Chapter 72
Using Technology in a Studio Approach to Learning:
Results of a Five Year Study of an Innovative Mobile Teaching Tool

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ABSTRACT

Presented in this chapter are findings related to the use of the Mobile Studio concept in STEM classes including how the use of an innovative technology that replaced traditional equipment in STEM classes was able to increase student learning. Findings also show that the Mobile Studio Learning Platform supports variations in instructional style and goals as well as learning across different content areas and type of implementation. Use of the Mobile Studio was piloted and implemented in multiple undergraduate engineering courses; the pedagogy expanded beyond this original setting to include use in K-14 sites as well as pre-service and in-service training for science teachers. Data from multiple sources are presented in support of the finding that diverse learners with various instructional needs and user characteristics are positively served by the use of student-centered mobile technology within the domain of STEM education.

INTRODUCTION

Learning and teaching in the 21st century requires the use of new strategies to engage students and promote enhanced learning opportunities, particularly in areas important to success for the future. This is especially true in the STEM area (Science, Technology, Engineering, Math) (Brown, Hansen-Brown, & Conte, 2011). Students of the 21st century are diverse in nature; they are multi-cultural, come to education with different experiential backgrounds, and generally, have had technology as a central component of their upbringing from computers to cell phones to multimedia players and beyond. In addition, we now know that to succeed in an increasingly competitive workforce,

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the incorporation of technology into education is no longer thought of as an option, but a necessity (Earle, 2002). Because of these factors, a major focus of educational technology development and research has been the development of effective ways to teach students of the 21st century using evidence-based practices supported by technology integration.

The purpose of this chapter is to present findings summarizing five years of student data gathered from a program that developed, implemented, and replicated an integrated hand-held mobile technology device into STEM education. The chapter includes information on how multiple instructors who used the approach over multiple semesters in multiple courses increased and changed their use, strengthening student learning. In addition, using data obtained from cross section assessment for one course over several terms, results show how the Mobile Studio Learning Platform impacted student cognitive outcomes.

BACKGROUND

Constructivist-based and constructionist-based instruction, both supportive of discovery learning, have been shown to be effective ways of helping students to obtain and retain new concepts and skills (Clinton & Rieber, 2010; Piaget & Inhelder, 1955; Vygotsky, 1978). These forms of instruction allow the learner to explore and tryout new concepts in relation to what they already understand, using trial and error to develop or strengthen understanding. Constructivist theory indicates that inquiry learning, rooted in guided teaching, enables learners to understand complex material through their own experiences (Powell & Kalina, 2009). Inquiry learning can be taught through active experimentation and real world experience; both have been noted as beneficial for knowledge building, and are the main tenets of constructionism (Kafai & Resnick, 1996). Romiszowski (2009) explained the specific benefits for active knowledge building in terms of retention, "Retention of a complex task … and mastery of new skills, is based on the execution of authentic and learner-relevant tasks, learned through exploratory practice followed by expository review" (p. 218). Research has shown that technology can play an active role in assisting instructors in providing constructivist and constructionist instruction and guided learning (Akhras & Self, 2000; Cheng, 2006; Newman & Gullie, 2009). Through the use of Web-based tools as well as local technology, students' learning can be scaffolded to meet both individual and group needs and can be tied to hands-on, real life experiences, data sets, and simulated outcomes (Newman, Reinhard, & Clure, 2007). Rodd and Newman (2009) have reported positive outcomes related to the use of technology in STEM education; students who had access to technology supported, technology guided, and technology reinforced learning had more positive attitudes toward learning the content, greater retention of direct content, and greater transfer to other areas.

Despite these findings, a major barrier still exists within the applied science and engineering fields (Jonassen, Strobel, & Lee, 2006). Web-based practices do not allow students the hands-on tactile practice that is needed to stimulate constructionist learning of applied knowledge and the real equipment is generally available only in expensive, controlled lab settings. To address this barrier, the Mobile Studio concept was developed, designed, and implemented under National Science Foundation funding[1]. The key objective of the Mobile Studio concept is to provide an affordable technology that can be used anytime and anywhere to implement student-centered laboratory experimentation thus vastly increasing the amount of real life, hands-on experience to which a student can be exposed, providing students more freedom than site-based labs which are limited by time and space. In the pilot, an Input/Output circuit board (I/O board) was developed that can be plugged in to students' individual laptops; the measurement

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