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A creative thinking approach to enhancing the web-based problem solving performance of university students

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ABSTRACT

Along with the advancement of information and communication technology, researchers have pointed out the necessity and challenges of developing effective instructional strategies to enhance students' web-based problem-solving performance, which refers to the ability of investigating a series of related problems via searching for, abstracting and summarizing information on the web. In this study, a creative thinking strategy is proposed to cope with this problem. Moreover, an experiment was conducted on 80 freshmen from two classes of a university to evaluate the effectiveness of the proposed approach. The experimental results show that the proposed approach improved the students' web-based problem solving performance in comparison with the conventional approach in terms of "problem finding" and "idea finding." Moreover, it was found that the proposed approach could improve the "fact finding" performance of the students with intuitive-type cognitive style. Accordingly, some implications and suggestions are given for educators who attempt to conduct web-based problem-solving activity.

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1. Introduction

Nowadays, society is changing in the face of the global information explosion; thus, it is important for schools to cultivate students' abilities of seeking, identifying and applying information on the web for investigating specified issues (Bilal, 2002; Thompson, Martin, Richards, & Branson, 2003; Tsai & Shen, 2009). Such learning activities referring to answering a series of questions related to a particular issue via comprehending the issue and questions, searching for web information, selecting and abstracting the searched information, and summarizing the information to answer the questions, have been called web-based problem solving by researchers (Kuo, Hwang, & Lee, 2012). Scholars have emphasized the need for conducting web-based learning activities in universities to help students learn to investigate important issues using web resources (Kear & Heap, 2007; Siragusa, Dixon, & Dixon, 2007). It is expected that students can develop systematic problem solving approaches for correctly analyzing the issues to be investigated, evaluating the correctness of the obtained information, and summarizing their findings (Hwang & Kuo, 2011; Tsai & Tsai, 2013).

However, researchers have found that most university students usually deal with web information-seeking tasks by accessing a small quantity of network resources without evaluating the correctness and quality of the acquired information; nor do they made proper abstractions and interpretations when using the information (Bruno, 1987; Clerehan, Kett, Gedge, & Tuovinen, 2003; Hwang & Kuo, 2011; Tseng, Hwang, Tsai, & Tsai, 2009). Therefore, it is important to improve students' web information-seeking and applied abilities, including identifying problems as well as searching for, analyzing, evaluating, interpreting, and utilizing information obtained from the web (Dickey, 2007; Eisenberg & Berkowitz, 2000; Lee, 2010; Liu, Cheng, & Huang, 2011; Scherer & Tiemann, 2012).

The strategy of Creative Problem Solving proposed by Treffinger and Isaksen (1992) is such an approach that engages students and teachers in the process of solving open-ended questions via a systematic thinking method (Abell, 1990; Ackerman & Karen, 2005; Ladbrook & Probert, 2011). It provides step-by-step guidance or scaffolding to help students identify the core of the target problem via knowledge sharing, peer interactions, conflict resolution, and information summarization. Previous research concerning applications of Creative Problem Solving strategy were proven to be effective for enhancing learning performance in various educational domains, such as mathematics (Kandemir & Gur, 2009), Engineering (Kashefi, Lsmail, & Yusof, 2012a), and nursing (Kane, 1983; Vanvactor, 2012).

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Consequently, a creative thinking approach that integrates the Creative Problem Solving strategy into a web-based learning environment is proposed in this study and an experiment on the "Information Technology and Society" course of a university has been conducted. Moreover, to investigate the effectiveness of the proposed approach in depth, the students' cognitive styles were taken into account when analyzing their learning performance. The research questions of this study are listed as follows:

(1) Do the students who learn with the creative thinking approach have better web-based problem-solving performance than those who learn with traditional instruction?
(2) Do the students with different cognitive styles show different web-based problem-solving performance when learning with the creative thinking approach and with traditional instruction?

2. Literature review

2.1. Web-based problem solving ability

Web-based problem solving ability refers to one's ability to retrieve information on the web to respond to a series of questions related to a target issue (Hwang & Kuo, 2011). With the advent of Internet and Communication Technology (ICT), schools are not only playing the role of delivery of knowledge to students, but are also key to cultivating their web-based problem solving abilities in quick response to a pluralistic community. It is necessary to facilitate students' problem-solving abilities to adapt to a future changing society through training courses concerning information retrieval, recognition and reorganization processes (Goldstein & Levin, 1987; Mayer, 1992; Tsai, Tsai, & Hwang, 2011). Furthermore, Ifenthaler and Seel (2013) have indicated that supportive information is an essential assistance to learners for constructing cognitive structures to solve inductive reasoning and problem-solving tasks.

Kuo et al. (2012) have indicated that students' web-based problem solving performance is highly related to their competence of realizing problems, searching for information, selecting relevant information, and summarizing information. Previous studies have revealed several influential factors on students' web-based problem-solving abilities, such as intelligence quality, learning materials, learning strategies, learning facility, problem-solving instruction strategies, and the socioeconomic background of parents (Hwang & Kuo, 2011; Mustafa & Özgül, 2009; Oloruntegbe, Ikpe, & Kukuru, 2010; Zheng, 2007). Among these factors, learning strategies and problem-solving instruction strategies are considered as key (Harskamp & Suhre, 2007; Kuo et al., 2012; Lo, 2009; Tsai & Shen, 2009; Woo & Reeves, 2007). That is, embedding proper learning strategies in web-based problem-solving activities is helpful to students in improving their learning outcomes (Chiou, Hwang, & Tseng, 2009; Hwang, Chen, & Tsai, 2011; Jung & OuYang, 2004). Additionally, Ifenthaler (2013) argues that the development of effective web-based instruction requires suitable learning strategy and timely prompts for promoting such personalized and adaptive learning processes. Thus, how to apply ICT to facilitate students' web-based problem solving performance via providing proper learning strategies has become an important and challenging issue of learning design.

2.2. Creative Problem Solving strategies

Creative thinking is the process of surpassing learned principles and creating new methods for solving problems (Woolfolk, 1987). Researchers have indicated that these two processes can be integrated into a single complicated process, i.e. Creative Problem Solving (Guilford & Hoepfner, 1971; Kashefi, Ismail, & Yusof, 2012b; Wu, Hwang, Kuo, & Huang, 2013). Fig. 1 shows the Creative Problem Solving model proposed by Treffinger, Isaksen, and Dorval (1994). It consists of three components:
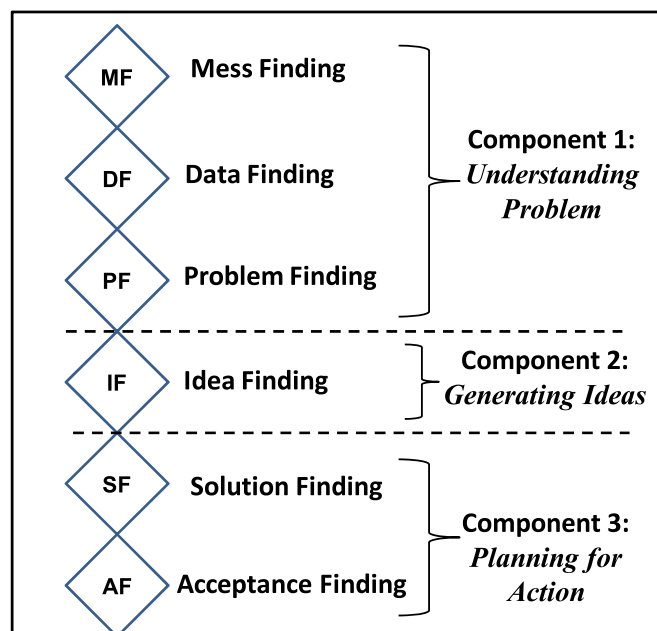

Fig. 1. The three components and six stages of Creative Problem Solving.