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The effects of analogical and metaphorical reasoning on design thinking

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ABSTRACT

This research sought to examine whether analogical and metaphorical reasoning could be taught as a teaching strategy to enhance students' creative thinking in the design process. To investigate the effects of analogical and metaphorical reasoning in design thinking, research was conducted with second year university students majoring in interior architecture. First, a pilot study was conducted to identify the effectiveness of analogical and metaphorical reasoning in supporting design thinking. Based on the results of the pilot study, a curriculum was developed and implemented in a studio course for one semester that encouraged students to engage in analogical and metaphorical reasoning. A further experiment was conducted to validate the effects of the curriculum on students' design thinking processes. The overall results suggested that a teaching strategy that emphasises the use of analogical and metaphorical reasoning could enhance students' design thinking and lead to more creative design processes.

1. Introduction

A considerable amount of research on creativity enhancement has been undertaken within design education. Cross (2007) argued for 'designerly ways of knowing', as distinct from scientific and scholarly ways of knowing. There is a distinction between 'knowing how' and 'knowing that' in designing; 'knowing how' is associated with 'design thinking', and further, with 'creativity', which is essential in designing (Peters, 1965). Design thinking can be a powerful way to allow interactive understanding of an ill-defined design problem, motivating additional design ideas (Teal, 2010). Dorst (2011) studied the core of design thinking for idea generation, and defined design-derived reasoning patterns, emphasizing abduction as the fundamental reasoning pattern for creative thinking. To produce the maximum values of design outcomes, the creative design process should be drawn up by adopting effective reasoning methods based on the understanding of key aspects of the design problem.

Our previous studies reviewed design studies, conducted between 2003 and 2012, on creativity enhancement and sought to identify important issues in design education (Choi et al., 2013). The studies were divided into three categories: design education methods, ideas development and design strategies. The results of the reviews showed that analogical and metaphorical reasoning that encourages reflection-in-action could be used as an effective design strategy to enhance students' creativity in designing. Ball and Christensen (2009) contended that analogical reasoning is a core design strategy that facilitates the resolution of design uncertainty by generating ideas for resulting representations. Snodgrass and Coyne (1992) argued that

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metaphors can assist in breaking away from the limitations imposed by initial problem constraints and thus assist in the exploration of design alternatives.

Design education is concerned with teaching methods or strategies by which students are educated to obtain the relevant knowledge or skills. Students are generally educated to develop a logical and convergent thinking to a correct answer, thus they are apt to adopt linear thinking even in solving ill-defined design problems. It is essential to adopt effective teaching strategies for an educational platform that encourages students to produce design thinking, which eventually leads to a creative design process. This research emphasised reflection-in-action (Schön, 1983) in architectural design and sought to examine whether analogical and metaphorical reasoning could be used as an educational method to support students' design thinking in a design studio. A design studio could provide 'a reflective practicum in designing' that involved 'active learning' and a 'conversation' with designs (Wang, 2010).

This research explored analogical and metaphorical reasoning as a teaching strategy for enhancing students' design thinking and established an education platform to support students' creativity in designing. To date, little empirical research has been conducted on analogical and metaphorical reasoning as a teaching strategy with a focus on design thinking and behaviours. Using a protocol analysis, studies were conducted in a design studio to investigate the effects of analogical and metaphorical reasoning on design thinking. It was hypothesised that the use of analogical and metaphorical reasoning in the design process would allow students to reflect on a design situation and overcome the constraints by logical inference, leading to greater explorations of design alternatives. It was anticipated that educating students in relation to analogical and metaphorical reasoning would enhance their divergent thinking as they would undertake more trials in sketches using analogical and metaphorical reasoning. Guidelines that encourage design thinking in education have been suggested based on the results of this research.

2. Related works

2.1. Design thinking and divergent thinking

Design thinking is essential for developing new concepts and values in all areas. The importance of design thinking has been argued by many researchers (Cross, 2010; Dorst, 2010). Design thinking can be developed based on divergent thinking. Divergent thinking may enable the production of various alternatives for a design problem by adopting different approaches to it. Divergent thinking does not guarantee creative outcomes, however it has been widely used as an index of creativity in the educational field (Charles & Runco, 2001).

Guilford (1950) described divergent thinking as the opposite of convergent thinking. Convergent thinking involves the emphasising of a single correct answer to a problem and leaves no room for ambiguity. The process of convergent thinking is logical and often features linear thinking (Cropley, 2006). For divergent thinking, Guilford emphasized ideational fluency, originality, flexibility and elaboration. Ideational fluency is a primary index of divergent thinking. Originality and flexibility relate to unusual ideas, and elaboration demonstrates a subject's ability to extend upon ideas (Chan et al., 2001; Wallach, 1985).

Teal (2010) argued the importance of a non-linear practice of design thinking. According to him, when a design is produced through linear thinking, calling upon faculties often considered a-rational and a-causal, creativity would be reduced because linear thinking follows a series of steps to an existing solution, thereby diluting the potencies of intuitiveness and variance. To provide a more complete picture of design thinking in the education of students, Teal employed Deleuze and Guattari's 'rhizome' concepts to imbue design work with meaningful complexity in practice. Rhizome is a philosophical concept based on the botanical rhizome. A rhizome constitutes linear multiplicities with n dimensions, connecting any point to any other point (Deleuze & Guattari, 1987). The rhizome approach promotes design thinking as a process comprising both linear and non-linear aspects.

2.2. Recognising and fostering creativity in designing

The term 'creativity' can be associated with certain design activities that have the potential to produce innovative ideas (Gero, 2000; Visser, 2004). The design process starts with ill-defined given requirements, thus 'problem–finding' is essential for the development of a final outcome (Ohlsson, 1984). With regards to the designers' perception of a problem situation, Suwa, Gero, and Purcell (2000) propose "unexpected discoveries of attending to implicit visuo-spatial features in an unexpected way" as a key to gaining a creative outcome. Co-evolutionary design is one of features associated with creative outcomes in which the design requirements and solutions evolve separately, but affect each other (Maher, Poon, & Boulanger, 1996).

While developing design solutions various strategies might be adopted, avoiding any fixation to the existing solutions. Roseman and Gero (1993) suggested five strategies by which creative design might occur: combination, mutation, analogy, design from first principles, and emergence. The 'mutation' strategy can produce an innovative design by transforming some features of an existing design, whereas the 'analogy' strategy can deduce a novel idea from an existing design by introducing some features in a similar way. Emergence can be associated with 'sudden illumination' and a 'creative leap', emphasizing 'insight' into innovative ideas (Cross, 1972; Koestler, 1964). Scott et al. (2004) emphasized the effectiveness of well-designed creativity training programs in developing creativity.