Chapter 22
Design and Evaluation of Mobile Learning from the Perspective of Cognitive Load Management

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ABSTRACT

Considering the ubiquitous presence of mobile devices around the globe, designing mobile interfaces into learning systems has quickly become a norm to better disseminate information to the intended audience. Existing design frameworks, however, have not fully addressed the unique features of mobile learning environments grounded in proven pedagogical frameworks. As these mobile environments enable learners to shift their cognitive engagement between virtual and physical settings, this transition from one setting to another presented new challenges to cognitive learning processes due to excessive distractions learners may encounter. With these new challenges in mind, this chapter first reviews design and learning theories grounded in cognitive load management and social learning. Then the chapter proposes a preliminary mobile learning design framework to augment existing design thinking and practice.

INTRODUCTION

The advancement of mobile learning technologies have provided abundant opportunities for learners around the world to identify, search, retrieve, apply, evaluate, and synthesize information "on the go." Learning, to a large extent, will be transformed into multiple "anytime and anywhere" events that can be fully controlled by the learners. In other words, temporal as well as spatial constraints will no longer be relevant for the learning processes to oc-

cur. Earlier research has embraced this seemingly boundary-less framework for mobile learning.

Recent studies on mobile learning further demonstrated diverse interests by covering topics related to gender difference, game-based learning, user-centered human-computer interface in mobile contexts, design recommendations for small screens, and applying Android apps in formal education settings. While all these examples largely illustrate the diversity of mobile learning in various learning contexts, the majority of mo-

bile learning studies to date rarely address issues related to learners' cognitive processing that are vulnerable to many extraneous stimuli from both virtual as well as physical environments. Consequently several challenges have emerged that discount the potential impact of mobile learning that could permeates through conventional educational boundaries in our societies.

To address the aforementioned concern, this chapter intends to first identify the strengths and weaknesses inherent with mobile learning grounded in a review of recent scholarly work with a specific grounding in Cognitive Load Theory. Second, the chapter will identify the emerging challenges that could impede a ubiquitous integration of mobile learning across educational levels that are mostly bounded by techno-centric perspectives as opposed to sound pedagogical rationales anchored in cognitive learning processing. Finally the chapter will propose a design framework to address the lack of emphasis on cognitive processing in mobile learning environments.

BACKGROUND

The Mobility of Learning

Most of mobile apps focusing on learning are designed only for delivering information and tracking activities according to a review by Libman and Huang (2013) in the context of science education. These applications have not fully adopted the "mobility of learning" that enables learners to simultaneously consume content, compute data, capture surrounding environments, and communicate with peers in order to optimize the intended learning experience (Wagner, 2008).

The advancement of mobile learning technologies has provided abundant opportunities for learners to identify, search, retrieve, apply, evaluate, and synthesize information "on the go" (Traxler, 2007; Wagner, 2008). Learning via mobile learing environments has been transformed into multiple "anytime and anywhere" events that can be fully

controlled by the learners. Temporal and spatial constraints are no longer relevant for the learning processes to occur (Huang, Li, & Lin, 2013). For example, Chen, Kao, and Sheu (2003) developed a mobile learning system hosted by PDAs for natural science courses in an elementary school. The authors favored the application of mobile learning with respect to its abilities to address immediate learning needs, deliver instructional information on demand, and situate instructional activities in authentic settings. In math learning, Peng and Chou (2007) developed the Mobile Computer Supported Cognitive Tool for middle schoolers. Participants used the mobile cognitive support tool for research tasks, problem-solving, and decision-making.

Recent mobile learning studies further demonstrated diverse interests by covering topics related to gender difference (Wang, Wu, & Wang, 2009), game-based learning (Huizenga, Admiraal, Akkerman, & ten Dam, 2009), user-centered human-computer interface in mobile contexts (Hollender, Hofmann, Deneke, & Schmitz, 2010), design recommendations for small screens (Churchill, 2011), and applying Android apps in formal education settings (Hsu, Rice, & Dawley, 2012). While all these examples largely illustrate the diverse applications of mobile learning, the majority of mobile learning studies are limited by two issues. First, learning engagement remains a secondary concern. Traxler (2007) asserted that the mobility of learning could be best manifested in engaging with learners in various contexts. By reviewing 164 peer-reviewed studies published between 2003 and 2010, however, Wu and colleagues (2012) concluded that current mobile learning studies mostly focus on the development aspects of mobile learning systems. Merely focusing on learning development effectiveness is insufficient to understand the true impact of mobile learning. Learning engagement must be considered as well to ensure meaningful interactions between learners and the technology-enabled learning environments (Keller, 2008). Second, practices overshadow theory building. Frohberg, Göth,

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