Design as a catalyst for engaging students in creative problem solving

Final Report

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Project site: <www.creativity-project.net>

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List of acronyms used

CPS   Creative Problem Solving

DBR   Design-Based Research

GQs   Graduate Qualities (also referred to as Graduate Attributes)

HE   Higher Education

JCU   James Cook University

PBL   Problem Based Learning

RMIT   RMIT University

UCT   The University of Cape Town

UNE   University of New England

UoA   The University of Adelaide

UniSA University of South Australia

Executive summary

This project addressed an identified need to support academics in the design and redevelopment of curricula in which creativity is embedded and serves as a catalyst for engaging students in the creative problem solving process (CPS).

Project aims

The project aimed to achieve this through the design and development of a CPS framework and open source online CPS tools (*Ingenium*) to act as a scaffold for academics in the development and redevelopment of courses (*Ingenium Teacher's Tool*) and a CPS tool for students (*Ingenium Student's Tool*) to guide them through the creative problem solving process in their coursework. The project also aimed to develop guidelines for academics and students, trials of the use of CPS in courses across a range of disciplinary fields and a suite of resources available via the project site. Through an engaged dissemination approach, the project sought to have an impact on the wider higher education sector.

Research approach

A design-based research (DBR) approach was adopted to develop a CPS framework and open source suite of CPS tools for academics, students and researchers. The DBR approach involved an iterative approach incorporating design of the CPS tools, trialling the tools in courses, evaluating the academic and student experience in those courses and then redesigning the tools based on the formative feedback. The CPS tools were developed as open source applications to enable them to be adapted to different institutional contexts and to ensure long term sustainability through further developments by the open source community. Formative feedback was obtained from academics and students via an anonymous online survey identifying the benefits and challenges in following the creative problem solving approach as well as the usability of the tools developed for teachers and students (see Appendix A for copy of research instruments). The research method included interviews with academics who trialled the tools and resources at the conclusion of the project to identify guidelines to assist other academics wishing to embed CPS in their curriculum. These guidelines were also informed by analysis of the trials developed through the trials and the findings from focus groups conducted at an employers' forum facilitated by the Career Services Team from the Learning and Teaching Unit at the University of South Australia.

The primary methods for evaluation of *Ingenium* were online and paper-based anonymous surveys for both the teachers and students participating in the trials, as well as teacher reflections on the experiences of their students and semi-structured interviews conducted with academics at the completion of the trials. The project website and CPS tools were also subjected to auditing for accessibility against the World Wide Web Consortium's (W3C) Web Content Accessibility Guidelines to ensure compliance at Double AA standards. An independent summative evaluation was undertaken by Ms Deanne Gannaway, Manager of the Evaluation Unit, at The University of Queensland. This summative evaluation included review of the project site and deliverables, review of project documentation and communication and interviews conducted with project team members and academics participating in the trials. Ms Gannaway's recommendations have been incorporated into the recommendations section of this report.

Trials of the CPS framework and tools

The CPS framework and tools were trialled in 12 courses across different disciplines and levels at several universities including the following courses: *Introduction to Digital Media* (UniSA), *Idea Generation Methods for Designers* (UniSA), *Mechanical Engineering Practice* (UniSA), *Creative and Accountable Marketing* (UniSA), *Festivals and Events* (UniSA), *Entrepreneurship Innovation* (University of Adelaide), *Principles and Practices of eLearning, Issues in Learning with ICT, Social Computing Tools, ICT Across the Curriculum*, (UNE) and *Develop Vision and System Installation Plans* (RMIT). Three trials are continuing in Health Sciences related disciplines including the School of Nursing and Midwifery at Flinders University and the School of Occupational Therapy at The University of Cape Town (South Africa).

Guidelines for academics

The trials and findings from teacher and student evaluations as well as the rich-thick data obtained from semi-structured interviews with the teachers at the completion of their courses informed the creation of a practitioner's handbook, which incorporates pedagogical guidelines and trials showcasing the effective use of the CPS system. An accompanying guide for students was also developed through the project and can be downloaded from the project website.

Project outcomes

The project achieved the following outcomes:

- enhancement of practical knowledge and understanding of the use of creative problem solving in the higher education curriculum

- an increase in the embedding of creative problem solving activities in curricula materials in the courses trialled

- cross-sector collaboration leading to the development of a CPS system that is flexible enough for use across a range of disciplinary contexts.

Dissemination approach

The dissemination activities facilitated and promoted through the project website (Ingenium), social media (Facebook (http://www.facebook.com/unearthingideas), YouTube (http://www.youtube.com/user/IngeniumUniSA/videos?view=0) and via HERDSA, ASCILITE and the Australian Virtual Worlds Working group, combined with national and international workshops, seminars, webinars and peer reviewed conference presentations and publications has ensured wide participation and contribution to as well as awareness of the project.

Recommendations

The following recommendations are clustered into three main areas:

1. Recommendations for further development of the tools and resources identified through trials, student and academic formative feedback and summative feedback

provided by academics through semi-structured interviews completed at the completion of the project;

2. Recommendations for better preparing graduates to be able to demonstrate and articulate creativity skills in professional practice and employment identified through focus groups conducted at an employers' forum;

3. Recommendations for continuing engagement with the higher education sector to promote uptake of the creative problem solving approach across disciplinary areas, as well as further areas for research identified through the independent evaluation.

1.   Further development of creative problem solving tools and resources

Analysis of trials and interviews with academics conducted at the end of the project identified the following further areas of development:

- All academics participating in the trials of the CPS tools commented on the usefulness of the introductory sessions given by project team member Ron Corso and it was suggested that a short video that could be played in lectures or put online for students for the next time the course is run could be produced.

- Some participants felt that they still struggled with assessment of creativity and would have liked more guidance on how to incorporate creativity into assessment.

- Some information about the importance of creativity, some examples and comments from employers would have made the introductory pages more interesting and engaging.

- Video vignettes of coordinators sharing their approach and experiences using the teacher tool and/or research tool and their students' use of the student tool would be valuable to provide short, but inspiring examples of practice.

- Similarly several academics suggested the benefits of including a few video vignettes with students discussing how they used the tool to support their creative approach.

- Academics also felt that it would be beneficial to have scenarios relating to a broader array of topics, for example IT, product design, health issues and business opportunities.

- Some academics suggested that the 'Contact Us' page could include all of the project team and particular areas of expertise or interest, so that those interested knew who to contact. Current photos of the team members and affiliations would be useful for those seeking further information.

- Academics from the School of Nursing and Midwifery, Flinders University expressed interest in further collaboration as a potential extension project that would focus on exploring the benefits as well as challenges in embedding creative problem solving in health sciences curricula and developing custom resources of particular relevance to the health science related professions.

2.   Recommendations for better preparing graduates for the workplace

Feedback from employers identified several factors that impact on how well graduates entering their profession are work-ready, particularly with respect to their ability to

articulate and apply creative problem solving in professional practice. Key findings suggest the following strategies that can be adopted by universities to better prepare graduates for the workplace:

- Provide work integrated learning opportunities, mentoring programmes and internships to better prepare graduates for the workplace.

- Encourage students to participate in extra-curricular activities such as societies, cultural integration, industry partnerships involving students and academics to help develop graduates' generic skills.

- Consider alternative assessment approaches to provide a balance - rewards and recognitions need to extend beyond grades.

3.   Recommendations for continuing awareness and areas for further research

The following recommendations have been proposed by the independent evaluator, Ms Deanne Gannaway:

1. That a change management project be undertaken that focuses on transforming the understanding of the place of creative problem solving in higher education teaching and learning.

2. That a robust summative evaluation strategy be developed to consider the kind of evidence that is required to convince potential adopters.

3. That the project team continue to engage in awareness raising activities on an ongoing basis.

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Chapter 1: Introduction

The central role that creativity plays in education and as the driver of social and economic success was highlighted in a report published in response to the Australia 2020 Summit held in 2008, which acknowledges that 'creativity, interpretation, innovation and cultural understanding are all sought after skills in the industries of the 21st century' (Responding to the Australia 2020 Summit, 2009, p. 193). Yet as Professor Erica McWilliam noted in her final Australian Learning and Teaching Council (ALTC) Associate Fellowship report in 2007, while 75 per cent of Australia's universities describe and list 'creative' student outcomes in their teaching and learning plans and graduate attribute lists, 'creativity is not an explicit strategy or approach to practices of learning and teaching' (McWilliam 2007b, p. 4). While there have been several notable ALTC funded projects addressing creativity at the disciplinary level since that time (Baker & Buckley, 2009; Elliot et al, 2010; Phillips, Stock & Vincs, 2008; Webb et al, 2008), as well as the ALTC Learning and Teaching Academic Standards: Creative and Performing Arts project, the CreateED: Strengthening Learning and Teaching in the Creative Arts Disciplines Project, and Examination of Doctoral Degrees in Creative Arts: Process, Practice and Standards Project, there have been no known projects specifically addressing the need for a framework and supporting online system designed to guide academics across a range of disciplinary fields, and those engaged in cross-disciplinary teaching, in the development or redevelopment of curricula in which creativity is embedded to facilitate learner engagement in the creative problem solving process.

This collaborative project undertaken by the University of South Australia (UniSA), The University of Adelaide, the RMIT University (RMIT), James Cook University (JCU), the University of New England (UNE) and Massey University in consultation with Professor Fredric Kropp (Monterey Institute of International Studies, Graduate School of Middlebury College, US) and our national reference group members, aimed to address this gap through the design and development of a creative problem solving (CPS) framework and associated online system to support academics in the development and redevelopment of curricula in which design is embedded and serves as a catalyst for engaging students in creative problem solving.

The project has addressed several priority areas of the Innovation and Development Grants programme, with the major focus being on curriculum renewal and innovation in development in learning and teaching through the use of new technologies. The project also focuses on issues of emerging and continuing importance by developing strategies to support teachers and learners in ways that foster creativity in the higher education curriculum across a wide range of disciplinary areas. As the Australia 2020 Summit Report affirms, creativity '. . . is one of the greatest contributors to productivity in the 21st century' (Responding to the Australia 2020 Summit, 2009, p. 20).

Chapter 2: Background

The need for a more creative workforce, one that is able to respond to complex and uncertain times, is a recurring theme in the literature (Craft, 2006; Florida, 2003; McWilliam, 2007a; Pink, 2006). It is argued that the key to economic growth necessitates both the ability to attract such a creative workforce as well as the ability to translate this advantage into new ideas, business generation, and economic growth (Florida, 2003). Creativity and innovation are therefore seen as crucial to the success of businesses in the networked information society of the 21st Century.

The demands of our increasingly complex world and the challenge of responding to uncertainty require a different set of graduate attributes. This represents a radical departure from the routine problem solving tasks that have characterised the information age (Florida, 2003). The marketing firms of the 21st Century, the 'conceptual age' as Florida calls it, require graduates who are able to undertake creative work in environments that are increasingly dependent on digital technologies (Cunningham, 2006) and who can make effective use of customer relationship management using social media, while also responding to the demands of the 'product-innovation-diffusion-stasis cycles of economic production' (McWilliam, 2007b, p. 5). Yet, despite consensus about these changing workforce demands, there is compelling evidence that universities are failing to equip our graduates with the creative skills they require to be effective in the 21st Century workplace (College learning for the new global century: Executive summary with employers' views on learning outcomes and assessment approaches 2008; Craft, 2006; Employer Satisfaction with Graduate Skills: Research Report, 2000; Iioka, 2010; Lincoln, 2010; Robinson, 1998, 2001; Schlee, 2009; Tosey, 2006).

In what has come to be regarded as a seminal presentation to the American Psychological Association, Guildford (1950) drew attention to the lack of research addressing the creative aspects of personality, arguing that since a creative act is an instance of learning, a comprehensive learning theory must take into account both insight and creative activity (p. 446). Guildford further pointed to the demand from industry and government for graduates with leadership skills who demonstrate the ability to lead, plan, and inspire vision. Craft (2006) suggests 'Surviving and thriving in the twenty-first century require a sort of 'personal effectiveness' in coping well with unknown territory and in recognising and making choices" (p. 19) and creative capacity building can empower workers to "persevere in the face of complexity and unresolvability' (McWilliam and Haukka, 2008, p. 660).

However, while many universities acknowledge the importance of creativity within the curriculum (McWilliam, 2007b), most programmes are structured around achieving certain graduate qualities that elevate traditional education methodologies and practice based on knowledge acquisition and retention, rather than creativity and the arts (Gluth and Corso, 2009; Robinson, 1998). Emphasis in education has been mostly concerned with what De Bono (1973) calls vertical thinking, the process of proving and developing concept patterns, whereas lateral or creative thinking sets out to restructure such patterns and provoke new ones. Although these traditional ways of teaching are acknowledged as destined to obsolescence (Robinson, 1998), the lack of explicit guidelines and a scaffold to guide academics in making the required shift from outmoded teaching approaches has become a significant impediment to the goal of embedding creativity within the curriculum. This is especially so in discipline areas outside of design and the arts (Gluth and Corso, 2009). Byron (2007) points out that despite the considerable recognition of the need for change, 'normal' features of education (and business) include intolerance of ambiguity, lack of time and space for experimentation, fear of making mistakes, excessive enthusiasm for the corporate position, excessive stress, and the lack of a sense of challenge. Tosey (2006) suggests that creativity in the higher education curriculum is more often used 'to converge and control' (p. 35) than to engage productively 'at the edge of order' (Fullan, cited in Tosey, 2006, p. 34). To change this prevailing culture, argues Jackson (2006), we need to change our approach from penalising mistakes to one of appreciating that making 'mistakes' provides

important lessons for learning. 'By perceiving 'mistakes' as opportunities for, and proof of, learning instead of failure, we begin to change the paradigm to one that is more enabling and valuing of creative effort' (Jackson, 2006, p. 197).

Another potential reason that universities have failed to embrace creativity in the curriculum more widely across different disciplinary fields is the lack of a concise definition of creativity within policy documentation (McWilliam, 2007a). Edwards (2000) suggests that the term 'creativity' has an amorphous nature and has traditionally been regarded as a gift that is only possessed by an exceptional few. However, research has also drawn attention to the importance of fostering the creativity of all learners (Csikszentmihalyi, 1982; McWilliam, 2007a). Researchers are challenging the assumption that creativity is purely an innate capacity and cannot be learned (McWilliam, 2007a; Robinson 2001). Moreover, researchers are beginning to understand that human intelligence is complex and multifaceted (Robinson, 2001). They are also beginning to recognise that creativity is enriched by other capacities and learner motivations (Robinson, 2001), as well as the cultural context. As Robinson (2001) points out, cultural conditions can kindle or kill creativity.

A third barrier to changing the educational paradigm in ways that foster the creative capacities of future graduates relates to the lack of strategies to help teachers develop the skills to engage with creativity 'intentionally as an outcome of pedagogical work' (McWilliam, 2007a, p. 4). While it is evident that fostering creativity is 'best achieved through a process-based or activity-based curriculum that engages students in challenging, novel and unpredictable ways of working and learning' (Jackson, 2003 cited in Jackson, 2006, p. 213), the strategies for achieving this goal have tended to remain elusive for many teachers. Our current work sets out to both demystify such limiting attitudes and to also develop a framework and supporting online system that can scaffold teachers and students through a creative problem solving approach.

2.1 A Systems Approach to Creativity

Creativity involves producing novel and useful ideas or products (Dewett, 2003). In defining creativity in this way, we acknowledge that creativity can be learned and assessed, and that there are several factors that either facilitate or impede the achievement of creativity performance. This view is consistent with Csikszentmihalyi's (1999) systems approach to creativity, which considers the interaction among three subsystems: the domain, the person, and the field. Thus, the framework for creative problem solving, with a focus on creative ideation, requires adaptation within the curriculum to accommodate diverse individual learner needs, taking into consideration their abilities, preferred learning styles, and needs to best fit the domain and field of study. The framework thus needs to optimise the opportunities for learners to exercise both divergent and convergent thinking, take risks, evaluate decisions, and synthesise existing and new information in order to arrive at an optimal outcome, while also maximising the conditions under which the experience of learning becomes its own reward (being in the 'flow', Csikszentmihalyi, (1996).

According to Amabile (1996), there are three main components of creative performance. These are: 1) domain-relevant skills; 2) creativity-relevant processes; and 3) task motivation. This model recognises that domain-relevant skills (for example, facts, principles, technical skills, and opinions) are required for a learner to have access to the full range of response possibilities from which a new response is to be synthesised, and the information against which the new response is to be judged (Csikszentmihalyi, 1999; Dewett, 2003). Creativity-relevant processes determine the degree to which one's response will surpass previous products or responses in the domain (Dewett, 2003), while task motivation refers to the learner's attitude and motivations for undertaking the task as well as his/her understanding about why the task is being engaged (Amabile, 1996; Dewett, 2003). Creativity is more likely to be facilitated when the task is intrinsically motivating (the experience of learning is its own reward) (Csikszentmihalyi, 1991).

2.2 The Creative Problem Solving (CPS) approach

Creative Problem-Solving (CPS) has its roots in the work of Alex Osborn (1953) who developed CPS as an aid to the understanding the different phases of creative problem-solving (Isaksen and Dorval, 1993). The approach was modified in 1967 by Sydney Parnes and thereafter became known as the Osborn-Parnes CPS model comprising three major stages (exploring the challenge, generating ideas, and preparing for action) incorporating six steps: 1) objective finding; 2) fact finding; 3) problem finding; 4) generating ideas; 5) solution finding; and 6) acceptance finding (Creative Education Foundation, 2010). The model is depicted as a cycle recognising that despite the seemingly structured approach, the model also allows for flexibility and tends to function in a more cyclical than linear pattern. Variations of the CPS model have been used to support the development of educational materials (Torrance, 1978) and to facilitate inclusive education (Giangreco et al., 1994), as well as a framework to support the marketing curriculum (Titus, 2000). Amabile's (1996) componential framework of creativity incorporates a similar CPS approach, but also takes into account the components of the creative performance (domain-relevant skills, creativity-relevant processes and task motivation) that impact on the individual's creative performance. It should be noted also that all of these approaches acknowledge the iterative nature of the problem solving process and the need for both divergent thinking (particularly during the early stages of the cycle) and convergent thinking as ideas are refined.

Chapter 3: Aims of the Project

The project aimed to achieve the following objectives:

- guide academics in the development or redevelopment of their own courses through the creative design process;

- develop students' understandings of the role of innovation and creativity in research and their capacity to undertake research within their disciplines and in multi-disciplinary contexts;

- encourage and raise awareness and the practice of the scholarship of discovery and engagement through the collection of exemplars based on trials of the approach across disciplinary fields;

- affirm the work of academics already active in the field by providing them with the opportunity to showcase their initiatives via a national online database;

- facilitate discussion within disciplines that will lead to review of current practices in the pursuit of excellence in embedding creative thinking and innovation in ways that strengthen the integration of research and creative problems solving in the curriculum.

The distinctive component of this project has been its focus on developing, trialling and evaluating a CPS framework and online system based on an existing framework that has been developed and trialled at the University of South Australia (Wood et al, 2011). The CPS system has been developed as open source, to enable it to be adapted by other institutions to suit their learning and teaching, and technical contexts.

The project also led to the development of exemplars showcasing use of the CPS system.

Chapter 4: Design-based research approach

4.1 Design-Based Research (DBR)

Design-based research (DBR) emerged as a methodological approach in the 1990s (Brown, 1992; Collins, 1992) and has gained increasing popularity in response to growing recognition of the need for educational research which produces 'new theories, artifacts, and practices that account for and potentially impact learning and teaching in naturalistic settings' (Barab & Squire, 2004, p. 3). DBR has been found particularly useful for research involved in technology enhanced learning initiatives. This is because DBR addresses complex problems in real contexts by building on theory and design principles to implement technology enhanced innovations that address complex problems. The process involves reflective inquiry in the process of designing, trialling and implementing innovative learning environments and leads to the creation of new design principles and practical guidelines for educators (McKenney & Reeves, 2012; Reeves, Herrington & Oliver, 2005; The Design-Based Research Collective, 2003).

DBR was therefore deemed to be a suitable research approach for the study reported in this paper given the project's aims to build on existing theories of creativity in the design and development of a framework and tool to scaffold educators in embedding creative problem solving in the higher education curriculum, while also developing a tool that students could use to help them to apply the principles in practice. In keeping with the characteristics of DBR, our research team comprises educators, researchers and designers working in collaboration, and the research approach has employed mix-methods with multiple iterations involving designing, developing, trialling, evaluating, reflecting and redesigning informed by each previous iteration.

The iterative nature of the systems life cycle adopted has involved formative evaluation throughout the project and revisions of the design of the CPS system in response to feedback from project team and reference group members, as well as from educators and students who have participated in trials of the CPS framework and CPS tool developed through the project. The stages of the DBR approach and the findings from each stage are documented in the following sections.

4.2 Design of CPS framework informed by theories of creativity

The framework developed for this study has been informed by the seminal literature on creativity (Csikszentmihalyi 1982, 1991, 1996; Guilford 1950; Torrance 1978) and contemporary research such as Amabile's (1996) componential framework of creativity and Titus's (2000) CPS model. Our adapted CPS framework involves six stages (Figure 1), which correspond closely to the Titus (2000) model (see Wood et al, 2012 for further details). In our revised model, idea generation is embedded in each stage of the process with alternating divergent and convergent ideation, shifting toward convergent thinking by the final stages of validation and completion/implementation (Brophy, 1998). Our model also recognises the impact of the domain, field, and individual factors (Csikszentmihalyi, 1999).
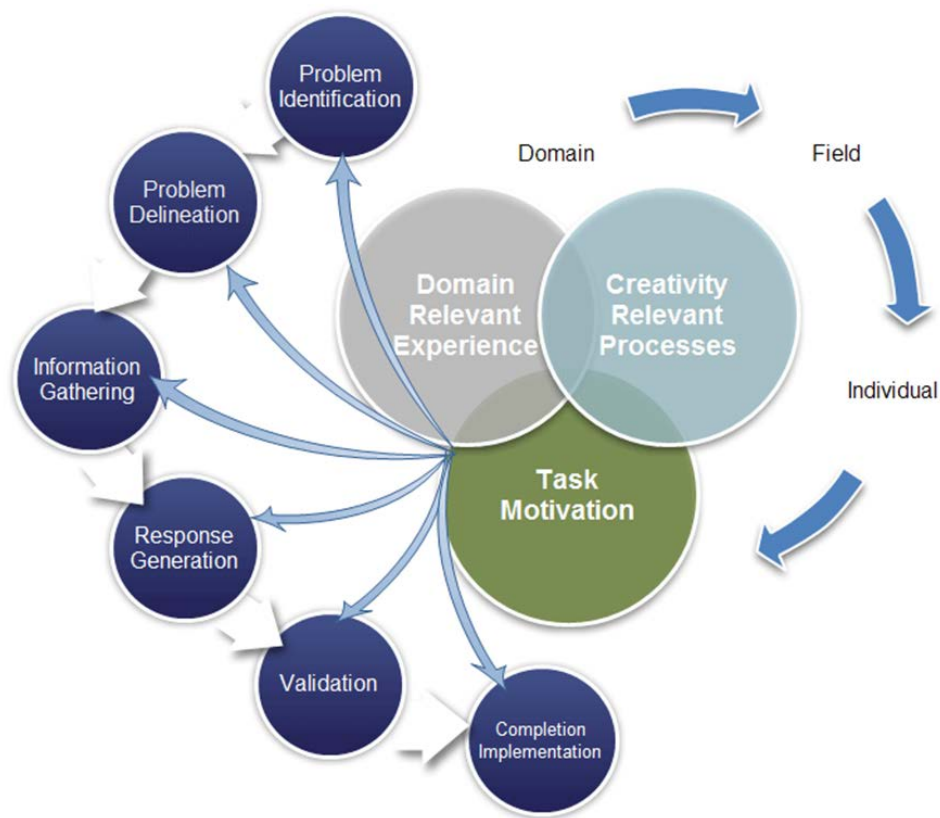
Figure 1: A Systems Approach to Creative Problem Solving (CPS)
adapted from Amabile (1996), Csikszentmihalyi (1999) and Titus (2000)

4.3 Preliminary trials of CPS framework

Introduction to Digital Media (IDM) is a first year undergraduate course offered in the School of Communication, International Studies and Languages at the University of South Australia. The aim of the course is to introduce students to the principles of digital media through a practice-led research approach. Prior attempts at engaging students in research had proved challenging (see Wood 2010, 2009a, 2009b for detailed discussion of the results of formal evaluations). The three assignments in the course build on each other and are designed to lead students through a practice-based research approach involving researching the services and needs of a not-for-profit organisation and producing pre-production documentation for a short promotional video clip for that organisation as the second assignment. Students then produce an associated website in which the promotional clip is embedded as their final assignment.

In the 2009 and 2010 offerings of the course, students were asked to formulate their research using a paper-based version of the CPS framework designed to guide them through the idea generation process. This CPS model was supported through the use of a range of social media tools including an 'ideas journal' maintained by students as a personal blog throughout the course, the use of a wiki to facilitate brainstorming and to encourage collaborative discussion supported by a discussion forum for peer review, as well as the use of a collaborative bookmarking site for the sharing of resources, and the use of YouTube enabling students to showcase their work to a broader audience and respond to their feedback.

Several key themes emerged from the application of CPS in this course (see also, Wood 2010, 2009a, 2009b) as reported by teachers through informal feedback and students via anonymous online course evaluations conducted at the completion of each offering of the course:

- Teachers reported much greater creativity and divergence in the approaches students adopted in their digital media research assignments.

- Students reported greater confidence in their ability to generate ideas for their research projects.

- Several students noted that CPS was critical to the success of their research.

- Most students enjoyed the collaboration with their peers and noted that the use of peer review facilitated via the discussion forum helped them to improve on their work.

- Students generally enjoyed the creativity activities as reflected by one student who suggested that 'I thoroughly enjoyed this topic as it was highly creative and we were given a high degree of creative freedom despite having to work within the limitations set down'.

- Others observed the relationship between creativity, research and practice noting 'The creativity component challenged my technical ability' and 'It was more research based and required a lot of creative thinking'.

- Creativity and problem solving developed through practice-led research was a commonly recurring theme in most student comments as this student's feedback indicates, 'Creative idea generation methods ... helped me to think very deeply and come up with alternative and sophisticated solutions to creative problems'.

While most students welcomed the brainstorming approach to idea generation implemented early in the course, two students commented that it was just 'mind mapping' and nothing particularly innovative; even though they acknowledged that the approach might be useful for 'other' students; 'It might work for some people but not so well for others. Only really suits a few types of learners'.

Another challenge encountered in using the 'ideas' blog for scaffolding throughout the IDM course, was the tendency for some students to post their reflections to their blogs in the week in which the assignments are assessed. This finding suggests that some students are not sufficiently "in the flow" (Csikszentmihalyi 1996) to maintain focus on the creative problem solving process throughout the duration of the semester.

4.4 Design of the CPS student tool

The CPS framework therefore required considerable revisions over time, and as noted in the more detailed findings reported elsewhere (see Wood 2010, 2009a, 2009b), the outcomes from each subsequent offering of the course helped to improve on the approach throughout 2011. From the paper-based version of the CPS framework, an online tool (*Ingenium*) was designed in late 2011 and early 2012. *Ingenium* incorporates the five stages of the CPS process with sub-sections comprising questions and prompts related to each of the five stages, which students access via arrows on each page (Figure 2). Video clips are also included for each CPS stage to help guide students through the required tasks relevant to that stage. A 'pencil' icon provides students with a link to a public blog site where they could set up and access their own blog account and another icon ('w') provides students with a link through to the project wiki. A menu was placed on the right-hand side of the

interface providing students with a series of creativity tools including a 'notebook', 'toolbox' and 'resources' (Figure 2). These sections include links to social media and other supporting resources that the student might need to support them throughout the creative solving process.
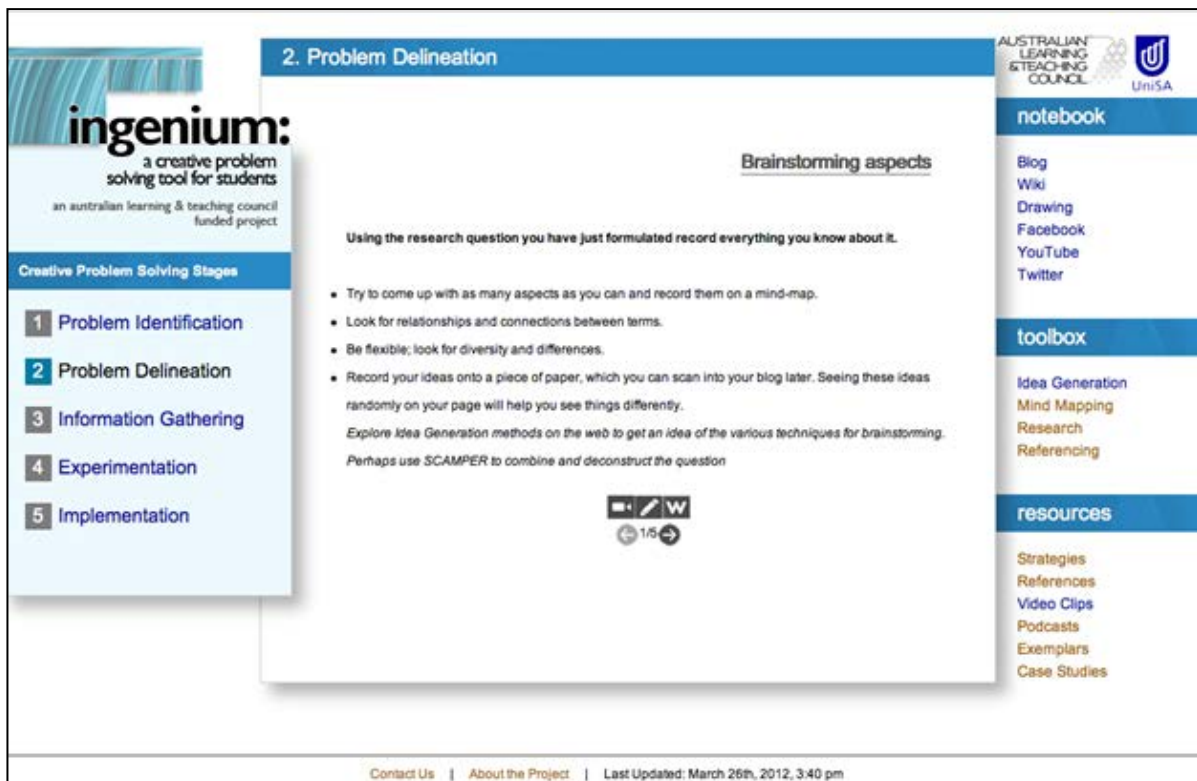
Figure 2: Design of the CPS tool for students

4.5 Trials of *Ingenium*

Preliminary trials of *Ingenium* were conducted in IDM in both semester one (Study Period 2; SP2) and semester two (Study Period 5; SP5) 2012. At the conclusion of the SP2 offering of the course students were invited to complete the university's approved anonymous online course evaluation, which included three custom open-ended text questions designed to evaluate the students' experience of the CPS process and use of the tool. Of the 250 students enrolled in the course, only 19 (7.6 per cent) completed the online evaluation and even fewer responded to the open ended questions. Nevertheless, student feedback combined with teachers' observations and reflections on the experience did provide insight into the potential benefits and challenges in applying the tool in this first-year course. Positive comments suggested that for at least some students the course encouraged students to explore creativity in ways that they had not experienced in courses with more traditional assignments as reflected by one student who stated that 'It was a good course to express creativity through a different format, one that was more interesting than just the regular essay writing in others' and another who stated that 'it helped to clarify the idea I had'. However, several students did not engage in the creative problem solving task as indicated by comments such as 'No, everyone already had their ideas to start with and in doing this did not further develop them or create them'. Some students also expressed frustration with the repetitive nature of the process indicating that the tool had not adequately reinforced the value of creativity occurring through a process of multiple iterations involving researching, designing, testing, refinement, collaboration and reflection.

Ingenium was trialled again in the same course in SP5 2012. At the conclusion of this offering of the course students were invited to complete an anonymous online survey, which included a mix of Likert-scale and open ended text items about their experience using the *Ingenium* tool. Twenty-seven students opted to complete this questionnaire and of those respondents, 48 per cent reported that *Ingenium* raised their awareness of creative problem solving and that the tool helped them to think more creatively about their assignment; 41 per cent indicated that they felt *Ingenium* would be useful to other areas of their studies; and 33 per cent of students reported that they felt more confident about their creative skills after using the *Ingenium*. While one student 'Found the tool a great catalyst for new directions in thinking" and another reported that it was a 'very good planning tool' others were challenged by the presentation of the interface as suggested by one student's comment that 'I found the site rather hard to use. It was hard to follow the layout of the information and contained a lot of writing that could be cut down to be more accessible and concise'. Students were also challenged by the amount of time it took to complete the process, as comments such as 'The principles and techniques are good, but the presentation and long winded nature make it unusable' and 'Thought it was very useable it was also slightly daunting because of the amount of subsections … this is incredibly tedious to work through' suggest. When asked what improvements should be made to the tool students suggested: 'better structural layout"; 'include some visuals'; 'perhaps find another way of presenting'; 'it needs a complete overhaul design-wise'.

This prototype version of *Ingenium* was also trialled in the course Idea Generation Methods for Designers (IDGMD); a common core course for Bachelor of Visual Communication students in the School of Art Architecture and Design (UniSA) during SP4, 2012. At the conclusion of this offering of the course students were invited to complete an anonymous online survey. Thirty-one students completed this questionnaire and of those respondents, 45 per cent reported that the CPS tool was useful for helping to think creatively about the given task. Given the creative background of these students 74 per cent already felt confident about their creative problem solving skills before using the CPS tool, but then 41 per cent still reported an increase in confidence after using the tool.

A distinctive characteristic of the trials conducted in this course was the use of the Facebook page 'Unearthing ideas' (www.facebook.com/unearthingideas). Unearthing ideas was used as an online space for students to share and discuss the ideas with their lecturers and peers, which were emerging from the CPS process. 42 per cent of respondents reported using the Facebook page.

4.6 Redesign of CPS tool

Based on the feedback from two semesters of trials in IDM in 2012, *Ingenium* was redesigned to include new video examples and text-based instructions (Figure 3). During the SP5 2012 trial, one teacher had observed that students were not using the example videos, 'The students would begin playing the video and only watch it for a few seconds before closing it'. In response to this observation, an animator was employed to replace the 'talking-head' videos with short animations that were more visually engaging and replicated the stages of *Ingenium*. The text component of the tool was also overhauled during this version. The stages were renamed, for example 'Problem Delineation' was changed to 'What's the big picture?' in response to student feedback suggesting that the language used was too abstract and not descriptive of the processes. The procedural text descriptions were also shortened in response to student feedback suggesting that the steps were too repetetive and long-winded. The structure of *Ingenium* was also redesigned as a mind map (Figure 4). The previous version of *Ingenium* included a basic mind map tool and this was redeveloped to allow the student to record notes (both text and audio-visual) about each stage of the creative solving process. This alternative non-linear approach complemented the original more linear framework.

Figure 3: Redesign of *Ingenium* with embedded video examples

Figure 4: *Ingenium* mind mapping tool

4.7 Trials of redesigned CPS tool

A new group of students enrolled in IDM undertook the same assignment to create the pre-production for a promotional video clip, in the first semester (SP2) 2013. The students were encouraged to use the new mind mapping tool that would allow them to access the process in a non-linear fashion, but during the trial, technical issues with the mind mapping tool were encountered and many of the students were forced to return to the original linear, step by step instruction approach.

Sixty-two IDM students responded to the same anonymous online survey and their responses indicate an increase in the percentage of students who thought that their awareness of creative problem solving had been raised through using the tool (48 per cent in SP5 2012 to 55 per cent in SP2 2013); 51 per cent of students reported that the tool had helped them think creatively compared with 48 per cent during the previous trial while 33 per cent of students reported that they felt more confident about their creative skills after using the *Ingenium*; the same as during the previous trial.

Many students responded favourably to the redesigned video examples with comments like 'the youtube videos linked to the pages were useful' and one teacher observed that unlike the previous trials, more students watched the videos in their entirety. Issues encountered by the students included: 'the mind map should be improved, as it is a useful tool but very unreliable'; 'the saving system definitely needs improving'; 'I liked how *Ingenium* was easy to use, however, I was not pleased with my mind map being entirely deleted days before my assignment was due'; 'the mind-mapping software isn't very aesthetically pleasing'; 'varying results with different web browsers and different computer architectures'; and 'it would have been wicked but it crashed a lot'. When asked what improvements should be made to the tool, students reported that 'the menu structure should be made more easy to understand'; 'it just needs to be fine-tuned so that the questions are less repetitive and the mind-mapping section works'; and 'work primarily on the user interface and the rest will come, as will interest'.
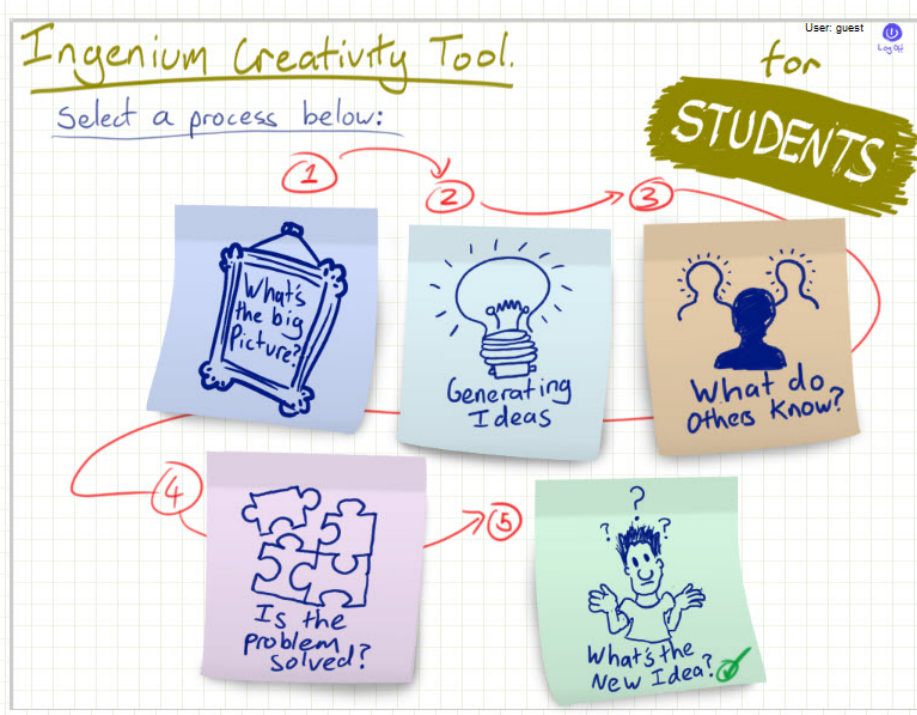
Figure 5: Revised *Ingenium* student tool

4.8 Further design revisions

The student feedback from the three trials of *Ingenium* reported in the previous sections informed the next iteration of the design and development cycle. The major revisions included a move to a more robust approach to coding the site to avoid the cross-browser compatibility issues reported by students, and redesign of the interface as a mind map with engaging graphics representing each stage of the CPS and each sub-section (Figure 5).

Students interact with each of the 'post-it' note image links to the various CPS progresses to sub-sections where they have access to an editor enabling them to embed their thoughts, research, images and links. A toolbar above *Ingenium* provides students with the ability to navigate back and forth in a linear or non-linear approach as they work through the CPS stages. Students can also open a browser tab to access the web based framework and video examples as a scaffold for them as they undertake the CPS process. An additional feature has been added to *Ingenium* to enable students to print out the contents of each stage of the CPS process in an outline format.

The revised *Ingenium* tool will be trialled in subsequent offerings of IDM and other courses across a range of disciplinary fields in SP5 2013 and this feedback together with summative evaluation of the process and the tool will be undertaken. It is anticipated that student feedback will indicate that this final iteration of the design and development of *Ingenium* represents a significant improvement on earlier attempts to develop a CPS tool as a scaffold for students undertaking creative problem solving activities within their courses. The trials in other courses, together with the feedback obtained from trials of *Ingenium* in IDM will then be analysed to inform the development of principles and practical guidelines that educators can use when redesigning their courses to embed creativity within the curriculum. Summative evaluation will then be undertaken to assess the extent to which educators regard the CPS framework, tool and guidelines as helpful in guiding them through the design and redevelopment process.
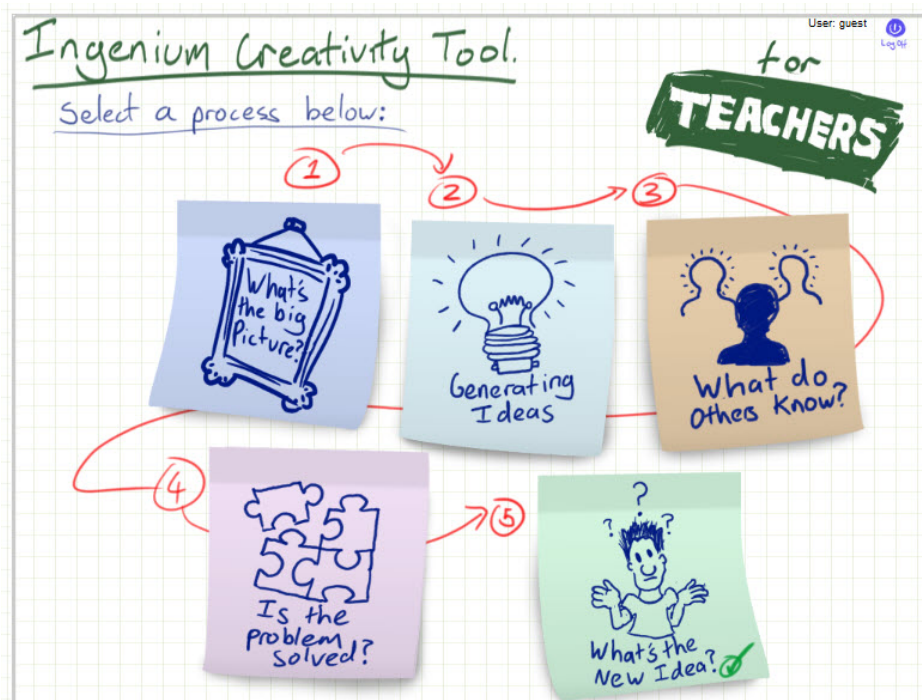
Figure 6: *Ingenium* tool for teachers

An accompanying tool for teachers was also developed to guide academics through the process of designing and redeveloping courses in which creativity is embedded (Figure 6). This tool is being trialled with academics from two health science departments (School of Nursing and Midwifery, Flinders University; School of Occupational Therapy, University of Cape Town) in Semester 2, 2013 and will be evaluated at the end of those trials.

While not a proposed deliverable, a tool for student researchers and early career researchers (Figure 7) is also currently under development and will be trialled in 2014.
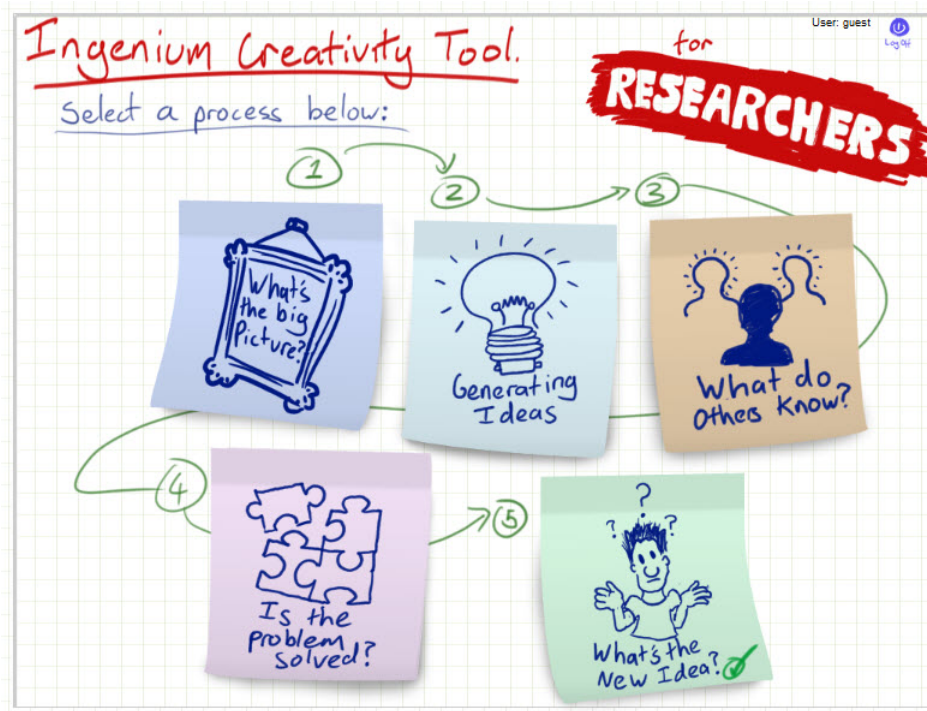
Figure 7: *Ingenium* tool for researchers

4.9 Accessibility and usability testing of *Ingenium tools*

An important aim of this project was to ensure that the project website and *Ingenium* tools are both accessible and usable to a diverse academic and student population. *Accessibility* can be defined as an approach designed to ensure that learners can access TEL anytime, anyplace using any technology (Wood, 2011). The World Wide Web Consortium (W3C) Web Accessibility Initiative (WAI) recognises the interrelationship between usability and accessibility in describing inclusive design as concerned with 'making technology available to and usable by all people whatever their abilities, age, economic situation, education, geographic location, language, etc'. The key elements of inclusive design are said to include: 1) interoperability; 2) accessibility to users with disabilities; and 3) customisation and localisation features for people from different countries and cultures. *Usability* has been defined as 'the extent to which a product can be used by specified users to achieve specified goals with effectiveness, efficiency and satisfaction in a specified context of use' (ISO 9241-11), and usability evaluation is critical for the design and redevelopment of usable websites/applications. Usability testing is proven to be a reliable, efficient method of collecting user data to inform and validate user interface designs (Nielsen, 1993; Nielsen & Mack, 1994; Ruben & Chisnell, 2008). The following sections describe the considerations and evaluation approach undertaken to ensure the final project site and tools are both accessible and usable for the target populations.

Accessibility

The importance of access to information and services to enable active participation are reflected in *Article 3* and *Article 9* of the Declaration on the Rights of Persons with Disabilities, which was proclaimed by the General Assembly of the United Nations on 9 December l975. Australia was the first Western country to ratify the convention in July 2008 and there are now 155 signatories to the Convention (UN Convention on the Rights of Persons with Disabilities: Status of Signatories and Parties, 2013). The principles set out in *Article 3* provide guidance for understanding and interpreting the UNCRPD and include the rights of people with disabilities to: a) Respect for inherent dignity, individual autonomy including the freedom to make one's own choices, and independence of persons; b) Non-discrimination; c) Full and effective participation and inclusion in society; d) Respect for difference and acceptance of persons with disabilities as part of human diversity and humanity; e) Equality of opportunity; *f) Accessibility*; g) Equality between men and women; h) Respect for the evolving capacities of children with disabilities and respect for the right of children with disabilities to preserve their identities. *Article 9* makes specific reference to the fundamental human right for people with disabilities to be able to live independently and participate fully in all aspects of life. *Article 9* further articulates that States Parties shall therefore,

> take appropriate measures to ensure to persons with disabilities access, on an equal basis with others, to the physical environment, to transportation, to information and communications, *including information and communications technologies and systems*, and to other facilities and services open or provided to the public, both in urban and in rural areas.

The release of the W3C Web Accessibility Guidelines (WCAG 1.0) in 1999 led to a new focus on addressing Web accessibility issues based on an inclusive or universal design approach. These W3C guidelines provide designers with the means for ensuring that the websites they create are accessible to a broad range of users, including those with visual impairments, hearing impairments, mobility impairments and learning disabilities. The updated Web Content Accessibility Guidelines (WCAG 2.0) became an official W3C standard in 2008.

WCAG 2.0 guidelines are based on a 'technology-neutral' perspective and can be more readily applied to new and emerging technologies such as Web 2.0, cloud computing, augmented and gesture based interfaces and mobile devices. There are four overarching WCAG 2.0 design principles. Online content must be: 1) Perceivable (ie information and user interface components must be presentable to users in ways they can perceive); 2) Operable (user interface components and navigation must be operable); 3) Understandable (information and the operation of user interface must be understandable); and 4) Robust (content must be robust enough that it can be interpreted reliably by a wide variety of user agents, including assistive technologies). Under each of these overarching principles are twelve guidelines that further clarify the purpose of each principle. Each guideline has a number of success criteria, which provide a means for checking conformance to each guideline. Both WCAG 1.0 and 2.0 employ a three-level rating system to identify the level of accessibility. The four WCAG 2.0 principles and associated guidelines are as follows:

Perceivable

- Provide text alternatives for any non-text content so that it can be changed into other forms people need, such as large print, braille, speech, symbols or simpler language.

- Provide alternatives for time-based media.

- Create content that can be presented in different ways (for example simpler layout) without losing information or structure.

- Make it easier for users to see and hear content including separating foreground from background.

Operable

- Make all functionality available from a keyboard.

- Provide users enough time to read and use content.

- Do not design content in a way that is known to cause seizures.

- Provide ways to help users navigate, find content, and determine where they are.

Understandable

- Make text content readable and understandable.

- Make Web pages appear and operate in predictable ways.

- Help users avoid and correct mistakes.

Robust

- Maximise compatibility with current and future user agents, including assistive technologies.

The project site and tools under development were reviewed against W3C WCAG 2.0 to determine their level of conformance. The review involved checking the validity of the HTML/XHTML and CSS coding of the websites using the W3C validation tools, testing the sites using semi-automated tools including SortSite and manual checking of features not easily tested using semi-automated tools.

Table 1 summarises the accessibility issues identified from preliminary review of the early iterations of the site and tools. A more detailed report from SortSite appears in Appendix G. As can be seen from Table 1 and Appendix G, the first version of the site and tools failed on several accessibility criteria. The final revision still opens new windows but title attributes have been added to the user to warn them that the link will open a new window.

Table 1: W3C WCAG 2.0 test results for first and final versions
of the project site and CPS Tools

WCAG 2.0 Guidelines	Preliminary Design	Final Revision
Level A compliance issues		
Each A tag must contain text or an IMG with alt text	✖	
Provide appropriate mark-up for all forms	✖	
Provide alternative content for iframe elements	✖	
Include title attributes for all frames	✖	
Provide a means for skipping navigation links	✖	
EMBED tags must have a non-blank ALT tag. Add an ALT attribute with alternative content to the EMBED tag.	✖	
Tab order must follow logical sequence		
Documents require titles	✖	
Avoid duplicate IDs or links to non-existent IDs	✖	
Provide lang attribute for all pages	✖	

Identify row and column headers in tables		
Level AA compliance issues		
Create pages that validate to W3C recommendations	✖	✖
Avoid specifying a new window	✖	
Do not use generic link text like "Click Here" or "Read More"	✖	
Ensure headings are nested correctly	✖	
Ensure all links using same link text point to same direction	✖	
Ensure that foreground and background colours have enough contrast	✖	
Use relative rather than absolute units in CSS property values.	✖	
Level AAA compliance issues		
Provide summary attributes for data tables		

Formal usability testing was beyond the scope of this study, however, formative feedback obtained through anonymous online surveys of academics and students following each trial revealed the following usability issues in early versions of the tools (more detail is provided in the next chapter reporting the findings from trials as well as Appendix C which includes the detailed findings from each trial.

Several students were challenged by the presentation of the interface as suggested by one student's comment that 'I found the site rather hard to use. It was hard to follow the layout of the information and contained a lot of writing that could be cut down to be more accessible and concise'.

Students were also challenged by the amount of time it took to complete the process, demonstrated by comments such as 'the principles and techniques are good, but the presentation and long winded nature make it unusable' and 'thought it was very useable it was also slightly daunting because of the amount of subsections … this is incredibly tedious to work through'.

When asked what improvements should be made to the tool students suggested: 'better structural layout'; 'include some visuals'; 'perhaps find another way of presenting'; 'it needs a complete overhaul design-wise'; 'the menu structure should be made more easy to understand'; 'it just needs to be fine-tuned so that the questions are less repetitive and the mind-mapping section works'; and 'work primarily on the user interface and the rest will come, as will interest'.

The limited timelines for the project meant that comprehensive usability testing of the final versions of the tools was not possible. However, feedback from academics who trialled the final iterations were generally positive as comments such as

> I have long sought a way to effectively, but also efficiently introduce a method of helping my students on this course be able to be more creative. The Course has as its title 'Creative' and accountable marketing, but I have struggled to fulfil the promise in the title. I could demonstrate, in various ways, what I judged to be examples of creativity at work but this does not necessarily enable students to be able to practice it. I was delighted to be exposed to the *Ingenium* tool and

have found it gives me a tool for more completely fulfilling my course objectives. My students are in full-time employment holding down responsible management positions but they found the *Ingenium* tool straightforward to use and helpful indicate.

Chapter 5: Trials

The Creative Problem Solving (CPS) tool *Ingenium* was trialed and developed over a four-year period, from 2009 – 2013, with trials continuing beyond the end of this project. Trials were conducted in courses across different disciplines and levels at several universities including: *Introduction to Digital Media* (UniSA), *Idea Generation Methods for Designers* (UniSA), *Mechanical Engineering Practice* (UniSA), *Creative and Accountable Marketing* (UniSA), *Festivals and Events* (UniSA), *Entrepreneurship Innovation* (University of Adelaide), *Principles and Practices of eLearning, Issues in Learning with ICT, Social Computing Tools, ICT Across the Curriculum*, (University of New England) and *Develop Vision and System Installation Plans* (RMIT). Three trials are continuing beyond the project in Health Sciences at The University of Cape Town (South Africa) and Flinders University. The detailed findings from the trials are available for download from the project site (http://www.creativity-project.net/testing.php).

5.1 Introduction to Digital Media, 2009 - 2013 (UniSA)

Trial 1: Preliminary trials of paper-based CPS framework (2009 - 2010)

Several key themes emerged from the application of the paper-based prototype CPS framework in this course as reported by teachers through informal feedback and students via anonymous online course evaluations conducted at the completion of each offering of the course:

- Teachers reported much greater creativity and divergence in the approaches students adopted in their digital media research assignments.

- Students reported greater confidence in their ability to generate ideas for their research projects.

  Several students noted that CPS was critical to the success of their research.

- Most students enjoyed the collaboration with their peers and noted that the use of peer review facilitated via the discussion forum helped them to improve on their work.

- One student suggested that 'I thoroughly enjoyed this topic as it was highly creative and we were given a high degree of creative freedom despite having to work within the limitations set down'.

- Another commented 'The creativity component challenged my technical ability' and another reflected on the link between research and creative thinking, 'it was more research based and required a lot of creative thinking'.

- Creativity and problem solving developed through practice-led research was a commonly recurring theme in most student comments as this student's feedback indicates, 'creative idea generation methods ... helped me to think very deeply and come up with alternative and sophisticated solutions to creative problems'.

While most students welcomed the brainstorming approach to idea generation implemented early in the course, two students commented that it was just 'mind mapping' and nothing particularly innovative; even though they acknowledged that the approach

might be useful for 'other' students; 'it might work for some people but not so well for others. Only really suits a few types of learners'.

Another challenge encountered in using the 'ideas' blog for scaffolding throughout the IDM course, was the tendency for some students to post their reflections to their blogs in the week in which the assignments are assessed. This finding suggests that some students are not sufficiently "in the flow" (Csikszentmihalyi 1996) to maintain focus on the creative problem solving process throughout the duration of the semester.

Trial 2: Design of the online CPS tool *Ingenium* (2011 - 2012)

Preliminary trials of *Ingenium* began in semester 1 of 2012 (Study Period 2; SP2) and continued in semester two (Study Period 5; SP5) 2012 in the course Introduction to Digital Media (UniSA). At the conclusion of the SP2 offering of the course students were invited to complete the university's approved anonymous online course evaluation, which included three custom open-ended text questions designed to evaluate the students' experience of the CPS process and use of the tool. Of the 250 students enrolled in the course, only 19 (7.6 per cent) completed the online evaluation and even fewer responded to the open ended questions. Nevertheless, student feedback combined with teachers' observations and reflections on the experience did provide insight into the potential benefits and challenges in applying the tool in this first-year course. Positive comments suggested that for at least some students the course encouraged students to explore creativity in ways that they had not experienced in courses with more traditional assignments as reflected by one student who stated that 'It was a good course to express creativity through a different format, one that was more interesting than just the regular essay writing in others' and another who stated that "it helped to clarify the idea I had'. However, several students approached the task with a closed mind and did not engage in the creative problem solving task as indicated by comments such as 'No, everyone already had their ideas to start with and in doing this did not further develop them or create them". Some students also expressed frustration with the repetitive nature of the process indicating that the tool had not adequately reinforced the value of creativity occurring through a process of multiple iterations involving researching, designing, testing, refinement, collaboration and reflection.

Ingenium was trialled again in the same course in SP5 2012. At the conclusion of this offering of the course students were invited to complete an anonymous online survey, which included a mix of Likert-scale and open ended text items about their experience using the *Ingenium* tool. Twenty-seven students opted to complete this questionnaire and of those respondents, 48 per cent reported that *Ingenium* raised their awareness of creative problem solving and that the tool helped them to think more creatively about their assignment; 41 per cent indicated that they felt *Ingenium* would be useful to other areas of their studies; and 33 per cent of students reported that they felt more confident about their creative skills after using the *Ingenium*. While one student 'Found the tool a great catalyst for new directions in thinking' and another reported that it was a 'very good planning tool' others were challenged by the presentation of the interface as suggested by one student's comment that 'I found the site rather hard to use. It was hard to follow the layout of the information and contained a lot of writing that could be cut down to be more accessible and concise'. Students were also challenged by the amount of time it took to complete the process, as comments such as 'the principles and techniques are good, but the presentation and long winded nature make it unusable' and 'thought it was very useable it was also slightly daunting because of the amount of subsections … this is incredibly tedious to work through' suggest. When asked what improvements should be made to the tool students suggested: 'better structural layout'; 'include some visuals'; 'perhaps find another way of presenting'; 'it needs a complete overhaul design-wise'.

Trial 3: Revision of *Ingenium* (2012 - 2013)

A new group of students enrolled in IDM undertook the same assignment as previous trials to create the pre-production for a promotional video clip, in the first semester (SP2) 2013.

The students were encouraged to use the new mind mapping tool that would allow them to access the process in a non-linear fashion, but during the trial, technical issues with the mind mapping tool were encountered and many of the students were forced to return to the original linear, step by step instruction approach.

Sixty-two students responded to the same anonymous online survey and their responses indicate an increase in the percentage of students who thought that their awareness of creative problem solving had been raised through using the tool increased by (48 per cent in SP5 2012 to 55 per cent in SP2 2013); 51 per cent of students reported that the tool had helped them think creatively compared with 48 per cent during the previous trial and 33 per cent of students reported that they felt more confident about their creative skills after using the *Ingenium*, which remained the same as during the previous trial.

Many students responded favourably to the redesigned video examples with comments like 'The youtube videos linked to the pages were useful' and one teacher observed that unlike the previous trials, more students watched the videos in their entirety. Issues encountered by the students included: 'The mind map should be improved, as it is a useful tool but very unreliable'; 'the saving system definitely needs improving'; 'I liked how *Ingenium* was easy to use, however, I was not pleased with my mind map being entirely deleted days before my assignment was due'; 'also the mind-mapping software isn't very aesthetically pleasing'; 'varying results with different web browsers and different computer architectures'; and 'it would have been wicked but it crashed a lot'. When asked what improvements should be made to the tool, students reported that 'the menu structure should be made more easy to understand'; 'it just needs to be fine-tuned so that the questions are less repetitive and the mind-mapping section works'; and 'work primarily on the user interface and the rest will come, as will interest'.

5.2 Idea Generation Methods for Designers, 2012 - 2013 (UniSA)

Trial 1: Design of the CPS tool *Ingenium* (2011 - 2012)
The prototype version of *Ingenium* was also trialled in the course Idea Generation Methods for Designers (IDGMD); a common core course for Bachelor of Visual Communication students in the School of Art Architecture and Design (UniSA) during SP4, 2012. At the conclusion of this offering of the course students were invited to complete an anonymous online survey. Thirty-one students completed this questionnaire and of those respondents, 45 per cent reported that the CPS tool was useful for helping to think creatively about the given task. Given the creative background of these students 74 per cent already felt confident about their creative problem solving skills before using the CPS tool, but then 41 per cent still reported an increase in confidence after using the tool.

A distinctive characteristic of the trials conducted in this course was the use of the Facebook page 'Unearthing ideas' (www.facebook.com/unearthingideas). Unearthing ideas was used as an online space for students to share and discuss the ideas with their lecturers and peers, which were emerging from the CPS process. 42 per cent of respondents reported using the Facebook page.

Trial 2: Revision of *Ingenium* (2012 - 2013)
This iteration of *Ingenium* was trialled in this course. Forty-three students responded to a paper based survey after their first assignment where *Ingenium* was used to generate ideas for 'making life at uni more exciting'. In this course students were also asked to use the new mind-mapping application as a part of the process and many survey respondents reported technical difficulties with the software, which affected the overall usability of the CPS tool. Comments included:

> the steps were ok, but the mindmap tool had many technical difficulties and I found it frustrating to use, if it was fixed it could be a useful tool'; and 'mind map resource needs to be de-bugged. Did not always work or allow me to save my work.

Despite the technical difficulties with the mind-mapping application 74 per cent of respondents agreed that the CPS tool was useful for helping think creatively about the task. 75 per cent of respondents agreed that the tool would be valuable in other areas of their studies.

Comments and suggestions for improvement included:

- 'Lots of potential. Questions could be more obvious and clear at times. A section for writing in solution may be needed'.

- 'I see a lot of potential in *Ingenium*, but I feel that the presentation/interface needs to be made a little more approachable. Currently there appears to be too much text, or instructional information which is quite overwhelming. Use of visual cues or symbols may be better'.

- 'Similar to what I would do anyway'.

- 'Should make it known to other classes/programmes. I didn't know about it before doing Idea Generation'.

- 'It would be good to have another video on solving a different question'.

5.3 Entrepreneurship and Innovation, 2013 (The University of Adelaide)

Revision of *Ingenium* (2012 - 2013)

The revised version of *Ingenium* was used in January, 2013 in the offshore offering of the postgraduate course Entrepreneurship and Innovation (The University of Adelaide). The tool was used as an introductory platform for discussing creativity in relation to entrepreneurship and innovation. The teacher of this course reported, 'I already had a prior understanding of creativity prior to using the *Ingenium* framework. This, no doubt, complemented my understanding of the benefits of using the framework and accelerated my ability to use the framework'. The teacher also stated that the addition of the video examples was useful to understanding the process, 'At first, as with anything new, I found the site a little foreign. However, after going through the materials (and viewing the video clips), I became comfortable with the process'. Eleven students responded to a paper-based anonymous survey of these 64 per cent reported that the CPS tool was useful for raising their awareness of creative problem solving and 63 per cent could see a use for the tool in other areas of their studies. Seventy-three percent reported that they could see a lot of potential in the tool, but would have liked more time with it to fully benefit from the process.

5.4 Mechanical Engineering, SP2, 2013 (UniSA)

Revision of *Ingenium* (2012 - 2013)

The revised version *of Ingenium* was also trialled in the undergraduate course Mechanical Engineering Practice (School of Engineering, UniSA) in SP2, 2013. In this course the tool was used by students to help conceive and design ideas for a mechanical device that could achieve the task specified in the national Warman competition. The teacher reported '*Ingenium* is undoubtedly an innovative tool for encouraging students to come up with new and innovative solutions to any design problems. I fundamentally find it very useful for anyone who is passionate about creativity and uniqueness'. The use of the CPS tool was voluntary in this course and as a result only two students responded to an online anonymous survey. One respondent was already confident with their creative problem

solving ability and the other was not, but both respondents agreed that the tool was useful for raising their awareness and practice of creative problem solving. One respondent reported that they could see potential for using the tool in other areas of their study while the other wasn't sure and gave a neutral response.

5.5 Develop Vision and System Installation Plans, Semester 1, 2013 (RMIT)

Revision of *Ingenium* (2012 - 2013)

Ingenium was also trialled in the course *Develop Vision System Installation Plans,* RMIT, which is a component of the Diploma of Audio Visual Technology. The teacher of this course used the CPS tool by presenting and discussing it in class and found it 'very user friendly' and 'clear and fun to use'. She also reported 'It was so easy playing the videos and talking about the tools possibilities'. Just under half of the students (17 out of a total of 40, 42.5 per cent) responded to the survey about the *Ingenium* creative problem solving tool.

Responses indicated that 15 (95 per cent) students used the tool for less than two hours and 2 students (5 per cent) used the tool for about half a day in total. This suggests that students engaged mainly with the tool in class when the assessment was discussed and perhaps for a short time outside of class.

However, more than half (10, 58 per cent), reported that they found the tool useful with two of those students reporting that it was useful but that there were some drawbacks. Comments included:

- 'It helped me to start my project'.

- 'I like[d] some bits not all though'.

- 'I think the ideas and concepts are great but some of the videos are a bit patronizing'.

- 'The videos are great'.

- 'It helped me to think clearly about my assessment'.

In addition, two students found the *Ingenium* tool 'boring' or 'did not use it much'.

Students found the tool easy to use and were quickly confident in using the tool with the majority of those surveyed (88 per cent, 15) reporting that in they felt confident in less than 2 hours, and two students (12 per cent) taking about half a day to build their confidence.

5.6 Creative and Accountable Marketing SP2, 2013 (UniSA)

Revision of *Ingenium* (2012 - 2013)

A trial of the CPS tool was conducted in the Masters of Business Administration degree course Creative and Accountable Marketing. The teacher of the course reported:

> At the end of the course the students rated the use of the *Ingenium* tool as the most interesting and useful part of the course. For one particular case study that I have used many times, that looks at pricing decisions, I have always been disappointed in the range and quality of students' suggestions for how to solve the dilemma posed by the (real) case. After being introduced to *Ingenium* ideas and processes in this course they came up with much more positive and creative solutions. The students' final Group Assignment at the end of this course contained a much greater variety of proposed ideas and proposed plans of actions than usual. I made it known that this

was expected given their exposure to *Ingenium* and I was not disappointed.

5.7 Festivals and Events, SP2, 2013 (UniSA)

Revision of *Ingenium* (2012 - 2013)
The final trial conducted of this version of *Ingenium* was in Festivals and Events, which is a core course of the Master of Management degree in the School of Management and UniSA. In this trial *Ingenium* was used in the first assignment, which required students to design a creative concept for a festival and/or special event. The teacher reported:

> While it was evident that the imaginative ability to be creative was an important characteristic in the area of Festival and Events, it was not an easy task to embed creativity in to the curriculum. As the course Coordinator and Lecturer in this course, I found it difficult to facilitate the creative idea generation that was required of the students as there was no specific strategies to conceptualise the proposed assignment problem and formulate a range of creative solutions.

After using *Ingenium* to facilitate the creative idea generation process in the assignment the teacher reported that, '*Ingenium* has been an invaluable creative idea generation tool to both my students and I'.

The teacher reported that both the internal and external students of the course appreciated both the online nature of the *Ingenium* tool and the Unearthing ideas complementary Facebook site where they could discuss their ideas with their peers.

5.8 Principles and Practices of eLearning, Issues in Learning with ICT, Social Computing Tools, ICT Across the Curriculum, Semester 1, 2013 (University of New England)

Trial 1: Revision of *Ingenium* (2012 - 2013)
From the teacher's perspective, the tool was easy to implement as access to the tool was provided through the university's Learning Management System. The tool was perceived as 'excellent' and will continue to be implemented in all units. Although students reported that the tool was excellent to use, students did not complete the feedback survey (sent at a time that was inconvenient to them – such as assessment tasks or exams being on).

5.9: Trial of the CPS tool for teachers in the School of Nursing and Midwifery, Flinders University (Semester 1, 2014)

The *Ingenium* tool for teachers was trialled in the re-design of a first-year course (Dynamics of Practice 1) offered in the School of Nursing and Midwifery at the Flinders University of South Australia. Key findings from that experience are summarised in Appendix E.

5.10 Trials of the CPS tool for teachers in the School of Occupational Therapy, The University of Cape Town (Semester 2, 2013)

Ingenium tool for teachers is currently being used in the re-design of a first-year microenterprise assignment in a course titled Occupational Perspectives on Health and Well-being offered in the School of Occupational Therapy at the University of Cape Town.

5.11 Further sites

Interest has been expressed by academics from several other national and international institutions including Professor Stoyan Sgourev, Professor, Management Department, ESSEC Business School, Cedex, France and STEM academics from two Australian universities. This report will be updated once those trials are confirmed.

Chapter 6: Development of guidelines

The findings from teacher and student evaluations as well as the rich thick data obtained from semi-structured interviews with the teachers at the completion of their courses informed the creation of a practitioner's handbook, which incorporates pedagogical guidelines and exemplars showcasing the effective use of the CPS system. An accompanying guide for students was also developed through the project and can be downloaded from the project website.

6.1 Planning to teach creative problem solving

6.1.1 Changing to a new teaching method takes flexibility and practice

This process requires a commitment to transforming the teaching and learning approach from a model that is teacher directed and knowledge structured to one that involves speculation, experimentation and a greater responsibility on outcomes by the students and a change in the role of the teacher to become more of a facilitator and sometimes co-learner. It takes time to gain the necessary confidence to teach in this way and it is highly recommended that all teaching staff practice using the *Ingenium Teacher* and *Student Tools* to complete the task that the students are being asked to do. This kind of practice-based knowledge produces a level of tacit knowing and confidence that cannot be acquired from reading through the process alone.

6.1.2 Prepare examples of past student work

Consider asking students who have used *Ingenium* or the general creative problem solving process in an exemplary fashion to showcase their work on the *Ingenium* site. Contact the project research team to add examples or set up your own online platform using Facebook or YouTube to display previous examples of work.

6.2 Teaching creative problem solving

6.2.1 Teaching the value of creativity

Some students have difficulty understanding why creativity is an important graduate attribute that they will need to develop skills in. Giving practical examples of creativity in the profession/discipline can help in engaging students. Employer feedback as to the need for creative thinking in graduates will also interest students as will explaining which employability skills (specifically creativity) will be addressed in the course. Ask students to think of situations where creative thinking will be important in their future professional roles. This will help students broaden their thinking about the skills they will need in a professional capacity.

6.2.2 A future-focused methodology

There needs to be an understanding and emphasis on methodology from experiences where students deal in past scenarios to one that is dealing with possible future scenarios. The following should be questions that students need to consider when using *Ingenium*.
- Why are things the way they are?

- Why should they continue this way?

- How might they be different?

The first two are to do with investigation, research, observation, analysis of things and the last is the application of this investigation into an outcome, an application and something new. There is not a lot of this 'new possibilities' in our teaching and learning. We mostly focus on what is already known and done.

6.2.3 'Little steps' toward creativity

Take 'little steps' in teaching creativity and don't try to do too much too soon.

6.2.4 Moving beyond instructional teaching

Being creative and generating ideas is a lot harder to do than just following instructions and teaching creativity is a lot harder than giving set instruction. The end result is far more satisfying but it involves some risk taking on the part of both students and teachers. We have found that reluctance on the part of teachers to attempt the inclusion of creative approaches in their teaching has been due to a lack of confidence in their ability. This comes about due to a lack of understanding of what creativity is and we have found in our teaching that devoting time to explaining the nature of creative thinking, defining what it is before attempting activities creates understandings and confidence in subsequent tasks.

6.2.5 Valuing exploration and mistakes

Build in exploration time and playfulness where there is not initial demand on having specific product outcomes. Build in acceptance of mistakes. Validate this by assessing students' involvement in the process and an understanding of the evolution of an idea and not just the value or finish of the end product. One needs to ask what do we want students to learn and what the teacher knows or what students can discover for themselves. Learning should be something that the learner experiences rather than something they have done to them.

6.2.6 Provide experiences based on student interests

Create experiences based on student's interests even if there is a compulsion to cover certain topics and material to satisfy the curriculum. Consider whether essential topics in the curriculum can be reconfigured to align to student interests.

6.2.7 Enhance opportunities for collaboration

Look for opportunities where collaboration can occur both between students in one class/discipline to cross curricula. Ideas thrive in collaborative environments and the opportunity to look for relationships/inspirations between disciplines facilitates this. *Ingenium* provides an ideal process for students from different disciplines and backgrounds to contribute to common issues in ways that do not exist in the current university environment. Student feedback supported this and the novelty of ideas they said they would never have achieved on their own or with like-minded colleagues. We seemed obsessed with the assumption that we teach a specific discipline in ways that only consider the specialisations of that discipline without ever inviting an 'outside' view. The danger that one becomes so specialised that one can build so convincing an argument for that discipline's approaches and methodologies and in so doing removing any possibility of any alternative. We build this attitude in much of our teaching...argument and logic that

validates the truth but in so doing eliminating other possibilities.

Social media can be used to facilitate cross-discipline collaboration. Social media by its nature is very public, transparent and encourages opinions and conversations. In creating an environment suitable for student collaboration this seemed a space worth exploring as we wanted to take creativity, and the ability to generate ideas, out of the formality and limitations of the classroom and the 'specialist' realm and into a broader community context. The Facebook Page 'Unearthing Ideas Online' is one such channel of collaboration for creative learners so your students or you can use this can initiate your own channel.

6.2.8 Provide platforms for students to record their journey

Creative problem solving is a step-by-step process and sometimes the journey taken by students is not evident in the product submitted for assessment. Provide a platform for students to record their creative problem solving journey in the form of a blog or paper-based journal. This journal should contain all of their thoughts, research and collaboration notes collected on their way to completing their assignment, including the *Ingenium* process. If maintained regularly a student's journal will reveal an emergence of ideas that will show evidence of creativity.

6.2.9 Customising *Ingenium* to suit your curriculum

If the vignettes provided for the student CPS framework do not relate to your discipline/profession, consider providing a worked example of a relevant problem to students.

6.3 Assessing creativity

6.3.1 Self and peer assessment

Allow students to self and peer-assess in their learning process and in this way develop an understanding of what criteria are valued in the experience. Often in class we challenge the students to objectively determine how much they have learned from the task and not wait in anticipation for the teacher to make the determination.

6.3.2 Assess the process rather than the end product

By assessing the student's creative problem solving journey, recorded in either an on or offline journal, will reveal creative thinking that sometimes isn't evident in the final assignment product. This can happen for various reasons, for instance if a student's theoretical ability is more advanced than their practical skill some of the ideas that emerged from their problem solving process will not translate into their finished assignment. Recognising and rewarding creative problem solving, even if it isn't evident in the final product helps to build the student's confidence as a creative thinker.

6.3.3 Embed elements of *Ingenium* into assessment

There is a tendency for students to skip through the creative problem solving process as quickly as possible. As a way of encouraging students to engage in the creative problem solving process ask students to provide elements of *Ingenium* (eg the mind map) into the assessment.

Chapter 7: Employer consultation

As noted in the background chapter, the need for a more creative workforce that is able to respond to complex and uncertain times is well established (Craft, 2006; Florida, 2003; McWilliam, 2007a; Pink, 2006). Creativity and innovation are seen as crucial to the success of businesses in the networked information society of the 21st Century, necessitating graduates who are able to undertake creative work in environments that are increasingly dependent on digital technologies (Cunningham, 2006). Recognition of the changing demands in a knowledge based economy and the need to better prepare graduates with 21st century skills has refocused attention on the need for Higher Education institutions (HEIs) to foster the development of graduates' employability skills; the 'non-technical skills and competencies' (Precision Consulting, 2006) first outlined in the Employability Skills for the Future Report (Australian Chamber of Commerce and Industry & Business Council of Australia, 2002).

Yet as also noted in the background chapter, there is increasing evidence that universities are failing to equip our graduates with the creative skills they require to be effective in this new 21st Century workplace (College learning for the new global century: Executive summary with employers' views on learning outcomes and assessment approaches 2008; Craft, 2006; Employer Satisfaction with Graduate Skills: Research Report, 2000; Iioka, 2010; Lincoln, 2010; Robinson, 1998, 2001; Schlee, 2009; Tosey, 2006). Creativity, creative thinking and innovation are all regarded as generic skills required for life-long learning, yet as with many other generic skills identified by employers, do not feature in any Australian Graduate Attributes Statements (see Oliver, 2011; Barrie et al, 2012). Moreover, research has shown that there are differences in the development of generic skills across disciplinary areas (Bath et al, 2004; Pascarella & Terenzini, 1991), and that there are differences between academic staff and students' views regarding the extent to which these skills are facilitated through their studies (Leckey & McGuiga, 1997).

Aware of this mis-match between reported employer expectations, current graduate attributes articulated by Australian universities and understandings of academics and students, the project team undertook consultation with the Careers Services Team at the University of South Australia to identify strategies that could assist the team to better understand employer expectations and their perception of the work-readiness of graduates entering their professions. As a result of these consultations it was agreed that an employers' forum with facilitated focus groups would be an effective strategy for gathering evidence from employers that could better inform the strategies developed through this project to communicate employer expectations more effectively to the sector.

The Careers Services Team subsequently sent out letters of invitation to employers registered on their database. A total of 26 employers attended the employers' forum, which was conducted in June 2013 (see Appendix E). Attendees were allocated to four different focus groups facilitated by Careers Services staff enabling the project team to engage with industry across diverse disciplines to better understand employer perspectives on the importance of graduates demonstrating creative skills in their place of employment, and to also identify the extent to which employers believe graduates are entering the workplace equipped with the generic skills they believe are required within their disciplines.

Careers Services staff provided scribes who recorded in writing all employer discussions and then assisted with thematic analysis of the transcripts following the session (the facilitated questions and employer responses are available in full from Appendix F). The following themes emerged from the focus group discussions.

7.1 What does the term 'creativity' mean to employers?

Participants identified different terms they used to define creativity, with many from

business related professions indicating a preference for terms such as 'innovation' and 'entrepreneurship' rather than creativity. Another alternative term suggested by a health science professional is 'lateral thinking'.

There was acknowledgement that everybody is creative in some way and everyone within an organisation can be creative. Employers indicated that 'passion' is often a key indicator they look for during recruitment as well as the applicant's ability to articulate graduate skills and attributes.

The major finding from focus group discussions is that terms such as 'innovation', 'creative thinking' or 'enterprising' might be better than creativity, since creativity implies 'thought'.

7.2 What graduate employability attributes do employers seek?

Participants suggested that employers seek graduates who have a mix of 'hard'/technical skills as well as 'soft'/generic skills such as the ability to demonstrate communication skills, an understanding of cultural diversity and cross cultural communication, given most companies work in a global context. One focus group identified 'adaptability' and students having the tenacity to go the extra mile as important graduate attributes. Several participants suggested that they also look for well-rounded individuals, so involvement in community organisations, sports clubs, leadership and other social activities by graduates was considered just as important as academic results.

The major findings from this discussion are: 1) that graduates should demonstrate both discipline specific and generic skills; 2) generic skills such as the ability to work within a culturally diverse setting are increasingly important; 3) and evidence that the graduate has also engaged in diverse extra-curricular activities is considered to be important by employers.

7.3 How employers measure the performance of a graduate?

There was general agreement that graduates are expected to be able to solve problems on the job, achieve tangible outcomes and key performance indicators, and be able to learn quickly on the job. 'Soft skills' such as the ability to communicate effectively with the team, intercultural awareness, self-awareness and reflexivity were also considered to be effective indicators of a work-ready graduate on the job. Participants also noted the importance of graduates being able to deliver on what they promised in the job interview.

7.4 Are graduates 'creative ready'?

Participants generally agreed that work experience prior to employment is important because a university education does not provide all of the background and skills graduates require to be successful in the workplace. There was a view that graduates may not yet demonstrate creativity skills when they first enter the workforce (be 'creative ready'), but that education combined with workforce experience can help to build creativity skills. Again extracurricular activities were regarded to be vital and to add value to the work readiness of graduates.

Key findings from this discussion highlight the importance of work-integrated learning, mentoring programmes, and extra-curricular activities, particularly those involving cultural integration, and industry partnerships with universities.

7.5 Summary of key issues

Overall preferred terms/language for describing creativity skills:

- Innovation, creative thinking, enterprising

Preferred list of graduate level employability attributes:

- Technical Skills
- Creative thinking; solutions focused; ability beyond the 'average'
    - Maturity and Capability (Workplace Awareness)
    - Leadership
    - Cultural Awareness
    - Understanding the variation in Induction Training in different companies
    - Social Integrity and responsibility – ability to manage personal brand and market self
    - Demonstrable ability to deliver on set tangible outcomes and KPIs

Key learning for universities:

- Provide work integrated learning opportunities, mentoring programmes and opportunities for student development

- Encourage students to participate in extra-curricular activities such as societies, cultural integration events, mentoring etc

- Rewards and recognitions need to extend beyond merely formal academic grades

Key learning for employers:

Universities can't do it all – there is a need for a partnership between employers and universities facilitated through industry linkages, placements/internships, mentorships etc.

7.6 Overall findings from the employers' forum

The employers' forum highlighted and confirmed varying understandings of terms such as 'creativity' across different disciplines. Regardless of the language used, it is evident, at least among this group of employers, that creative thinking and innovation are core generic skills required of 21st century graduates, and that a mix of generic and technical skills are required of graduates entering the workplace. The findings highlight the importance of universities building strong relationships with industry to ensure employer expectations are reflected in the priorities established by higher education institutions.

Chapter 8: Outcomes

This project has followed an engaged dissemination approach involving a wide range of activities promoted through the following avenues:

- Project website: http://www.creativity-project.net

- Social media:

    o FaceBook - http://www.facebook.com/unearthingideas

    o YouTube - http://www.youtube.com/user/IngeniumUniSA/videos?view=0

- HERDSA, ASCILITE and Australian Virtual Working Group member lists.

This dissemination approach has led to the following deliverables.

8.1 Project outputs

The project outputs include the following:

- Establishment of the project website (http://www.creativity-project.net) providing background information to the project including the project proposal, progress reports and final report (when published); examples of best practice; recordings of webinars; the details of the framework; CPS tools for teachers, students and researchers as well as downloadable source code of these tools

- Development of a framework and model informed by the literature, trials, survey and interview data collected through the project, which highlights the individual academic, disciplinary and institutional factors that either facilitate or impede the uptake of strategies for embedding creative problem solving in the curriculum across different disciplinary areas

- Development of a CPS framework for teachers, students and researcher aimed at supporting academics in the design of curricula to strengthen creative problem solving in a range of disciplinary fields

- Development of an open source, accessible CPS system designed to scaffold academics in the curriculum renewal process and enhance students' creative problem skills

- Development of an open source CPS system for students designed to guide them through the creative problem solving process in their studies

- Development of an open source CPS system for researchers designed to guide student researchers and early career researchers through the process in designing and developing a research proposal

- Publication of a practitioner's guide outlining strategies that can assist academics in designing and redeveloping courses in which creative problem solving is embedded in the curriculum.

- Trials in courses exploring pedagogical benefits of embedding CPS in the curriculum including:

- Introduction to Digital Media INFT 1014, UniSA (revised based on updates to CPS)

- Idea Generation Methods GRAP 2019, UniSA (revised based on updates to CPS)

- Entrepreneurship and Innovation TECHOM 5016, UniSA

- Managing the Hospitality Experience TOUR 2005, UniSA

- Postgraduate course - Festivals and Events TOUR 5002, UniSA

- Teacher education course in 3D virtual world (Second Life) at University of New England

- Mechanical Engineering Practice, UniSA

- Principles of Marketing (Massey University)

- Develop and apply creative arts industry knowledge, RMIT

- Diploma of Audio Visual Technology, RMIT

- Entrepreneurship (The University of Adelaide)

- Four courses in occupational therapy (University of Cape Town)

- Nursing and midwifery course (Flinders University)

- Webinars showcasing best practice including:
  - Idea generation techniques (Mr Ron Corso and Mr Stuart Gluth, UniSA)

  - Creative problem solving in a first-year undergraduate course (Associate Professor Denise Wood and Dr Carolyn Bilsborow, UniSA)

  - The CreatEd project (Professor Barbara de a Harpe and Ms Thembi Mason, RMIT)

  - The Conversation with myself (Ross Bateup, cartoonist)

  - Fostering Creativity (Robyn Phillip, QUT)

  - Teaching with *Ingenium* (Robyn Phillip, QUT)

  - Teaching with *Ingenium* in engineering (Associate Professor Kazem Arbrahary, School of Engineering, UniSA)

  - Teaching with *Ingenium* (Dr Sue Gregory, UNE)

  - Teaching with *Ingenium* in entrepreneurship courses in Adelaide and Singapore (Professor Noel Lindsay, University of Adelaide – forthcoming August).

- Workshops, seminars, and conference presentations conducted nationally and internationally including the following:

Table 2: National and international dissemination

Event date	Event title	Location: city and country	Brief description of participation
July 2011	Conference presentation	France	Conference presentation on the project and CPS tool demonstration at the 2011 AMS World Marketing Congress
19th June 2012	In-person workshop	Adelaide	Workshop on creative problem solving held for academics, project leaders and industry
10th October 2012	Seminar	Johannesburg	Seminar for PhD students conducted at University of the Witwatersrand
12th October 2012	Public lecture	Johannesburg	Public lecture on the research conducted at the University of the Witwatersrand and attended by academics from local universities in South Africa
February 2013	Trials of courses	Singapore	Trial of course in entrepreneurship conducted at Singapore Campus of The University of Adelaide
April 2013	Seminars	Cape Town	Seminar scheduled for University of the Western Cape and Stellenbosch University for the Directorates of Teaching and Learning
June 2013	Employer forum	Adelaide	Industry engagement event in which focus groups were held with employers about their views on the importance of creative problem solving and their experience of the ability of graduates to demonstrate, articulate and apply creative problem solving in professional practice
June 2013	Conference Presentation	Cape Town	ICEL conference presentation
July 2013	Workshop	Cape Town	Workshop conducted on designing a research proposal using creative problem solving approaches at the University of the Western Cape
September 2013	Conference Presentation	London	Presentation at the International Conference on Knowledge, Innovation and Enterprise
September 2013	Conference Presentation	Bologna	Presentation at the International Conference on

- Formative and independent summative evaluations conducted focusing on the process, quality assurance processes, outcomes and dissemination strategies undertaken through the project

- Formative evaluation of the suitability of the open source tools undertaken through the design-based research approach adopted for the project.

- The following peer reviewed publications:

  - Lindsay, N. and Wood, D. (in press). Facilitating Creative Problem Solving (CPS) in the Entrepreneurship Curriculum through Authentic Learning Activities. In Bozalek, V., Ng'ambi, D., Wood, D., Herrington, J., Hardmann, J. and Amory, A. (Eds). *Activity Theory, Authentic Learning, and Emerging Technologies: Towards a Transformative Higher Education Pedagogy*. Routledge: Taylor and Francis Group Publishers

  - Wijesinghe, G., Corso, R. & Gluth, S. (forthcoming). Teaching Creative Idea Generation Techniques for Designing Creative Festival/Event Concepts: A Case Study from an Australian Educational Context, *Tourism Management Journal*.

  - Wood, D. and Bilsborow, C. (2014). 'I am not a person with a creative mind': Facilitating creativity in the undergraduate curriculum through a design-based research approach. *Electronic Journal of e-Learning*, 12(1).

- Several conference presentations including:

  - Corso, R. and Robinson, H. (2013). The impact of social media in facilitating the creative thinking abilities of students. *Proceedings of the International Conference on Knowledge, Innovation and Enterprise*, London, UK, 19th to 13th September 2013.

  - Corso, R., Wood, D. & Bilsborow, C. (2013). 'Ingenium': An online tool for facilitating creative problem solving in Higher Education. In *The First International Conference on the Science of Creative Thinking*, September 29th - October 1st, 2013, Bologna, Italy.

  - Wood (2013). Enhancing creative problem solving in the higher education curriculum through the use of innovative e-learning technologies. *Proceedings of the 8th International Conference on e-Learning*, Cape Town, South Africa, 27-28 June 2013.

  - Wood, D., Lindsay, N., Gluth, S., Corso, R., & Bilsborow, C. (2011). Facilitating creative problem solving in the marketing curriculum in response to the demands of the networked information society. Proceedings of the 2011 AMS World Marketing Congress (WMC), Reims, France.

8.2 Project outcomes

- Enhancement of practical knowledge and understanding of the use of creative problem solving in the higher education curriculum.

- Increase in the embedding of creative problem solving activities in curricula materials in the courses trialled.

- Cross-sector collaboration leading to the development of a CPS system that is flexible enough for use across a range of disciplinary contexts.

Chapter 9: Evaluation of the project

Evaluation was conducted in a formative manner throughout the design and development stages, and an independent summative evaluation will be conducted on completion of the project (see evaluation table below). The national/international reference group oversaw the project and monitored the outcomes at each evaluation milestone. Ethics approval was obtained prior to commencement of trials and evaluation of the system. The evaluation strategy included evaluation of:

- the student's experience using the CPS system in the nominated courses

- the teacher's experience using the CPS for redevelopment of courses and the student version for use in the nominated courses

- pedagogical guidelines developed through consultation with experts from industry and professional bodies, and a review of existing guidelines and enhanced through experience gained in the trials

- how the findings from this project can contribute to the growing awareness of the value of creative problem solving in the higher education curriculum

- the project overall.

9.1 Formative evaluation

Project team members have been reviewing the CPS framework and tool progressively. The project site includes a wiki for feedback. Reference team members met three times at regular intervals throughout the project.

Alpha testing was conducted in designated undergraduate courses in 2012. The student feedback from the anonymous survey and teacher experience informed revisions to the approach and CPS tool which will be trialled through Beta testing in first semester 2013. Revisions have responded to three major areas of concern reflected in student feedback:

- <u>The difficulty in accommodating diverse student needs and interests</u>; students who did not consider themselves 'creative' or familiar with creative problem solving were generally positive about the scaffolded approach provided. For example, positive feedback from students using the CPS tool in the first year introduction to digital media course commented on the value of the tool as *'a great catalyst for new directions in thinking, I definitely would not have looked into so many areas to do with my topic, or tried to combine my ideas if I wasn't using this tool'*; *'It was well laid-out, with clear progression. As a starting point, especially for someone unused to the creative process, it is probably a very helpful tool'*; *'i do really like the tool, i feel it helps open more doors to so many possibilities'*; *'loveeeeee it*!' However, student feedback also reflected the diversity of students who need to be accommodated in a first year course offered across many different undergraduate programmes. For example, one student noted '*I was already confident about my creative problem solving skills. For someone less confident, I can certainly see the potential, however I was mostly just bored*'. Similar comments from students enrolled in creative programmes reflect this limitation of the approach we had adopted to scaffold students. For example, '*This*

course is a prerequisite for many programmes that are CREATIVE COURSES and therefore you do not often get people who are not creative doing them, therefore this programme is unnecessary and seriously too long' and similarly, '*Give your users a higher level of assumed knowledge to avoid appearing condescending and over stating your point. Perhaps provide in-text links to terms and techniques that are references but not explained in detail for people to follow, if they are unfamiliar with it*'.

- <u>The need to provide alternative pathways and a more visual interface</u> to accommodate different student learning styles as reflected in comments such as: '*Whittle down the information to the pure techniques and processes, remove all unnecessary text and page clicks, then structure it in a cleaner, more visually concise layout, then it will be a lot easier to use and more likely to become a resource people will come back to*'; '*Include some visuals would help some understand better*'.

- <u>The need for more examples within the CPS</u> tool for teachers to adapt their teaching to incorporate more creative approaches was evident from teacher feedback, and as a result, we created a series of videos using an animation style, which we hoped would be both visually engaging (responding to student feedback for a more visual tool) and also act as a scaffold (see Appendix E2 for example screen shots). Teacher and team member feedback has been overwhelmingly positive with email comments such as '*Wow! The series captured my attention as opposed to the previous site! It is very well done and no doubt will capture student attention and increase their likelihood of engagement*'; '*The animations are fantastic! Well done! They are very impressive and should make the students enjoy their learning more*'.

Based on that feedback, the following changes have been made:

- The mind map tool itself has been further developed as a complete authoring environment to provide a more visually interesting tool. This also provides an alternative visual approach to students not requiring the more linear scaffolded approach shown in the screen shots in Appendix C1, which show the various stages students were required to step through in the creative problem solving process. The new tool shown in Appendix C2 enables students to generate their ideas and embed their research and concepts within the mind mapping tool itself rather than needing to step through each stage in a linear manner. Links are provided to enable the student to refer back to the more detailed information provided via the website.

- As noted above, video tutorials designed as animations to be visually engaging have been added to the site to scaffold both students and teachers in the CPS approach (YouTube channel http://www.youtube.com/user/IngeniumUniSA/videos?view=0 and Appendix E2).

- The visual interface of the CPS tool has been made more interesting with the use of graphic buttons, arrows and background sketches (see Appendix C3).

9.2 Summative evaluation

9.2.1 Semi-structured interviews with academics participating in the trials

Semi-structured interviews were conducted with 8 academics participating in the trials of *Ingenium* at the conclusion of the project. These interviews were conducted by Dr Sheila Scutter, a project team member who did not trial the tools in courses, so was in a sense independent for the purposes of the interviews.

The responses from academics appear under each question together with a summary of the implications and recommendations arising from this feedback.

Was the CPS tool easy to use? (I could find the buttons I needed quickly and the interface was logical).

Most academics found the tool easy to use and to navigate around, and that the buttons were quite intuitive and explanatory.

There were some difficulties with navigation as the "Home" page actually went to the Project Home Page rather than the Page that was the Gateway to the CPS frameworks for Students, Teachers and Researchers. The Project Home page served that purpose well, but was not intended to specifically engage and enthuse students in the potential of the Ingenium Tool. The Gateway Page itself was also seen as informative rather than encouraging, and it was suggested that some more explanation of how the frameworks could be helpful could have been included. Navigating back to the Gateway Pages was not straight-forward…a "home" key back to this page would have been useful.

All respondents commented on how useful the introductory sessions given by Ron Corso were and commented that they would have felt unsure giving this session themselves. It was suggested that a short video that could be played in lectures or put online for students for the next time the course is run could be produced to great effect. This could be linked to the Gateway Page.

Students who were studying externally would have benefited from an introductory session such as that provided by Ron, but still managed to negotiate around and effectively use the tool. The short video discussed above would be of benefit to these students.

Did the CPS tool enhance your awareness of creative problem solving techniques?

Since I was involved with the design of the framework and then the tool my awareness and understanding of creative problem solving evolved over time so by the time I implemented in my courses I had developed a good understanding of the techniques and benefits for my approach and for students. Students who did not engage with the process generally produced far less innovative approaches to their assignments, so the framework and tools have enhanced my teaching approach and for the students who use the student tool, their ability to produce innovative work.

All respondents found that the resources were useful in providing different approaches to CPS techniques. Respondents felt that the site was a useful point to add (current and useful) links to in order to make it a comprehensive CPS site.

Respondents indicated that they gained increased confidence in teaching creativity after using *Ingenium*.

One respondent stated *'…my background is as a professional in the field rather than as an educator. So although I have done a teaching certificate, I was not sure how to address the*

issue of adding creativity into the curriculum'.

Some participants felt that they still struggled with assessment of creativity and would have liked more guidance in as to how to incorporate creativity into assessment … *'as students are driven so much by assessment I feel that I need a way to assess the creativity component to get them to engage in the process. I can show them the web page and the resources but it is difficult to how to encourage them to engage'.*

'I already teach creativity and this is just a component in the course I used it in. So I did not feel that I learnt a great deal personally about creativity, but this was still a great resource for students. As students do other courses that focus solely on creativity the skills learnt in my course will assist them'.

What aspects of the CPS tool did you find challenging to use? (eg button meanings were unclear, the menu structure was difficult to understand, it was unclear how to accomplish a task, etc)?

'It is pretty straight forward to use with minimal learning curve. The toggle functionality of the graphic icons might not be self-evident, but experimentation soon reveals the functions'.

'When first navigating to the page I felt a bit lost and the Home Page was not obvious. The Home Page could have been more interesting and engaging…the Home Page and Pilot page were very dry and really just told me about the project and the funding rather than explaining how it would help me and my students. The text on these pages was rather small and it would have been good if the links to the OLT and UniSA were active for further information'.

'Some information about the importance of creativity, some examples, comments from employers etc…would have made the introductory pages more interesting and engaging'.

'Students were very keen to use the page and it was clearly evident in the work they submitted who had used the resources and who had not…the quality was much better'.

Can you suggest any additional resources that should be included in the CPS tool?

Video vignettes of coordinators sharing their approach and experiences using the teacher tool and/or research tool and their students' use of the student tool would be valuable to provide short, but inspiring examples of practice. While there are case studies, short videos (as opposed to the lengthy webinars) would provide inspiration for other teachers. These videos are planned as is a video animation of the application in nursing to contrast with the digital media example currently available for students. It would be great to also have a few student video vignettes with students discussing how they used the tool to support their creative approach.

The videos were universally appreciated and all respondents suggested that it would be an advantage to have more examples. The example use of the vignette of creating a community garden was helpful, but it was felt by most respondents that a more "concrete" example would be useful, for example design of a new product. Teachers felt that it would be beneficial to have scenarios relating to a broader array of topics, for example IT, product design, health issues, business opportunities. This was seen as being advantageous not only to students but to teachers as well. However, interestingly it was commented by some that videos should not be discipline specific as this would narrow rather than broaden the focus of student thinking.

As discussed later, it was difficult to recruit health science academics into the project.

Comments from those who did investigate the tool strongly requested example videos relating to health science scenarios.

Videos of a teacher and researcher using the tool to develop creative curriculum examples were also requested.

Responses about the mind mapping tool included in the resources were mixed. *'My students are not used to using such resources, so a worked example (in the discipline area) would be very helpful'.* In contrast, others commented that their students were familiar with mind maps and no introduction was needed. The mind map tool was considered extremely effective, easy to use and useful by these respondents. In contrast, the facility to download unzip and install the mindmap tool (used in earlier versions of the tool) was seen as somewhat cumbersome.

Do you have any other comments or suggestions for the CPS tool developers?

The design based research approach has ensured iterative development of the tools over time in response to student and teacher feedback. The developers have taken into account this feedback and been responsive to modifying the tools progressively, so at this stage the tools I think reflect a logical and usable approach to scaffolding academics and students in the CPS approach.

The Contact Us page could include all of the project team and particular areas of expertise or interest, so that those interested knew who to contact. Current photos of the team members and affiliations would be useful for those seeking further information.

Ron Corso came to do an introductory session for students, which was excellent. Without this session it would have been difficult for me to effectively demonstrate the tool and speak about the concepts. I would like to use the tool again next year but am not sure that I will be able to introduce it effectively without a session from Ron. I did have a look at the webinars but did not find them particularly useful. If Ron is not available to do introduction to classes in the future, a videocast that could be played and commented on would be useful.

'I will certainly be using it again. It was a fantastic tool to take them step by step through a creative problem solving process'.

Other comments

The project has highlighted the challenges in engaging some academics in the process of redesigning their courses in ways in which creativity is clearly embedded within the curriculum. While it has generally been easy to find academics who are already creative and innovative to engage, others from more rigid, traditional science backgrounds have been less willing to even meet to discuss the benefits of embedding CPS in the curriculum. Our experience recruiting academics reflects a broader issue that was identified in Simon Barrie's (2004) finding that academics appear to hold four different conceptions of generic attributes (precursor; complementary; translation; and enabling conceptions). Those most resistant to engaging in trials of the framework and tool tended to see creative problem solving as complementary attributes that require a special module or series of modules conducted by experts in creativity and thus difficult to include in their already packed curricula. Some also appeared to equate creative problem solving to other generic skills they already incorporate in their curriculum. The only way we were able to break through this barrier was to recruit health science professionals who are already highly creative innovative academics and understood the value of CPS in their discipline to serve as role models for others (Flinders and South African projects).

The outcomes from this project also indicate the need for further studies extending the approach, framework and tools to other generic attributes that several leaders of graduate attributes related projects (Simon Barrie, Bev Oliver, Barbara de la Harpe) have identified as challenging for academics to embed within their curricula.

Despite extensive efforts, it was only towards the end of the project that academics from health sciences were successfully recruited to trial *Ingenium*. A variety of reasons for not trialling the tool were given, and it is helpful to reflect on these issues.

The use of the term 'creativity' in the context of health sciences may be misleading for some academics. Health Sciences content is viewed as hard core science based on evidence and facts. Hence, the concept of including creativity was met with scepticism by some academics, being seen as not relevant to health sciences. It might be that using different terminology, for example 'lateral thinking' would be more attractive in health science curriculum.

Some health science academics commented that their curriculum was already overloaded and that there was no room for additional content such as would result from embedding creative approaches.

Although it was explained that using the CPS tool need not actually change the content taught, but could be used as a tool in creative thinking activities relating to the existing curriculum, there was still concern that this was a new activity in an already full curriculum. Some academics were concerned that reducing any other content in order to introduce creativity would lead to difficulty with accrediting bodies. Other courses are also accredited (eg education) but they did not feel as constrained by the prescribed curriculum.

Aside from curriculum squeeze, one of the most challenging issues in encouraging academic staff to incorporate new creativity appeared to be the mindset of academic staff as to what is 'relevant' for their discipline. There are increasing competing demands in Health Sciences curricula which render 'creativity' lower down the list of importance. Some health sciences disciplines are moving into a new national accreditation framework which requires a different mindset and approach towards demonstrating compliance. In this context and coupled with a tightly jam-packed curriculum, it is extremely difficult to encourage staff members to consider trialling and incorporating a new teaching tool that, in their view, does not contribute to the core competency of health care practitioner.

In addition, it was felt that health sciences students would view 'creativity' as not core to their disciplines. Academic staff are acutely aware of student feedback and mention that introducing creativity into the curriculum would result in poorer student feedback.

Other issues impacting on health science courses were that large classes taught in relatively small groups required the employment of hourly paid staff, who it was felt would need training to use the CPS tool with students. The time required to train tutors, and the additional hours needed to pay tutors to learn the tool, were seen as problematic.

In some health science courses, the introduction of common courses for first year students resulted in class sizes that could not fit into any lecture theatres at the university. Therefore these courses were changed to be taught solely online. It was felt that introducing the CPS tool and explaining the relevance to students would be difficult in an online environment.

Some health science course coordinators indicated that it was not necessary to include creativity skills within the curriculum as they were already included in the form of clinical problem solving.

Some senior academics indicated that clinical problem solving addressed the need for creative thinking, as described in the graduate qualities espoused by the institution:

'is an effective problem solver, capable of applying logical, critical, and creative thinking to a range of problems'.

Indeed some academics considered that introducing students and academics to the *Ingenium* framework would be a *'distraction to staff who were working on disciplinary content'*.

'I would see this (including creativity into the curriculum) as a diversion to staff that would hinder the hard work they are undertaking to comply with the approach directed from the university and division. The focus of curriculum development was on *"assessing programmes for appropriate volumes of learning, learning outcomes for each AQF level, and to show progression of disciplinary content within our degree programmes'*.

In the current climate encouraging teachers to undertake a new initiative in a time poor environment is challenging. Such initiatives are left to the highly motivated, keen enthusiastic staff members who are passionate about learning and teaching and this often constitutes a very small minority.

9.2.2 Independent evaluation

The independent summative evaluation involved a more formal approach using a structured questionnaire and interviews undertaken by Ms Deanne Gannaway. Her review considered:

- how the findings from this project can contribute to the development of guidelines for the use of the CPS system in the participating institutions and the OLT community

- the open source CPS system according its fitness for purpose and its technical adequacy

- the project overall and how the collaboration of institutions in this area can be taken forward.

Table 3: Summative evaluation framework

Timing	Factor to Evaluate	Questions to Address	Method(s)	Measure of Success
Nov to Dec 2011	The reviewers' experience (in each) partner institution of evolving CPS system.	Usability & accessibility of interface; adequacy of metrics established.	Interview and anonymous survey	Positive feedback from reviewees.
March 2012	The students' perspective/experience.	Usability & accessibility of interface; experience relating to: engagement; sense of community; learning, satisfaction with course and CPS system.	Online anonymous survey	Reliability; ease of use; sense of learning community; level of engagement; satisfaction with course; and the CPS system.
April 2012	The teachers' perspective/experience.	Usability & accessibility of interface; Satisfaction with authoring tools; reported students' satisfaction; adequacy of guidelines.	Online anonymous survey	Reliability; ease of use; extent to which CPS facilitated student engagement; satisfaction with CPS system & guidelines.
May – June 2012	The reviewers' perspective /experience in each institution.	Adequacy of pedagogical guidelines.	Anonymous survey	Positive feedback from reviewees.
June 2012	The reviewers' and users with disabilities experience	Usability of interface; adequacy of metrics for	Anonymous survey & accessibility	Positive feedback from reviewees and users; level

	trialling final version of user interface and authoring environment.	evolving guidelines.	testing.	of accessibility measured against established metrics.
July 2012	The wider view of how each institution may take forward the CPS system.	Practicality. Collegiality.	Review and report from each partner.	Practical insight.
July 2012	The CPS framework, online system, guidelines and the project itself.	Is there value in having close (sub-regional) links on the issues surrounding the CPS system & guidelines?	Review by steering committee and reference group; external review.	Commitment to maintain partnership in some form.

Ms Gannaway's key findings are as follows:

1. Project milestones were achieved, despite initial delays, according to a time line adjusted in negotiation with OLT

2. The primary goal to develop open source, adaptable web based resources that can be accessed by staff and students has been met

3. Project outcomes align with the OLT grant objectives

4. The project has been well managed, adhering closely to the project time lines and milestones and has resulted in quality, accessible resources

5. The project team was responsive to formative feedback and needs of the community

6. The web-based resources are accessible, useful, searchable and easy to use. It is also continually evolving due to enthusiasm from the targeted audience

7. There has not been sufficient time to conduct a summative evaluation that measures long term benefits

8. This project has established that there is limited understanding or adoption of creativity as a fundamental graduate skill or outcome that should be taught across all disciplines. It has identified a particular need that can be acted on in future projects as well as having developed the resources that can be used in future change projects

9. The project has opened up the conversation and understandings of what is meant by creativity, both across different disciplines and between industry and the academy

10. The project has developed a deeper understanding of some of the barriers and hindrances for adoption by a wider group

11. The ground work for changing practice has been laid through the development of a robust set of resources that have been embraced and are championed by a group of first level adopters.

Chapter 10: Discussion and conclusions

This project sought to maximise the benefits of creative problem solving by developing a CPS framework and associated tool designed to scaffold students through the creative problem solving process and guide educators in the design and redevelopment of the curriculum. By employing a design-based research approach, the project facilitated the development of a CPS tool informed by student and teacher feedback through multiple iterations involving design, development, trials, evaluation, collaboration, reflection and revision. Consistent with a DBR approach, the research built on a strong theoretical foundation informed by creativity theories and contemporary research showing the benefits of creative problem solving in education to address the challenges reported in the literature as inhibiting educators from incorporating creativity into their courses.

The DBR approach outlined in this paper involved mixed methods design and multiple iterations undertaken in the 'living laboratory' (Kafai, 2005) of the online classroom to ensure the design and development process was informed directly by student and educator feedback. While this approach is not without its challenges (see for example Anderson & Shattuck, 2012; Barab & Squire, 2004) as the highly critical feedback by students to early iterations suggest, the approach demonstrates the value of research which seeks to address 'real-world' problems through 'an iterative research process that does not just evaluate an innovative product or intervention, but systematically attempts to refine the innovation while also producing design principles' (Amiel & Reeves' 2008, p. 34). The findings highlight the potential of CPS in the undergraduate curriculum as well as some of the challenges, with specific reference to the experience trialling the framework and tool in a first year course.

The trials have highlighted strategies that might be employed to better engage students in creative problem solving. The DBR approach employed in this study demonstrates the effective use of evidence to inform practice multi-disciplinary collaboration and consideration of strategies designed to ensure the long term impact and sustainability of the project through the planned future trials of the CPS approach across a broad range of disciplines in other institutions and contexts. The majority of course coordinators who trialled the CPS framework and tools have indicated their intention to continue incorporating these resources into their courses. Thus the lead institution (UniSA), which is also hosting the site, has a commitment to maintaining and updating the site and tools continuously each semester. The open source framework and tools have also been packaged and available for download via the project site. In adopting this approach, the project has sought to ensure that the key factors shown to contribute to successful outcomes from technology enhanced learning and teaching initiatives (Keppell, Suddaby & Hard, 2011, p. 24) are addressed.

Finally, the project's experience employing DBR as the preferred methodological approach to research of this kind highlights the value that should be placed on students being integrally involved in the design and development of technology enhanced learning innovations. Future research using this DBR approach to further develop the CPS tool informed by trials across a broader range of disciplinary fields and in other HEIs aims to ensure the flexibility, adaptability, suitability and sustainability of the approach across the HEI sector.

Chapter 11: Recommendations

The following recommendations are clustered into three main areas: 1) Recommendations for further development of the tools and resources identified through trials, student and academic formative feedback and summative feedback provided by academics through semi-structured interviews completed at the completion of the project; 2) Recommendations for better preparing graduates to be able to demonstrate and articulate creativity skills in professional practice and employment identified through focus groups conducted at an employers' forum hosted at the University of South Australia in June 2013; and 3) Recommendations for continuing engagement with the higher education sector to promote uptake of the creative problem solving approach across disciplinary areas, as well as further areas for research identified through the independent evaluation process.

Further development of creative problem solving tools and resources

Analysis of findings from trials and interviews with academics conducted at the end of the project identified the following further areas of development:

1. All academics participating in the trials of the CPS tools commented on the usefulness of the introductory sessions given by project team member Ron Corso and it was suggested that a short video that could be played in lectures or put online for students for the next time the course is run could be produced to great effect.

2. Some participants felt that they still struggled with assessment of creativity and would have liked more guidance in as to how to incorporate creativity into assessment.

3. Some information about the importance of creativity, some examples and comments from employers would have made the introductory pages more interesting and engaging.

4. Video vignettes of coordinators sharing their approach and experiences using the teacher tool and/or research tool and their students' use of the student tool would be valuable to provide short, but inspiring examples of practice.

5. Similarly several academics suggested the benefits of including a few video vignettes with students discussing how they used the tool to support their creative approach.

6. Academics also felt that it would be beneficial to have scenarios relating to a broader array of topics, for example IT, product design, health issues and business opportunities.

7. Some academics suggested that the 'Contact Us' page could include all of the project team and particular areas of expertise or interest, so that those interested knew who to contact. Current photos of the team members and affiliations would be useful for those seeking further information.

Recommendations for better preparing graduates for the workplace

Feedback from employers attending the UniSA hosted employers' forum identified several factors that impact on how well graduates entering their profession are work-ready, particularly with respect to their ability to articulate and apply creative problem solving in

professional practice. Key findings suggest the following strategies that can be adopted by universities to better prepare graduates for the workplace:

1. Provide work integrated learning opportunities, mentoring programmes and internships to better prepare graduates for the workplace

2. Encourage students to participate in extra-curricular activities such as societies, cultural integration, industry partnerships involving students and academics to help develop graduates' generic skills

3. Consider alternative assessment approaches to provide a balance between the rewards and recognitions beyond grades.

Recommendations for continuing awareness and areas for further research

The following recommendations have been proposed by the independent evaluator, Ms Deanne Gannaway:

1. *That a change management project be undertaken that focuses on transforming the understanding of the place of creative problem solving in higher education teaching and learning.* It is strongly recommended that the project team pursue a follow up project that specifically targets a wider audience that includes industry and discipline areas resistant to embedding graduate attributes that embrace teaching innovation and creativity. This project would need to examine what is understood by these terms across a range of industry and disciplinary areas.

2. *That a robust summative evaluation strategy be developed to consider the kind of evidence that is required to convince potential adopters.* There is anecdotal and some hard evidence that the resource has been adopted and used to success in members of the project team. It would be useful to develop an understanding of the longer term impact on student learning and employability experiences. The evaluation strategy could be developed with the audience that would be targeted as part of the change management strategy identified above.

3. *That the project team continue to engage in awareness raising activities on an ongoing basis.* The impact of the capacity of the project team membership, to act as champions to encourage potential adopters to use the resources and visit the website, has an effect of generating a need. The ongoing enthusiasm of this group should be supported.

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Appendix A: Ethics application and research tools

> **The Ethics protocol (or application for ethics approval) is in three sections:**
> ❖ **Section 1** is a coversheet which records your contact details and the title of your project.
> ❖ **Section 2** is a checklist of yes/no responses which identify key issues.
> ❖ **Section 3** is the proforma which provides the ethics committee with more detail about your project and particularly your interaction with research participants.
> ❖ **Guidelines** to help you prepare your ethics protocol are accessible from the Research and Innovation Services, website www.unisa.edu.au/res/ethics/human.asp#forms
> **Please complete and submit all three sections**.

Section 1: **Coversheet**

Researcher's name	**Dr Denise Wood**
(Please underline your family name)	

If there is more than one researcher, please indicate who should receive correspondence

Researcher's School and Division	**School of Communication, International Studies and Languages**
	Division of Education, Arts & Social Sciences
Postal address for correspondence	**School of CIL, GPO Box 2471, Adelaide, South Australia, 5001**
Telephone number/s	**8302 4642**
Email	**Denise.wood@unisa.edu.au**

Please circle the type of research being undertaken

Staff	PhD	Professional Doctorate	Masters Research	Masters Coursework	Grad Dip/ Grad Cert	Honours	Undergraduate	Other

Title of research project	**Design as a catalyst for engaging students in creative problem solving**
Plain English title	
For inclusion on material provided to research participants	
Proposed commencement date	**Data collection to begin June 2012**
Researcher's signature	

	I certify that the protocol is complete and the research will be conducted in accordance with the protocol and in an ethical manner.
Supervisor's signature (if researcher is a student)	
	I certify that this protocol has been completed in accordance with the requirements of the UniSA's protocol guidelines. I have considered the ethical implications of the proposed research and believe that the research will be conducted in accordance with the relevant local, state, national and Uni SA policies, guidelines, regulations and legislation.
Supervisor's name (if researcher is a student)	
Supervisor's contact details (mail and email addresses, telephone number/s)	

> **Please note that protocols which do not provide sufficient information for HREC or DEC to make an adequate assessment may be returned for revision.**

Section 2: **Checklist**

Please circle your response to each of the following questions:

Does the research involve participation of Aboriginal or Torres Strait Islander people who have been selected
as research participants because they are indigenous Australians?   YES / **NO**

Does the research involve any artifacts that are of cultural, spiritual or religious significance to
Aboriginal or Torres Strait Islander people?   YES / **NO**

Does the research involve an unusually dependent relationship between the researcher and any of the
 research participants?   YES / **NO**

Could the research place research participants in an unusually vulnerable situation?   YES / **NO**

Is there any potential risk (physical, emotional, social or legal) to individual participants' well being,
beyond that normally encountered in everyday life, as a result of their involvement in the research?   YES / **NO**

Does the research involve the administration or application of drugs and/or Clinical Trial Notification Scheme (CTN) documentation? (*see www.unisa.edu.au/res/ethics/human.asp#forms*)   YES / **NO**

Is there any reasonable likelihood that the research will result in the reporting of

suspected child abuse?   YES / **NO**

Is there any potential risk to the researcher's safety, beyond that normally
encountered in everyday life, as a result of their involvement in the research?   YES / **NO**

Do you plan to vary the usual written consent processes?   YES / **NO**

Is the study known to involve research into illegal activities?   YES / **NO**

Does the study have potential legal implications for the researcher or the
University?   YES / **NO**

Have you applied for funding for this research (other than Divisional funds)?   **YES** / NO

If YES, please give the name of granting body applied to and the type of grant sought.

 12 month ALTC grant confirmed

> ❖ **Staff, PhD, Professional Doctorate and Masters by Research proposals must be
>   considered by the Human Research Ethics Committee.**
>
> ❖ **All other student research should be considered by the appropriate Divisional Ethics
>   Committee unless the researcher answered YES to <u>any</u> of the questions above.**
>
> ❖ **If you are uncertain about how to answer any of the questions or whether HREC or
>   a Divisional Ethics Committee should consider your proposal please seek advice
>   from the chair of the Divisional Ethics Committee.**

The checklist continues on the next page.

Please answer the remaining questions

What research methodologies will you use (tick those applicable)

Anonymous questionnaires	4	Questionnaires requesting intimate personal, identifying, or sensitive information	
Internet questionnaires	4	Face to face interviews which request personal or sensitive information	
Other questionnaires		Focus groups	
Face to face interviews which do not request personal or sensitive information	4	Action Research	
Observation of participant's usual activities		Experiment or testing of a procedure, drug or equipment	
Observation of an activity set up for the purposes of the study		Use of biological hazards, GMOs or pathogenic organisms.*(Refer additional approval requirement: www.unisa.edu.au/res/ethics/biohaz.asp#biological)*	
Access to medical records (or records which contain intimate personal information, <u>and</u> are individually identifiable <u>and</u> are not publicly available)		Use of carcinogenic and/or toxic chemicals, including heavy metals. *(Refer additional approval requirement: www.unisa.edu.au/res/ethics/biohaz.asp#biological)*	
		Use of Radiation (Ionising and/or Non-ionising) *(Refer additional approval requirement: www.unisa.edu.au/res/ethics/biohaz.asp#biological)*	

Other   (please specify)

Please tick the group/s from which your sample of participants will be drawn for this study

General public		Children or young people under the age of 18	
Friends or family		Patients of a hospital or clinic where you need approval to do the research	
Work colleagues		Prisoners or people in the care of correctional services	
People with whom you have an ongoing professional relationship (eg students or clients)	4	Members of the armed forces	

Other   (please specify) _____

In which country is data collection to take place? _____Australia and New Zealand
_____

List the organizations where the research will be undertaken. (Please note that written approval from all organizations must be obtained before the research can commence).

| University of South Australia |
| University of Adelaide |
| Royal Melbourne Institute of Technology |
| |
| James Cook University |
| University of New England |
| Massey University |

Will the research involve access to individuals, clients or records required from any organization?   **NO**
   (Refer additional approval requirement   www.unisa.edu.au/res/ethics/human.asp#access)

      If YES, has approval been received from these organizations?
                                                                                                         Y
      ES / NO

Will the research involve access to Uni SA staff, students or data?
   YES / NO
   (Refer additional approval requirement   www.unisa.edu.au/res/ethics/human.asp#access)

       If YES, has approval been received?
                        YES / NO

Will you access individually identifiable information about participants from any government department?
   YES / **NO**
or
from another organization (for example a state based register, education department, hospital, health department, correctional services)?
   YES / **NO**

If YES, list the government department(s) and/or organisation(s)

_____

_____

_____

Have you received approval to access this information from the government department(s)/organization(s) listed above?   YES / NO

Will the research take place in South Australia in schools, preschools, child care centres or other educational facilities?   **NO**
   (If YES, refer Police Clearance requirement www.unisa.edu.au/policies/codes/miscell/policeclear.asp)

Are the following appendices attached?

- Appendix 1 **Reference list** **YES** / NO

Appendix 2 **Research tools** **YES** / NO/ Not required for this study

- Appendix 3 **Recruitment material** **YES** / NO/ Not required for this study

- Appendix 4 **Information sheet** **YES** / NO

- Appendix 5 **Consent form** **YES** / NO / Not required for this study

- Appendix 6 **Correspondence** Not required for this study

Language of the Consent Form, Participant Information Sheet and any other material provided to research participants if other than English.

How do you intend to report your research?

Thesis/dissertation		Conference presentation	4
Journal article/s	4	Commissioned report	4
Research paper	4	Other (please specify)	

Will research participants have the opportunity to receive a copy of your final report or summary of the findings if they wish? **YES** / NO

If YES, how will you provide a copy of the final report or summary of the findings and/or, if NO, detail reasons why a copy will not be provided.

The final report will be available through the Department of Education, Employment and Work Place Relations, Office for Learning and Teaching

Will research participants receive any payment in relation to their participation? YES / **NO**

Ethics approval will not be finalised until copies of all necessary materials have been received by the executive officer of the ethics committee considering your protocol.

Section 3: **Ethics protocol proforma**

Please keep your responses as brief as possible while providing enough information for members of the ethics committee to gain a good understanding of what your research will involve. The *Guidelines for Gaining Ethics Approval* provide advice about what the committee requires. Remember that members of the ethics committee might not have the same background in your area of study that you have. Your responses should be written in plain English for a non-expert audience.

The suggested length of responses is a guide only. Simple, uncontentious research might be adequately explained more briefly. Research projects with a number of component parts or which involve possible risks to the research participants will require more detailed explanation.

Some questions might not be relevant to your study, for any that are not simply write N/A.

1 RESEARCH AIMS

1.1 State the aims of your research

The overall aim of this project is to design and evaluate a tool that promotes student engagement in creative problem solving. The project has been inspired by ongoing research in learning and teaching undertaken at UniSA (Gluth and Corso 2009; Wood 2010; Wood et al. in press), which has demonstrated the potential for creative thinking in guiding curriculum renewal and engaging students in enquiry-based learning at all levels of the undergraduate curriculum in varying disciplinary-based contexts. The project thus aims to:

- Guide academics in the development or redevelopment of their own courses through the creative design process;
- Develop students' understandings of the role of innovation and creativity in research and their capacity to undertake research within their disciplines and in multi-disciplinary contexts;
- Encourage and raise awareness and the practice of the scholarship of discovery and engagement through the collection of exemplars based on trials of the approach across disciplinary fields;
- Affirm the work of academics already active in the field by providing them with the opportunity to showcase their initiatives via a national online database;
- Facilitate discussion within disciplines that will lead to review of current practices in the pursuit of excellence in embedding creative thinking and innovation in ways that strengthen the integration of research and creative problem solving in the curriculum.

1.2 Explain the need for, and value of, your research

As Craft (2006) suggests "Surviving and thriving in the twenty-first century require a sort of 'personal effectiveness' in coping well with unknown territory and in recognising and making choices" (p.19) and creative capacity building can empower works to "persevere in the face of complexity and unresolvability" (McWilliam and Haukka 2008, p.660). However, while many universities acknowledge the importance

of creativity within the curriculum (McWilliam 2007b), most programmes are structured around achieving certain graduate qualities that elevate traditional education methodologies and practice, based on knowledge acquisition and retention, rather than creativity and the arts (Gluth and Corso 2009; Robinson 1998). Emphasis in education has been mostly concerned with what De Bono (1973) calls vertical thinking, the process of proving and developing concept patterns, whereas lateral or creative thinking sets out to restructure such patterns and provoke new ones. Although these traditional ways of teaching are acknowledged as destined to obsolescence (Robinson 1998), the lack of explicit guidelines and a scaffold to guide academics in making the required shift from outmoded teaching approaches has become a significant impediment to the goal of embedding creativity within the curriculum. This is especially so in discipline areas outside of design and the arts (Gluth and Corso 2009). Tosey (2006) suggests that creativity in the higher education curriculum is more often used "to converge and control" (p.35) than to engage productively "at the edge of order" (Fullan, cited in Tosey, p.34). To change this prevailing culture, argues Jackson (2006), we need to change our approach from penalizing mistakes to one of appreciating that making 'mistakes' provides important lessons for learning. "By perceiving 'mistakes' as opportunities for, and proof of, learning instead of failure, we begin to change the paradigm to one that is more enabling and valuing of creative effort" (Jackson 2006, p.197).

Another potential reason that universities have failed to embrace creativity in the curriculum more widely across different disciplinary fields is the lack of a concise definition of creativity within policy documentation (McWilliam 2007a). Edwards (2000) suggests that the term "creativity" has an amorphous nature and has traditionally been regarded as a gift that is only possessed by an exceptional few. However, research has also drawn attention to the importance of fostering the creativity of all learners (Csikszentmihalyi 1982; McWilliam 2007a). Researchers are challenging the assumption that creativity is purely an innate capacity and cannot be learned (McWilliam 2007a; Robinson 2001). Moreover, researchers are beginning to understand that human intelligence is complex and multifaceted (Robinson 2001). They are also beginning to recognise that creativity is enriched by other capacities and learner motivations (Robinson 2001), as well as the cultural context. As Robinson (2001) points out, cultural conditions can kindle or kill creativity.

A third barrier to changing the educational paradigm in ways that foster creative capacities of future graduates relates to the lack of strategies to help teachers develop the skills to engage with creativity "intentionally as an outcome of pedagogical work" (McWilliam 2007a, p.4). While it is evident that fostering creativity is "best achieved through a process-based or activity-based curriculum that engages students in challenging, novel and unpredictable ways of working and learning" (Jackson 2003 cited in Jackson 2006, p.213), the strategies for achieving this goal have tended to remain elusive for many teachers. Our current work sets out to both demystify such limiting attitudes and to also develop a framework and supporting online system that can scaffold teachers and students through a creative problem solving approach.

1.1.1 2   RESEARCH METHODOLOGY

2.1   List your research questions or hypotheses

The hypothesis guiding this research is that an online CPS framework can assist in encouraging students, both at a graduate and undergraduate level and across disciplines, to think more creatively about solving problems in general, but also to assist in developing their own research enquiries.

2.2 **Outline your research design and methodology**
This project will be conducted over a one-year period beginning in June 2012 (data collection to commence in June 2012).

In collaboration with national/international project team members representing different disciplinary areas, a CPS framework will be developed that guides academics in the development and redevelopment of their courses through an innovative approach that emphasises creative thinking as the catalyst for engaging learners in the research process.

Informed by our consultation with teaching and learning experts and industry, develop the CPS system incorporating a graphic based interface designed to facilitate creative thinking and idea generation, while also guiding teachers through the curriculum renewal process.

Building on the framework and prototype CPS system for guiding curriculum renewal, an online CPS system will be developed that can be used by learners as a tool to aid in the generation of ideas and guide them through the research design process.

Guidelines will then be developed for the use of the framework and related instruments for curriculum renewal designed to strengthen creative thinking, innovation and research in the graduate and undergraduate curriculum.

Trials of the CPS framework and online system will then be conducted in at least 10 courses across different disciplinary fields.

Throughout one-year project monthly webinars showcasing exemplars in the effective use of creativity to engage learners will be held. In addition, workshops will be conducted in five States to facilitate the uptake and inclusion into the curriculum by the higher education community.

The national/international reference group will oversee the project and will monitor the outcomes at each evaluation milestone. Key focus areas of the evaluation strategy are: 1) the student's and teacher's experience of the CPS system; 2) the pedagogical guidelines developed through consultation; 3) the contribution this project makes to creative problem solving in higher education curriculum and 4) the overall project.

The theoretical framework guiding this research has been adapted from Amabile's (1996) componential theory of creativity and Titus's (2000) Creative Problem Solving (CPS) model within a systems approach that incorporates a six stage creative problem solving process: (1) objective finding; (2) fact finding; (3) problem finding; (4) generating ideas; (5) solution finding; and (6) acceptance finding (*Creative Education Foundation* 2010). The framework also recognises the impact of the domain, field, and individual elements identified by Csikszentmihalyi (1999) as central factors in the creative process.

2.3 **Indicate whether your research is the first stage of a larger project**
This is the complete research project and not part of a larger project.

3 RESEARCH PARTICIPANTS
3.1 **Who will be approached or recruited to be research participants? How many participants will be involved in your study?**
Teachers and their students from the project-partner institutions will be invited to trial the CPS system.

3.2   How will you recruit participants for your research?

Each representative of the project-partner institutions will, in the first instance review the prototype CPS system. Following this each reviewer will distribute a one-page project information sheet (Appendix 3), detailing the project amongst other teacher's in his or her institution. The CPS system will then be trialled by their students.

A project website has also been established, which will be a vehicle for recruiting other universities wishing to participate in the project.

3.3   How will you provide detailed information about your study to potential participants?

Detailed information will be provided to potential participants through a participant information sheet. See Appendix 4.

3.4   Describe how you will obtain consent to participate from those volunteering as participants for your research

Written consent will be gained from participants through a consent form. See Appendix 5.

3.5   If your research participants will be drawn from any dependent group (people who have an unequal power relationship with you or with an organisation which is cooperating in the research) please detail how will you ensure that participants do not feel under any obligation to assist you with your research as participants.

The students participating in the evaluation of the CPS system can be considered a dependent group. Both the participant information sheet (Appendix 4) and consent form (Appendix 5) explain that participation in the research is entirely voluntary and that there will be no ramifications (academic or other) for the student if they do not wish to participate in the trials.

3.6   Describe how you will preserve participants' confidentiality as you collect and analyse the data and when you report the results.
The collection of data will be done through audio interviews and online surveys, both of which will be voluntary and anonymous.

3.7   If there are any potential risks (physical, emotional, social or legal) to individual subjects' well being (beyond those normally encountered in everyday life) as a result of their involvement in the research, detail the steps that will be taken to address, minimise and/or manage these risks including any support facilities such as counselling, debriefings or referrals.

It is not envisaged that there will be any potential risks to the well being of individuals.

3.8   If there are any potential safety implications for yourself as the researcher (beyond those normally encountered in everyday life) please indicate how these will be addressed.

It is not envisaged that there will be any implications for the research project team.
3.9   If research participants will receive any payment, reimbursement or other

benefit from participation in the research, please detail this and provide a justification for the level of compensation.

Research participants will not receive any reward, financial, academic or other for participating in this research project. Both the participant information sheet (Appendix 4) and consent form (Appendix 5) contain this information.

4 RECORDING, REPORTING, STORAGE AND ACCESS TO THE RESEARCH DATA AND RESULTS

4.1 Describe briefly how the research data will be recorded, for example, audiotape, videotape, or written notes.
Research data will be collected through both audio interviews and online surveys. Explicit consent for the audio interviews will be gained through the consent form (Appendix 5).

4.2 Describe what you will do with the recorded data once it has been analysed. In order for the University to comply with the *Australian Code for the Responsible Conduct of Research* your research data must be stored securely for five years in a safe environment. Describe how and where the data will be stored and whether the data will be individually identifiable, re-identifiable data; or non-identifiable data

The data will be stored at the University of South Australia in a locked cabinet or on a password protected computer in a secure office within the School of Communication, International Studies and Languages. During analysis the research data will be stored on the researchers' hard disk drives for easy access and retrieval.

After project completion, data will be stored as written transcripts, audio, audiovisual and digital files on CDs. The original data will be stored for 5 years in a locked cupboard in a secure office within the School of Communication, International Studies and Languages at the University of South Australia.

4.3 Specify who apart from yourself (and your supervisors if applicable) will have access to the research data and results, and any conditions to be placed on that access.

Only the researchers and other project research staff will have access to the data for the purposes of the research project.

5 OWNERSHIP OF THE RESEARCH

5.1 Detail who will own the data and the results of your research.
The anonymised research data will be owned by the chief investigators.
The CPS system and associated guidelines will be open-source

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Participant Information Sheet

2.1.1 Interview Questions – the reviewer's initial experience of the prototype

Questions to address the usability and accessibility of the interface; adequacy of metrics established

2.1.2 Anonymous Survey Questions (email distribution) - the reviewer's initial experience of the prototype

Questions to address the usability and accessibility of the interface; adequacy of metrics established

Measure of success: positive feedback from reviewees.

2.2 Online Survey Questions – the students' perspective and experience

Questions to address usability & accessibility of interface; experience relating to: engagement; sense of community; learning, satisfaction with course and CPS system

Measure of success: Reliability; ease of use; sense of learning community; level of engagement; satisfaction with course; and the CPS system.

2.3 Online survey questions – the teachers' perspective and experience

Questions to address usability & accessibility of interface; satisfaction with authoring tools; reported students' satisfaction; adequacy of guidelines.

Measure of success: Reliability; ease of use; extent to which CPS facilitated student engagement; satisfaction with CPS system and guidelines.

2.4 Anonymous survey questions (email distribution) – The reviewers' perspective/experience in each institution

Questions to address the adequacy of pedagogical guidelines.

Measure of success: Positive feedback from reviewees.

2.5 Anonymous survey and accessibility testing – the reviewers' and users with disabilities experience trialling final version of the user interface and authoring environment.

Questions to address the usability of the interface; adequacy of metrics for evolving guidelines.

Measure of success: positive feedback from reviewees and users; level of accessibility measured.

Project Information Sheet

Design as a catalyst for engaging students in creative problem solving

This one-year, Australian Learning and Teaching Council funded project aims to design and evaluate a tool that promotes student engagement in creative problem solving (CPS). While many universities acknowledge the importance of creativity, effective systems that actually promote creative problem solving for students remain elusive. This project has set out to develop a framework and supporting online system that can scaffold teachers and students through a creative problem solving approach. Both teachers and students may benefit from such a system because it will take students beyond basic knowledge acquisition and enable them to think creatively or laterally about problem solving.

The University of South Australia in conjunction with the University of Adelaide, University of New England, RMIT, James Cook University and Massey University is running the project and we're looking for university teachers across these institutions, in any discipline, which have a class that could benefit from the use of this CPS tool. Trials of the prototype tool will begin in April 2012 and the project will be completed by October 2012.

Your involvement as a participant in this research would include:

- Trialing the prototype tool in one of the classes you teach
- Completion of an anonymous online survey by you and your students
- The option to host a webinar showcasing your use of the CPS tool
- The option to contribute content for the CPS tool

The project team will also be conducting workshops and webinars throughout the project to promote and provide support for the use of the CPS tool.

The outcomes of the research will be:

- A creative problem solving system and associated guidelines for supporting academics in the design of curricula to strengthen creative problem solving in a range of disciplinary fields
- Development of an open source, accessible CPS system

The project partners are:

Dr Denise Wood (Project Leader) University of South Australia	Mr Ron Corso University of South Australia
Mr Stuart Gluth University of South Australia	Professor Noel Lindsay University of Adelaide
Professor Barbara de la Harpe RMIT	Dr Jenny Sim RMIT
Associate Professor Sheila Scutter James Cook University	Ms Sue Gregory University of New England
Dr Terry Macpherson Anderson Massey University	Dr Ewen Cameron Massey University
Professor Ingrid Day Massey University	

Who to contact?

If you would like to participate, or if you would like more information, please contact Denise Wood on (+61 8) 8302 4642.

Your participation in this project is completely voluntary, and non-participation will not affect your status in any way. You are free to withdraw at any time during the project.

The University of South Australia's Research Ethics Committee has approved this study. If you have any questions related to this project or your rights as a participant, please contact the Ethics Officer, Ms Vicki Allen on (+61 8) 8302 3118.

Participant Information Sheet

Design as a catalyst for engaging students in creative problem solving

Thank you for agreeing to participate in the research project, 'Design as a catalyst for engaging students in creative problem solving'.

This one-year, Australian Learning and Teaching Council funded project aims to design and evaluate a tool that promotes student engagement in creative problem solving (CPS). While many universities acknowledge the importance of creativity, effective systems that actually promote creative problem solving for students remain elusive. This project has set out to develop a framework and supporting online system that can scaffold teachers and students through a creative problem solving approach. Both teachers and students may benefit from such a system because it will take students beyond basic knowledge acquisition and enable them to think creatively or laterally about problem solving.

You've identified that you teach a class that could benefit from the use of this CPS tool and have agreed to take part in trials of the tool. Trials will begin in April 2012 and the project will be completed by October 2012.

Your involvement as a participant in this research includes:

- Trialing the prototype tool in one of the classes you teach
- Completion of an anonymous online survey by you and your students
- The option to host a webinar showcasing your use of the CPS tool
- The option to contribute content (creativity resources or case study) for the CPS tool

The project team will also be conducting five workshops nationally throughout the project to promote and provide support for the use of the CPS tool.

The outcomes of the research will be:

- A creative problem solving system and associated guidelines for supporting academics in the design of curricula to strengthen creative problem solving in a range of disciplinary fields
- Development of an open source, accessible CPS system

The project partners are:

Dr Denise Wood (Project Leader)
University of South Australia

Mr Ron Corso
University of South Australia

Mr Stuart Gluth
University of South Australia

Professor Noel Lindsay
University of Adelaide

Professor Barbara de la Harpe
RMIT

Dr Jenny Sim
RMIT

Associate Professor Sheila Scutter
James Cook University

Ms Sue Gregory
University of New England

Dr Terry Macpherson
Massey University

Dr Ewen Cameron
Massey University

Professor Ingrid Day
Massey University

Your participation in this project is completely voluntary, and non-participation will not affect your status in any way. You are free to withdraw at any time during the project. If you would like to discuss the project please contact Denise Wood on (+61 8) 8302 4642 or denise.wood@unisa.edu.au.

The University of South Australia's Research Ethics Committee has approved this study. If you have any questions related to this project or your rights as a participant, please contact the Ethics Officer, Ms Vicki Allen on (+61 8) 8302 3118.

Consent form - teachers

Researchers' names: Dr Denise Wood, Mr Stuart Gluth, Mr Ron Corso, Professor Noel Lindsay, Professor Barbara de la Harpe, Dr Jenny Sim, Associate Professor Shelia Scutter, Ms Sue Gregory, Professor Ingrid Day, Dr Terry Macpherson and Dr Ewen Cameron

Research Officer: Ms Carolyn Bilsborow

- I have read the Participant Information Sheet and discussed my involvement with someone who is not connected with the project. I understand and agree to take part.

- I understand that I will not be identified in any of the research publications. All details will be presented anonymously.

- I understand that I may withdraw from the research project at any stage and that this will not affect my status now or in the future.

- I understand that I will be audio-taped during the interview.

- I confirm that I am over 18 years of age.

I **would / would not** like the option of contributing content (creativity resources or case study) in the form of video, text or audio to the CPS tool.

I **do / do** not wish for a transcript of my interview to be placed in storage in the archives.

I **would / would not** like to receive a newsletter of research progress.

Name of participant…………………………………………………………….......

Signed……………………………………………….**Date**……………………….

Consent form - students

Researchers' names: Researchers' names: Dr Denise Wood, Mr Stuart Gluth, Mr Ron Corso, Professor Noel Lindsay, Professor Barbara de la Harpe, Dr Jenny Sim, Associate Professor Shelia Scutter, Ms Sue Gregory, Professor Ingrid Day, Dr Terry Macpherson and Dr Ewen Cameron

Research Officer: Ms Carolyn Bilsborow

- I have read the Participant Information Sheet and discussed my involvement with someone who is not connected with the project. I understand and agree to take part.

- I understand that I will not be identified in any of the research publications. All details will be presented anonymously.

- I understand that I may withdraw from the research project at any stage and that this will not affect my status now or in the future.

- I confirm that I am over 18 years of age.

I **would / would not** like to receive a newsletter of research progress.

Name of participant………………………………………………………………….......

Signed…………………………………………………….**Date**……………………….

Appendix B: Trials

The detailed findings from the trials can be downloaded from the following links:

 Introduction to Digital Media (UniSA)

Idea Generation Methods for Designers (UniSA)

Entrepreneurship and Innovation (University of Adelaide)

Mechanical Engineering Practice (UniSA)

Develop Vision and System Installation Plans (RMIT)

Creative and Accountable Marketing (UniSA)

Festivals and Events (UniSA)

Courses in ICT in Education (University of New England)

Appendix C: Survey feedback

C.1 Survey Data for Idea Generation Methods for Designers (Study Period 4 2012)

C.2 Survey Data for Introduction to Digital Media (Study Period 5 2012)

C.3 Survey Data for Idea Generation Methods for Designers
(Study Period 7 2012)

C.4 Survey Data for Mechanical Engineering Practice (Study Period 2 2013)

C.5 Entrepreneurship & Innovation (January 2013)

C.6 Survey Data for Diploma of Audiovisual Technology (RMIT) 2013

C.1 Survey Data for Idea Generation Methods for Designers (Study Period 4 2012)

31 responses

1. How long have you been using the CPS tool?

Less than 2 hours	18
Half a day (about 4 hours)	6
One day (about 8 hours)	
Two days	1
One week	4
More than one week	2
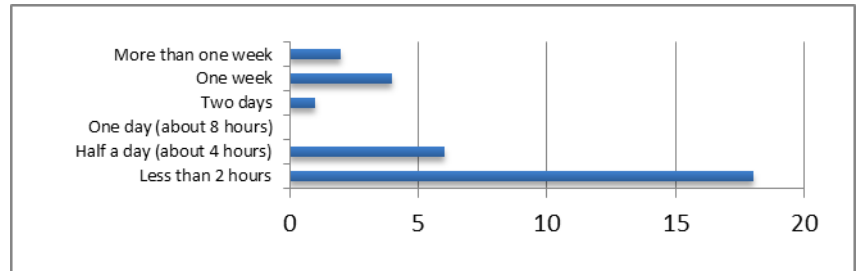
Comments

Been using this since beginning this course and find it very helpful.
Given that it wasn't gone through in class, I used the process talked about more so.
We weren't really introduced to it very strongly.
I did not use the tool
It would be more useful if there were examples using the process with an object
I found it too wordy for the mood I was in
Used it for assignment 1. That's it.
It was hard to understand
The CPS tool really helped me discover my own creative thinking and helped me control my own creative thoughts.
I believe had the programme been explained better I would have used it more.
I think the programme might have helped more if it had been explained better.
I took notes in Ron's lecture and followed my notes rather than the online tool.
Only looked at resources on page.

2. How long did it take before you felt confident using the CPS tool?

Less than 2 hours	13
Half a day (about 4 hours)	2
One day (about 8 hours)	2
Two days	
One week	
More than one week	
I am still not confident	13
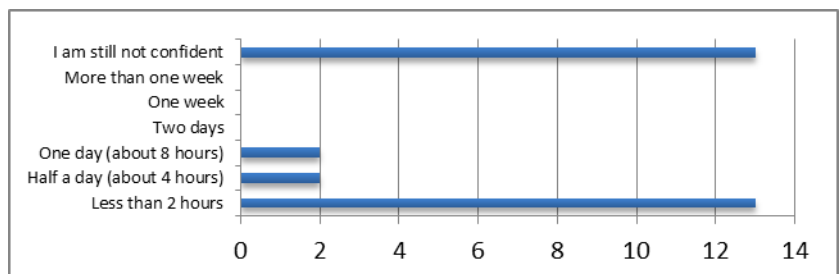
Comments

Didn't really use it ...
Easy to follow
I thought it was a bit boring to use, it could be in a more engaging. Less words on each slide - more slides
It didn't take me long to feel confident with using that tool as its structure was easy to understand.
I believe had the programme been explained better I would have used it more.
I did not use it.

3. The CPS tool was useful for helping me think creatively about the task I was given.

Strongly Agree	2
Agree	12
Neutral	9
Disagree	5
Strongly Disagree	1
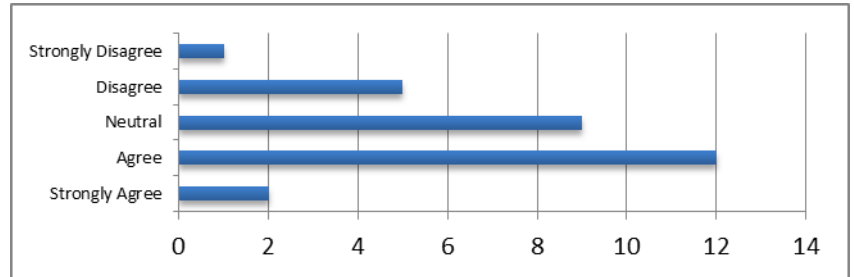
Comments
We didn't really know how to use it.

4. Before I used this CPS tool I was not confident about my creative problem solving skills

Strongly Agree	1
Agree	6
Neutral	12
Disagree	10
Strongly Disagree	1
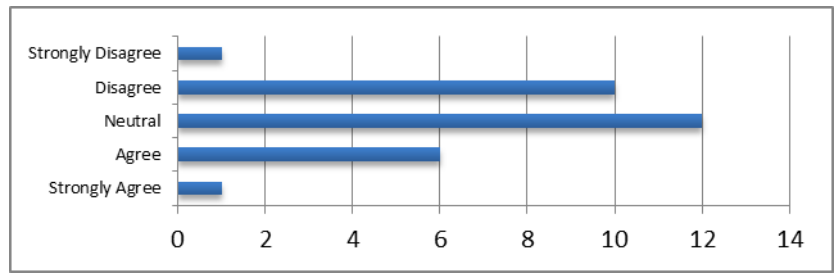
5. The CPS tool was useful for raising my awareness and practice of creative problem solving techniques

Strongly Agree	4
Agree	16
Neutral	3
Disagree	6
Strongly Disagree	
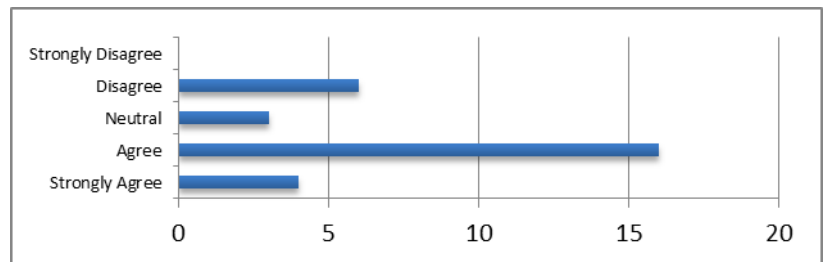
Comments
More so what Ron spoke of, not the actual website

6. The CPS tool has given me a process for applying creative thinking

Strongly Agree	2
Agree	17
Neutral	7
Disagree	3
Strongly Disagree	
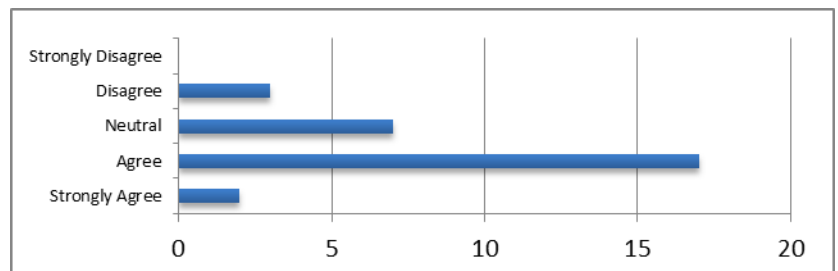
7. I can see a use for using the CPS tool in other areas of my studies

Strongly Agree	6
Agree	11
Neutral	5
Disagree	7
Strongly Disagree	
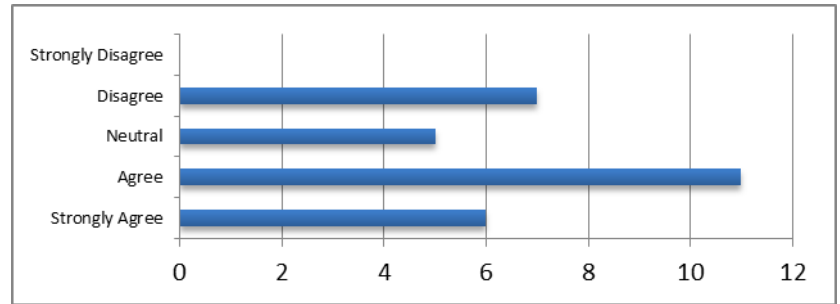
8. I can see a lot of potential in the CPS tool but feel that I would need to invest more time using it before I could benefit from it

Strongly Agree	3
Agree	19
Neutral	5
Disagree	9
Strongly Disagree	

Comments
Need examples with the step by step guide
I was expecting a programme instead of words
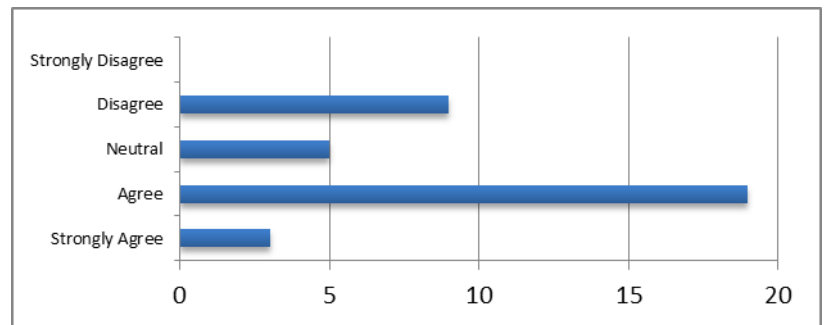
9. After using the CPS tool, I feel more confident about my creative skills

Strongly Agree	2
Agree	11
Neutral	6
Disagree	10
Strongly Disagree	
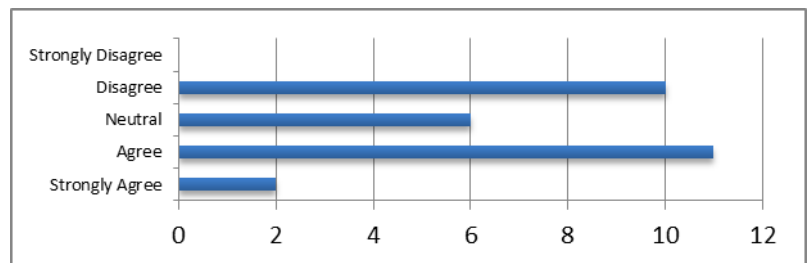
10. I used the following social media platforms linked through the CPS tool

Facebook	13
Wiki	1
Twitter	
YouTube	6
Blog	1
I didn't use social media	11
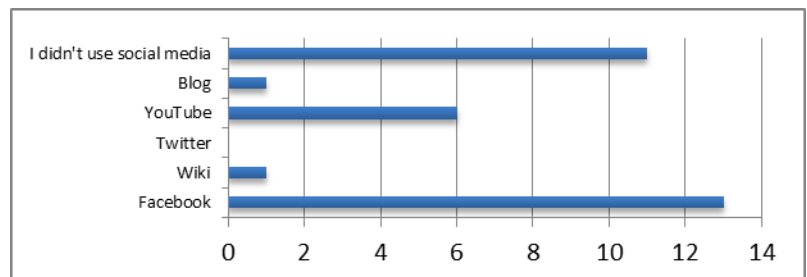
11. The CPS tool was easy to use (I could find the buttons I needed quickly and the interface was logical)

Strongly Agree	2
Agree	11
Neutral	7
Disagree	6
Strongly Disagree	2
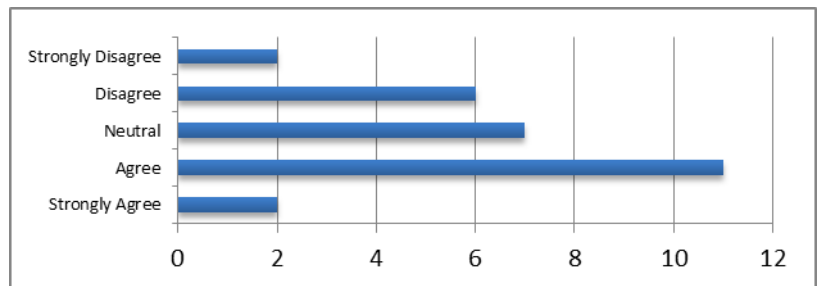
Comments

I didn't really use the online tool much, I found that Ron's lecture was enough information to
 know how to go through the processes.

I didn't use the online tool I only used the framework given in the lecture.

The first time I went through the programme I didn't notice the arrows at the bottom only topics on the side.
I thought this can't be it and had to look closer. Other people I talked to didn't know there were arrows.

Really helped me open up my mind to creative design and helping me access the thoughts I never had.

12. What aspects of the CPS system did you find challenging to use?

Comment

Some aspects of Ingenium are not explained in detail if you are new to the Ingenium method/site.

It was hard to find, had to google Ingenium because I couldn't find it on the website.

I did not use the tool.

It was clear

What it's intended for (What is it intended for?)

All parts were challenging

All of the above

The application of the CPS to our specific project was unclear

The only thing I didn't like was I felt that it pushed me into a direction I didn't actually wanted to go in.

I thought the layout was clear but didn't find any benefit from it.

I found the site a bit strange. An introduction would have helped.

13. What improvements should be made to the CPS tool? What features or resources are missing?

Comment

Maybe a homepage to explain and describe what Ingenium is and how to use it.

I didn't even see there were arrows @ the bottom of the pages, so I though each one was "what ya see is what ya get"

The steps needed to be more detailed with examples maybe link examples through facebook.

I suggest quickly introducing this to show buttons and processes. It should be straight forward and unassuming.

It's purpose. What it means.

Task/tool to be explained better before you use it.

Explain the tool better

Not so much anything to do with the tool itself, but the knowledge of it being there.

Instead of links to examples etc. It should be embedded into the site.

14. Any other comments or suggestions?

Spend more time introducing us to the programme

Topics are good but it could be broken into more details.

None

Just to promote it.

Think it is useful for people that work well with using tools to work creatively.

C.2 Survey Data for Introduction to Digital Media (Study Period 5 2012)

27 responses

1. How long have you been using the CPS tool?

Less than 2 hours	7
Half a day (about 4 hours)	7
One day (about 8 hours)	2
Two days	0
One week	1
More than one week	10
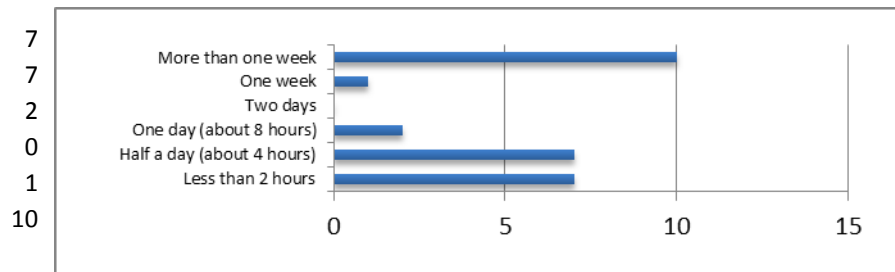
Comments

I couldn't get onto ingenium at home, so i had to screen shot the questions to take them home which was annoying

I used ingenium at irregular times over a few weeks.

 Only really looked at it when it was introduced to us during the prac

 loveeeeee it!

I like to use bubbl.us instead.

Very good planning tool.

I do not enjoy Ingenium. It is unnecessarily long and is not at all necessary for this assignment.

This course is a prerequisite for many programmes that are CREATIVE COURSES and therefore you do not

often get people who are not creative doing them, therefore this programme is unnecessary and seriously too long.

 I use it as little as possible.

I found the site rather hard to use. It was hard to follow the layout of the information and contained a lot of writing

that could be cut down to be more accessible and concise.

I didn't find it useful

I dislike having to follow structures when trying to be creative, only used Ingenium because it was part of the tutorials.

The Ingenium process was very helpful to start out, but I felt it was too long and for a simple idea was to time consuming.

Ignium was very useful

2. How long did it take before you felt confident using the CPS tool?

Less than 2 hours	14
Half a day (about 4 hours)	2
One day (about 8 hours)	1
Two days	1
One week	1
More than one week	1
I am still not confident	7
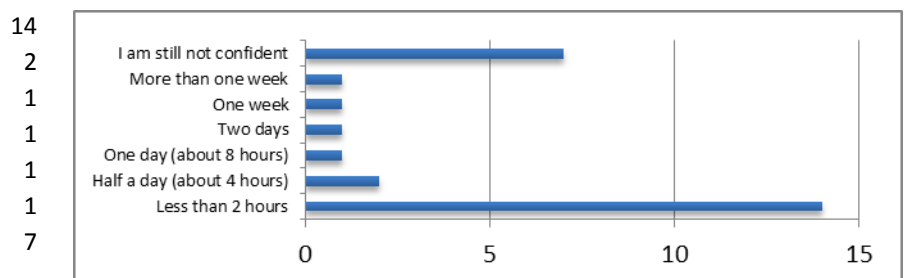
Comments

loveeeee it!

 I have taken a look at it, but honestly i prefer bubbl.us to help me form ideas.

Very easy to understand and follow the appropriate steps.

It's easy to use but MY GOD is it the most unnecessary programme I have ever come across.

It is confusing

Was a very straightforward layout and instructions.

 I found there was not much difficulty using Ingenium as it provided clear procedures that we simply needed to just follow.

3. The CPS tool was useful for helping me think creatively about the task I was given.

Strongly Agree	6	22%
Agree	7	26%
Neutral	8	30%
Disagree	5	19%
Strongly Disagree	1	3%

Comments
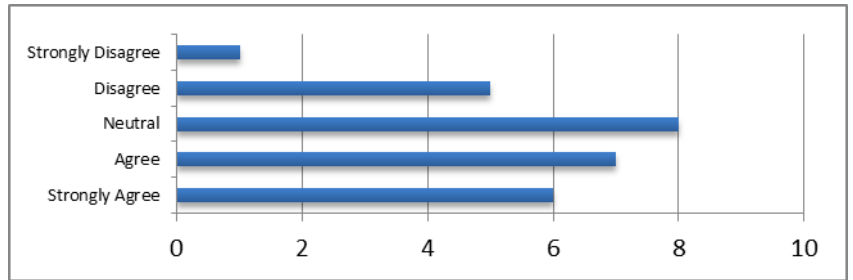
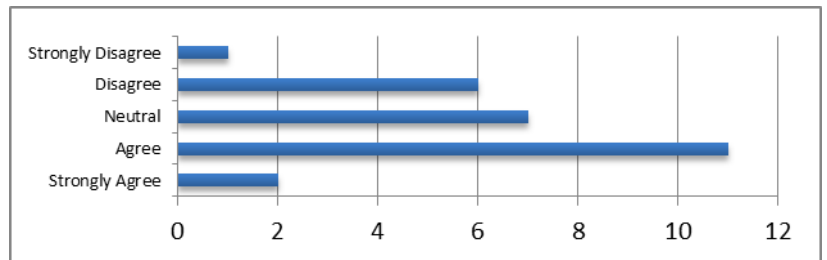**4. Before I used this CPS tool I was not confident about my creative problem solving skills**

Strongly Agree	0
Agree	4
Neutral	9
Disagree	8
Strongly Disagree	5
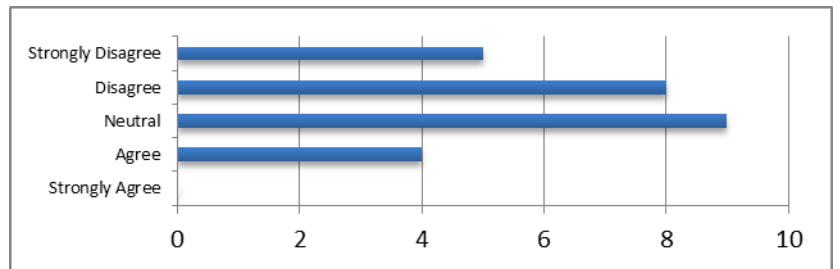
5. The CPS tool was useful for raising my awareness and practice of creative problem solving techniques

Strongly Agree	2
Agree	11
Neutral	7
Disagree	6
Strongly Disagree	1

Comments

6. The CPS tool has given me a process for applying creative thinking

Strongly Agree	2
Agree	8
Neutral	9
Disagree	5
Strongly Disagree	1
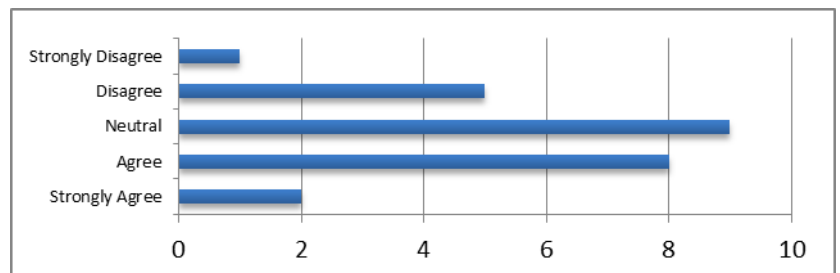
7. I can see a use for using the CPS tool in other areas of my studies

Strongly Agree	3
Agree	8
Neutral	8
Disagree	3
Strongly Disagree	5
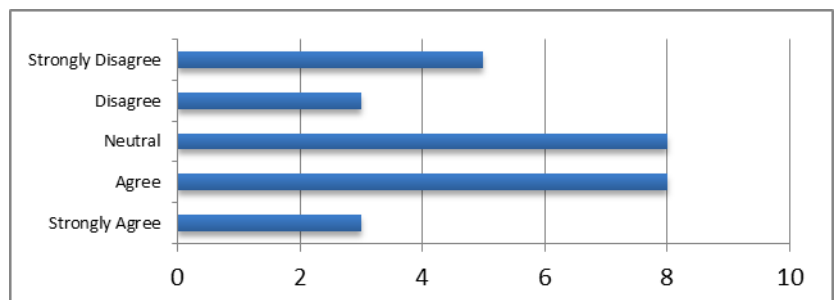
8. I can see a lot of potential in the CPS tool but feel that I would need to invest more time using it before I could benefit from it

Strongly Agree	3
Agree	9
Neutral	8
Disagree	4
Strongly Disagree	3
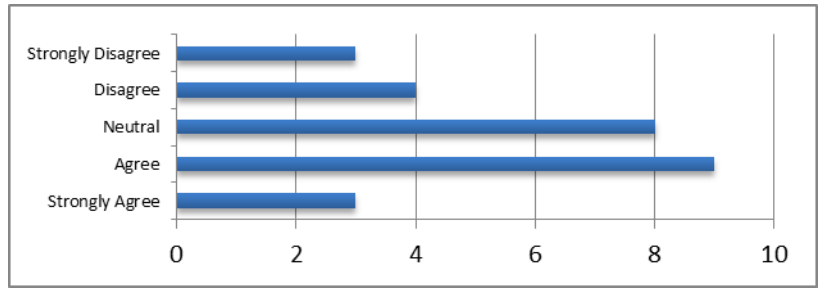
Comments

I found the tool a great catalyst for new directions in thinking, I definitely would not have looked into so many areas to do with my topic, or tried to combine my ideas if I wasn't using this tool.

I think the only potential in ingenium are, the mind map activity and the activities linked to this.

In saying this, they did not need to be stretched into a massive task, it was just time consuming and got to the point of being not useful at loveeeee it!

Ingenium is pretty good, you just have to have time to go through all the steps.

It. Is. Terrible. That is all.

The principles and techniques are good, but the presentation and long winded nature of it make it unusable

I dont see potential

I was already confident about my creative problem solving skills. For someone less confident, I can certainly see the potential, however I was mostly just bored. It forced me to do things in an unfamiliar way, and was more of a hindrance.

9. After using the CPS tool, I feel more confident about my creative skills

Strongly Agree	3
Agree	6
Neutral	11
Disagree	5
Strongly Disagree	2
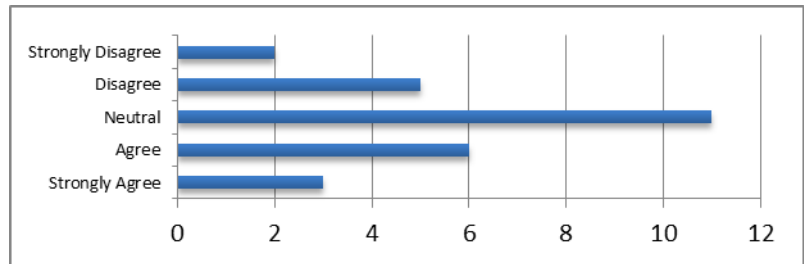
10. I used the following social media platforms linked through the CPS tool (tick one or more of the following)

Facebook	5
Wiki	1
Twitter	1
YouTube	1
Blog	3
I didn't use social media	20
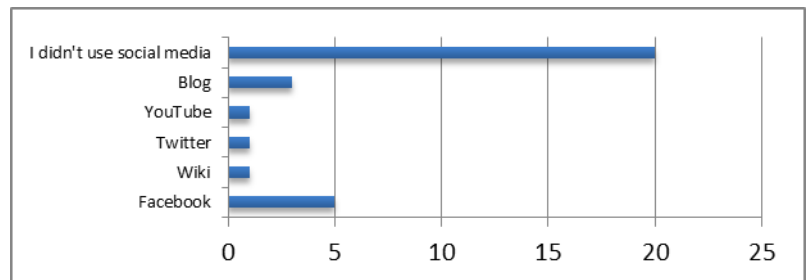
11. The CPS tool was easy to use (I could find the buttons I needed quickly and the interface was logical)

Strongly Agree	2
Agree	11
Neutral	7
Disagree	6
Strongly Disagree	
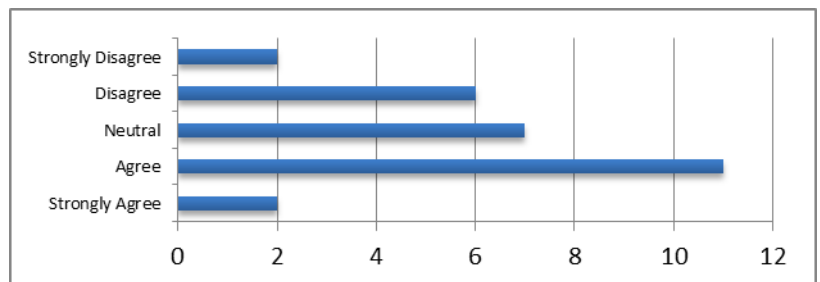
Comments

The interface was easy to use

thought it was very useable it was also slightly daunting because of the amount of subsections for example, in part 2, had 5 pages to it, all of which had at least two questions, this is incredibly tedious to work through

Gottaaaaa have it!

A previously stated, it is terrible.

I think it helped a little bit, but didn't really make a difference to my creative process, it didn't make a big impact.

It's difficult to use

It was well laid-out, with clear progression. As a starting point, especially for someone unused to the creative process, it is probably a very helpful tool.

The step by step process was helpful when starting out; when you have no idea what you are doing.

12. What aspects of the CPS system did you find challenging to use?

Comment

Unattractive and busy page layout

None. It was very straightforward, it asked things that don't need to be consciously thought about, many of us are experienced with creative thinking, planning and research, due to the research project at school which required the same processes

If you don't got Ingenium consider me miles davis!

Menu structure and side many category names names were unclear as to what the sections were actually on

It was stupid! Completely unnecessary!

menu structure , some meanings

It was very simple. No challenges to do with the site.

The mind mapping programmes are not very good. I felt that traditional media still offered a better alternative.

None, I found it very straight forward.

some parts seemed repetitive and i found this a little confusing as I kept thinking i had gone back a step

The challenge was to take in all the information and questions and think about one question at a time as there were many others that were in my mind and confusing me

13. What improvements should be made to the CPS tool? What features or resources are missing?

Comment

Examples of peoples work maybe?

Better structural layout

Questions seem a little repitetive.

Shorten its content, it does not need to be so drawn out and broken down, some parts are just not helpful at all.

None, because I.. Loveeeee... it

Make an app for iphone and mac

Just improve the category names to reflect on what they are on

Improvements? Take it off the internet. Any helpful content is missing.

Although I can see this being useful, it wasn't particularly to me, but it could be helpful to someone else, so I don't know how to directly improve it to help everyone.

Whittle down the information to the pure techniques and processes, remove all unnecessary text and page clicks, hen structure it in a cleaner, more visually concise layout, then it will be a lot easier to use and more likely to become a resource people will come back to.

I dont think it should be used

I felt as though it was already very useful.

Include some visuals would help some understand better.

Maybe the set up having number and then sub headings under those numbers seemed a bit excessive and overwhelming perhaps finding another way of presenting samples

14. Any other comments or suggestions?

I found it interesting that we were asked to brainstorm, write down assumptions and deconstruct/reconstruct first
Then to do further research. Usually it is the other way around.

I liked this approach as I didn't have any pre conceived ideas or restrictions influencing my ideas, but I do wonder how my ideas would have differed if I had research first.

ingenium should be used specifically for the mind mapping and word brainstorming/inversion/reversion exercises.

The rest, most students are familiar with and it is just pain staking having to go over things that we already know a second nature due to previous study at the uni, or skills from high school

They should make an app if they haven't already (both for mac and iphone)

Not really

I seriously hated using that programme, and found it completely unnecessary. It should not be anywhere near this course!

No.

Give your users a higher level of assumed knowledge to avoid appearing condescending and over stating your point.

Perhaps provide in-text links to terms and techniques that are references but not explained in detail for people to follow, if they are unfamiliar with it

Generating a user-friendly version that may be simpler and shorter.

I do really like the tool, I feel it helps open more doors to so many possibilities

C.3 Survey Data for Idea Generation Methods for Designers (Study Period 7 2012)

7 responses

1. How long have you been using the CPS tool?

Less than 2 hours	0
Half a day (about 4 hours)	2
One day (about 8 hours)	1
Two days	1
One week	1
More than one week	2
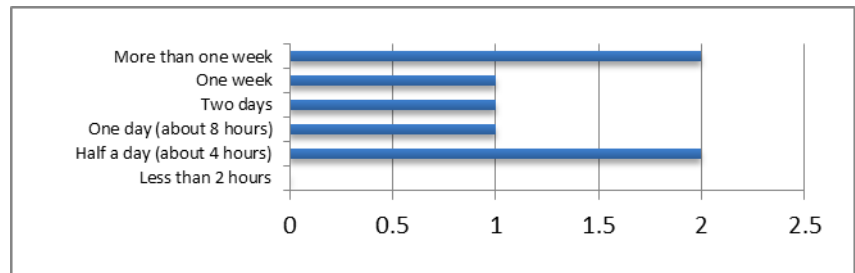
Comments

The headings and questions provide quite a good direction/guide for the ideas to develop
Extremely difficult to use without explanation and examples provided by mentor
The introduction was not clear for its intended outcome.
In my opinion all of the skills, techniques and methods used during this particular course gave the student invaluable insight into new, fresh and inspiring ways of thinking. The course was a veritable eye-opener and has changed the way in which I approach my art practice. Thinking outside the box, being prepared to challenge preconceptions, brainstorming and collaboration are now compulsory element of
all learning. Outstanding approach to opening the mind in order to achieve maximum results.

2. How long did it take before you felt confident using the CPS tool?

Less than 2 hours	0
Half a day (about 4 hours)	1
One day (about 8 hours)	4
Two days	1
One week	0
More than one week	1
I am still not confident	0
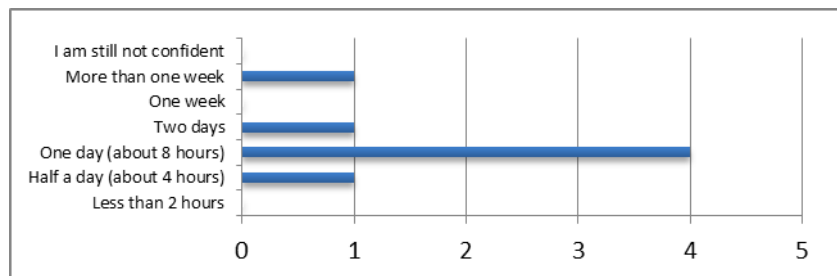
Comments

It took me a while to get used to Ingenium's framework, but as I got the hang of it, it was a very helpful structure for idea generation.
I believe I can use this often in the future!
It is hard to assign a time frame to when you become confident using any new technique. The more you practice a new skill the better you progressed so did my skill and therefore more confidence and as I continue to use these skills the more I master them.
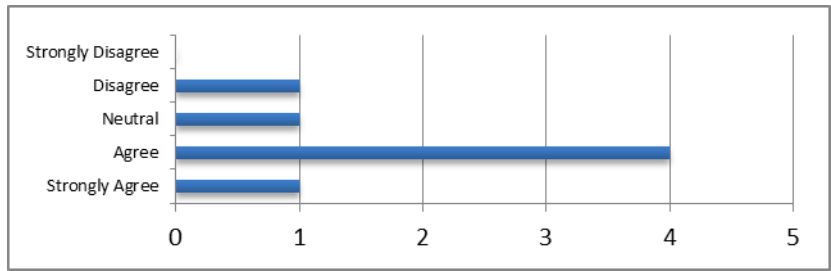
3. The CPS tool was useful for helping me think creatively about the task I was given.

Strongly Agree	3
Agree	2
Neutral	1
Disagree	0
Strongly Disagree	1
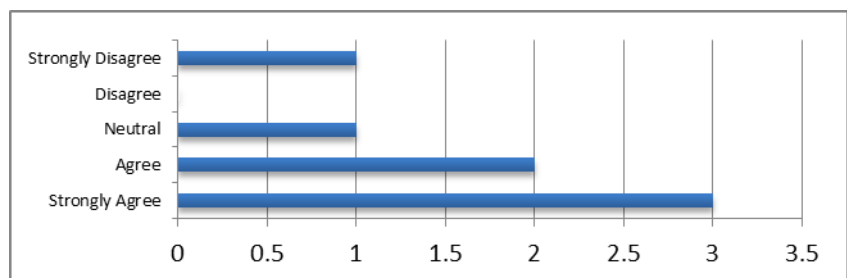
4. Before I used this CPS tool I was not confident about my creative problem solving skills

Strongly Agree	1
Agree	4
Neutral	1
Disagree	1
Strongly Disagree	0

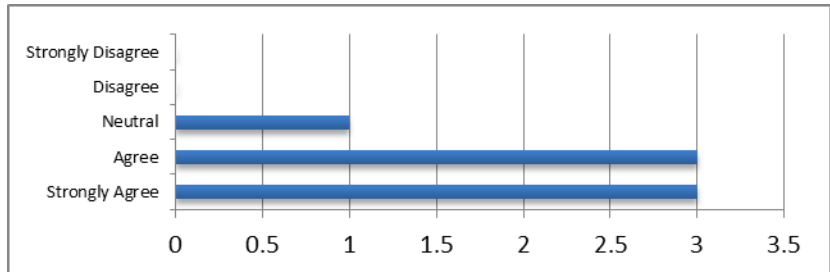**5. The CPS tool was useful for raising my awareness and practice of creative problem solving techniques**

Strongly Agree	3
Agree	2
Neutral	1
Disagree	1
Strongly Disagree	0
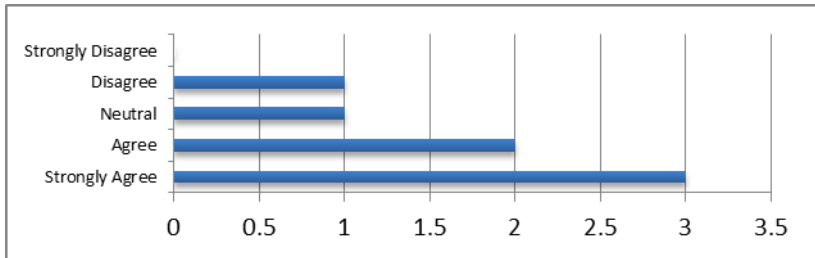
Comments

6. The CPS tool has given me a process for applying creative thinking techniques

Strongly Agree	3
Agree	3
Neutral	1
Disagree	0
Strongly Disagree	0

7. I can see a use for using the CPS tool in other areas of my studies

Strongly Agree	4
Agree	2
Neutral	1
Disagree	0
Strongly Disagree	0
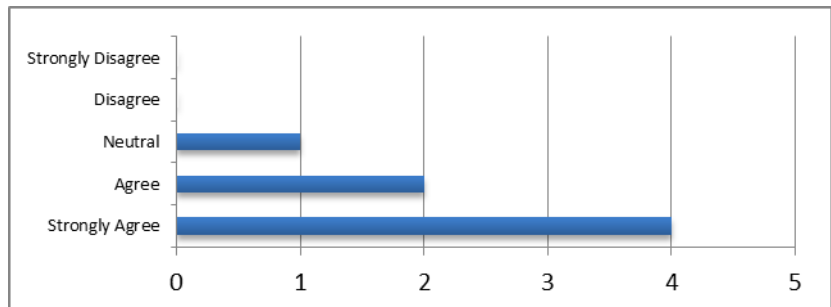
8. I can see a lot of potential in the CPS tool but feel that I would need to invest more time using it before I could benefit from it

Strongly Agree	0
Agree	5
Neutral	2

Design as a catalyst for engaging stud 99
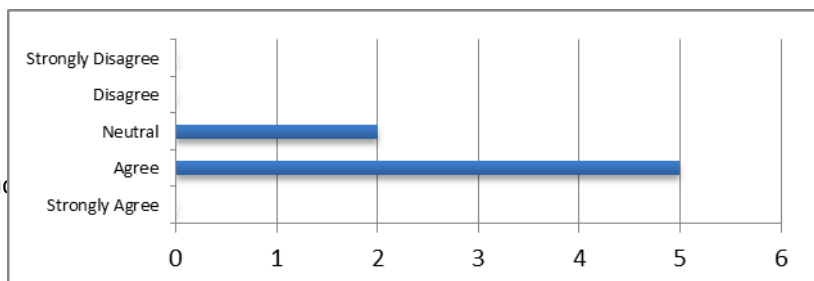
Disagree   0

Comments
I strongly believe that to get the most of this type of programme, you have to be prepared to be open to trying a fresh approach. Therefore the more you invest, the more you will get out of it. I began to benefit immediately from the skills learnt which assisted my progression throughout the course, where I went from strength to strength and continue to do so as I practice and put into use what I have learnt.
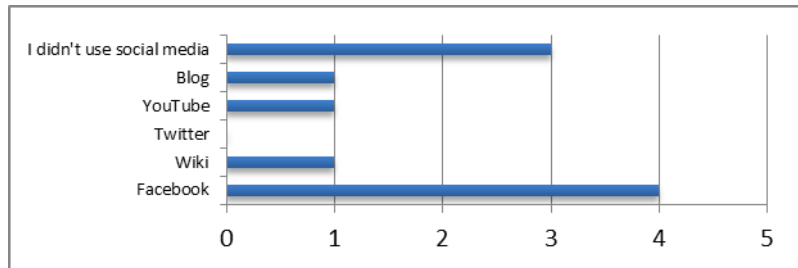
9. After using the CPS tool, I feel more confident about my creative skills

Strongly Agree	3
Agree	2
Neutral	0
Disagree	2
Strongly Disagree	0
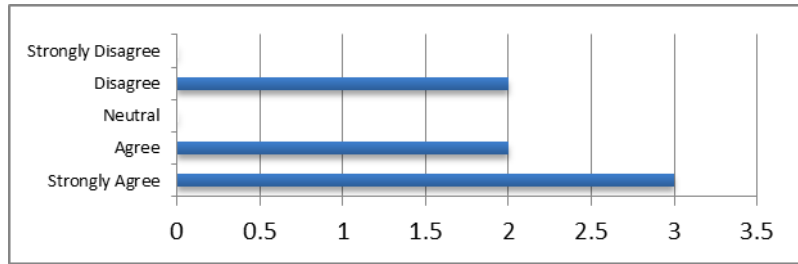
10. I used the following social media platforms linked through the CPS tool (tick one or more of the following)

Facebook	4
Wiki	1
Twitter	0
YouTube	1
Blog	1
I didn't use social media	3

11. The CPS tool was easy to use (I could find the buttons I needed quickly and the interface was logical)

Strongly Agree	1
Agree	3
Neutral	1
Disagree	0
Strongly Disagree	2
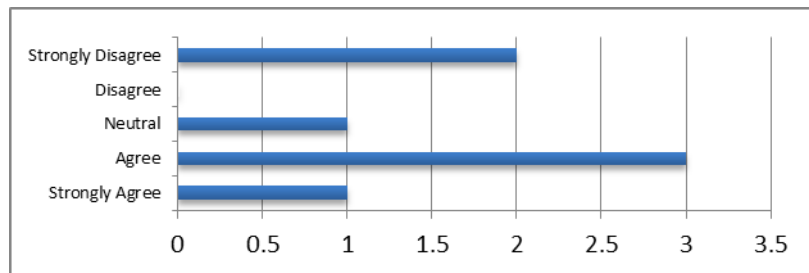
Comments
At no time have i seen or was introduce to the interface of ingenium.
The charismatic Ron Corso and charming Charlie-Helen Robinson were both interesting and engaging and the programme fresh and inspiring.

12. What aspects of the CPS system did you find challenging to use?

Comment
Different areas need to be given more detail in their explanation on what is needed
I didn't realise there were sub steps within each step in the beginning, tool a while to familiarise myself with the layout of each step
 I did not find it unclear.

13. What improvements should be made to the CPS tool? What features or resources are missing?

Comment
Give descriptions next to headings and examples in the different section
Essentially everything was well covered. My only feedback is I would like to have lasted longer.

14. Any other comments or suggestions?
 Keep doing what you are doing.....you are an inspiration.

C.4 Survey Data for Mechanical Engineering Practice (Study Period 2 2013)

2 responses

1. At which university are you studying?

UniSA

UniSA

2. Which course did you use 'Ingenium' in?

Mechanical Engineering practice

Mechanical engineering practice

3. How long have you been using the CPS tool?

Less than 2 hours	2
Half a day (about 4 hours)	0
One day (about 8 hours)	0
Two days	0
One week	0
More than one week	0
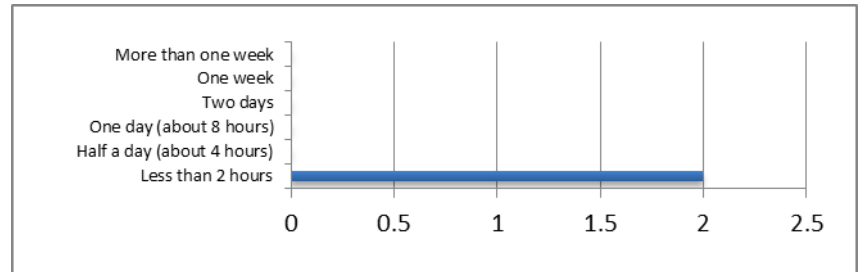
Comments

(no response)

To think outside the square when problem solving

4. How long did it take before you felt confident using the CPS tool?

Less than 2 hours	1
Half a day (about 4 hours)	0
One day (about 8 hours)	0
Two days	0
One week	0
More than one week	1
I am still not confident	0
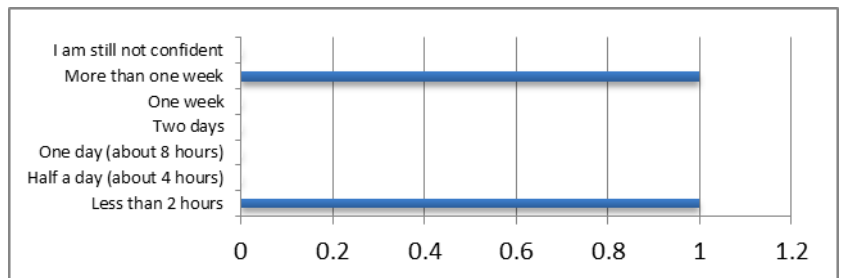
5. The CPS tool was useful for helping me think creatively about the task I was given.
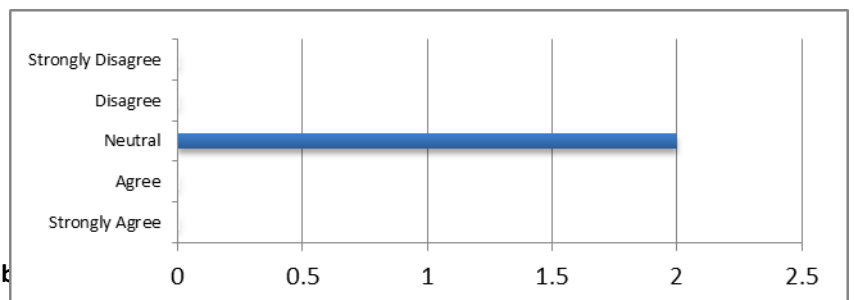
Strongly Agree	0
Agree	0
Neutral	2
Disagree	0
Strongly Disagree	0

6. Before I used this CPS tool I was not confident ab

Strongly Agree	0
Agree	1
Neutral	0
Disagree	0
Strongly Disagree	1

7. The CPS tool was useful for raising my awareness and practice of creative problem solving techniques
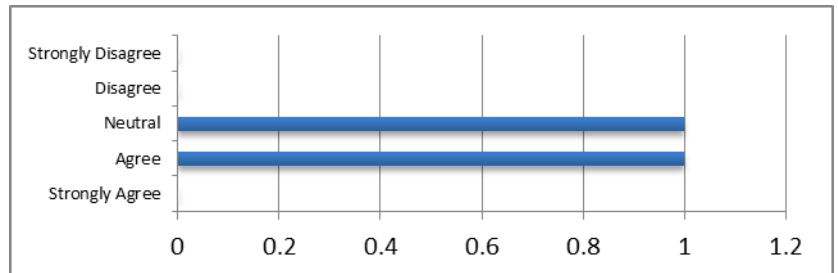
Strongly Agree	0
Agree	2
Neutral	0
Disagree	0
Strongly Disagree	0
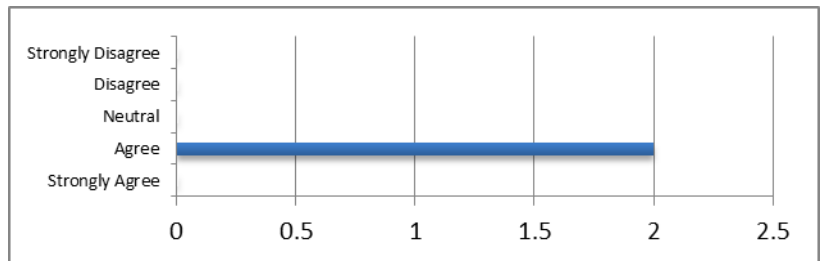
Comments

8. The CPS tool has given me a process for applying creative thinking techniques

Strongly Agree	0
Agree	1
Neutral	1
Disagree	0
Strongly Disagree	0

9. I can see a use for using the CPS tool in other areas of my studies

Strongly Agree	0
Agree	1
Neutral	1
Disagree	0
Strongly Disagree	0

10. I can see a lot of potential in the CPS tool but feel that I would need to invest more time using it before I could benefit

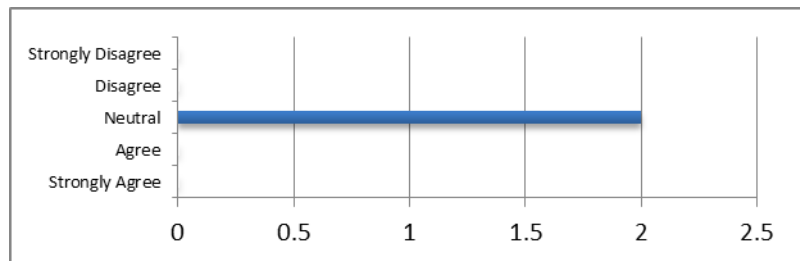|	
Strongly Agree	0
Agree	0
Neutral	2
Disagree	0
Strongly Disagree	0
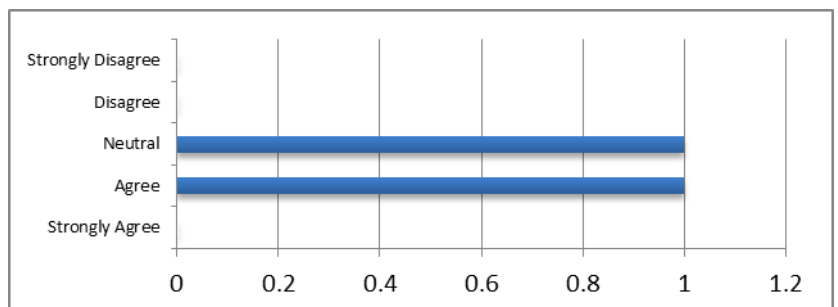
Comments

(no response)

give examples of how it can be applied in other areas of study

11. After using the CPS tool, I feel more confident about my creative skills

Strongly Agree	0
Agree	0
Neutral	2
Disagree	0
Strongly Disagree	0

12. I used the following social media platforms linked through the CPS tool (tick one or more of the following)

Facebook	0
Wiki	0
Twitter	0
YouTube	1
Blog	0
I didn't use social media	1
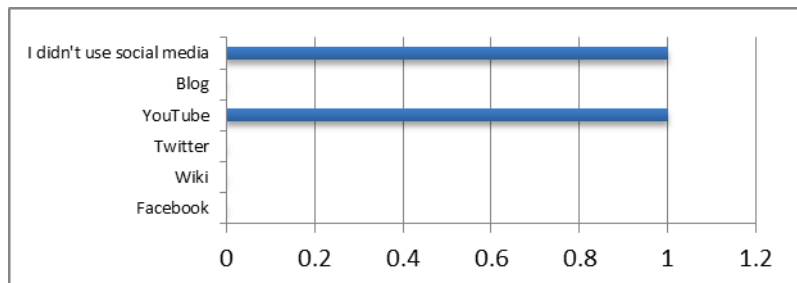
13. The CPS tool was easy to use (I could find the buttons I needed quickly and the interface was logical)

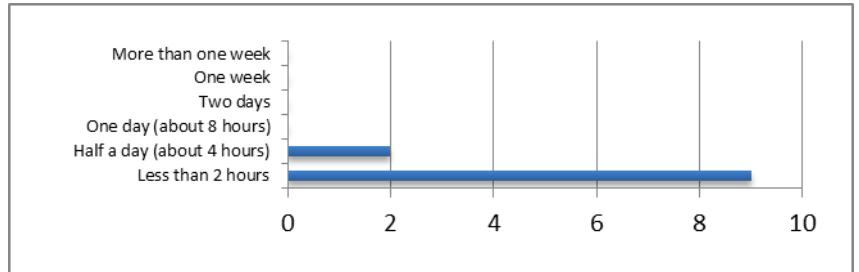|	
Strongly Agree	0
Agree	0
Neutral	2
Disagree	0
Strongly Disagree	0
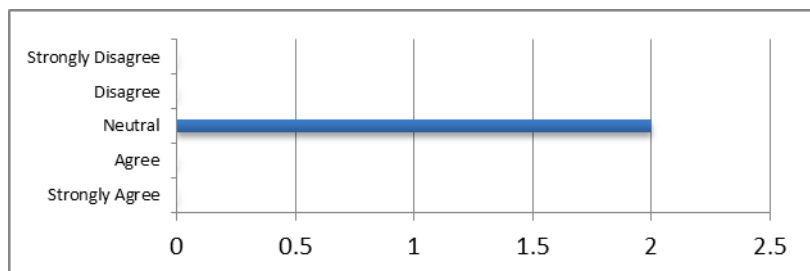
Comments

(no response)

(no response)

C.5 Entrepreneurship & Innovation (January 2013)

11 responses to an paper-based survey

1. How long have you been using the CPS tool?

Less than 2 hours	9
Half a day (about 4 hours)	2
One day (about 8 hours)	0
Two days	0
One week	0
More than one week	0

Comments

Seems ok. I need to use it more before I can properly comment.
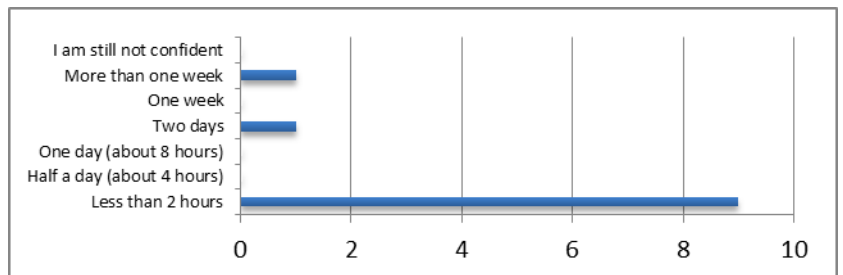
Easy to use.

Easy to follow. Clear videos.

User friendly. Fun and creative presentation.

Easy to use.

From the first look, the overall process is too complicated. I have to view through all the video clips,
 just to understand. But I somehow got drifted off in the midst of watching the video.

2. How long did it take before you felt confident using the CPS tool?

|	
Less than 2 hours	9
Half a day (about 4 hours)	0
One day (about 8 hours)	0
Two days	1
One week	0
More than one week	1
I am still not confident	0

Comments

It is easy to understand and follow. It is fun and brightly created platforms brings out enthusiasm.

But I did not get to use it too much, as the initial perception is that this is time consuming.

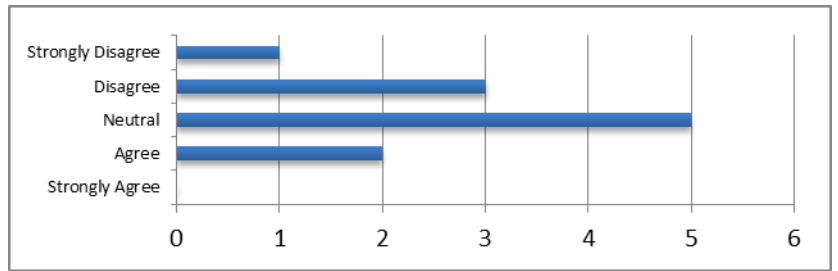## 3. The CPS tool was useful for helpig me think creatively about the task I was given.

Strongly Agree	0
Agree	6
Neutral	5
Disagree	0
Strongly Disagree	0
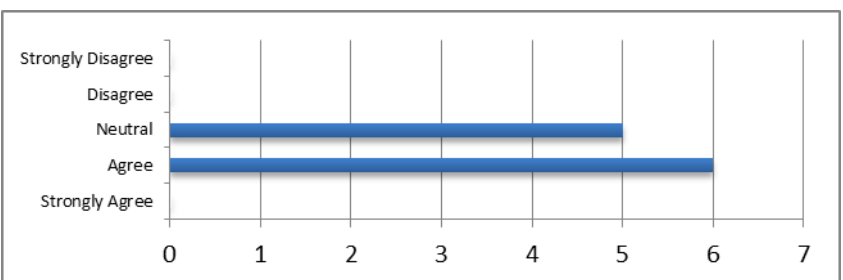
Comments

4. Before I used this CPS tool I was not confident about my creative problem solving skills

Strongly Agree	0
Agree	2
Neutral	5
Disagree	3
Strongly Disagree	1

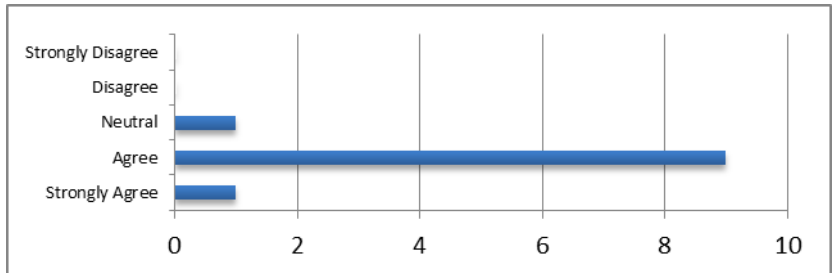**5. The CPS tool was useful for raising my awareness and practice of creative problem solving techniques**

Strongly Agree	0
Agree	7
Neutral	2
Disagree	1
Strongly Disagree	1
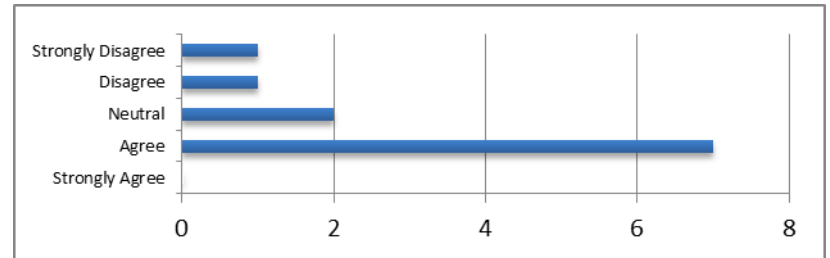
Comments

6. The CPS tool has given me a process for applying creative thinking techniques

Strongly Agree	1
Agree	9
Neutral	1
Disagree	0
Strongly Disagree	0

7. I can see a use for using the CPS tool in other areas of my studies

Strongly Agree	2
Agree	5
Neutral	3
Disagree	1
Strongly Disagree	0
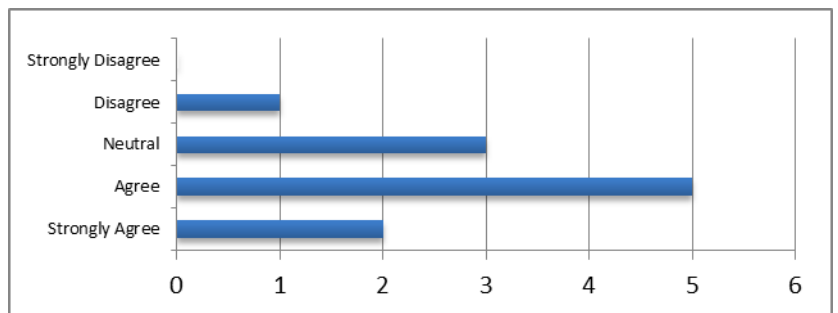
8. I can see a lot of potential in the CPS tool but feel that I would need to invest more time using it before I could benefit from it

Strongly Agree	2
Agree	6
Neutral	2
Disagree	1
Strongly Disagree	0

Design as a catalyst for engaging students in cre
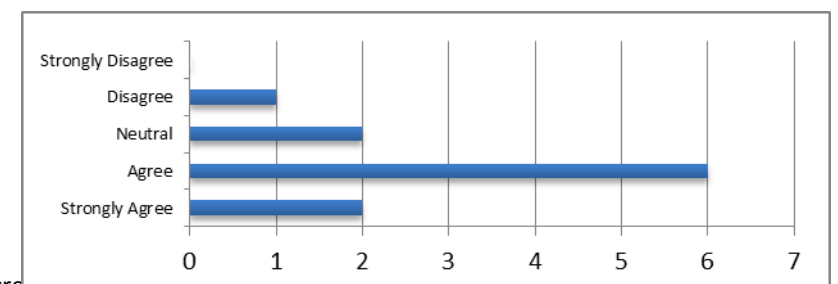
Comments

Most certainly, more time is needed!

The concepts are basic/common. Therefore, this is only a communication channel.

9. After using the CPS tool, I feel more confident about my creative skills

Strongly Agree	0
Agree	5
Neutral	6
Disagree	0
Strongly Disagree	0

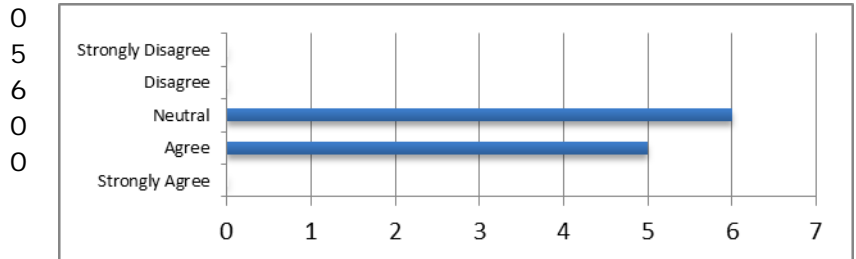**10. I used the following social media platforms linked through the CPS tool (tick one or more of the following)**

Facebook	9
Wiki	0
Twitter	0
YouTube	0
Blog	0
I didn't use social media	2
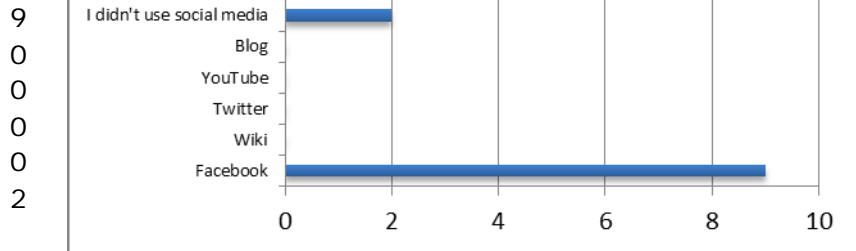
11. The CPS tool was easy to use (I could find the buttons I needed quickly and the interface was logical)

Strongly Agree	1
Agree	9
Neutral	0
Disagree	0
Strongly Disagree	1
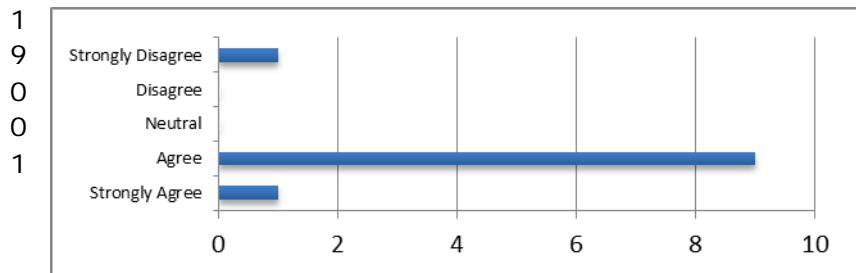
Comments

12. What aspects of the CPS system did you find challenging to use?

Comment
No, easy to navigate.
Video is sequential.
Video are long and separated.

13. What improvements should be made to the CPS tool? What features or resources are missing?

Comment

The creativity videos from Youtube should have click-ons on the subtopics. Eg. Indication of 1.1, 1.2, 2.2 etc

More stories about creative ideas.

More interactive

To enable touch-based technology

Make it 1 video or reduce no. of videos. To many steps.

14. Any other comments or suggestions?

Make it KISS concept.

C.6 Survey Data for Diploma of Audiovisual Technology (RMIT) 2013
17 responses

1. Which University are you at?
RMIT

2. Which course did you use 'Ingenium' in?
Diploma of Audiovisual Technology

3. How long have you been using the CPS tool?

Less than 2 hours	15
Half a day (about 4 hours)	2
One day (about 8 hours)	0
Two days	0
One week	0
More than one week	0
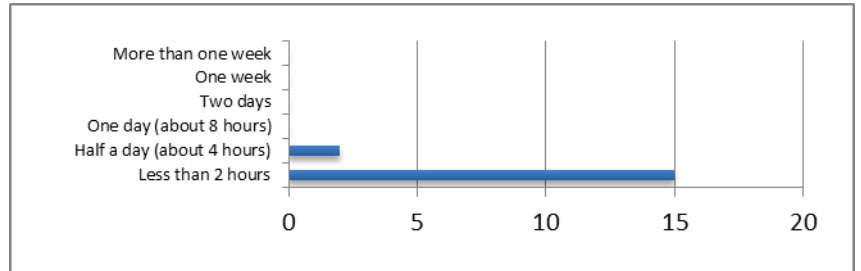
Comments
I helped me to start my project
I like some bits not all though
pretty good
I think the ideas and concepts are great but some of the videos are a bit patronising.
The videos are great
did not use it much
I liked it because of its ideas
Boring
I liked it
It's good to help me on studies
It helped me to think clearly about my assessment.
It was good - I like ideas

4. How long did it take before you felt confident using the CPS tool?

Less than 2 hours	15
Half a day (about 4 hours)	2
One day (about 8 hours)	0
Two days	0
One week	0
More than one week	0
I am still not confident	0
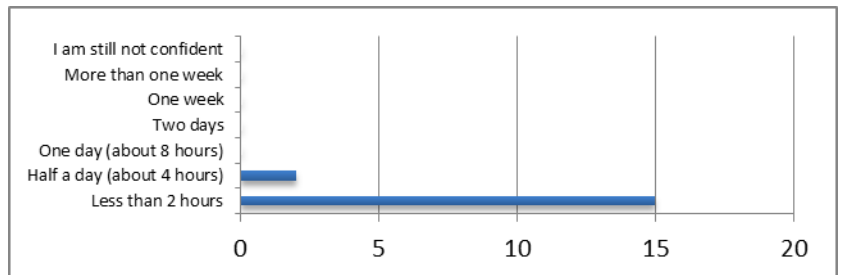
Comments
it was a bit obvious i think
I need to look at it more
I really enjoyed using the videos to help me study
Pretty easy I think

5. The CPS tool was useful for helping me think creatively about the task I was given.

Strongly Agree	4
Agree	8
Neutral	4
Disagree	1
Strongly Disagree	0

6. Before I used this CPS tool I was not confident about my creative problem solving skills

Strongly Agree	5
Agree	7
Neutral	1
Disagree	2
Strongly Disagree	2

7. The CPS tool was useful for raising my awareness and practice of creative problem solving techniques

Strongly Agree	3
Agree	11
Neutral	2
Disagree	1
Strongly Disagree	0

Comments

8. The CPS tool has given me a process for applying creative thinking techniques

Strongly Agree	3
Agree	11
Neutral	0
Disagree	3
Strongly Disagree	0

9. I can see a use for using the CPS tool in other areas of my studies

Strongly Agree	3
Agree	10
Neutral	3
Disagree	1
Strongly Disagree	0

10. I can see a lot of potential in the CPS tool but feel that I would need to invest more time using it before I could benefit

Strongly Agree	4
Agree	7
Neutral	4
Disagree	2
Strongly Disagree	0

Comments

I have not used it that much

Bit boring maybe I think I know this stuff from school

I like how it helped me with making decisions and what to do

I think I got the tools pretty fast and I already do most of it anyway

I really liked the videos and brainstorming ideas and ways to look at my assessments.

I don't know

No sorry

I already know this stuff from school

it did not help me. Sorry.

It is a good to help international student

it's a good one

I will use it for major project in vision and manage projects

11. After using the CPS tool, I feel more confident about my creative skills

Strongly Agree	3
Agree	9
Neutral	4
Disagree	1
Strongly Disagree	0
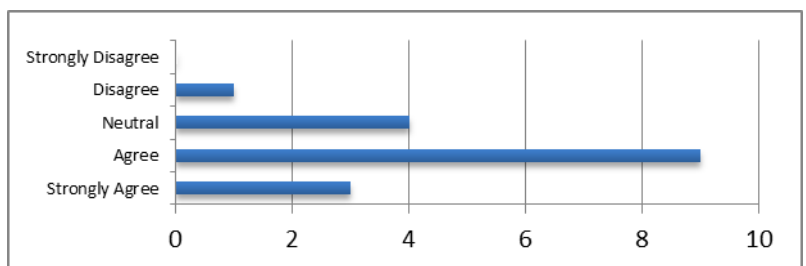
12. I used the following social media platforms linked through the CPS tool (tick one or more of the following)

Facebook	0
Wiki	0
Twitter	0
YouTube	4
Blog	0
I didn't use social media	13
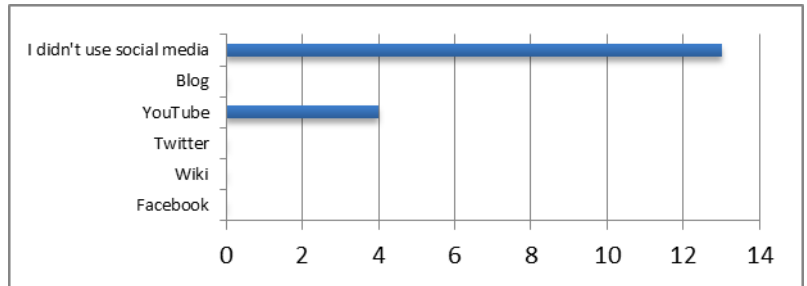
13. The CPS tool was easy to use (I could find the buttons I needed quickly and the interface was logical)

Strongly Agree	10
Agree	5
Neutral	1
Disagree	0
Strongly Disagree	0
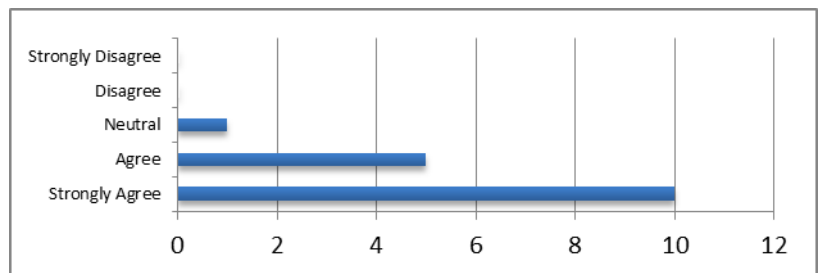
Comments
nah
I hope I go well in my assignment
sorry no
I only used it in class
no sorry

14. What aspects of the CPS system did you find challenging to use?

Comment
Nothing
not really
none
not sure sorry
Sometimes with what things mean. My teacher help me.
none

15. What improvements should be made to the CPS tool? What features or resources are missing?

Comment
Dunno
I think the videos are good but a guy talking who is really a student, not an actor
don't know

16. Any other comments or suggestions?
it's a bit weird
thank you for the opportunity
Make the voiceovers better

Appendix D: Summary of interviews with academics

Was the CPS tool easy to use? (I could find the buttons I needed quickly and the interface was logical).

Most academics found the tool easy to use and to navigate around, and that the buttons were quite intuitive and explanatory.

There were some difficulties with navigation as the "Home" page actually went to the Project Home Page rather than the Page that was the Gateway to the CPS frameworks for Students, Teachers and Researchers. The Project Home page served that purpose well, but was not intended to specifically engage and enthuse students in the potential of the Ingenium Tool. The Gateway Page itself was also seen as informative rather than encouraging, and it was suggested that some more explanation of how the frameworks could be helpful could have been included. Navigating back to the Gateway Pages was not straight-forward…a "home" key back to this page would have been useful.

All respondents commented on how useful the introductory sessions given by Ron Corso were and commented that they would have felt unsure giving this session themselves. It was suggested that a short video that could be played in lectures or put online for students for the next time the course is run could be produced to great effect. This could be linked to the Gateway Page.

Students who were studying externally would have benefited from an introductory session such as that provided by Ron, but still managed to negotiate around and effectively use the tool. The short video discussed above would be of benefit to these students.

Did the CPS tool enhance your awareness of creative problem solving techniques?

Since I was involved with the design of the framework and then the tool my awareness and understanding of creative problem solving evolved over time so by the time I implemented in my courses I had developed a good understanding of the techniques and benefits for my approach and for students. Students who did not engage with the process generally produced far less innovative approaches to their assignments, so the framework and tools have enhanced my teaching approach and for the students who use the student tool, their ability to produce innovative work.

All respondents found that the resources were useful in providing different approaches to CPS techniques. Respondents felt that the site was a useful point to add (current and useful) links to in order to make it a comprehensive CPS site.

Respondents indicated that they gained increased confidence in teaching creativity after using *Ingenium*.

One respondent stated *"…my background is as a professional in the field rather than as an educator. So although I have done a teaching certificate, I was not sure how to address the issue of adding creativity into the curriculum."*

Some participants felt that they still struggled with assessment of creativity and would have liked more guidance in as to how to incorporate creativity into assessment … *"as students are driven so much by assessment I feel that I need a way to assess the creativity component to get them to engage in the process. I can show them the web page and the resources but it is difficult to how to encourage them to engage."*

I already teach creativity and this is just a component in the course I used it in. So I did not feel that I learnt a great deal personally about creativity, but this was still a great resource for students. As students do other courses that focus solely on creativity the skills learnt in

my course will assist them.

What aspects of the CPS tool did you find challenging to use? (eg button meanings were unclear, the menu structure was difficult to understand, it was unclear how to accomplish a task, etc)?

It is pretty straight forward to use with minimal learning curve. The toggle functionality of the graphic icons might not be self-evident, but experimentation soon reveals the functions,

When first navigating to the page I felt a bit lost and the Home Page was not obvious. The Home Page could have been more interesting and engaging…the Home Page and Pilot page were very dry and really just told me about the project and the funding rather than explaining how it would help me and my students. The text on these pages was rather small and it would have been good if the links to the OLT and UniSA were active for further information.

Some information about the importance of creativity, some examples, comments from employers etc…would have made the introductory pages more interesting and engaging.

Students were very keen to use the page and it was clearly evident in the work they submitted who had used the resources and who had not…the quality was much better.

Can you suggest any additional resources that should be included in the CPS tool?

Video vignettes of coordinators sharing their approach and experiences using the teacher tool and/or research tool and their students' use of the student tool would be valuable to provide short, but inspiring examples of practice. While there are exemplars, short videos (as opposed to the lengthy webinars) would provide inspiration for other teachers. These videos are planned as is a video animation of the application in nursing to contrast with the digital media example currently available for students. It would be great to also have a few student video vignettes with students discussing how they used the tool to support their creative approach.

The videos were universally appreciated and all respondents suggested that it would be an advantage to have more examples. The example use of the vignette of creating a community garden was helpful, but it was felt by most respondents that a more "concrete" example would be useful, for example design of a new product. Teachers felt that it would be beneficial to have scenarios relating to a broader array of topics, for example IT, product design, health issues, business opportunities. This was seen as being advantageous not only to students but to teachers as well. However, interestingly it was commented by some that videos should not be discipline specific as this would narrow rather than broaden the focus of student thinking.

As discussed later, it was difficult to recruit health science academics into the project. Comments from those who did investigate the tool strongly requested example videos relating to health science scenarios.

Videos of a teacher and researcher using the tool to develop creative curriculum examples were also requested.

Responses about the mind mapping tool included in the resources were mixed. *My students are not used to using such resources, so a worked example (in the discipline area) would be very helpful.* In contrast, others commented that their students were familiar with mind maps and no introduction was needed. The mind map tool was considered extremely effective, easy to use and useful by these respondents. In contrast, the facility to download unzip and install the mindmap tool (used in earlier versions of the tool) was seen as somewhat cumbersome.

Do you have any other comments or suggestions for the CPS tool developers?

The design based research approach has ensured iterative development of the tools over time in response to student and teacher feedback. The developers have taken into account this feedback and been responsive to modifying the tools progressively, so at this stage the tools I think reflect a logical and usable approach to scaffolding academics and students in the CPS approach.

The **Contact Us** page could include all of the project team and particular areas of expertise or interest, so that those interested knew who to contact. Current photos of the team members and affiliations would be useful for those seeking further information.

Ron Corso came to do an introductory session for students, which was excellent. Without this session it would have been difficult for me to effectively demonstrate the tool and speak about the concepts. I would like to use the tool again next year but am not sure that I will be able to introduce it effectively without a session from Ron. I did have a look at the webinars but did not find them particularly useful. If Ron is not available to do introduction to classes in the future, a videocast that could be played and commented on would be useful.

"I will certainly be using it again. It was a fantastic tool to take them step by step through a creative problem solving process"

Other comments

The project has highlighted the challenges in engaging some academics in the process of redesigning their courses in ways in which creativity is clearly embedded within the curriculum. While it has generally been easy to find academics who are already creative and innovative to engage, others from more rigid, traditional science backgrounds have been less willing to even meet to discuss the benefits of embedding CPS in the curriculum. Our experience recruiting academics reflects I think a broader issue that was identified in Simon Barrie's (2004) finding that academics appear to hold four different conceptions of generic attributes (precursor; complementary; translation; and enabling conceptions). Those most resistant to engaging in trials of the framework and tool tended to see creative problem solving as complementary attributes that require a special module or series of modules conducted by experts in creativity and thus difficult to include in their already packed curricula. Some also appeared to equate creative problem solving to other generic skills they already incorporate in their curriculum. The only way we were able to break through this barrier was to recruit health science professionals who are already highly creative innovative academics and understood the value of CPS in their discipline to serve as role models for others. (Flinders and South African projects).

The outcomes from this project also indicate the need for further studies extending the approach, framework and tools to other generic attributes that several leaders of graduate attributes related projects (Simon Barrie, Bev Oliver, Barbara de la Harpe) have identified as challenging for academics to embed within their curricula. It is hoped that the findings of this CPS focused OLT project will serve as a model for future such research.

Despite extensive efforts, it was only towards the end of the project that academics from health sciences were successfully recruited to trial Ingenium. A variety of reasons for not trialing the tool were given, and it is helpful to reflect on these issues.

The use of the term 'creativity' in the context of health sciences may be misleading for some academics. Health Sciences content is viewed as hard core science based on evidence and facts. Hence, the concept of including creativity was met with skepticism by some academics, being seen as not relevant to health sciences. It might be that using different terminology, for example "lateral thinking" would be more attractive in health science curriculum.

Some health science academics commented that their curriculum was already overloaded and that there was no room for additional content such as would result from embedding creative approaches.

Although it was explained that using the CPS tool need not actually change the content taught, but could be used as a tool in creative thinking activities relating to the existing curriculum, there was still concern that this was a new activity in an already full curriculum. Some acadamics were concerned that reducing any other content in order to introduce creative would lead to difficulty with accrediting bodies. Other courses are also accredited (eg education) but they did not feel as constrained by the prescribed curriculum.

Aside from curriculum squeeze, one of the most challenging issues in encouraging academic staff to incorporate new creativity appeared to be the mindset of academic staff as to what is "relevant" for their discipline. There are increasing competing demands in Health Sciences curricula which render 'creativity' lower down the list of importance. Some health sciences disciplines are moving into a new national accreditation framework which requires a different mindset and approach towards demonstrating compliance. In this context and coupled with a tightly jam-packed curriculum, it is extremely difficult to encourage staff members to consider trialling and incorporating a new teaching tool that, in their view, does not contribute to the core competency of health care practitioner.

In addition, it was felt that Health Sciences students would view 'creativity' as not core to their disciplines. Academic staff are acutely aware of student feedback and mention that introducing creativity into the curriculum would result in poorer student feedback.

Other issues impacting on health science courses were that large classes taught in relatively small groups required the employment of hourly paid staff, who it was felt would need training to use the CPS tool with students. The time required to train tutors, and the additional hours needed to pay tutors to learn the tool, were seen as problematic.

In some health science courses, the introduction of common courses for first year students resulted in class sizes that could not fit into any lecture theatres at the university. Therefore these courses were changed to be taught solely online. It was felt that introducing the CPS tool and explaining the relevance to students would be difficult in an online environment.

Some health science course coordinators indicated that it was not necessary to include creativity skills within the curriculum as they were already included in the form of clinical problem solving.

Some senior academics indicated that clinical problem solving addressed the need for creative thinking, as described in the graduate qualities espoused by the institution: "is an effective problem solver, capable of applying logical, critical, and creative thinking to a range of problems". Indeed some academics considered that introducing students and academics to the *Ingenium* framework would be a *"distraction to staff who were working on disciplinary content"*.

"I would see this (including creativity into the curriculum) as a diversion to staff that would hinder the hard work they are undertaking to comply with the approach directed from the university and division. The focus of curriculum development was on *"assessing programmes for appropriate volumes of learning, learning outcomes for each AQF level, and to show progression of disciplinary content within our degree programmes".*

Appendix E: Discussions with academics from the School of Nursing and Midwifery, Flinders University

The challenges in implementing creative problem solving in the health sciences curriculum identified in preceding sections of this report led us to consult with academics from the School of Nursing and Midwifery at Flinders University, South Australia who had agreed to review the framework and tools. Four academics from the school (Associate Professor David Gilham, Dr Wendy Abigail, Dr Amanda Muller and Ms Anna Hall) agreed to a teleconference meeting during which some of the issues were explored. This meeting identified the following issues that need to be addressed for the framework and tools to be effective within the nursing curriculum.

- There is a need for a broad overview introducing students to the relevance of creative problem solving within the course. This overview would need to be customised by course coordinators to ensure alignment with the aims, objectives and desired learning outcomes for each course. Therefore, there is a need for further exemplars to guide academics to enable them to explain to students how the embedding of CPS applies within their course.

- There was general agreement that the tool does facilitate lateral thinking, however, academics expressed uncertainty about how to overcome the negativity of students to using a tool to achieve this goal. It was suggested that perhaps a more useful approach would be for academics to introduce their students to the tool as a scaffold for developing creative problem solving skills rather than requiring students to use the tool to complete assignments.

- The animated clips provided via the website to guide students in the use of CPS are relevant to design focused courses. Those participating in the meeting noted that it is difficult for both teachers and students to extrapolate from those examples to health science related assignments. Therefore, there is a need to develop libraries of animated clips that demonstrate the use of the tool in assignments across a broader range of disciplines.

- Those participating in the discussion agreed that further development of the resources to assist academics in a range of disciplines is required. These resources would include the animated clips mentioned above as well as worked through examples of the use of CPS in specific assignments for a broader range of disciplinary areas.

- Two of the academics at the meeting expressed interest in continuing with this project to develop the resources further and were keen to explore the possibility of an extension project more specifically focused on addressing the challenges of embedding creativity skills in the health sciences profession.

Appendix F: Participants attending the employer forum

Debbie Thompson	PWC
BRYCE COOMBE	Clemenger
Michael Browne	PWC
Danielle Finnimore	WALLBRIDGE & GILBERT
Ron Corso	University of South Australia
Marc Colquhoun	OurSA
Bree Hartas	OurSA
Brittany Warren	OurSA
Peter Birchall-Hunt	DHL
Kelly Burton	Deco
Daren Harvey	Engineers Australia
David Dahm	Health & Lifestyle
Leanne Steele	Law School
Charlie Helen Robinson	Social Media expert
Brenton Gowlands	The Nucleus
Darien Canepa	CPA
Rebekah Ireland	University of South Australia
Catherine Klimes	University of South Australia
Kerren Vandepeer	SA Power Networks
Amy Bestwick	Robert Walters
Wendy Perry	Wendy Perry & Associates
Chris Hooper	Cirillo Hooper & Company
Todd Miller	Aussie Inc
Eloise MacFarlane	HR / Recruitment Specialist
Denise Wood	University of South Australia
Tom Woods	University of South Australia
Scott Baldwin	Solomons Carpets
Matt Golley	Institute of Public Accountants
Edwin Manica	dws
Dan Withey	Illustrator
Phillip Dautel	ITEK
Carolyn Bilsborow	University of South Australia

Appendix G: Employer feedback

Focus Group One

Q1: Is creativity a Graduate Employability Attribute you look for?

- Innovation & entrepreneurship rather than creativity is more sought after in finance and accounting
- How do you define creativity? Innovation is possibly a better word to use – i.e. how to do more for less
- Advertising & Design require more creative skills, while creativity in Sales requires being able to see the big picture and look into the future.
- Everybody is creative in some way, and everyone within an organisation can be creative.
- Creativity is also dependant on role – i.e. accountants and HR look for more conservative people as opposed to advertising where creativity is important. However, in both fields creativity is not the same term, and may be more effectively be named Creative Problem Solving
- When looking for someone creative during the recruitment process passion is often a key indicator and ability to articulate their skills and attributes. From a small business space people are required who can think outside the box when resources are limited

Key Points: Innovation might be a better word than creativity; creativity implies 'thought'

Q2: What Graduate Employability Attributes do you seek out for Graduate positions in your Organisations?

- Need for hard/technical skills – graduates lacking skills such as use of Excel. However, hard skills can be taught whereas soft skills are harder to teach e.g. communication skills
- Having travelled gives graduates an advantage over other candidates, however work experience and being able to demonstrate communication skills is most important, especially in a global environment. Having an understanding of cultural diversity and cross cultural communication is vital in this day and age.
- Recruiters look for well-rounded individuals. Involvement in community organisations, sports clubs, leadership and other social activities are just as important as academic results.
- Important attributes when hiring a graduate:
    - Technical Skills
    - Creative thinking and problem solving
    - Ability to think outside the box
    - Maturity and Capability (Workplace Awareness)

- o Leadership
- o Cultural Awareness
- o Understanding the variation in Induction Training in different companies
- o Social Integrity & responsibility – ability to manage personal brand and market yourself

Key points: being aware of and being able to work within a cultural diverse setting

Q3: How do you measure the performance of a Graduate once recruited?
- Graduates are given projects and are expected to find solutions. Can be measured by tangible outcomes and KPIs
- Soft skills are important
- The ability to learn quickly is very important, especially in small business. If you don't have technical resources then "Google it". Organisations don't expect graduates to know everything, but do expect them to be able to research or find out the knowledge they need to learn it.

Key Outcomes (irrespective of business type & size)
- Soft Skills
- Ability to put money where mouth is
- Understand Software
- Perform all duties without asking questions

Big business key outcomes
- Understand software and perform all duties
- Soft skills
- Understand where their career is going and what they can do in terms of work

Small business key outcomes
- Understand how business or organisations runs
- Understand where they can and can't do things, and are able to use common sense, make mistakes and able to admit and see where you went wrong. Being intuitive and knowing their limitations and asking for help.
- Ability to think things through and have the leadership skills there to take the hit and responsibility for your grad's success or failure
- For both big and small business 12 month graduate outcomes are the same
- Expectations also change for business – if people stay two years in one position it is a bonus – leaving after 12 months is standard
- It is also expected that there are graduates who do not want progress and are just going to plod along

Self-aware or reflective personality
- Self-aware – am able to judge/understand what I can do. Outcome focussed
- Reflect – able to weigh up what you have done, good & bad, and learn from it

<u>How do you measure in an interview?</u>

- Self-awareness – look for examples and then ask why and how can I do it better
- Reflection – mainly on what you did well, but again think about how you can do it better again and share it with others
- Depending on role desired behaviour differs – i.e. whether you are self-aware or creative

Q4: Are graduates "Creative Ready?"

- Work Experience is important however a university education does provide the background and skills to progress.
- Graduates are perhaps not creative ready, but education combined with workforce experience builds creativity
- University gives graduates skills to learn soft skills to take a step further and put it in practice
- Extracurricular activities are vital and add a lot of value
- Key points: Work integrated learning, mentoring programmes, push on developing student societies, cultural integration, industry partnership with students & academics, being able to sell yourself

Focus Group Two

Q1: What Graduate Qualities do you look for?

- Know how, can do, and want to (personal work ethic); how you conduct yourself, understand culture of the organisation.
- Aspiration – want to – have a goal and be inquisitive if they don't know something
- Communication – discuss plan, work as part of a team, explain, speak to people, win the bid, set the sell
- Adaptability – willingness to roll with the punches, and have the tenacity to go the extra mile

Q2: Is creativity a Graduate Employability Attribute you look for?

- Innovation is what is looked for. Taking something that exists and turning it into something else
- Being able to problem solve – face to face and on the spot – and create a solution that will solve everything
- Human creativity – get thrown a curve ball – then a series of ideas. Sit outside of the status quo
- Communication is also vital. It's one thing to be able to solve problems, but they need to be communicated upwards. Need a safe environment for communication to flourish.
- Creativity must benefit the organisation
- Self-belief underlies all creativity

Q3. How do you measure the performance of a Graduate once recruited?

- Understand their job and fit within the team structure
- Understand their role
- Feedback loop and acting on feedback – creativity often comes out in these meetings
- Achieve desired results from work and KPIs
- Skills and attitude – did the graduate live up to his/her promises? Did they maintain their attitude? Have they progressed?
- Should be actively seeking feedback
- Expectations/outcomes from employer: make an improvement and add value to the company, fit in with the organisational culture, self-motivated, meet deadlines, keep clients happy.

Q4. Are graduates creative ready?

- Depends on the university environment – often technically very good but can't sell themselves
- Often up to the individual to be proactive – having real world experience to compliment study is vital
- Awareness – confidence and purpose in what they do. Think ahead of the curve, and headspace they need to be operating in
- Articulation of ideas and how they will benefit the organisation, and follow through on ideas
- Success = creativity + persistence + self confidence
- Creativity is a spectrum
- Creativity requires an environment or a structure in order to happen. Employers can be the problem – are employers creative ready? If they don't support it, it creates a negative work culture.
- Having competition with your own performance
- Reward creativity for it to grow

Summary of key issues

Overall preferred definition of Creativity:

- Communicate - translate and apply

Preferred list of graduate level employability attributes:

  o Technical Skills
  o Creative thinking; solutions focused; ability beyond the 'average'
  o Maturity and Capability (Workplace Awareness)
  o Leadership
  o Cultural Awareness
  o Understanding the variation in Induction Training in different companies

- o Social Integrity & responsibility – ability to manage personal brand and market yourself
- o Demonstrable ability to deliver on set tangible outcomes and KPIs

Key learning for universities:

- Provide Work integrated learning opportunities, mentoring programmes, push on developing student
- societies, cultural integration, industry partnership with students & academics, being able to sell yourself
- Rewards and recognitions needed beyond grades - formal feedback on processes; might inspire to think beyond

Key learning for employers:

Universities can't do it all – it's a partnership and employers must be involved to provide the industry linkages, placements/internships, mentors etc. This is about the long-term.

Appendix H: SortSite accessibility test results

First version of the project site and tools

Overall Quality	121 pages with quality issues
Errors	43 pages with broken links or other errors
Accessibility	87 pages with accessibility problems
Compatibility	31 pages with browser specific issues
Compliance	20 pages with compliance or legal issues
Search	66 pages with search engine issues
Standards	51 pages have W3C standards issues
Usability	69 pages with usability issues

Totals 440 pages and images checked

Final version of the project site and tools

⊘ Broken links - No issues found.

⊘ ASP, ASP.NET and PHP script errors - No issues found.

⊘ W3C HTML/XHTML Validation - All pages valid.

⊘ W3C CSS Validation - All pages valid.

⊘ W3C Style Guide - No issues found.

⊘ W3C Deprecated Features - No issues found.