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Re.: Final Report for the research paper presented at the Society for Information Technology and Teacher Education (SITE) 2013 held in New Orleans, Louisiana, United States; March 25-29, 2013.

A. Paper entitled: *“Assessing the Effect of Applying Cognitive Theory of Multimedia Learning on Students’ Learning Outcome and Self-efficacy in Online Learning Environment”*

B. Research problem:

With the increase accessibility and convenience of online courses, online enrollments have continued to grow at rates far in excess of the total higher education student population (Allen, Seaman, Babson Survey Research, & Sloan, 2010). Although online courses are convenient to adult learners, where they can study anytime, anywhere and accessing rich online resources, cognitive researchers have found that online learning inherently involves more cognitive resources than traditional face-to-face courses. While many studies examined the effect of Cognitive Theory of Multimedia Learning (CTML) design strategies in animations and educational games (Mautone & Mayer, 2001; Mayer & Chandler, 2001; Moreno & Mayer, 2000), there has been little research that has examined the effects of these strategies in the context of online learning environment and its effects on students’ self-efficacy. Therefore, the purpose of this study was to investigate the effect of design online learning environment based on CTML design strategies on students’ learning outcome and perceived self-efficacy.

C. Research procedure

This study used a quasi-experimental, between-subjects design to measure the effect of segmentation and signaling (SS) as independent variables on two dependent variables: (1) knowledge retention and (2) transfer of knowledge. Students’ prior knowledge was included as a covariate. The instructional content used in the present study was an online learning module developed for pre-service teachers focusing on the integration of technology in the classroom and students with special needs. Participants were randomly assigned to groups (SS or non-SS group) using the random selection tool for group membership in Blackboard. The online modules were offered for a week to both groups as extra credit and students were free to opt out of the experiment without penalty at any time.

D. Summary of findings

The most significant finding of this study is that students’ knowledge can indeed benefit from cognitively appropriate design of online courses. This benefit was demonstrated by the

statistically significant differences between the experimental groups on transfer test scores, with higher scores achieved by the treatment group. The treatment group also produced better scores on the retention test; however these differences weren't statistically significant. A possible interpretation for the lack of significance on the retention test measure is that the content used in this study involves low level of interaction between the learning concepts. Consequently, the instruction does not overload students with essential processing needed for understanding and recalling the underlying concepts. This interpretation is consistent with past research showing that the effectiveness of CTML design principles are limited to complex learning unless methods that foster higher-order thinking during problem solving are present (Ward & Sweller, 1990). In situations where the learners were required to apply knowledge in new contexts (knowledge transfer as higher-order thinking indicator), segmentation and signaling helped students assimilate and accommodate new concepts into their existing schema structure and apply these concepts effectively in new situations.

Another significant finding of this study is that students' self-efficacy perception were strongly and positively correlated with their transfer test scores (the higher students' transfer test scores, the more they feel confident in their online learning). A possible interpretation for this result is that segmentation and signaling promote students' cognitive engagement and helped them to interact efficiently with learning content than students in non-SS group (as reflected by the higher transfer scores in SS group) and consequently improve their self-efficacy perception. This interpretation requires assessing whether the improvement in students' perceived self-efficacy is due the students' cognitive engagement. Therefore this hypothesis should be empirically tested.

E. Conclusions and recommendations

The present study is an important contribution to the growing body of research grounded in cognitive theories and based on evidence to improve learning in online environment. Because the online course environment is an essential component of formal and informal education, improving its design can enhance learning in a wide range of contexts and on multiple levels. Furthermore, improving higher-levels of learning such as transfer of knowledge resulting from design manipulation is particularly important as transfer of knowledge is considered by many educators to be the ultimate goal of learning. Furthermore, segmentation and signaling of online learning are important for courses containing conceptually and structurally complex content, especially for learners with little prior knowledge of the domain. Finally, as a result of online course design manipulation and the subsequent improvement of students' learning outcome, there was strong improvement in students' self-efficacy in online learning environment. Increases in students' self-efficacy in online learning may indicate a decrease in the frustration level among online students and could result in a decrease in the dropout rate of online students.