*Training for academic research:* Of the student cohort, a small number were already enrolled in PhD programs within our research groups and some of the coursework students undertook their research projects with us. The students who were already familiar with our laboratories reported that they found the “Kitchen Chemistry” activities quite challenging as they had to ignore the suite of instruments in their normal work environment and instead find new ways to demonstrate the microstructural or fluid properties that they wished to illustrate. The research students also benefited from the breadth of the reverse engineering activity in that it pushed a long way beyond their more narrow research activities. Given that the vast majority of the research students participating in this course will work in industry, the industrially relevant troubleshooting dimension of these activities also provides further useful training.

**CONCLUSIONS**

Teaching the underpinning science and the engineering aspects of colloids and complex fluid flow to a diverse student cohort provides many challenges but also significant opportunities for students to tailor aspects of the course to their interests. The central role of complex fluids in formulated product development makes it an ideal platform for training in visual communication and innovation through a collaborative team environment. The use of an extended self-directed investigation into products chosen by the students offered an authentic exercise for the students to reverse engineer common products. By developing hypotheses linking molecular structures, microstructure and fluid flow within their products, the students engaged deeply with the course content and also learned how to discuss their approach within their teams and the teaching staff. The teams were further challenged to develop visual methods for experimental verification of their hypotheses. The students produced videos, analysed the footage to produce a summary video, and these results were communicated to the whole student body, thereby also broadening the reverse engineering experience beyond a single product.

The weakest aspects of the current implementation of the reverse engineering activity are the self- and peer-assessment of the presentations. Simplified rubrics and additional guidance in the process and desired outcomes of the assessments can be expected to improve engagement.
It is worth noting that, despite the wide use of skills like product design and performance testing in cosmetic, pharmaceutical, food, and consumer product industries, there is no textbook or laboratory manual dealing with these subjects, although texts addressing at least the complex fluid component of this material are becoming more common.

REFERENCES


Consider the chemical and microstructural components of your selected formulated product. Making use of literature data, describe each component of the product in terms of the colloidal phenomena it typically exhibits (it might not actually exhibit them in the product you are studying though). It will not be sufficient to list raw ingredients; you will be required to characterise the molecular, colloidal, and physical phenomena each material exhibits to justify its presence in the product.

**Deliverables:**
- 5 minutes presentation (4 min talking + 1 min for questions) in class from each team
- presentation slides (from Impress, Powerpoint, Keynote etc.) uploaded to the assignment submission activity in Moodle prior to the presentations.

**Indicative hours per person:** 10.

**Presentation 2**

For your selected product, describe the microstructures that are present in the formulation. What behaviours are dominant from the components under different scenarios (e.g. mixing/manufacture, bottling, storage, dispensing, end use)? Describe the microstructures, the consequent rheology and the combined traits.

**Deliverables:**
- 5 minute presentation (4 min talking + 1 min for questions) in class from each team; presentation should include a video element you have created
- presentation slides (from Impress, Powerpoint, Keynote etc) uploaded to the assignment submission activity in Moodle prior to the presentations.
- video element (uploaded via TheBox: see separate notes on uploading videos via TheBox)

**Indicative hours per person:** 10.

**Presentation 3**
For your selected product, show evidence for the microstructures and rheology present. Use one or more of the experimental activities or demonstrations from this course to illustrate the microstructures and their influence.

**Deliverables:**
Each of these is to be uploaded to the assignment submission activity in Moodle prior to screening the videos).

- 6 minute presentation video from each team, uploaded via Moodle to The Box
- presentation slides used in video
- script used for video
- table listing tasks performed by each member of the team over the course of the three presentations

**Indicative hours per person:** 20.

**Video requirements:**
- A short 6-minute video to explain your product, its microstructures and its rheology.
- Show the product.
- Summarise its ingredients from a microstructural perspective.
- Experimentally demonstrate key physicochemical performance phenomena.
- Support assertions in video with literature information.
- The video recording, content, and text must be original.
- The video ends with a list of the group members and any credits (assisting people, references, other assistance received) and this part does not count against the 6 minute total.

**Video presentation tips:**
- Each team will need access to a video recording device: a video camera or digital camera on a tripod is best but even a mobile phone camera will do. Video editing software will also be necessary; good, free choices include:
  - Mac: iMovie
  - Windows: Windows Movie Maker
  - Linux: Kdenlive
- If you want to separately record the audio and video and then join them together afterwards, Audacity is a useful audio editor.
- Write a proper script of what will be in the video, including all of the spoken text and an indication of what will be on screen. A "story board" is a good way of putting it all together. You will submit this script as part of your assessment.
- You have a choice between audio (spoken word) and text (typed) presentation of the information on the product and its properties.
• Be visual! Now is not the time to offer scrolling text to the viewer.
• Be edited! It will be obvious if you just throw together a bunch of first-draft video clips. Look at your videos with a critical eye, practice, improve and re-take videos. Listen to the video for sound quality and excessive background sounds. Watch your video as an observer to note any lack of clarity in the sequence of ideas, the video or the audio.
• Be careful! Make sure the lighting is appropriate, take care of distractions or mess in the background of shots.
Visual Tools for Developing Cross-Disciplinary Collaboration...
Chapter 21

Applied Visual Metaphors in Organisational Management

Jonathan Blackwell (Linebrand)

This chapter offers an applied example of practice-based visual approaches to convey a concept. In this case study visual metaphors initiated in a meeting with the client, were developed between two workshops by Linebrand, in partnership with Identify Corporate Innovations.

In the first workshop, the client requested an exploration into the social dynamics of the workplace. Interviews were conducted and the results indicated a shared interest in exploring behavioral styles. This resulted in a presentation of the traditional behavioral style quadrants with a new metaphor to resonate with the spirit of the remaining creative contract. This metaphor plays on The Renaissance, a period of cultural rebirth appropriate for the context of the workshop and a source of inspiration for the employees.

The second workshop was scheduled as a training session to implement an additional visual metaphor that emerged. In the process of Identify Corporate Innovations writing job descriptions and a new employee manual, the business owner introduced the concept of Work Buckets to explain how work would flow downstream from one team to another. Linebrand developed a visual workflow diagram that was produced as an interactive tool and implemented in the workshop.

Introduction

Working with clients drives a needs-based approach to analyzing inherent needs and devising evidence-based solutions. By working with people and solving problems, creative design is applied and valued as a method of improvement. Following Agile diagrams clockwise with requirements, design, test, and deploy, the process outlined below follows the multiple stages of creative process used by Linebrand, fitting into a regular cycle of client need. Together the two form a closed loop of call and response for each other’s activity. In some cases the client need will call for the creative process, and in some cases the creative process will pull the desire of the client.

This chapter falls in the fourth part of this book, where part (i) focused on visual tools for collaboration, (ii) concentrated on visual tools for innovation, (iii) related to visual tools for entrepreneurship, and (iv) focuses on current integrated approaches. The instance of the applied visual framework developed by Linebrand is literally integral to the client’s business, as it led into, and out of, several meetings and two major workshops, commissioned by the business owners to clarify the changes they desired for their Human Resource (HR) strategy.

While the revised HR strategy implemented by Identify Corporate Innovations (iCi) included rewriting their HR Manual with specific HR consultants, Linebrand as a design and content consultant focused on rewriting the Job Descriptions and creating a visual framework to summarize the changes in roles, titles, and organizational structure. To make this process more engaging, a visual metaphor was established with the business owner to convey these changes graphically.
This chapter will focus on the graphical visual metaphor and how it came out of the workshop processes. Writing of job descriptions and the HR manual will not be the primary focus. They do, however, serve as necessary prerequisites to inform the visual documentation. Whilst Linebrand is additionally engaged in managing online reviews, social media, and website content, these will also remain outside the content of this chapter, as will the details of surveys conducted.

**Client Need: Tip of the Iceberg or Island Hopping**

When Linebrand began work with this client, they were uncertain of the direction their consulting would take. They were given a few key concerns regarding how the staff relate to each other. One way of looking at the early stages of the engagement is to suppose we were either scratching the surface of a deeper underlying problem, like finding the tip of an iceberg, or to re-approach the same area from another angle until the root cause is discovered, similar to exploring an island until its boundaries are understood, only to scan the neighboring island for a conclusive search of the territory.

**Figure 21.3:** Discovering depth of purpose or boundaries of territory in each process.

**First Workshop Retreat: Rebuilding Trust**

The tip of our iceberg in the case of this client was an underlying lack of trust between employees they shared in the survey we issued. The further we analyzed this feature of the client’s culture, the more the iceberg emerged. As anyone who has suffered a lack of trust may agree, the resulting suspicions that formed were toxic to the positive comraderie the collective otherwise possessed. They sincerely wanted to help each other as a team, and as a result they had all been given essentially the same job description. While this would be a good footing for equality on the surface, in an ongoing culture the client agreed that more differentiation was needed and more definition of roles with job descriptions was necessary.
In order to understand more about the business and interrelationships between roles and responsibilities, we planned a workshop retreat in which behavioral styles were covered, showing individuals how they might relate to one of four quadrants regarding how social or analytical they may be on the X axis, with rapid pace versus methodical approaches on the Y axis. The behavioral style workshop, scheduled in the morning, along with corresponding visual exercises, produced the beginning of a new footing for trust and understanding between each individual, highlighting how each person is different and unique, and only together do they make the whole. To make sure the diagrams and methods covered during the morning retreat schedule would stick, we employed a Renaissance theme to fit the culture of the business and to provide a foundation for further design choices.

In the afternoon the team was led in a low ropes course at the retreat center, where their tour guide and trainer adopted the language of our morning session. While the DISC profile would have D, I, S, and C quadrants, this client had Knight, Merchant, Monk and Apothecary to describe the Dominance, Influence, Steadiness, and Conscientiousness behavior styles respective to each quadrant, where Knights are Dominant, Merchants are Influential, Monks have Steadiness and an Apothecary is Conscientious.
In order to plan the job descriptions accurately, our team started with the existing organizational structure. Under the leadership of Identify Corporate Innovations, it was suggested that a new visual metaphor be explored to define the internal functions of the group. While the group are all good at their jobs, by changing job titles and arranging the work visually in a natural flow, our aim was to remove unnecessary overlap between workers and transform a competent group into a high performing team of specialists. With the direction of the client and business owner, a Managing Partner of Linebrand started to develop a visual language to explain the flow of work. Like a flow of water downstream, the owner explained that the work would settle for a time in what were conceived to be buckets, where each team or department shares in a bucket of pooling work. After some effort of exploring alternative titles, the Work Bucket name stuck and the concept diagrams began in drafts.

The final diagram has buckets with color coded rims for each work area, where bucket-colored arrows indicate where each department is linked through team interactions. Dark blue arrows indicate the Director’s stream of supervision. The illustration starts with Market Demand & Activity, and ends with Products, Services & Events. Buckets are labeled to indicate each work team, with some labels added to the arrows.
Figure 21.6: Work Bucket Diagram - Work flows downstream.

**Metaphor in Motion: Work Bucket Workshop**

Once the diagram had reached its ninth draft with various revisions, the twelve job descriptions were also in their first draft of completion, along with a new 50-page HR Manual. With these new documents in circulation amongst the Directors and employees to review, they provided feedback and guidance towards revisions. In this step of the creative process, referring back to Figure 21.2, the matching interval of client need was expressed as a second workshop, to introduce the visual changes we had made to their existing organisational structure. This sent us away preparing the next phase of the creating process, planning to return and deliver the workshop to meet the client need.

Several approaches were discussed as a way to make the workshop interactive and fun, and most importantly as a way to understand the framework created for the staff as a visual tool to understand how they all worked together. We wanted to assure the staff that in some ways their work would remain the same to put them at ease, but
that we had mapped out their interdependencies to provide more clarity, less conflict, and make their jobs working together that much easier.

Before we made our final decision, there were two concepts contending for the workshop format. One was to create physical buckets, where the staff would be required to label the buckets, place names into the buckets, and lay the buckets out in the same order designed to reflect the day to day reality of their work together. While this may have been easier to execute as far as raw materials, it did not fit with the Linebrand approach to brand management and consistency of messaging. As a result, the second option was chosen, to print the visual diagram on poster board, cutting out the graphic elements one by one with an scalpel, and creating a way to stick each element in place, building up the final diagram one person at a time during the workshop.

After this decision had been made in the creative process, our next meeting with the client to assess their needs informed us that the workshop would be split into two groups. This meant that the interactive diagram would have to be created in a way to be fully assembled once, then taken apart and reassembled a second time by a different group of people. This affected the design process by enforcing more order in the structure of how pieces were assembled, as they had to be more sturdy and how the pieces were distributed, as this had to be recorded in such a way as to repackage the material and distribute everything a second time immediately after the first. We printed three versions of the full sized poster: One with primary labels and blank buckets to show where the pieces went, one with full detail which was carved up into pieces, and one which was a fully complete copy for the client to hang in their common area. We showed up on the day with bags label 1-16, giving one bag to each participant in two rounds where they completed the first half of the diagram together, followed by the second half once they’d laid the foundation.

Figure 21.7: Bucket Workshop - Assembling the physical diagram piece by piece
In a parting survey, the team expressed how useful it was to assemble the image together and how much more fun the process was than just being given a completed diagram. Now when the team sees the completed diagram, exactly as it is on paper and an organisational point of reference, they know they essentially designed it themselves. This was the primary motivator for arranging the workshop as it was, to give the collective creative ownership of the actual diagram itself, not an abstract version using physical buckets as had been considered in the ideation phase of workshop planning. Alternative methods could have been useful to make the exercise more kinesthetic, rather than simply sticking the pieces in place, or as we affectionately referred to the process, as “pinning the work on the bucket.”

REFERENCES

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https://www.linkedin.com/in/chuckschaeffer/
Chapter 22

Key Insights for Developing Integrated Visual Approaches for Supporting Collaboration, Innovation and Entrepreneurship Skills Acquisition

Kate Carruthers (UNSW Sydney)

This chapter summarises and reflects on the key insights of the book. The case studies provide examples of how visual tools can be used for developing cross-disciplinary collaboration, innovation and entrepreneurship capacity. It also provides insights into pedagogical and practice-based visual approaches to scaffolding and developing capacity for cross-disciplinary collaboration, innovation and entrepreneurship. Further, a number of theoretical approaches to capacity building, which will benefit practitioners, are developed in the case studies. This chapter also explores some of the potential impacts of new technologies such as virtual reality and augmented reality on the practice of skills development. It also explores some of the implications of these new technologies for teachers and teaching and for professional development.

Visual Tools

Visual tools can be used to support learners, participants or collaborators in the process of sensemaking. They enable them to collect information, to organise, and analyse, and share that information in order to generate knowledge and to inform action. Sensemaking is a social process that is driven by collaboration, discussion, and consensus-building. It is essentially a soft skill. This notion of is an important part of developing skills for collaboration, innovation and entrepreneurship. The ability to acquire skills in innovation and entrepreneurship is critical for future employability particularly in the growing gig economy. The student of today will be expected to have entrepreneurial skills in addition to the domain specific skills relating to their studies. As found in her literature review the key “elements that foster learning and human capital development necessary for an innovative society” are: “(1) the mismatch between formal education and the challenges of an innovative society; (2) the shift from what we learn to how we learn; (3) the fluctuating relationship between digital technologies and contents; (4) the changing conceptions of space-time and the emphasis on lifelong learning; and (5) the development of soft skills.”

While there is little evidence for learning styles in education; there is an increasing preference for the incorporation of visual tools as educators embrace more
constructivist models. With such approaches there is evidence that “visually representing thoughts and relationships of past and newly gained knowledge encourages students to think critically and thus facilitate meaningful learning to take place” (Cottenie & Staempfli, 2016). A study of the literature in science education by Tippett indicates that there is a “shift in emphasis on learning with rather than learning from representations was evident across the three 5-year intervals considered, mirroring a pedagogical shift from science instruction as transmission of information to constructivist approaches in which learners actively negotiate understanding and construct knowledge.” Based upon the case studies presented here, this tendency is across the board and not merely in science education.

Each of the case studies in this volume has harnessed the power of collaborative and creative solutions in a variety of educational contexts, with several extending into a workplace or community context. They have explored cross and transdisciplinary approaches using visualisation tools. They have also adopted co-learning and co-creation techniques. Many were underpinned by techniques, such as design, thinking as a mechanism to drive innovative approaches. Many of the visual tools used were lo-tech or no-tech, and familiar to those who have studied design or business. What is different is their use in co-design, participatory, transdisciplinary and collaborative contexts. They have each demonstrated how visual tools can be incorporated into the educational experience to develop skills in innovation and entrepreneurship.

The Case Studies

The case studies presented in this volume have demonstrated the utility of the visual tools used to build skills in innovation and entrepreneurship. They have also demonstrated how the tools can also be used in other settings, such as in the workplace or in the community, to deliver value. Here we see the interplay between the principles of action learning and design thinking, together with the idea of participatory or collaborative work approaches, using visual tools, to deliver genuinely transformative learning experiences. Drawing together the historical context for visual tools and identifying practical ways in which visual tools can assist in learning, in business and in the community. They draw out the utility of visual tools as scaffolding collaboration skills that are so critical for modern business (Ashman, 2001) and education. Further, they frame the need for integrated practice for successful innovation and entrepreneurship.

Whitton’s (2017) work with the Engaged Learning framework shows how one can use visual techniques in curriculum to develop learning that can benefit “students, the community, and academic staff”. While Thuot-Dube’s (2017) work with the Montreal Museum of Fine Arts demonstrates how the use of cross-curricular approaches can create a “framework for transdisciplinary aesthetic appreciation”. Matthews’ (2017) use of simple visual tools - such as mind maps, Ishikawa diagrams, rich pictures, and force field analysis - for problem framing and problem solving enables students to obtain insights from multiple perspectives as a precursor to identification of possible solutions. Witteveen and Lie (2017) have done interesting work with the film-based learning strategy of Visual Problem Appraisal, which
enables transformative learning as participants come to see that there are multiple framings of reality between the observers and observed.

De Lorenzo and Ashburn (2017) provide an historical insight into a unique studio that enabled communities to develop proposals to improve the built environment of small regional towns. This pioneering project developed meaningful knowledge exchange between the community and students that was based in a cross-disciplinary approach between art, landscape architecture and design at UNSW. The principles enunciated during this project are still in use today at UNSW.

Lofthouse et al. (2017) demonstrate how they used seven visual tools to enhance the teaching of cross-disciplinary teams of students. In particular, they showed the need to develop soft skills to bridge gaps in communication in cross-disciplinary teams. This focus on building soft skills is an interesting by-product of the use of visual tools and is important in preparing students for the workplace.

The work of Kenning (2017) with people living with dementia demonstrates how visual tools together with the principles of participatory and co-design can be used to create positive life experiences. Key to this outcome was a cross-disciplinary team and a commitment to a visual research and analysis approach. This case study demonstrates how the principles and approaches of visual tools can be used innovatively in a community setting.

The work of Kälviäinen (2017) on learning by doing as part of cross-disciplinary innovation courses is instructive in its approach. With its focus on the fuzzy front end, with its ambiguity at the start, the hypothesis is that there are benefits to “applying cross-disciplinary innovation practice since visual both concretises the abstract development discussions and it catches the non-verbal emotional experiences.” This use of visual methods provides support for integration, dialogue and interaction for shared cognition and skills development.

Kueh and Thom (2017) take an interesting theoretical approach to integrate empathy with his Integrated Visual Empathic Design Process to teach empathy to design students at university level. Using visual ethnography, the framework encourages students to learn about empathy through both thinking and doing, again linking the sensemaking with the practical outcomes of innovation. Wechsler (2017), while exploring the enabling roles of specific design artefacts within an innovation project relying on human-centred design methods, also introduces a pedagogical framework. This framework “provides a conceptual tool" to help designers consider the social context of innovation initiatives, enabling them to deliver useful visual tools that scaffold innovation through supporting others to do their work.

The work of Reed (2017) “is motivated by a need for an adaptive and anticipatory model of opportunity seeking by entrepreneurial firms” and he explores the emergent framework of the parabolic scramble. Using the methodology of action learning action research assisted by grounded theory, the parabolic scramble is found to translate easily as a visual tool that can be used to contextualise ‘uncertainty’ in an entrepreneurial context. O’Connor and Roos (2017) discuss their use of Intellectual Capital Visual Tools for entrepreneurial strategy, which are based on the well-known business model canvas tool. They provide a demonstration of the strategy visualisation design tools for entrepreneurial ventures as used in a classroom setting.
This again translates into the development of skills for innovation and entrepreneurship.

The work of Sadowska and Laffy (2017) investigates the effectiveness of using design mock-ups by business learners as part of their development of innovative business opportunities, using design and strategic thinking. They have focused on the impact of participatory action research and found significance in “the purposeful process of making such artefacts as a way to make sense of the innovation”. With his focus on creating a meaningful connection between the campus and industry Dong’s (2017) work in combining the User Experience Design Award into the curriculum together with the visual tools and the practice of rapid prototyping has potential impact well beyond that explored in this paper. As he notes it “can be expected that visuals will play an even [more] pivotal role with the rise of AR and VR applications in the near future”.

Many of the challenges facing the world today are ‘wicked’ problems and visual tools and techniques can provide mechanisms for collaborative sensemaking. Cahill’s (2017) study, distilling twenty years of action research in collaborative innovation, strategy and change, demonstrates how visual tools can provide benefit in “communicating complex systems and solving complex intractable ‘wicked’ problems characterised by uncertainty.”

The case study presented by Bliemel (2017) demonstrated how a ‘flipped classroom’ environment with students of multiple disciplines in an entrepreneurship course, enabled students to see each other’s use of various tools throughout the course had a positive impact on student capacity. Further he shows how the physical attributes and affordances of the space depend less upon the technology, and more upon the physical proximity and immediate visual and auditory access to other students. In fact, one benefit of the PLACE model is that it can continue to function as a teaching space in the case of an IT failure. And it supports student collaboration outside of the classroom – extending the learning space outside of class hours. It also serves to prepare students for the use of open collaborative spaces, which are increasingly prevalent in industry.

Griffith (2017) explores visual tools and techniques that have been developed for use in both undergraduate and post graduate courses. These were intended to facilitate collaboration in innovation and entrepreneurship-based projects in disciplinary diverse cohorts. This chapter draws from disciplines such as design thinking; service design, business, psychology and education practice and demonstrate how they can be iterated to suit the context of the classroom. The author also shares tools that she has developed as well as some tools developed in collaboration with students, thus providing insights to practitioners looking to develop a toolbox for their students, that is flexible and adaptable.

The work of Tregloan, Wise and Fountain (2017) used visual coding to translate complex ideas into other forms of interaction with the Multiple Measures project and online tool. The sought to assess learning outcomes associated with innovation and collaboration, and also demonstrated how the design of visual aspects of the tool supported effective user engagement. The project offers a new approach to benchmarking mediated by visual tools and applies this to interdisciplinary education.
In the work of Prescott and Spicer (2017) they used a novel combination of visual and collaboration techniques together with students designing and executing “simple experiments [about complex fluids] using only equipment that was to hand in their kitchens”. The students were then given an opportunity to make a video reporting their findings. By having the students develop their hypotheses prior to designing and executing their experiments there was deeper engagement with the course content.

Blakewell demonstrates how tools like DISC (Slowikowski, 2005) can be used as the start of a visual metaphor to drive organisational change. Further, the use of the visualization of the 'work buckets' and the adoption of a kinaesthetic technique to enable the participants to feel a sense of collective ownership of the outputs goes to the heart of why these techniques work.

In these case studies we can see the value provided by visual tools and their use within a context of participatory experiential learning for innovation. We also see the benefits arising from the development of collaboration and soft skills that are so critical to the workplace today. Each in their own way contributes to the body of knowledge that demonstrates the criticality of visual tools in developing skills for entrepreneurship and innovation.

**SOME FUTURE DIRECTIONS**

Each of the case studies in this volume has used 20th century technology, yet we are now in the 21st century. We are seeing digital technologies playing an increasingly important role in education, and have seen the emergence of scholarly articles about digital pedagogies (Prensky, 2001). As McLoughlin and Lee noted (2008), in the post web 2.0 world we have technologies that more easily enable learner centred models. However there are some emerging digital technologies that will shift how we teach – virtual reality (VR), augmented reality (AR), 3D printing, social media and gaming. There are many opportunities that these emerging technologies provide for educators. There remains little evidence for generational differences (Lai and Hong, 2015) in the use of technology by students. With the advent of VR and AR in education this will drive different approaches and visualisation techniques will evolve with them. Along with the anticipated growth in AR and VR we can expect to see increased gamification of learning. Of interest in this context is the work of Bliemel and Alí-Hassan (2014) with game-based experiential leaning in an online Management Information System Management class. They integrate playing of the IT Manager 3 game with reflective questions, and the learning outcomes indicate that the desired lessons regarding being an IT Manager have been learned by students as a result of playing the game. This is an interesting combination of visual tools – the game – and reflective practice.

Edutech, or educational technology, is evolving fast in response to the need to engage the so-called digital native students that are coming through now. Universities are doing this in response to falling class attendances and low rates of online course completion. However, many institutions are moving to a computer centric model that does not meet the expectations of smartphone wielding students. Further, institutions are seeking to reduce staffing requirements by shifting to online delivery. There are
challenges with the online models that are being adopted, for example, they are predicated on accessing the learning via computer when the average young person’s primary technology is the mobile phone. Further, the computer based online model requires students to work alone rather than to collaborate, when in terms of workplace readiness students need to learn how to collaborate and share knowledge and experiences. This means that we need to develop mechanisms to enable students to collaborate effectively when engaged in online learning.

**VIRTUAL REALITY**

Virtual Reality (VR)s is a visual tool that will revolutionise how we can teach and collaborate. We have had VR environments available for most of the century to date, but they have been clunky to use, expensive to develop and not easy for students to access. VR is an immersive media experience that is starting to become commoditised, and it will merge with responsive 3D platforms like as Minecraft (2017) and ROBLOX (2017), where children routinely construct immersive 3D content for consumption by their peers. With the ability to merge user-generated content with an immersive media experience educators of the future will have a rich visual toolset to use.

Educators have had access to a virtual world via Second Life since the early 2003 and it has provided a constructivist environment for education (Girvan et al., 2013), however it was not a fully immersive world. While there are many reports of successful course delivery, Second Life did not become ubiquitous. This is due to a combination of factors; but chiefly that the average teacher cannot easily know how to create educational material for consumption within the virtual world. But now, with the emerging commercially available technologies for VR, this is a viable technology to consider for the average classroom. It is this nexus between costs and utility that is required for the technology to reach scale.

Many of the features that have contributed to Second Life’s longevity – such as allowing users to not only create their own avatars, but also to shape and create the world they are in, but also the ability to import their own 3D assets and modify the world with the Linden Scripting Language (2017) - are now possible with commercially available VR applications and hardware. There are now many startups that enable users to create their own VR applications within minutes such as InstaVR (2017), create an entire virtual lecture hall such as Immersive VR Education (2017) or to immerse students in a virtual story such as, Alchemy - Virtual Reality storytelling (2017) that relates to their education. The new VR applications use commercially available hardware such as Facebook’s Oculus Rift, Leap Motion (2017) and other major vendors such as Samsung, Google, Sony and HTC. The growth of consumer access to VR is borne out by examples like the New York Times and their 2015 VR project (Somaiya, 2015) that saw them distribute more than a million Google Cardboard VR viewers. The critical shift is in the affordability and availability of the VR applications and hardware. For example, in 2015 Google Expeditions (2017) released their enables teachers to access everything they need to take their class on a virtual trip (at the time of writing the cost of all hardware for a class of 10 is
US$3,999). The opportunity cost for VR is coming down dramatically, both in skills required by teachers and the cost of the technology.

Evidence based studies indicate the utility of VR for education. For example, in a 2002 study of surgical residents “VR surgical simulation to reach specific target criteria significantly improved the OR performance of residents” (Seymour et al., 2002). The ability to provide students with simulacra of real world environments, especially laboratories and operating theatres will drive changes in how we teach. VR also offers the opportunities for students to collaborate remotely within the VR environment. The affordances provided by VR will give rise to new visual tools and to new visual languages in similar ways to those that have developed in gaming. We can see precursors of this phenomenon in studies such as Song et al. (2012) in their work with visual metaphors and hand position with Microsoft Kinect sensors.

**Augmented Reality**

Augmented reality (AR) is already changing how teaching happens. There are a plethora of new startups embracing this kind of technology. It is enabling educators to combine gamification and AR technology to provide collaborative learning experiences. O’Shea and Elliott (2016) define AR as “an immersive environment through which digital content is displayed over the real-world, using a technological medium (such as a smartphone or tablet computer)”. They go on to discuss some of the barriers to developing good educational AR applications, and to identify the primary barrier to successful educational AR application development, namely “the disconnect between the individuals who have the technical expertise to build the apps but lack knowledge of educational pedagogy and the individuals with pedagogical expertise by no technical proficiency” (O’Shea & Elliott, 2016). This disconnect is real and is only growing. It highlights an emerging need for proficient educational developers who also have knowledge of the particular domain. During a recent engineering educational application development project we discovered a dearth of educational developers with undergraduate physics knowledge. This can have real impacts on the abilities of institutions to deliver effective AR and online applications, particularly in fields such as engineering and the sciences.

A good example of how AR is being used in the field is a startup called arludo. A Senior Lecturer at UNSW Sydney, Michael Kasumovic, has developed an AR application called arludo that is being used to teach science. The application arludo contains various games for teaching science, which use visualisation techniques in a gaming metaphor. In one game Kasumovic reports: “The final approach arludo uses in their games is allowing students the opportunity to make mistakes in experimental situations. In their game Reservoir Crabs, students work in games to design and perform an experiment. In many biology practicals when students are tasked in designing and carrying out an experiment with real animals, they are doomed to fail because they have never performed such an experiment before, they have never handled animals thus leading to increased stress for the students and animals, and they are often working in a group for the first time. But Reservoir Crabs involves using augmented reality crabs that ‘behave’ the exact same way each time. Thus, when
students handle the augmented reality tags and pair two males to fight, they get the exact same outcome. The major benefit is if that students design an experiment incorrectly, because the data collection is performed quickly, redesigning the experiment and collecting the data is simple and efficient, making mistakes a learning opportunity rather than a chore” (Kasumovic, 2016). Here the visual cues that are typically provided in ‘real life’ are delivered in a game-like context, with the effect that students learn by failure before attempting the experiment in ‘real life’. An additional benefit is that students are using their mobile phones for the experiment, a tool with which they are familiar.

**IMPLICATIONS FOR TEACHERS AND TEACHING**

The use of visual tools is likely to increase as educators respond to workplace needs for students who can synthesise inputs from various sources and who have the soft skills necessary for successful collaboration. Further, the increased need for students to be able to develop creative solutions and to demonstrate skills of innovation and entrepreneurship means that we need to provide educational experiences to support this.

The reliance on cloud services to deliver the educational technology means than when the service is not available then teachers will need to provide an educationally relevant alternative – for example when Google Drive had an outage (Lardinois, 2017) Google Expedition was also not available.

Keeping in touch with lo-tech and no-tech forms of visualisation tools can provide benefits – not merely in terms of what to do if the cloud goes down, but also in changing the nature of the experience for learners. It has been noted that in three studies “students who took notes on laptops performed worse on conceptual questions than students who took notes longhand” (Mueller & Oppenheimer, 2014). This is supported by examples like the moveable sticky notes used by Probst et al. (2014) whereby learning is improved with physical interaction with the medium, that is the moving of sticky notes around. Visual tools can support the physicalisation of the experience allowing students to embody their experience.

**Implications for Higher Education**

Visual tools need to be seen as part of the tool kit for educators. They are an important part of developing students who are ready for modern workplaces that are using approaches like design thinking, and collaborative or participatory design techniques to deliver innovation. This has implications for how institutions educate their teachers, and teacher training will need to incorporate visual tools.

With the growth in AR and VR, there will be increased capital cost to deliver these new technologies and it will come at a time when education is facing cost pressures and disruption. Further, the education of teachers does not traditionally include education in technology. This means that development of ancillary roles, such as educational developers, will become critical to achieving scale. Educational
institutions will need to ensure that they have the skills to develop pedagogically sound applications.

The growth of commercially available applications and visual tools also opens up educational institutions to disruptions from the startup sector. The opportunity for startups to develop pedagogically sound applications and to displace traditional educational institutions in the market is a real possibility.

REFERENCES


developing student capacity for cross-disciplinary collaboration, innovation and entrepreneurship (1st ed.). Champaign, Illinois: Common Ground.


Visual Tools for Developing Cross-Disciplinary Collaboration, Innovation and Entrepreneurship Capacity identifies and documents pedagogical and practice-based visual approaches to scaffolding and developing these capacities in your classes, with your clients or in your teams. The editors have selected a diverse range of best practice case studies and theoretical frameworks from leading international educators and practitioners across a broad range of disciplines to illustrate how visual tools can be used to greatest effect. Divided into four logically sequenced sections, the book will progressively build upon the array of visual tools you can employ in your practice. Initially starting with tools for collaboration it expands to include ways to overcome the challenges of cross-disciplinary collaboration. Building on this foundation you will then explore visual tools for stimulating and supporting Innovation in classrooms, with clients and customers, or your team. The third section introduces strategies for selecting visual tools to aid in Entrepreneurship and entrepreneurial activities. The final section provides you with case studies of fully integrated practice where teams have collaborated to innovate and bring the resultant outputs to market. Visual Tools for Developing Cross-Disciplinary Collaboration, Innovation and Entrepreneurship Capacity is the perfect companion for an educator, facilitator or practitioner to help students, clients or teams maximize their potential through the use of visual tools. Read cover to cover or dip in as you need to.

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