DESIGN THINKING: EMPLOYING AN EFFECTIVE MULTIDISCIPLINARY PEDAGOGICAL FRAMEWORK TO FOSTER CREATIVITY AND INNOVATION IN RURAL AND REMOTE EDUCATION

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ABSTRACT

This paper outlines a project to develop and track 'design thinking' skills within groups of students in late primary and early secondary years of schooling in order to strengthen their creative skills and innovative mindsets. The outcome of the research will be the development of a model for the broad-based implementation of design thinking in schools which will foster students' creative skills, critical for 21ˢᵗ century living and their capacity to make a strong contribution to innovation in their future workplaces. Students will develop competence in using the steps - 'understand, observe, visualise, evaluate, refine and implement'- in relation to examining contemporary issues concerned with living in rural and remote areas and will subsequently design illustrative multimedia presentations or computer games. Design thinking as a framework to solve problems and/or as a pedagogical framework has emerged from the processes that designers have used over the last twenty years to create unique and innovative products. A convincing literature base has continued to grow across almost every discipline area, yet 'design thinking' is only just starting to influence school-based education.

INTRODUCTION

Proponents of design thinking (e.g., Brown, 2008; Martin, 2009) claim that explicitly teaching students to 'think like a designer' within a project-based learning environment enhances their abilities to be creative and to contribute to the process of innovation. They claim that traditional education develops content knowledge along with the ability to choose between available paths and options but it fails to produce graduates who can create different paths and options (Wylant, 2008). National testing aims to bolster basic skills that are important foundations for learning and often the result is an over-emphasis on learning 'the basics' and the reproduction of knowledge at the expense of nurturing students' creativity and imagination and the related development of innovative mindsets and 21st century literacies. Yet these

qualities are those most likely to enable them to succeed as sophisticated, flexible knowledge workers and citizens of the future (Gee, Hull & Lankshear 1996).

BACKGROUND AND DEFINITION OF 'DESIGN THINKING'

Dunne and Martin (2006) claim that 'design thinking is the way designers think: the mental processes they use to design objects, services or systems, as distinct from the end results of elegant and useful products' (p. 517). Almost two decades ago, Gee, Hull and Lankshear (1996) predicted that a designer mentality would be a fundamental skill needed for full participation in the knowledge economy. A designer mentality results from the nature of design work: a project based work flow around problems. Explicit steps are typically used as guides in the process, such as: understand, observe, point of view, ideate, prototype and test (Carroll, et al., 2010). More complex and nuanced explicit steps such as those developed by Beckman and Barry (2007) have been designed for specific industry applications but the simpler steps used by Carroll and colleagues in school-based education and Bell (2008) in library and library services design are more appropriate as a way of introducing design thinking to school-aged students and are the steps adopted for this project. Design thinking differs from previous approaches to developing innovative mindsets due to its emphasis on focusing the learner on empathy and understanding the systems and users at the beginning of the process. In recent design thinking models, the design approach is applied more broadly than producing a product, leading proponents to claim that the approach is useful in solving a wide range of problems (Brown, 2008). Design thinking has been used in expected areas such as art, engineering and business but also in climate change, medicine, library services and sustainability (Dunne & Martin, 2006; Dym, Agogino, Eris, Frey & Leifer, 2005; Senturer & Istek, 2000; Uehira & Kay, 2009).

The curricula of some of the world's leading universities have been altered in recent years to include design thinking: Harvard Business School, Stanford University, the University of California, Berkeley, and MIT's Engineering Schools (Dym, et al. 2005; Wylant, 2008). Other studies have acknowledged the contribution that design thinking has made to diverse fields such as creating different types of libraries and library services, improving patient experiences in Japanese hospitals and engaging medical students in problem solving in Australian medical schools (Bell, 2008; Uehira & Kay, 2009; McDonagh & Thomas, 2010). Large companies, such as Oracle and SAP, have required executives to undertake training in design thinking. Design thinking has elements of 'problem-based learning' and 'systems-based thinking' within an overall coherent framework. Jones (2009 n.p.), a system thinking theorist, argues that 'design thinking is different even if only because the *actions* of designing that we draw from are tangible ways of knowing and working...systems thinking is more abstract in action and representation'.

Design thinking had its origins in design faculties and colleges over 20 years ago and was then developed throughout the early 90s (Rowe 1998), but only recently has been seen as a wider strategy to enable innovation across all areas, including rural education. Design thinking skills which were earlier focused on designing a product are now used broadly in higher education and across a diverse range of industries. In his influential book 'The Art of Innovation' Kelley (2001) identifies design thinking as the driving force behind innovation in industry and ties this back to his own company's innovation in producing the Apple mouse and the Palm Pilot and a host of products and business practices. Kelley argued that the main stages of design thinking are: understand, observe, visualise, evaluate, refine and implement. Since little empirical research outside of design schools existed to support design thinking, proponents such as Kelley (2001) and Brown (2008) have argued from the point of view that it had been implemented in their business innovation and had been successful. Without a strong research evidence base and a lack of refined definitions, design thinking was in danger of being dismissed as a fad, despite its practical success in small and large business. In the last six years, a body of research has emerged across many different discipline areas to support the claim that design thinking provides an effective framework for solving problems in innovative ways or producing innovative products. This process of refining definitions and the testing of various explicit steps has led to a critique that complex, nuanced steps utilised by designers (including their tacit knowledge) have been reduced to simple definitions and over-simplified steps.

Notwithstanding, promising results from a broadening research evidence base include applications in IT (Tufte, 2009); Architecture (Galle & Kovacs 1996); Arts and Humanities (Bruton, 2007), Library services (Bell, 2008), Business (Beckman & Barry 2007); Health and Education (Carroll, et al., 2010); (Dunne & Martin, 2006); Zelenko and Hamilton (2008); Medicine (McDonagh & Thomas, 2010) and Engineering (Nagai & Noguchi, 2003). An exciting feature of design thinking research has been the development of a common multi-disciplinary discourse that can assist in the formation of multi-disciplinary teams to create innovative solutions to problems. Although certain aspects of design models have been evident in the school curriculum for some years, the application of design thinking to school-based settings is a relatively new phenomenon. An opportunity now exists to use design thinking as an effective pedagogical framework for the development of new ICT based literacies in rural schools as well as an effective framework for examining and solving problems.

IMPORTANCE OF DESIGN THINKING

Design thinking has been shown to be effective in industry and across multiple discipline areas but not applied significantly in schools. There is only a very small current evidence base about design thinking in schools although the MacArthur Foundation has recently funded the establishment of a whole school in New York, based around design thinking as the pedagogical framework (see Salen, et al., 2011) and the implementation of design thinking in the US rural county of Bertie, N.C. has

produced encouraging results. DT offers a framework that can be applied to solving problems or creating products, as well as being a skill set that is easily transferable. In addition, it is particularly important to nurture students' creative and innovative capacities in the face of national testing that emphasises basic learning which dominates school-based educators' attention

This project (see Appendix 1 for the explicit project intervention steps) which aims to test the usefulness of design thinking in rural school contexts is particularly important since design thinking is growing in significance across many discipline areas after being widely and successfully used in industry and tertiary education, yet very few empirical studies or projects exist to inform debate about the use of design thinking in school settings, to promote innovative, flexible and creative thinking and the development of multimodal literacies. Students based in rural areas are particularly suited to design thinking strategies as they have the opportunity to develop more independence and 'inventiveness' compared to their metropolitan peers. Moreover, contemporary rural themes offer fertile ground to use this pedagogical framework to competently and collaboratively complete two separate tasks – first, sparking the discussion and attempted resolution of rural issues and second, designing ICT based products, including games and multimedia that highlight these issues. This is currently important, given the backdrop of the growing importance of national testing and its unintended negative consequences. National testing of basic learning in schools threatens to diminish the importance of learning tasks that require young people to develop imagination, creativity and innovative mindsets. The rationale for an emphasis on design thinking offered by its key exponents is that it fosters collaboration, empathy and a deeper understanding of others and that it leads to people being more usefully creative and innovative (Brown, 2008; McDonagh & Thomas, 2010; Ward, Runcie & Morris, 2009). Although not all people in society are required to be expertly creative or innovators, these theorists argue that some experience in the process leads to an understanding and appreciation of how it works that in turn enables a more questioning and critical mindset of the complex world in which we live.

EXPECTED OUTCOMES OF THIS RESEARCH:

- Acquisition by students of an explicit set of design thinking skills, involving problem solving and collaboration.

- A framework for embedding design thinking skills across the curriculum.

- Better theoretical understanding of the design thinking model as it applies to classroom use.

- Development of a learning model that fosters closer links between the school setting and students' lives out of school.

- A means of increasing engagement (e.g., student concentration, interest and enjoyment) with schooling.

- Insights into the ways in which design thinking might promote increased competence in print and multimodal literacies.

- Consolidation and further trialling of the games-as-action/games-as-text model of games literacy.

RESEARCH METHOD

The study aims to capture data from 125 Year 7 or Year 8 students in four schools, with two schools in Queensland, one in Victoria, and one in the ACT. To increase validity, mixed methods and parallel methods will be combined in a multi-stage approach, which includes: attitudinal and engagement questionnaires (pre and post); in-situ journal observations and recording of competencies using the technology essential learnings framework; collection of artefacts related to the intervention activities; focus groups and interviews with the ICT teacher and students. Written and spoken records will be subject to discourse and content analysis using methods outlined by Gee (2011). The key method of data collection involves the deployment of a carefully structured research journal that will give explicit guidance to research assistants about what data needs to be consistently collected and recorded. It will include evidence of acquisition and use of design thinking principles along with related academic progression in multi-literacies and traditional literacy and technology competencies. School students involved as participants will also complete a reflective journal on their perceptions of the program. Cognitive scaffolding in the form of questions will guide school students when completing the reflective journals.

DESIGN THINKING AND FOSTERING AN INNOVATIVE MINDSET

Innovation involves the development of new ideas, implementing the ideas in a system/institutional context and researching the effectiveness of the ideas to make positive change. Under this commonly accepted definition of innovation, this project promises to be particularly innovative as there are currently very few studies that provide an evidence base about the acquisition of design thinking skills and how these skills support learning within existing curriculum areas in rural areas. A significant outcome of this study will be to enhance understanding of how design thinking can provide an effective cognitive framework for rural students as they examine relevant social problems and apply their knowledge to creating computer games or multimedia to represent their ideas. Bransford, Brown and Cocking (1999) have argued that educational programs should involve students in linking, connecting and integrating ideas in relation to authentic contexts through the examination of real-world problems. The rural issues that will be examined by the students will be authentic and important to particular rural communities. The use of themes have been supported by Caine and Caine (1997) and Kovalik (1994) as

helping students understand new concepts by providing mental organising schemas. In general, the design thinking literature is built around using various frameworks to solve authentic problems (Beckman, et al., 2007; Dunne & Martin, 2006).

CONCLUSION: CAN DESIGN THINKING WORK IN RURAL CONTEXTS?

Barseghian (2010) reported on the work of Emily Philloton with school superintendants in the rural school district of Bertie in North Carolina (population 20 000) from 2009 to revitalise public education in the rural district where education had become jaded through teaching and learning to tests and general over-testing. Philloton aimed "To teach design thinking as part of the curriculum within the public school system, in conjunction with real product design and building skills, and apply it toward the tangible needs of the community" (Philloton & Miller, 2011, n.p.). She argued that:

> This type of design offers an antidote to boring, rigid verbal instruction that most school districts are plagued by. It's hands on, in your face and requires active engagement that applies core subject learning in real ways… It's precisely this type of creative thinking that should be applied to education reform: Defining one problem at a time, involving the most important stakeholders in the process, and using sound ideas to push for progress.

Philloton's program has achieved wide-spread acclaim and despite taking schools away from a concentrated testing practice regime, test results have improved from the previously dismal results of only 27% of students in the district meeting state standards. Philloton and Miller describe their program as:

> Learning through a non-linear design process, which includes ethnographic research, generation of multiple ideas, development of a few of those ideas into workable concepts, prototyping of those potential solutions, iterative refinement, and finally the construction and implementation of the solution. The process is messy, creative, surprising, and human-centered, resulting in solutions that emerge from need and community interest rather than schematic form-making. An iterative process (which usually includes multiple rounds of prototyping-refining) and distils concepts into working solutions through testing and user feedback.

In another example of rural implementation, Stanford University K12 Laboratory (2011, n.p.) hosted a strategy workshop:

for school principals and members of the Royal Education Council of Bhutan. Topics included implications of using design thinking in rural schools, fostering innovation and creativity as a way to prepare youth for democratic society, as well as problem-solving techniques for teachers facing a variety of challenges in the former kingdom of Bhutan.

Stanford has been at the forefront of advocacy for design thinking as a means of fostering creativity and innovation in many different contexts. In addition, Krieger (2010) has successfully introduced design thinking strategies in rural schools located in India and Mexico.

Another example of an authentic rural issue solved by the utilisation of a design thinking framework is the work of Sandhu (2009, n.p.) who used the steps to facilitate the development of solution to providing safe drinking water for rural Mexicans in La Paz.

The reports in this last section of the paper are gleaned from non-academic websites as many of the successful trials using design thinking for rural benefit have not yet made their way into academic publications and therefore larger quotes have been used to convey a sense of the progress and outcomes of these early implementations. In contrast, our proposed project has a strong research base and will provide much needed academic evidence based on sound and rigorous research methods. Two separate versions of the project have been planned to introduce design thinking into rural schools, with both using the design thinking steps of understand, observe, point of view, ideate, prototype and test. Both versions will engage school based students in using the framework to discuss and solve problems and to create ICT products in multimedia or computer games. One intervention centres on the theme of 'rural issues' in small rural schools in three Australian states, whereas the other intervention is designed for schools in North Queensland with a very high percentage of Indigenous students and is focused on using Indigenous knowledge as the central theme. Without such carefully planned and executed research, design thinking is in danger of being viewed as a passing fad rather than the end result of 20 years of progression from the original ideas that flowed from design education, and the positive impact of these ideas that have been evident in other discipline areas such as business, engineering and medicine may be lost to Australian school-based education or the potential benefits delayed.

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Appendix 1. Intervention Steps

Stage A

- Teachers undertake professional development using the 'Design Thinking Professional Development Pack' and the companion 'Design Thinking Resource Pack', which will be compiled by senior RA under the guidance of CIs.

Stage B

Students systematically follow the Design Thinking steps:

- Understand: In groups, examine needs, challenges and perceptions around the chosen theme (migrant or rural)
- Observe: Investigate how these issues impact real people in real life situations
- Visualise: Ideate, brainstorm, sketch, storyboard, role play - how could these issues be addressed by multimedia or a game? Create rapid prototypes of selected concepts
  - Evaluate and Refine: Test prototypes with sample users, refine solution
- Implement: Create chosen multimedia or game with ICT scaffolding from teacher and RA.

Throughout Stage A and B

During the activity, teachers focus on developing the students':

- Cognition and metacognition
- Creativity
- Critical problem solving and understanding of game or multimedia logic and rules
- Empathy/understanding the end user and systems that the user operates in
- Reverse engineering (e.g., being able to look at other students' completed work and explain the steps that they might have followed to achieve that result)
- Ability to articulate and defend design ideas used in the game or multimedia
- System-based thinking (e.g., ability to understand the software system used and the social system for its use).