



Collaborative digital environments to enhance the creativity of designers



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ABSTRACT

This study explores the interaction of the essential components of creativity and collaboration in a digital environment in the design process. The framework is based on Amabile's componential theory of creativity, which is composed of three intra-individual components of creativity and the social environment. The digital environment as the social component of creativity provides the technical infrastructure for the analysis of data related to creativity and collaboration. Protocol coding method is used for the analysis of the qualitative and quantitative data stored in The Modular Object Oriented Developmental Learning Environment (MOODLE) forum posts that were formed by the comments or critiques given during the collaboration process by the team members, instructors or jury members. Findings indicate that the social environment component named as the reactivity to proposals is closely related to idea generation as the creative relevant process component and group interaction as the task motivation component. Furthermore, it is found that the number of sketches and design ideas produced through critiques are the main design issues that enhance creativity in collaborative digital environments.

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1. Introduction

The creativity support environments extend the capability of designers for making creative designs in the conceptual phase of design. According to Greene (2002), the digital environments support creativity in design process at two different levels. At the first level, they support the creativity of designers in knowledge gathering, knowledge sharing and knowledge integration and in idea generation. At the second level, the digital environments should support the design of creative products in a particular domain while providing the essential creativity characteristics. Furthermore, the digital environments should provide support for the integration of these two levels in a creative design process.

In the National Science Foundation Workshop Report, Shneiderman, Fischer, Czerwinski, Resnick, Myers, (2005) stated the goal of a digital environment is to develop improved software and user interfaces that give power to the users for being more productive and innovative. Shneiderman, et al., 2005 added that the improved interfaces search more effectively in the intellectual resources, develop collaboration among even geographically distributed teams and provide rapid design processes. Also, comparing the digital

environments with the traditional ones, Nakakoji (2005:70) concluded that “because creativity is such a humane matter, designing, developing, and evaluating tools for supporting creativity will uncover issues and challenges that have not been so obvious in the traditional HCI [human–computer interaction] research framework”.

Fischer, Rohde, and Wulf (2007) defined the term ‘social creativity’ as working together to solve a problem with the help of the computer media and technologies. The collaboration process is a core concept for social creativity in design problems that requires expertise in a wide range of domains. Solving design problems requires “different perspectives, exploit conceptual collisions between concepts and ideas coming from different disciplines, manage large amounts of information potentially relevant to a design task, and understand the design decisions” (Fischer, Giaccardi, Eden, Sugimoto, & Ye, 2007; Fischer, Rohde, & Wulf, 2007: 16).

Focusing on the relationship between the problem solving process and digital environment Vandeleur, Ankiewicz, de Swardt, and Gross (2001: 269) named the creative relevant processes as direct creativity indicators and stated that they are “...observable behavior that is a prerequisite for creativity to take place...”. Furthermore, they named the domain-relevant skills and the motivation components as indirect creativity indicators and stated that they are not necessary for creativity to take place, but they enhance creative activities.

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In the literature, some applications and digital environments that support creativity are present, such as the Envisionment and Discovery Collaboratory (EDC), Caretta and I-LAND (Warr & O'Neill, 2007). Warr and O'Neill (2007:128) described the characteristics of these tools as “EDC supports the design process as a group activity; Caretta supports personal and shared spaces throughout the design process; and I-LAND supports individual, sub-group and group activities in design”. EDC as creativity support tool facilitated shared understandings and provided a common ground in design activities through problem framing, idea generation and idea evaluation. Caretta allowed the manipulation of physical and virtual objects in the shared spaces while providing the opportunity to examine the ideas in the personal spaces. Besides, I-LAND has a dynamic nature for the integration of new technologies in three different interaction spaces.

In the last years, the creativity environments focused more deeply on the brainstorming process in order to enhance the group creativity. As, the Idea Expander is a creativity support environment that establishes communication among the members with pictorial stimuli that are based on the brainstorming sessions (Wang, Cosley, & Fussell, 2010). Also, the Interactive Creative Collaborative Environment (ICE) concentrates on the brainstorming sessions while combining the physical space with a digital space where the meeting room is equipped with an interactive table, interactive multi-touch screens and whiteboard walls (Benyon & Mival, 2012). Furthermore, the Idea Playground system supports both synchronous and asynchronous sessions for idea generation based on the brainstorming sessions with a pen based large digital whiteboard, multiple projectors and mobile computing devices (Perteneder et al., 2012).

Design process is composed of a sequence of goal-oriented problem solving activities. The efficiency of the creativity support environments and the amount of information retrieved from the design team members determine the level of creativity and the quality of the design process (Afacan & Demirkan, 2011). Integration of digital collaboration to design process broadens a designer's point of view by enhancing the ability to share and assess various design concepts and ideas. As Csikszentmihalyi (1996) explained the social characteristics of creativity as “does not happen inside people's heads, but in the interaction between a person's thoughts and a sociocultural context. It is systemic rather than an individual phenomenon” (p. 23). In a collaborative digital design medium, designers form teams and members of the team in this social environment share experiences, ideas, resources or responsibilities.

Creative designing is also viewed as a process that develops iteratively in design problem space and solution space (Lahti, Seitamaa-Hakkarainen, & Hakkarainen, 2004; Wiltschnig, Christensen, & Ball, 2013). Furthermore, collaborative design is considered as an innovative activity when the members of the team have shared understanding on the design process as well as being familiar with the team members (Kleinsmaa & Valkenburg, 2008; Pearce & Ensley, 2004). The quality and amount of communication among the team members is an effective measure in the assessment of success in collaboration (Shen, Ong, & Nee, 2010). However, Hulsheger, Anderson, and Salgado (2009) found that the quality of communication is more effective for creativity and innovation compared to its composition.

The previous research on creativity was either focused on the development of software and digital environments (Nakakoji, 2005; Shneiderman et al., 2005) or on the social creativity elements that foster the creativity of the individuals or organizations in collaboration sessions (Benyon & Mival, 2012; Perteneder et al., 2012; Wang et al., 2010). It is a widely agreed issue that the creativity in design solutions increases, if the team members in a collaborative digital environment develop them from various perspectives (Karakaya, 2011).

Firstly, this study focuses on the intra-individual components that influence creativity in digital environments. Task motivation, domain-relevant skills and creative relevant processes are considered as the three intra-individual components that influence creativity in the social environment (Amabile, 1996).

Secondly, the indicators of collaboration activities and the communication pattern characteristics that determine the social environment component in the design process are identified. This study deeply focuses on the indicators of collaboration that were introduced by Calvani, Fini, Molino, and Ranieri (2010). Furthermore, the communication patterns in the collaborative digital environment are analyzed using the Functional Category System developed by Jonassen and Kwon (2001).

Thirdly, this study tries to find the interactions between the intra-individual components and social environment components. Communication acts among the team members stored as the design critiques reveal the creativity components as well as the collaboration characteristics among the team members. The digital environment as the social component of creativity provides the technical infrastructure for the relevant data. Over the past years, mostly researchers have analyzed either the intra-individual components or the social environment components separately. In this study, building on Amabile's (1996) componential theory of creativity, which is composed of three intra-individual components of creativity and social environment, the design process of collaborative teams in a digital environment is analyzed. Furthermore, this study delves deeper in each component and tries to find the interaction of the two components in a real design environment.

2. Componential theory of creativity

For the past 25 years, research focusing on creativity in design has been influenced by what is known as the 4P's of Rhodes (1961): person, process, product, and press (environment). “Due to the nature of design process, designers solve problems that are not well defined and the methods that they use are not fully understood” (Demirkan & Hasirci, 2009: 294). The 4P's helped designers to structure their thinking on design creativity in solving these not well defined problems. Therefore, the previous research in design, mostly with a disjointed vision of creativity, was based on the independent components of creativity (Demirkan & Afacan, 2012; Demirkan & Hasirci, 2009; Hasirci & Demirkan, 2003). Recent trends in creativity research show that the social environmental forces influence creativity in design. Thus, the present study aims to approach to creativity in design in the social environment building on Amabile's (1996) componential theory of creativity.

According to the componential theory of creativity of Amabile (1983 and 1996), task motivation, domain-relevant skills and creative relevant processes are the three intra-individual components that influence creativity in the social environment. Furthermore, the external component named as the social environment could affect each intra-individual component. As Amabile (1983) stated in the Intrinsic Motivation Principle of Creativity, intrinsic motivation evolves from the individual's perceived value of engaging in the task itself while extrinsic motivation stems from the outside sources. Furthermore, she added that while intrinsic motivators are positively challenging the creative behavior of individuals, the extrinsic ones could weaken creative behavior. Based on the latter evidences found in the researches, Amabile (1993) concluded that extrinsic motivation sometimes act together with intrinsic motivation in supporting creativity. Working in organizational settings, Zhou (2003) found that close monitoring of a supervisor as an extrinsic factor has a negative effect on the intrinsic motivation while developmental feedback has a positive effect on the intrinsic motivation. Furthermore, Liu, Chen, and Yao (2011) found that the

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