2013

Mobile Teaching and Learning in the Classroom and Online: Case Studies in K-12

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Published as:
Grant, M.M. & Barbour, M.K. (2013). Mobile teaching and learning in the classroom and online: Case studies in K-12. In Z. Berge & L. Muilenburg (Eds.), Handbook of mobile learning (pp. 285-292). New York, NY: Routledge.

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Abstract
In this chapter, we describe two projects to integrate mobile teaching and learning into K-12 schooling. First, we consider the rationale for increased use of mobile devices with today's students, and we describe a professional development program to deploy iPads to classroom teachers. Next, we discuss the growth of K-12 online learning, and we describe a project for students enrolled in an online Advanced Placement course was delivered through a mobile learning content management system. Lastly, we discuss some of the lessons learned from these pilot projects and some of the promise and challenges of mobile teaching and learning.

KEYWORDS: mobile learning, m-learning, K-12 schools, K-12 teachers, teacher professional development, virtual schooling, cyber schooling, iPads, cell phones, smart phones, apps

Introduction

There has been a push to introduce technology into K-12 classrooms since the 1980s. This has included the implementation of online learning and, most recently, the potential of teaching and learning with mobile computing devices. Mobile devices are becoming increasingly ubiquitous in society, particularly with youth. Recent survey research indicates that overall, 75% of American teens own cell phones, with 58% of 12-year-olds owning cell phones to 83% of 17-year-olds owning cell phones (Lenheart, Ling, Campbell, Purcell, 2010). Around the world, the numbers are just as remarkable (see e.g., GSM Association & the Mobile Society Research Institute, 2010).

In addition to this market penetration, "cell phones are not just about calling or texting — with expanding functionality, phones have become multimedia recording devices and pocket-sized Internet connected computers" (Lenhart, 2010, p. 5). Yet that same research indicated, "most schools treat the phone as a disruptive force that must be managed and often excluded from the school and the classroom" (Lenhart, 2010, p. 4).

Even in its infancy, m-learning projects have begun to proliferate in educational environments. For example, publisher Houghton Mifflin Harcourt has created interactive curriculum apps for algebra and geometry, while K-12 online learning programs such as the Florida Virtual School and K12, Inc. have created mobile apps to accompany their virtual school offerings. Similar mobile campaigns have also occurred on college campuses.

In this chapter, we will briefly describe a series of projects designed to integrate mobile teaching and learning into K-12 schooling. In the first section, we outline the perceived rationale for increased use of mobile devices with today's K-12 students, and we will describe a professional development project to deploy iPads to classroom teachers in the science department at a suburban high school. Next, we will discuss the growth of K-12 online learning in the United States, and we describe a second project where the course content for students enrolled in an online Advanced Placement (AP) European History course was delivered through a mobile learning content management system (mLCMS). This is followed by a discussion of some of the lessons learned from these

limited pilot projects and some of the promise and challenges of mobile teaching and learning.

M-Learning in K-12

The notion that today's students are different than previous generations has become a common one, both in the popular media and within more academic literature. Labels such as the "net generation" (Tapscott, 1998), "digital natives" (Prensky, 2001), and "millennials" (Rainer & Rainer, 2011) suggest that today's youth have grown up surrounded by digital technology since birth and that has influenced how they live, work, play, and learn. Over the past two to three decades these perceptions, along with a general belief in the power of technology to improve learning, have driven the purchase of technology to be placed in K-12 schools at a phenomenal rate. It is this belief that today's students are digitally savvy, as well as digitally immersive, that has prompted some schools to consider integrating mobile computing devices through school implementations or bring-your-own-device (BYOD) programs.

Until now, tthe adoption of m-learning and mobile devices in K-12 schools has been slow. One of the reasons for this lack of adoption is the fact that mobile devices are banned in many schools (Katz, 2005; Lenhart, 2010). As a potentially disruptive, non-educational device, many school and district administrators see the potential problems that cell phones and smart phones can cause in a classroom; and these potential problems have overshadowed their views on the promise these devices may have as educational tools. Further, there are reasonable concerns over the cost associated with many of these devices (and their associated data plans), along with the coverage provided by cellular companies (particularly in rural jurisdictions). Moreover, some school districts are admittedly reticent to implementing BYOD programs due to regulations associated with the Internet and the protection of children (see Nair, 2006), because smart phones and cell phones may use a cellular network bypassing the school's network altogether.

Project 1: Science Teacher iPad Deployment

The first project entitled "Professional Development for Mobile Technology Integration" was funded by a small grant from the Michigan Association for Computer Users in Learning. The goal of this project was to provide professional development and on-going support to four secondary school science teachers on using the iPad as a tool for technology integration. Research has shown that there is an increase in teacher learning from professional development when teachers take ownership of that professional development (Loucks-Horsley, Love, Stiles, Mundry, & Hewson, 2009). As such, the focus of the professional development was based upon the teachers' specific interests related to using the iPad. In addition, research has shown there is a higher level of transfer in professional development initiatives when on-going support is provided to the teacher following the initial training (Desimone, Porter, Garet, Yoon, & Birman, 2002; DuFour, Eaker, & DuFour, 2005; Heck, Banilower, Weiss, & Rosenberg, 2008). As such, the provision of support after each professional development was planned to increase the level of effective use of the iPad as a tool for technology integration by the teachers in this project.

The initial professional development session was designed to introduce the teachers to using the iPad, setting up their devices and iTunes accounts, and providing a initial orientation to some science-related applications (apps) that had been preloaded on their devices (e.g., *3D CellStain*, *Molecules*, *Rocks*, *WTunnel Lite*, *Video Physics*, *Science@VL*, several periodic table apps, etc.). The subsequent professional development sessions would begin with each of the teachers describing how they had used the iPad over the past month, and then do a show-and-tell of any new apps that they may have found. This was followed by an illustration from the researcher of how the iPad, or mobile devices in general, could be used in the classroom, as well as providing an orientation to any new science-related apps the researcher had discovered.

Most of the teachers used the iPads primarily as a personal learning tool. This meant that the professional development sessions were largely focused on the potential of the devices and not necessarily how these teachers were actually using it (or planned to use it during the life of the project). Beyond using it for their own learning, several teachers also used it as a teacher resource or supplemental tool for explaining concepts to students in the classroom. For example, a couple of teachers made regular use of one of the periodic table apps (e.g., Memorex, AMC, EMD, etc.) as a reference when students had specific questions beyond the information contained on their paper copies of the table. The teachers felt each of these apps offered something a little different for the students.

Interestingly though, while all of the teachers felt that the iPad was a potentially powerful pedagogical tool, only one of the four teachers felt confident enough with the device to attempt using it with his students. In this single instance, the teacher pooled together approximately a dozen iPads from colleagues in the school and also encouraged students to bring in their own devices. He began the lesson by having the students complete a quiz on their mobile device using the mLCMS *Mobl21*. This

was followed by the teacher demonstrating a particular chemistry concept using a 99-cent app from his own iPad (i.e., *QR Reference*) and a document camera to project his screen to the class. After the demonstration, the students completed a set of activities using two free apps that had been preloaded on the iPads or that the students had been asked to download to their own devices (i.e., *3D Cell* and *VCell*). The lesson concluded with the students completing a second quiz using *Mobl21*. Both the teachers and the students felt that this single mobile integration activity was quite successful, as the students were engaged and the teacher was able to integrate several different mobile learning activities into that single lesson.

Among the teachers, including the one who attempted the mobile technology integration lesson, they felt the potential use of the iPad as a classroom device was limited at present. Teachers expressed concern about the student care with the devices. They felt that students would see and treat the iPad more as mobile devices to be handled with less care, as opposed to laptops or netbooks that were generally respected as a "computer." Teachers were also concerned about the cost of the iPad. As a singe device, it was approximately the same cost as the purchase of two netbooks. Granted, the teachers did not consider other tablet devices that were cheaper in price than the iPads used in this pilot. However, the largest concern about the potential use of these devices was ensuring a one-to-one student-to-device ratio. All of the teachers felt that without this student-to-device ratio, the potential of the device in the classroom was severely limited.

M-Learning with K-12 Online Learning

One example of technology in education that has grown substantially over the past two decades, and somewhat successfully, is the use of K-12 online learning (also called virtual schooling or cyber schooling). To date, few K-12 online learning programs have ventured into m-learning. For example, the Florida Virtual School (FLVS) was the first to introduce m-learning apps to their suite of tools with the creation of the Revu4U app. Revu4U was designed to assist students with test preparations by providing multiple-choice questions in Algebra Readiness, AP Microeconomics, AP Psychology, AP Language, and AP Literature. Since they have teamed with developer GWhiz to create a series of meStudying apps. These apps, which include Algebra 1, Reading for College Success, AP Language, AP Art History, and AP Psychology, generally provide students with a minimal amount of text, visual, and audio instructional content, and then provide students with significant amounts of test preparation. Finally, FLVS has been working with Emantras and Pearson Education to begin the process of converting some of their existing online courses to a truly mobile format.

Similarly, K12, Inc. has created a number of m-learning applications that can be used as a part of their online learning although the K12, Inc. apps are more focused on the elementary and middle school population. For example, *Counting Coins* and *Counting Bills & Coins* are two apps designed to teach elementary students mathematics skills using money. Similarly, K12, Inc. has also released two *What's Sid Thinking* apps for middle school students, which are memory games designed to help students memorize the 50 US states, facts about the Presidents, various land animals and objects in the solar system. K12, Inc. also has an app that focuses upon Algebra I, and like the FLVS, it provides minimal review and significant test preparation. K12, Inc.'s collection of apps — for both Apple iOS and Google's Android environments —is the most extensive of any K-12 online learning program.

There are other K-12 online learning programs that have created their own m-learning apps (e.g., the Virtual Community School of Ohio has created an app that allows parents/guardians to monitor their child's grades and attendance); and many others that use m-learning apps as a part of their instructional model. There are many more K-12 online learning programs that leverage the m-learning apps created by various LMS companies to delivery their content to mobile devices. For example, a teacher in Tennessee collaborated with the Hamilton County Virtual School to produce course content inside Mobl21 (see Meehan, 2010). However, beyond these individual efforts described above there has been little success by K-12 online learning programs to pursue m-learning in systematic ways.

M-learning has the potential to change K-12 online learning in significant and rapid ways, as applications are specifically developed to deliver content to mobile devices. At present, the majority of apps available for m-learning are those developed by Blackboard, Desire2Learn, and other course or learning management systems — and many of these apps simply convert web-based or online content to be viewable on a mobile device.

Project 2: Virtual Schooling and mLCMS

The purpose of the study was to explore the use of mobile learning in a virtual school environment, specifically to gauge student perceptions and usage of the Mobl21 app and m-learning in general. Students in an AP European History course, offered by a statewide, supplemental K-12 online learning in the American mid-west, completed two of their 26 content units (i.e.,

approximately four weeks) using the Mobl21 app. The remainder of the course was delivered using Desire2Learn. The 11 students enrolled in this course were in grades 10 through 12, and lived primarily in rural areas. As with most supplemental online learning experiences, the students were provided with a slot in their daily school schedule for their online course and a space in their school with computer access to engage in their online course.

While the students were generally favorable towards the concept of m-learning, they indicated their experience with this particular project was somewhat negative. The content delivered through the Mobl21 app represented less than 10% of their overall course and occurred at the beginning of the second semester. The students had already become comfortable with the other tools inside Desire2Learn's course management system. It was also interesting to note that of the 11 students who participated in this project, only one of the students actually used the Mobl21 app from a mobile device. The remaining ten students used the desktop client on their school computer. When asked why they did not use their mobile devices, they stated that either their mobile device was not a smart phone (i.e., their phone did not support apps), the cost of data plans was so high they chose to limit their data usage, or they simply did not have a data plan on their mobile device.

In addition, the case here followed a more direct instruction model, which admittedly was reinforced by the Mobl21 application. So, there were not opportunities for students to create artifacts or representations of their knowledge (see e.g., Grant & Branch, 2005; Grant, 2011) nor were there opportunities to leverage other social media that may have encouraged informal learning.

Lessons Learned from Both Projects

Computing in the twenty-first century is becoming more powerful, and it continues to become available in more portable devices. While both of the projects described in this chapter were limited pilot studies with very small samples, there are some general lessons that can be taken from these projects; as well as trends that should be explored in the future.

Tablets, such as the iPad, are the first series of devices that provide the processing potential (and screen size) of a netbook, but the portability of a mobile device. Since the launch of the iPad, a number of other tablet computers have been deployed with Google's Android operating system, including Amazon's Kindle Fire and Samsung's Galaxy. Data from the iPad deployment with the science teachers indicated that the teachers believed the device could have many potential classroom uses. However, these teachers also felt extremely limited in their ability to use the device in the classroom by only having one iPad per teacher, as opposed to one device per student. Further, while the teachers used their iPads extensively as a personal and professional development tool, in a very pragmatic way they also believed the expense of providing enough tablets for each student was a luxury that schools simply couldn't afford. The teachers' alternative perspectives tempered enthusiasm for what was possible, with what was practical for these students.

A number of schools across the US are piloting tablet computers and ereaders as viable alternatives to print textbooks (see e.g., Ferlander, 2012; Gleason, 2012; Hu, 2011). In addition, most recently, the Partnership for the Assessment of Readiness for College and Careers (PARCC assessment) accompanying the Common Core State Standards for Math and Language Arts announced that it would be compatible with iPads and Android devices (see http://www.parcconline.org/technology). So schools have added incentive to consider these devices.

At present there has been little focus by K-12 online learning on developing m-learning as a part of what is already a technologically innovative course delivery model. In fact, the only systematic efforts to develop substantial mobile learning initiatives have been by FLVS and K12, Inc. However, the apps developed by these programs have been limited to knowledge and comprehensive review activities and test preparation. Yet, the process of turning these learning opportunities into smaller, more modularized segments that are suitable for mobile devices could assist in the process of providing a personalized learning experience. This personalized learning, particularly if it is based on a repository of learning objects that can be drawn upon based on individual student needs, could allow for K-12 education to truly be any time, any place, any pace.

Given the proliferation of mobile devices among today's youth, data driven information focused on how students perceive learning through these devices is important. However, there are still many geographic locations in North America where mobile access is limited or data plans are simply too expensive for mobile learning to be both possible and cost efficient. It is worth noting that many students engaged in K-12 online learning — particularly those engaged in supplemental K-12 online learning (such as the students included in the mLCMS project) — are located in rural areas where cellular networks are unavailable or limited and the cost is prohibitive for these students. Additionally, many of the mLCMS apps that are currently available do not provide all of the same features or ease of use as the web-based LMS programs. This makes students less inclined to use the mobile versions after becoming comfortable with the

web-based environment. This period of development provides both researchers and practitioners the opportunity to experiment on a small scale with this form of learning will provide lessons that can be applied when mobile access becomes more complete.

Finally, students may need to overcome the stereotype of "a time for learning" to take full advantage of m-learning and mobile computing devices. For example, in the case of the online learning students, only one of the students actually used a mobile device to complete the unit. While some students reported they did not have a smart phone or data plan to take advantage of the unit, it is also probable that when we dedicate specific time and place to learning, such as the case here, it may be more desirable for students to choose to use a larger screen and not be mobile. We have found similar reports from graduate students in other research. This certainly runs counter to more opportunistic definitions of m-learning (e.g., Crompton, Muilenburg, & Berge in Chapter 1; Quinn, 2000).

Conclusions and Recommendations

Because of the increased availability of mobile computing devices, we are now seeing schools encouraging students to bring in their personal mobile computing devices (e.g., BYOD), as well as use school owned devices in both K-12 and higher education. The increased availability of mobile computing devices "enables a transition from the occasional, supplemental use of classroom computers and school computer labs to the frequent, integral use of portable computational devices" (Swan, van't Hooft, Kratcoski & Unger, 2005, p. 100). Yet we caution those who assume or believe that these devices have become ubiquitous. As we saw with the K-12 online learners, there are many youth who do not have access to these devices or who choose not to use their devices to the fullest extent because of barriers such as cellular coverage or data plan rates.

Mobile devices do not guarantee their potential or use. Liu, Han, and Li (2010) are explicit in their reminders that adoptions or ownerships of mobile devices will not assure that devices meet their potential for formal and informal learning. In our present cases, K-12 student chose to access curricular content designed for mobile computing devices on computers and student may possibly dedicate time to studies preferring a larger screen and dedicated computer.

Finally, adoption of mobile computing devices does not guarantee m-learning. For example, some K-12 schools are experimenting with classroom sets of mobile devices, where the teacher determines when the devices will be used and the students are unable to take the devices home or use them with autonomy (e.g., Grant et al., forthcoming). Similar challenges existed in one of the K-12 projects described above, with the inability of teachers to envision ways to use the mobile devices without having a one-to-one environment but at the same time questioning the expenditure necessary to provide one mobile device per student. While we are not critiquing the value of using the mobile devices, we are highlighting that this use does not reflect Crompton, Muilenburg, and Berge definition of mobile learning presented in Chapter 1, where learning occurs across multiple contexts. Indeed, m-learning may not work in all contexts, contents, or with all learners.

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