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THE EFFECTIVENESS OF DESIGN THINKING TECHNIQUES TO ENHANCE UNDERGRADUATE STUDENT LEARNING

DESIGN THINKING | ACTION LEARNING | META-COGNITION | ACTION RESEARCH



ABSTRACT

STUDENTS HAVE ACCESS TO AN EVER-INCREASING QUANTITY AND DIVERSITY OF INFORMATION, PRESENTED TO THEM IN MULTIPLE FORMATS; THE CHALLENGE FOR THEM IS TO IDENTIFY AND USE THIS DATA EFFECTIVELY. MANY UNDERGRADUATE STUDENTS EXPERIENCE DIFFICULTIES IN MANAGING THE KNOWLEDGE THAT THEY GATHER, IN RECOGNISING THE QUALITY AND AUTHENTICITY OF THIS INFORMATION, AND IN ASSESSING THE IMPORTANCE AND PRIORITY OF DATA. THIS THEREFORE REQUIRES THE DEVELOPMENT OF STRATEGIES TO SUPPORT THEIR LEARNING.

This paper explores the potential for using design thinking tools and techniques to enhance the learning of creative industries undergraduate students. Design thinking is an approach to problem solving that is a collaborative, iterative and reflexive process (Brown 2008), and as such is closely aligned to action research and action learning. Using an action research methodology, workshops were developed to encourage and support the students in the formulation and development of their ideas for case studies, dissertations and major projects. The workshops were conducted with successive cohorts of final year fashion business students.

Within the series of workshops students engaged with collaborative tools and techniques of design thinking, drawing from their prior knowledge and experiences of work and placements to contribute to the development of each other's ideas and concepts. The paper documents the outcomes of the workshops, how the group discussion and subsequent reflective activities, with peers and individually, motivated and supported students in the development of their individual projects. The iterative process of presenting their ideas and how this supported the development of communication skills will also be discussed.

This study has demonstrated the importance of action learning in a collaborative context to the development of student learning and metacognition. The collaborative tools of design thinking have the potential for application not only to collective projects, but can also be used for the benefit of individual student projects. Design thinking offers a strategy for tutors to engage their students in reflection, to encourage students to integrate their knowledge and experience, to demonstrate the benefits of collaboration and to build students' communication skills. The development of these abilities and skills is fundamental to the readiness of students for employment upon graduation.

CONTEXT

The continual growth of resources available to students provides both opportunity and challenges. Managing data, which is varied in quality and authenticity, is becoming increasingly challenging for students, particularly within a context of problem solving, creativity and innovation.

The researcher's experience of leading group tutorials for textile design

students, over a period of ten years, encountered the considerable potential of tutorials for the constructive and creative development of individual student research projects. Providing opportunities for collective discussion of gathered data, common issues and ideas sharing. Tutorials offer a constructive and supportive environment for student learning.

The subsequent development of the BA (Hons) Fashion and Textile Buying Management programme aimed to provide a learning environment to support and engage students with an appropriate balance of creativity and business acumen. The teaching and learning strategies previously developed for design students offered a platform from which to build a learning environment to engage students in a creative approach to developing research strategies and problem solving. Although not practice-based, Fashion and Textile Buying Management students are highly creative in their approach. As such the assessment strategy for this course is weighted heavily towards project work. To support this project work, in particular the final year Major Project, group tutorial-based learning was adopted and practised for a number of years.

Sometimes Major Project group tutorials worked extremely well and at other times less so. Where it worked well students were generous and supportive, the group discussion providing insightful and constructive suggestions. They are considerably less effective where students perceived an obligation to bring tangible evidence of development to the tutorials. This is notably more difficult for students who are not engaged in the development and creation of artefacts and therefore, are more likely to bring examples and accounts of information gathered.

The conventional tutor-led group tutorial provides an environment for constructive discussion to support the management of information. However, the tutorials lacked consistency in their effectiveness and appropriateness for some fashion management students. This has prompted the search for a more effective learning strategy to support the knowledge management and learning of these students.

Knowledge management for researchers consists of making connections among ideas, integrating new information into what we already know, developing new ideas, and bringing knowledge from the depths towards the surface, where it's ready to be transformed into information.

(Orna & Stevens 2009: 14)

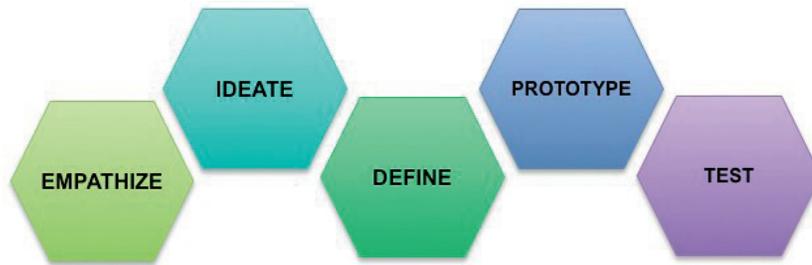
The development of these skills can be directly linked to graduate employability. According to the Department for Business Innovation & Skills (BIS) (2013), important benefit is gained from increased employability and skills development. Employers value graduates because they:

- Challenge how things are done and come at things from a different perspective
- Use their initiative and act without waiting for instruction
- Problem solving and operate with flexibility
- Assimilate knowledge quickly and bring new ideas and energy (BIS 2013: 49)

These skills are embodied in the concept of design thinking.

DESIGN THINKING

Research into design methods has evolved to establish the nature of design thinking as a human-centred approach with particular concern for



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the nature of the problem, notably those that are complex and ill-defined, termed ‘wicked problems’ (Buchanan 1992, Cross 2001). The view of design as an activity of changing existing situations into preferred ones established by Simon (1996) is wider and more inclusive. This has subsequently been developed with the application of design thinking from a human-centred approach to the innovation of products to encompass strategic decision-making in business and social innovation (Melles et al. 2015). For example, as evidenced by the work of Tim Brown (2008) as Chief Executive Officer of the design agency IDEO and Roger Martin (2009). A number of discourses have been identified from design thinking as a mechanism of reflective practice, to an activity to create meaning, to a way of problem solving (Melles et al. 2015, Johannsson-Sköldberg et al. 2013). Although there has been an increase in the implementation of learning and teaching in design thinking, published research is still relatively limited.

The design thinking process is described as an iterative process informed by reflection and one that relies on hunches resonating with the work of Martin (2009). The identification of this collaborative, iterative and reflexive process,

during action or retrospectively, establishes the foundational elements of design thinking. Much of this research originates within the fields of architecture, industrial design and engineering (Dym et al. 2005, Lawson 1997, Rowe 1987). This problem-solving process as identified by Brown (2008) and Brown and Katz (2009), becomes visualised in three modes: inspiration, ideation and implementation. This is not regarded as a linear process, but offers the opportunity to cycle through modes to improve problem definition and to achieve more sophisticated solutions (Brown 2008, Brown & Katz 2009). Related to this, Drews’ (2009: 39) research found that:

A design thinking mindset includes the urge to create something new; to challenge the given problem; to be comfortable with ambiguity; to connect with people; to create multiple solutions using various methods; and to visualize intangible concepts, models or ideas.

Kelley (2001) and Kelley et al. (2006) concurrently developed this human-centred, multi-disciplinary and collaborative process within IDEO and within an educational context in the post-graduate d.School at Stanford University Institute for Design (see figure 1).

There has been considerable development in the explicit use of design thinking within teaching and learning, primarily within the design subject area at undergraduate level, becoming broader in scope at post-graduate level.

Acknowledging recent developments in higher education, Melles & Mistic (2011: 4) note that there are currently four broad approaches: ‘...design thinking as course logic, e.g. Masters in design thinking; within a course as a discrete program unit; as individual seminars or lectures; or a combination of any of the above as a general philosophy for schools’. The integration of design thinking within education from primary to post-graduate, from design specialist to non-design specialist has prompted developments in both curricula and strategy.

ACTION LEARNING

The concept of learning has evolved during the 20th century from the work of Piaget (1952) which has led to a focus on the active role of the learner as a sense-maker. This constructivist view has been further developed to highlight the role of context in which cognition and learning take place (de Corte 2010: 41). Driscoll (1994, cited in Downing et al. 2007, Downing

DESIGN THINKING FACILITATES THE OPPORTUNITY FOR UTILISING AND BUILDING ON EXPERIENCE, LEARNING THROUGH SOCIAL INTERACTION AND REFLECTION WITHIN AN ITERATIVE, AND CONSEQUENTLY LESS RISK AVERSE PROCESS, WITH THE AIM TO BUILD CREATIVE CONFIDENCE.

et al. 2009) identifies three basic principles on which cognitive theorists generally agree:

1. The learning environment should support the activity of the learner (i.e. an active, discovery-orientated environment);
2. The learner's interactions with peers are an important source of cognitive development (i.e. peer learning and social negotiation);
3. Instructional strategies that make learners aware of conflicts and inconsistencies in their thinking promote cognitive development (i.e. problem-solving and Socratic dialogue).

Further to this McWilliam (2009: 291) states that 'Active engagement reflects the learning preferences of the current student' (McWilliam, 2009). It can therefore be proposed that a learner-centred approach that is active, inclusive of social interaction and focused on problem solving, offers a valuable learning model.

Within education design thinking is most frequently observed as a progressive, stepped process with the opportunity to cycle backwards as well as forwards through the steps. Different competencies are developed throughout the steps such as communication skills, analytical skills,

capability of adopting perspectives and empathy. The collaborative nature of design thinking develops cognition by building on '...the shared cognitive processes, appropriating what was carried out in collaboration to extend existing knowledge and skills' (Rogoff 1990: 141). Dewey (1916) advocates activity-guided problem solving to facilitate education, the context of real-world problem solving in a project based approach. Design thinking not only addresses these needs but also enriches the experience through social interaction. The iterative and reflective nature of this interaction offers opportunities for more experimental 'ideation' (Brown 2008, Brown & Katz 2009) and more error-tolerant modes of engagement.

Active engagement is identified as learning suited to the preferences of the current student. Therefore the 'real-life' problem-solving context of design thinking combined with active engagement provides an effective active learning opportunity. Design thinking additionally facilitates the opportunity for utilising and building on experience, learning through social interaction and reflection within an iterative, and consequently less risk averse process, with the aim to build creative confidence. Students' conceptions of their learning are an essential element of effective learning.

...the challenge for teachers is to help undergraduate students develop skills that will not become obsolete. As such, metacognitive strategies are essential for the twenty first century because they will enable students to successfully cope with new situations, and the challenges of lifelong learning.

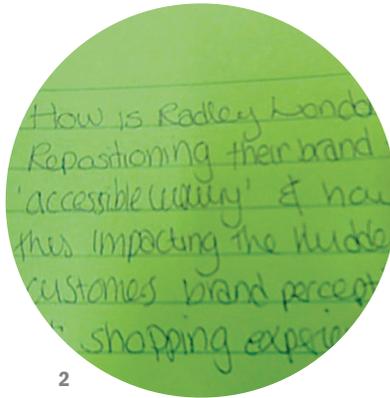
(Downing et al. 2007: 11)

The reflective and iterative nature of design thinking provides this opportunity to students.

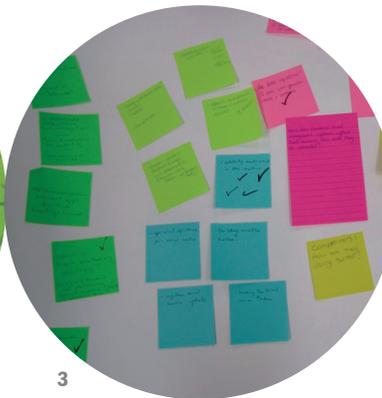
METHODS

Within a framework of action research, an action learning approach was taken. There are clear parallels between the processes of action research, action learning and design thinking in that they are participatory, iterative and reflexive. Action learning as a continuous process of learning and reflection is facilitated through the iterative steps of the design thinking process. The collaborative context of action research is equally fundamental to design thinking.

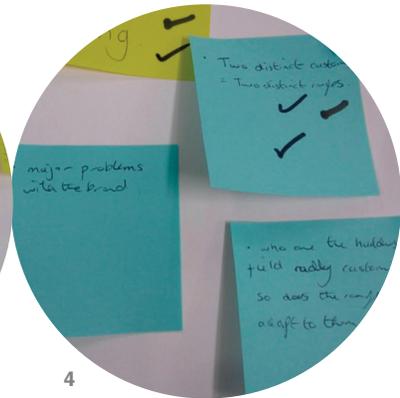
Purposive sampling identified the population for the study. The participants were the researcher, a fellow tutor and final year students from cohorts in two successive academic years. The majority of each cohort had previously undertaken a placement year before the final year of the course.



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DESIGNING THE WORKSHOPS

There are varied methods of approach to design thinking education practice. However, in the main, these comprise of, introduction to the concept of design thinking through literature review prior to the practical application of methods. Design thinking is normally a collaborative activity by a group working towards a common goal. This research seeks to establish the application of collaborative working to support the individual outcomes of students. Methods, and process to an extent, are identified typically through use of resources developed by IDEO and the d.School at Stanford. An analysis was undertaken to identify themes between the following sources:

- d.school bootcamp bootleg document and process model (d.school 2015)
- IDEO design thinking for educators (IDEO 2011)
- Design thinking process model - Harvard Business Review (Brown 2008)

- Designing for Growth: A Design Thinking Toolkit for Managers (Liedtka and Ogilvie 2011).

Four themes emerged: generating ideas, synthesis, enhancing research and reflection.

From these themes appropriate tools and techniques were selected, the following criteria were used to make the selection:

- That the techniques be appropriate to the stage the students were at in the development of their research projects;
- That the techniques provided an opportunity for students to 'build' ideas and subsequently develop their individual subject.

The techniques that resulted from this process were:

- Storytell;
- Brainstorm;
- Voting;
- Feedback & Capture.

The selection of modules in which to situate the workshops was based

on those in which the assessment required students to self-select their own topic and to plan, execute and report their research findings on an individual basis: case study, dissertation and major project. The workshops were situated in three action cycles. The participants in the first and second cycle were the first action set of students, in the third cycle the second action set of students participated. Each set had the opportunity to repeat the design thinking techniques for each individual assessment. Within the workshops the process followed four sequential steps: storytell, brainstorm, voting, concluding with feedback and capture.

Storytell – students were asked to individually describe the key focus of their research on large post-it notes. Participants were then divided into groups of approximately six to eight students. Students placed their 'storytell' post-it note in the centre of a large sheet of paper then briefly described, verbally, the focus of their research (figure 2).



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Key to template symbols:

- Things you like, find notable / positive put in the upper left (+)
- Constructive criticism in the upper right (Δ)
- Questions that have been raised go in the lower left (?)
- Ideas that have emerged go into the lower right (💡)

Brainstorm – this element required the student participants of the group to contribute thoughts and ideas on the subject of the ‘storytell’. The ideas contributed were recorded informally on post-it notes positioned on the A1 sheets of paper (figure 3).

Voting – on completion of each storytell and collaborative brainstorm the large sheets with post-it notes were laid out across the tables. All the participants were then offered the opportunity to ‘vote’ for three ideas, per sheet, voting for ideas that they judged to contribute most to the topic (figure 4).

Feedback & Capture – this was a systematic tool for reflection on feedback and what had been learned from the collaborative discussion and voting exercises. Students were provided with a template and asked to construct their own grids and to use these to reflect on the feedback contributed (figures 5 and 6).

DESIGN THINKING WORKSHOPS – METHODS OF EVALUATION

Observation notes were made by the researcher and the fellow tutor / observer. Immediately on conclusion of the sessions students were invited to give feedback on their experience of the workshops. Large post-it notes were supplied to the students for them to record individual, reflective commentary on the practice and experience of participating in the workshop. These were used to reflect the open-ended, un-restricted approach of the workshop, and therefore to encourage and capture a broad spectrum of responses.

FINDINGS

Positive student responses indicated that the design thinking workshops and the tools employed proved to be a helpful experience, and one that they wished to repeat to support further projects. This was exemplified by the student comment ‘Really helpful exercise. I think it would be useful for

dissertation and major project early on’. Other students noted the potential benefits of using the tools during projects as well as at the beginning: ‘Could be done a couple of times to help at different stages of the project’. A considerable majority of respondents found the techniques beneficial for the case study, for the dissertation this increased slightly for the first action set and for the major project a more notable increase was recorded for both sets (figure 7).

DESIGN THINKING TOOLS

Evaluation of the design thinking tools was overall positive. A considerable majority of respondents viewed the design thinking tools as being beneficial for all three assignments. The tools of ‘storytell’ and in particular ‘brainstorm’ were identified as being the most helpful for projects. The majority of respondents regarded the ‘voting’ tool as ‘neutral’. ‘Feedback & Capture’ received the greatest range of responses but the majority regarded this as helpful overall.

	FIRST ACTION SET	SECOND ACTION SET
CASE STUDY	82.3%	75%
DISSERTATION	88.2%	75%
MAJOR PROJECT	94.1%	100%

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DESIGN THINKING OFFERS A STRATEGY FOR TUTORS TO: ENGAGE THEIR STUDENTS IN REFLECTION, ENCOURAGE STUDENTS TO INTEGRATE THEIR KNOWLEDGE AND EXPERIENCE, DEMONSTRATE THE BENEFITS OF COLLABORATION AND BUILD STUDENTS' COMMUNICATION SKILLS.

STORYTELL

Students perceived the articulation of their ideas to others to be helpful, prompting the formulation and development of their ideas: 'Encouraged to think in terms of a viable idea', 'Helps to structure the idea in your head by explaining it aloud'.

BRAINSTORM

Students were observed to be very engaged during this activity, making full and effective use of the time allowed for the task. Some students 'sneaked' post-it notes onto the brainstorming sheet under discussion without verbally articulating their point, thus allowing them to make a contribution even if initially, they lacked the confidence to verbalise their point. Some wrote notes, acting as scribe for others, to allow them to talk more easily, practically aiding the discussion.

Comments on the collaborative brainstorm noted value and proposed more extensive use: 'Loved it. Should do this on every project – even first year stuff'. Of particular value was the collaborative aspect: 'It was great to get feedback from other classmates to see what their opinions were and to build ideas', 'Gathers different opinions and perspectives previously not thought [of]'.

VOTING

In comparison the voting tool was viewed less positively by the first action set. However, improvements to the

technique resulted in a more positive response from the second action set. All participants, including tutors, took part in the voting exercise, the second action set had the benefit of additional post-it notes. Feedback on this development was positive: 'Useful to let other people add ideas when voting', 'like that the whole group gives feedback.' Increasing confidence was also perceived as a benefit: 'Helps to make us more confident about our idea and shape it better.'

FEEDBACK & CAPTURE

Although 'Feedback & Capture' was positively regarded by most, some students would have preferred to develop their own categories for the quadrants: 'It was sometimes hard to categorize ideas in these four areas'. However, a number of benefits were noted: 'See common themes and areas that need further development', 'Develop[s] triangulation', 'Feedback capture grid – very easy way to [show] new results and to put points in categories and relevance', 'Excellent. Allowed ideas to be organised from the beginning', 'Gave my idea structure.'

GENERATING IDEAS

Student responses indicated that the activities were beneficial in respect of the quantity and the quality of ideas generated. Also noted was the positive impact of the speed by which this was accomplished. Comments demonstrated that not only were ideas generated but limitations were

also considered: 'Very helpful in generating a lot of initial ideas as well as [identifying] problems', 'Really helpful, I came away with lots of new ideas', and 'Gives new directions and focus points', '...best idea generating tool I've ever used...'. In particular, the expansion of ideas was commented on: 'It all helped me think of alternative ideas and not have tunnel vision', 'Great to get ideas from people with different experiences in the industry'. A caveat is noted in one comment: 'With dissertation I found it slightly confusing and overwhelming having so much input'.

Some students found that they were more open in their perspective: 'I am much more creative, open to think outside of box...', 'I am more open to more ideas now, before if I had an idea I would stick with it and not consider better ideas.'

DEVELOPMENT AND MANAGEMENT OF IDEAS

Student comments related to the development and management of their ideas and information were positive, one student offered a clearly considered view: 'A mechanism to strategically organise all your thoughts that are circulating and manage your progression'. Viability was an objective indicated by a further comment: 'My ideas were very broad before these but it helped me see which looked best and most viable'. An interesting comment saw the value in varied feedback: 'Negative feedback was the most helpful to see what I should avoid.'

The benefit of the identification of limitations was noted: 'If someone put an idea that was off tangent, I would know that was a boundary'. However, this also provided challenges: 'This framework allows you to consider limitless avenues for exploration, therefore may prove difficult in anticipating the limitations of possibly

a weaker idea due to volume of ideas...'. The collaborative benefits were appreciated: 'Got me thinking about ideas I probably wouldn't have had on my own'.

Another comment indicates the opportunity for reflection in the development of ideas: 'Your project is personal and sometimes your thoughts can be biased but this method allows you to take a step back'.

COMMUNICATION

The increased experience of presentation of their ideas developed student confidence in their communication skills: 'Much more confident, believe in my ideas more...', '...more confidence in presenting and sharing after doing so regularly'. Collaboration developed students' communication with others, listening to others, sharing ideas, giving feedback and consideration of what others needed to know: 'By listening to the way others expressed ideas has allowed me to communicate mine more clearly', '...it encouraged me to share ideas'.

MANAGING INFORMATION

A significant number of students identified that the activities were beneficial to their organisation and management of information: 'Very useful organisational tool...' 'Really helped to organise information in the way that we did'. Slightly fewer students perceived benefit to the quality of information gathered. The majority perceived the workshops to have expanded their sources of information. The development of organisational skills was noted: 'I feel more organized after the sessions, it gets you off to a good start...', 'I'm much more organised - I do more planning...', '...over the course of final year my planning has improved loads'.

COLLABORATION

The aspect of collaboration gained more feedback than any other aspect.

For some there was initial difficulty and apprehension with the idea of collaborating: 'I thought I wouldn't like it, but I found it really helpful and enabled me to grow my projects in ways I didn't expect...'. 'I was unsure at first but now that I see the benefits I think it is a great thing to do.' In particular students valued contributions that expanded and developed their work: 'Extremely beneficial to gain alternative views and ideas on your subject', 'It has helped me realise how important it is to ask other people's opinions at the ideas stage and not just at the end of the project'.

One comment captured the breadth of application: 'Talking through ideas with peers helps anticipate limitations / areas to focus on', '[I] think the design thinking has opened up more research methods and 'community' thinking'. However, one comment was cautionary: 'It was really helpful at the initial point of thinking, but less towards the end as people concentrate on tangents that are not the main point of projects.'

Students related the importance and value of collaboration to the work place and their future working practice: 'Collaboration is the most important aspect of project management...', 'I will definitely ask for other people's contributions in future as I feel this has helped develop my project', 'Love it! Going to continue this in my work life'.

Students noted the impact on their confidence: 'Very good, helpful, confidence boosting, interesting to hear other's ideas - very good!', 'Very helpful and positive - gives a confidence boost'.

The democratic nature of the activities was observed: 'This should be used in team projects as an effective way for everyone's ideas to be heard'. Working with different people to gain new perspectives was valued; one

student recommended extending the activities beyond their own course: '... collaborating with different courses would be a good idea'.

MOTIVATION

All respondents noted that the activities had been helpful in motivating them to develop their projects. One student comment noted the practical impact: 'Very pro-active after the sessions'. Another noted the impetus provided: 'It got us more involved and pushed us into starting to develop ideas in an enjoyable way.' Further comments expanded on this: 'I've got loads of ideas now and excited to start researching more...', 'Made me want to start, gave me motivation', 'Excites you when people engage and are positive about your ideas'.

STUDENT REFLECTION

Themes were identified in the student reflection on their self-learning:

COLLABORATION:

'I believe I really enjoy helping others with their projects and believe with the useful help I have given I have got it back from them in return.'

'I can take feedback well and I am often able to respond accordingly.'

'I realise I handle criticism well, I appreciate the opinions of others to improve my work.'

PREPARATION AND PLANNING:

'I work best under pressure the design techniques deadlines forced me to project ideas.'

'I start projects a lot earlier and think about them earlier than I did in first and second year.'

THE DEVELOPMENT AND MANAGEMENT OF IDEAS:

'Found it useful to brainstorm all thoughts in order to evaluate them collectively.'

'I have learned to take a step back and have become very analytical of my ideas'. 'Enabled me to think more critically.'

One respondent identified opportunity for development: 'Take too much on initially [I] need to be more specific'.

PRESENTATION AND COMMUNICATION SKILLS:

'It has improved my presentation skills.'

'It's given me more confidence in presenting and change my openness about sharing ideas.'

CONFIDENCE:

'My confidence in the ability to develop ideas has improved, this is a great confidence builder!'

RECOMMENDATIONS FOR THE DEVELOPMENT OF WORKSHOPS

Demonstrating active participation in the action research process, the students included a number of recommendations for the development of the workshops:

- Group sizes were recommended to be no larger than six
- Groups were encouraged to include new members
- Students were given the option to add to / to amend their original 'storytell' between the 'brainstorm' and 'voting'
- In the introductory talk students were made aware of the feedback capture quadrants so that they could, if appropriate consider them during 'brainstorm'
- Participants were advised to use orange post-its for notes added during voting stage to identify them separately from those contributed during the brainstorm.

PEER OBSERVER / FELLOW TUTOR OBSERVATION

Reflecting on the impact on student work, the tutor observed that '...the activities have empowered the students, they have grown in confidence and therefore delivered some outstanding projects'. She believes that the students are happy to work collaboratively on each other's individual projects '... as long as it is reciprocal'. Although the students are '...competitive, benchmarking themselves against one another', they '...share their resources and pool resources really successfully'. They gain the benefits of being a mentor, '...growing in their own confidence [by] being generous with their resources'. The student engagement in this reflection was observed: 'This type of mentoring process is reflective in nature, a positive process for the students'.

The effect of placement and workplace experience on students contribution was noted: 'You can see them reflecting on the resources that they have, they filter it, drawing on this wealth of resources, sieving out the best bits to contribute'. The tutor observed that the students talk very freely, building on their own and others ideas. Also, the impact of the activities on students' ability to manage information was enhanced. The tutor's has found evidence of this impact on subsequent project management sessions that she delivers to these groups of students. Increasingly she needs to '...do less on project management, the development of the student's idea is further on.' 'Before this project (the activities) started there were a number of students who underperformed in both the description of their idea and their project management'. She observes that they have now developed tangible skills in project management, notably in managing their resources.

**THROUGH THE APPLICATION OF DESIGN THINKING,
STUDENTS HAVE THE OPPORTUNITIES TO DEVELOP A
SKILL SET BEYOND THOSE IN TRADITIONAL SETTINGS.
THE DEVELOPMENT OF THESE CREATIVE ABILITIES
AND SKILLS IS FUNDAMENTAL TO THE READINESS OF
STUDENTS FOR EMPLOYMENT ON GRADUATION.**

DISCUSSION

The close alignment of the common characteristics of collaboration, iteration, reflexivity and a concern for change, between action research, action learning and design thinking have been of benefit to this research project. Levin's (2003, cited in Coghlan & Brannick 2014: 167) framework, devised to explore quality in action research has equal application to the evaluation of quality in design thinking. This framework identifies four criteria for evaluation: participation, real-life problems, joint-meaning construction and workable outcomes (Levin 2003).

The participants engaged constructively in both the action research process, the design thinking activities. For example, the request for individual reflection at the end of each activity is a natural extension of the design thinking process. The willingness of students and fellow tutors to share their reflections and experience has been beneficial to the learning of all participants. The expectation of reciprocity is not articulated but observed. This expectation may be a difficulty for those less comfortable with collaboration. However, student comments suggest that this apprehension can be overcome through iteration.

The problem addressed by this research, to enhance student skills

and learning in the management of information and problem solving, is directly related to the prominent issue of student employability, therefore a very 'real-life' issue. The problem solving and problem setting core of design thinking engages the students as they seek support to develop ideas for projects. The iterative reflection, selection and analytical elements has supported not only the generation, but also the development and organisation of ideas. Evaluating the outcomes as a workable solution, design thinking tools were found to be flexible, in that they could be integrated at the point of student need; they could be easily repeated and they could be extended and adapted in line with the development stage of student projects. The critical issue of whether the foundation of design thinking, collaborative working, could be adapted to suit individual outcomes reached a positive conclusion. Students enjoyed the activities, their commitment to contribute and in turn gain benefit was evident to those observing. The opportunity for students to reflect and draw from their experience in the workplace and during work placement provided a wider view of current industry practice for all participants. The benefits extended beyond those intended, to develop confidence, motivation and communication skills, all equally

valuable for subsequent employment. The number of comments received in relation to repetition support the view that the design thinking workshops are sustainable. The students themselves identified opportunities for further development, both incrementally to the tools and more fundamentally to introduce other courses to become multi-disciplinary, aligned with the traditions of design thinking.

CONCLUSION

This study has demonstrated the importance of action learning in a collaborative context to the development of student learning and metacognition. The collaborative tools of design thinking have the potential for application not only to collective projects, but can also be used for the benefit of individual student projects. Design thinking offers a strategy for tutors to: engage their students in reflection, encourage students to integrate their knowledge and experience, demonstrate the benefits of collaboration and build students' communication skills. Through the application of design thinking, students have the opportunities to develop a skill set beyond those in traditional settings. The development of these creative abilities and skills is fundamental to the readiness of students for employment on graduation.

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FIGURE CAPTIONS AND CREDITS

Figure 1: Design Thinking Process – adapted from d.school Stanford University Institute for Design.

Figure 2: Storytell.

Figure 3: Brainstorm.

Figure 4: Voting.

Figure 5: Feedback & Capture.

Figure 6: Feedback & Capture.

Figure 7: Number of respondents who found the techniques helpful or very helpful by assignment.