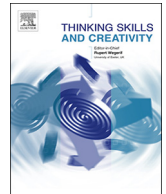




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The effects of the alternate writing and sketching brainstorming method on the creativity of undergraduate industrial design students in Taiwan

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ABSTRACT

Creativity, one of the important abilities of industrial designers, can help with designing and realizing innovative products. Today, industrial designs require group collaboration as well. To stimulate group creativity effectively is an important issue in promoting the innovation of products. Both the 635 brainstorming method and the C-Sketch method are popular team-based divergent thinking techniques. The former uses words while the latter uses pictures as a way to stimulate group creativity. This study fuses the 635 brainstorming method and the C-Sketch method by alternatingly passing pictures and words in the divergent thinking phase to help group designers with stimulating and integrating their ideas from different aspects for developing innovative products. To help industrial designer groups collaborating to design innovative products, this study develops an online collaborative design system that could support several divergent thinking methods, including the hybrid technique proposed in this study. To evaluate the feasibility of this hybrid technique, this study conducts two experiments. For the results in the first experiment, using the proposed method, the originality and the elaboration of group creativity score significantly higher than that using the 635 brainstorming method, but the fluency and the flexibility do not. In the second experiment, using the proposed method, the originality and the elaboration of group creativity score significantly higher than that using the C-Sketch method, but the flexibility does not. Nevertheless, the C-Sketch method performs significantly better in the fluency of group creativity than that of the proposed method. The proposed method scores significantly higher than the 635 brainstorming method and the C-Sketch method do in improving designers' creative thinking. Nevertheless, the measurements of the performances on the final products yield no significant differences between the proposed method and the 635 brainstorming method or the C-Sketch method.

1. Introduction

For industrial design, creativity is one important ability (Casakin & Goldschmidt, 1999; Casakin, 2007; Cross, 1997; Hasirci & Demirkan, 2007; Potur & Barkul, 2006). Creative designers could develop new, special or innovative products, particularly in the

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field of industrial design, that emphasize more customized design, different from other design domains (Woodruff, 1997). Hence, industrial designers have a more particular intention for looking for creativity in design (Christiaans & Dorst, 1992). Many studies emphasized the importance of creativity and innovation during industrial design processes (Dorst & Cross, 2001; Hsiao, Wang, & Chen, 2017; Lee & Chang, 2010). Therefore, for industrial designers, it is important to harness a method or tool to develop innovative solutions or ideas. In realistic work situations, idea generation tasks usually involve more than one individual when brainstorming collaboratively (Gabriel, Monticolo, Camargo, & Bourgault, 2016; Wang, Rose, & Chang, 2011; Wang, Schneider, & Valacich, 2015). Group brainstorming is a typical method for group creativity (Drucker, 2014; Gabriel et al., 2016; Shi et al., 2017). To help collaborative brainstorming, many team-based divergent thinking techniques have been developed. Both the 635 brainstorming method and the C-Sketch method are popular team-based divergent thinking techniques (Linsey et al., 2011; Petersson, Lundberg, & Rantatalo, 2017; Schroerer, Kain, & Lindemann, 2010).

In idea generation processes, collaborative brainstorming methods usually encourage group members to document their ideas by using sketches or words (Glier, Schmidt, Linsey, & McAdams, 2011; Linsey et al., 2011; Schroerer et al., 2010). Pictures have a great capacity for information encoding that can help stimulate ideas (Halin, Bignon, Scaletsky, Nakapan, & Kacher, 2003), and words are an integral part that facilitates the explanation of the concepts and the directions for the pictures (Delage & Marda, 1995).

The 635 brainstorming method stimulates ideas through words, and the C-Sketch method stimulates ideas by sketches. However, even when a designer uses appropriate past designs to trigger new ideas, the designer may filter out potential creative solutions and lose his or her imagination (Eckert, Stacey, & Earl, 2005; Schwert, 2007), which is called design fixation (Jansson & Smith, 1991; Purcell & Gero, 1996; Smith, Ward, & Schumacher, 1993). This design fixation might occur in the divergent thinking phase. Considering the suggestion from Linsey et al. (2011), a hybrid of methods of combining words and sketches might maximize the quality and number of ideas. A hypothesis is that considering sketches and words alternately in the divergent thinking phase to stimulate and integrate ideas from different aspects might be helpful for group designers to avoid design fixations and to develop innovative products.

This study proposes a creative thinking methodology that, by passing pictures and words alternately among group designers in the divergent thinking phase, helps the group designers think divergently. To evaluate the feasibility of this hybrid technique this study compared it with the 635 brainstorming method and C-Sketch method on the performances in the divergent thinking phase, the performances on the final product designs, and the performance of creative thinking. The research questions for this study are as follows:

- Q1: Are there performance differences in divergent thinking among designers who use the three methods?
- Q2: Are there performance differences in the final product designs among designers who use the three methods?
- Q3: Are there performance differences in creative thinking among designers who use the three methods?

2. Background

2.1. Words, pictures and creativity

In the creative design process, pictures or sketches play an important role for designers (Lawson & Loke, 1997; Nakakoji, Yamamoto, & Ohira, 1999). Designers often use visual pictures to help them generate new ideas by extracting properties that might map the identified design requirements (Nakakoji et al., 1999). Wang, Cosley, and Fussell, (2010) chose pictures as the stimuli of group brainstorming and noted that individuals' attention and perception to visual elements may vary based on prior experiences, cultural context and current framing. These perceptions may trigger interconnected ideas that are in the space of associative memory. Designers use not only pictures to stimulate idea generation but also sketches to express their ideas. Designers often produce sketches that are full of a large amount of uncertainty, but the uncertainty is at the heart of the creative design process so that they can explore several ideas (Lawson & Loke, 1997). Likewise, Linsey et al. (2011) noted that designers rely heavily on sketches to express their ideas during the creative design process. In a word, visual elements are important for designers in the creative design process.

Despite helping designers develop more ideas, pictures have one problem of representation. Pictures are too subjective to represent ideas and information completely and exactly (Schwert, 2007). In comparison with pictures in expressing design ideas, words have the ability to preserve a range of interpretation (Lawson & Loke, 1997). Lawson and Loke (1997) noted that experienced designers use words to communicate and express design concepts due to the insufficient vocabularies of graphical expression to stimulate and describe multifaceted design possibilities. Additionally, although design results are usually represented by pictures or models, explanations in words are necessary for most sketches to see the main ideas of design solution (Lawson & Loke, 1997). Kvan and Candy (2000) also suggested that using textual expression to communicate design ideas could encourage the exploration of elemental issues. Therefore, textual expression is still one of the important forms in expression and communication during a design process.

2.2. Brainstorming methods

A typical process for creative design includes four stages: collection of information, incubation, creative insight, and evaluation (Csikszentmihalyi & Sawyer, 2014). During the incubation and creative insight stages that could be considered as the divergent thinking phases, designers try to generate creative ideas by accumulating large amounts of information and discovering association regarding a particular piece of information (Nakakoji et al., 1999). Some creativity researchers noted that the more revelations to other potentially apropos ideas there are, the higher probability of creative idea generation (Osborn, 1957; Parnes & Noller, 1972).

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