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Can structured representation enhance students' thinking skills for better understanding of E-learning content?

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ABSTRACT

This paper proposes an e-learning model to assess the effects of online structured representation of content on learners' understanding. We designed a structured representation based on the theory of distributed cognition that provides seven segments for reading research articles. The study hypothesized that motivation, attention, and interactivity are essential factors that affect students' thinking skills for understanding e-learning content. To investigate and confirm the effect of these factors on the students' thinking skills, we designed a survey and analyzed the responses of 210 university students concerning the proposed structured representation. The results revealed that motivation, attention, and interactivity did contribute to the students' thinking skills. They also demonstrated that the structured representation helped students achieve an adequate level of thinking skills as they read research articles, which had a positive effect on their understanding. This finding demonstrates that structured representation has significant potential as a learning tool and that structure-based e-learning can influence students' metacognitive activities and facilitate their understanding.

1. Introduction

The introduction of virtual learning environment has revolutionized the educational arena. Namely, the introduction of online fora for electronic learning (e-learning) and interactions have brought about a paradigm shift in how educational technology is now offered and impact learners across all ages (Brown & Liedholm, 2002; Fulford & Zhang, 1993; Johnson, Aragon, Shaik, & Palma-Rivas, 2000; Kulik et al., 1985; Picciano, 2002; Swan, 2003), as well as learning outcomes based on cognitive motivational shifts (Bork, 1986; Clark & Paivio, 1991; Halpern, 1999; Pintrich, 1988; Shavelson, 1974). There have been arguments about the non—linear presentations on these e-learning sites and lack of an organized approach, thus creating entropic state giving rise to the superficial impression of a lack of regulation while organizing the contents of these e-learning environments (Benbunan-Fich & Hiltz, 1999; Thomas, 2002). Herein, we present evidence that may not necessarily be the case, and topical organization of e-learning environment may be framed by careful control of parameters involved in its design to enhance student motivation, interactivity, and attention.

E-learning technology is widely employed by educational institutions to create platforms that present onscreen content (in the form of text and/or graphics) for learners. The aim of e-learning is to retrieve, process, and deliver knowledge to the end user online. The current integration of instructional design theories into e-learning has led to platforms that are based on how learners interact with the representation of content during a particular task and how the representation fits into their learning process. Content management systems (CMSs), for example, are tools for producing, tracking, and classifying academic content on the Web (Vovides, Sanchez-Alonso, Mitropoulou, & Nickmans, 2007). Learning management systems (LMSs) range from procedures for administering training/educational details to software that provides collaborative features for e-learning in distributed courses (Coates, James, & Baldwin, 2005; Mittal, Krishnan, & Altman, 2006). Learning CMSs (LCMSs) provide templates for authoring and indexing learning content such as courses and reusable content objects. They can also be used to produce and customize content provided by LMSs (Khan, 2005) and to produce the learning content itself in different formats (Abazi-Bexheti, 2008).

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However, despite the advantages of e-learning, students may lose attention and focus for learning. These adverse effects, which negatively impact students' engagement with e-learning, are likely the result of student's needs for multiple forms of support (Lehtinen, 2003; McCombs & Vakili, 2005). The adverse effects may also arise from a failure to use appropriate design strategies for representing learning content (Botturi, Cantoni, Lepori, & Tardini, 2006; Hwang, Tsai, & Yang, 2008; Martinez, 2003). In research directed at determining the role that students appear to have in online classes and how this differs from their role in traditional lecture classes, Dutton, Dutton, and Perry (2002) found that a high percentage of students who begin e-learning courses do not complete them. Preliminary studies have investigated the reasons why students were less willing to engage in e-learning after their initial experience. For instance, Giannoukos et al. (2008) reported that current e-learning tools do not adequately support student interaction, which leads to students being insufficiently motivated, and this one of the reasons why they shift away from e-learning. Hardt (2009) posits that we lack a solid understanding of how certain forms of learning might help students understand content in e-learning.

In addition, most university students who rely on the resources available in e-learning environments struggle academically (Grundén, 2011), particularly during the first year of their studies, and many higher education faculties intend to address the challenge how they can help students learn in these environments. Some researchers have suggested that the problem may be that e-learning environments do not support the types of representation that are necessary for developing student thinking about learning content (Felix, 2005; Mandinach, 2005; Vrasidas, 2004). The metacognitive processes that students need for understanding contents may not be operant when they read in e-learning environments. The research reveals that metacognition-based student thinking is an essential element for the transfer of knowledge in e-learning, and that standard e-learning platforms may therefore not provide the most suitable way to represent every type of online content.

It appears that an approach may be adapted to provide the students with the necessary support to help them develop the thinking skills that they need for understanding learning content and to increase their awareness of their own thinking processes. Different factors have been examined which proposes contents of e-learning environment (Jiang & Ting, 2000). Here, we introduce a novel approach with an aim to create an adaptable and effective e-learning environment. We have designed a Structured Content Management System (SCMS) e-learning tool that displays the content of research articles in segments, based on the ideas of distributed cognition theory (Hutchins & Lintern, 1995). We also designed a model for assessing students' understanding of structured online content in the e-learning environment. The model consists of five factors: motivation, attention, interactivity, thinking skills, and understanding, and we examined these factors to determine whether presenting e-learning content with a certain structure facilitates better understanding.

2. Research model

This research proposes an e-learning model to assess the effects of online structured representation on the cognitive skills learners need for understanding content. The model consists of three major components: (1) external variables (motivation, attention, and interactivity), (2) metacognition (thinking skills), and (3) understanding. The aim of this study was to confirm that structured representations for e-learning can have a positive effect on the metacognitive skills students need for understanding content. The following sections explain the model's factors and the relations between them.

2.1. Metacognition

Metacognition generally refers to the ability to understand, control, monitor, and manipulate individual cognitive processes to facilitate learning (Reeve & Brown, 1985; Romainville, 1994). Metacognition can help e-learners enhance their understanding of how their knowledge is constructed (Veenman, Prins, & Elshout, 2002) and enables learners to significantly increase their understanding based on active and conscious control of how they process learning content. According to Brown (1987), metacognition affects understanding based on the level of reflection that results from learner's attention being directed to the representation of learning contents. By focusing on cognitive aspects of the mind, metacognition helps individuals develop and synthesize their own thinking skills. This suggests that the structured representation constructed for e-learning content should be based on the premises of cognitive instructional design theories, since not all instructional theories are concerned with cognition.

The main purpose of developing thinking skills is to promote the abilities to understand, evaluate viewpoints, and solve problems (Maiorana, 1992). Many researchers (e.g., Browne & Freeman, 2000; Elder & Paul, 1994; Liaw, 2007; Selwyn, 2007) have acknowledged the importance of thinking skills in fostering learners' ability to develop their understanding. This understanding is established by the inferences learners embed in their learning practices, and by examining these, learners can uncover the underlying assumptions (Paul & Elder, 2012). Therefore, it is important to foster learners' thinking skills related to processing and understanding e-learning content through the way the content is structured and represented, and this can be done through different instructional materials and design elements. However, the design need not presume that e-learners approach the material without previously developed thinking skills. It may be assumed that learners approach e-learning with a variety of thinking skills they have developed through previous experience, because "thinking skills are increasingly required for success in a knowledge-based society" (Liaw, 2007, p. 51). Liaw proposed that inadequate representations of learning material may affect the students' thinking skills in relation to the material. Hence, we concluded that learners' thinking skills might enhance their understanding when content is structurally represented in the e-learning environment. The present study aims at supporting learners' thinking skills by enabling them to become more critical about evidence, think more flexibly, and make reasoned judgments and decisions, all of which will result in a deeper understanding of the topics they study. We hypothesized students' thinking skills with regard to structured representation will effect their understanding by virtue of their being motivated, paying attention, and interacting with the e-learning content.

2.2. Motivation

The motivation to learn is considered an essential factor that affects a learner's cognitive ability to understand content, including immediate learning, by encoding the content within the domain (Mayer, 1992, 1999). Boulay et al. (2010) and Schunk and Zimmerman (1994)