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**A. Research paper entitled** *“Assessing the Effect of Designing Instructional Video Grounded on Cognitive Theory of Multimedia Learning on Students’ Academic Achievement in Online Course”*

**B. Research problem:**

Instructional video is increasingly becoming a key component in face-to-face, hybrid, and online learning environments, however there are a few drawbacks. Long videos or videos that contain complex topics while providing no assistance to students in understanding the content can be problematic. Other issues include videos where students have no control over its pace and they can view the videos only in a sequential, linear, and passive fashion. Additionally, cognitive researchers argue that video requires high levels of cognitive processing to synthesize the visual and auditory streams of information and extract the semantics of the message (Homer, Plass, & Blake, 2008). Therefore, a central problem in using video as an instructional device is how to direct learners’ attention to relevant information and decrease cognitive load (perceived difficulty) by creating conditions for the learners’ cognitive system to meet the processing demands needed to organize and integrate knowledge from a stream of visual and auditory information. Therefore, this study intended to assess the effect of design instructional video based on the Cognitive Theory of Multimedia Learning (CTML), and the correlation between students’ personal preferences (preferred learning styles and area of specialization) and their learning outcomes.

**C. Research procedure**

First, all students randomly assigned to one of the following video conditions: (1) segmented and signaled, (2) segmented without signaling and (3) no segmentation or signaling. The random distribution of participants to each of the video condition was via Blackboard Random Selection tool. Course instructors then emailed the instruction of experiment to their students to explain the purpose and procedure of the module. The e-mail included a brief introduction about the module, the scope of the study and students’ option to participate in the study for extra credit or to opt out. Second, students who agreed to participate in the experiment completed all tasks through the Blackboard adaptive release function (release a task after completing the previous task). Participants completed the module content on their own pace until a “Thank you” message appeared saying “Thank you for participating in this study”.

## **D. Summary of findings**

The main finding of this study is that educational video presented online has the potential to effectively help preservice teachers in online learning environment, but require design manipulations. The results of the present study support previous findings produced in the context of learning from educational animations and hypermedia and provide empirical evidence that validates Cognitive Theory of Multimedia Learning design manipulations of multimedia in several ways. The segmentation and signaling of the online video helped to introduce the TPACK concept to the preservice teachers and improved their learning outcome. Specifically, the preservice teachers' test scores improved when the online TPACK video presented in self-paced, segmented and signaled rather than continuous and non-signaled (Mautone & Mayer, 2001; Mayer & Chandler, 2001). According to cognitive research, segmentation and signaling are appropriate design strategies to help students to process long and complex multimedia learning materials. In this study, results showed that students' learning outcomes indeed benefited from cognitively appropriate design of the TPACK video. This benefit demonstrated by the statistically significant differences in learning outcomes between students in the three video groups, with the highest scores achieved by students in the segmented and signaled video condition and the least was in the no segmentation and no signaling condition. A possible interpretation of this result is that during processing long instructional video, novice learners may have to relate and reconcile too many new concepts presented in visual and auditory format included in the TPACK video. However, students in segmented and signaled condition were easily able to manage sequential segments with time breaks between them and highlighted the main concepts presented in the video. These design manipulations not only improve learning for novice learners for whom the learning concepts are new and lack adequate prior knowledge, but also eliminate a cognitive overload represented in students' perceived difficulty of the TPACK video. These results imply that segmenting and signaling the TPACK video provided cognitive guidance to help novice teachers learning about the TPACK concept.

## **E. Conclusions and recommendations**

The result of this study is consistent with the evidence that segmentation and signaling principles reduce students' perceived difficulty by focusing their attention on important aspects of the learning material, providing concise cues about relevant information, and guiding them to engage in organizing and integrating only the essential information. These cognitive activities contributed to the optimization of learners' cognitive processes during learning and helped reduce students' perception of the learning task's difficulty. However, the self-paced learning environment found equally in all three groups, assists students further to control the video pace for their needs which minimized to certain extend students' perceived difficulty associated with extraneous cognitive load in all groups. Therefore, the perceived difficulty between the three group design was minimized.