M-Learning: Promises, Perils, and Challenges for K-12 Education

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With cell phone ownership expanding to more students at younger ages, the prospect of leveraging these devices for learning is generating considerable discussion and debate among educators. Some argue that mobile learning is the next stage in technology-enhanced learning, and that the devices are much more promising compared to the desktop or laptop computer. Avid proponents predict that every K-12 student in the United States will be using a mobile learning device within five years (Norris & Soloway, 2010). Others are skeptical, wondering whether the excitement is more hype for unproven strategies and expensive gadgets that will not make any fundamental impact. Skeptics also point to the drawbacks of cell phones in schools, where policies often prohibit or severely restrict cell phone use.

Sorting out the promises and perils for m-learning is itself a challenge because research in this area is limited and the technology’s capabilities are changing rapidly. Nevertheless, the potential for mobile devices to make substantial contributions to education is high. Evidence-based knowledge about how to use computers effectively, drawn from research in education, psychology, communications, neuroscience, engineering, and other disciplines, will help us avoid past missteps. For this discussion, the focus is mainly on the mobile phone. While MP3 players and other handheld devices can certainly contribute to m-learning, the mobile phone offers more versatility and convergence.

Patterns of Ownership and Use
Studies that explore how youth are adopting mobile technologies confirm the explosive growth in cell phone ownership among pre-collegiate students. They also show shifts in the way students use their phones. A major 2009 study of teens in the United States, age 12 to 17, found that 75% owned a cell phone, a dramatic increase from the 45% who reported cell phone ownership in 2004 (Lenhart, Ling, Campbell, & Purcell, 2010). Texting has emerged as the preferred mode of communication, and 2/3 of the sample said they would be more likely to text friends than to call them. The sheer volume of texting is remarkable. About 1/3 said they send more than 100 text messages a day. Girls, in particular, use text messaging heavily. Depending on the cell phone's capabilities, young people also use them for taking pictures, playing music, playing games, recording and watching videos, accessing the web, and retrieving email.

Students with high academic abilities show similar patterns of ownership and use, with even higher rates of ownership. Almost 2/3 of students age 10 to 12 reported having a cell phone, a figure that leaps to over 90% for students age 14 to 17 (Wallace, 2011).

**Psychological Attachment to Cell Phones**

Many young people are developing strong psychological involvement with their mobile phones, almost as a personal companion. Comments such as “my cell phone is part of me,” or “I couldn’t live without my mobile phone,” along with the continuing personalization of the phone with special ringtones and wallpaper, suggest an attachment that goes beyond any relationships to other technologies. For instance, they perceive many psychological benefits, such as heightened social inclusion and connectedness (Matthews, 2004; Wei & Lo, 2006), and feelings of safety and security (Carroll, Howard, Peck, & Murphy, 2002). Those with the latest phone or most advanced features believe that their status with their peer group is enhanced (Ozcan & Kocak, 2003). Researchers studying Australian youth found that those who were most involved with their phone tended to tie it to their self identity, and that being a mobile phone user is an important part of who they are. (Walsh, White, Cox, & Young, 2011).

The power of the personalized ring tone also points to the growing
attachment young people develop to their phones. Subjects listened to various tones used to alert cell phone owners to an incoming text message, one of which was the tone the subject used on his or her own phone. Their neural activity increased when they heard their own ring tone, and the heightened response began just 40 milliseconds after the tone started (Roye, Schröger, Jacobsen, & Gruber, 2010). The customized ring tone is becoming a personally significant sound that affects brain activity and selective attention.

The Promising Potential of M-Learning

Why do so many educators think that m-learning has tremendous promise? Three important drivers include:

- Widespread adoption
- Ubiquitous access
- Support for individualized, multi-modal learning

Widespread Adoption

Widespread adoption is driven especially by parents who want their children to carry a phone for safety reasons. In fact, parents often object to school policies that ban cell phones, staging rallies and threatening lawsuits.

Adoption is also supported by the lower costs of a cell phone compared to a desktop or laptop computer. Unlike computers, where socioeconomic factors created a wide digital divide that hindered access, cell phones are more affordable and may narrow the divide. Teens from low-income homes where a computer may not be present are more likely to use their phones to access the internet. For example, 41% of teens living in homes with less than $30,000 annual income use their cell phones to go online. Also, black and Hispanic teens are more likely to use their cell phones to go online compared to white teens (Lenhart, et al., 2010). The lower cost of cell phones also makes it easier for educators to start pilot projects in which the school purchases the mobile devices and loans them to students.

Ubiquitous Access and Spaced Learning
Ubiquitous access is a critical element for m-learning that may offer very substantial benefits for education. The device is small and light enough to be carried all the time, even by elementary children who would have difficulty carrying a laptop in a backpack. The personal attachment factor, particularly for teens, may boost students' interest in using it for learning. In any case, students will rarely forget to bring their cell phones with them.

The small, always-on, and always available cell phone can be also leverage time slots that could not easily be used for learning before. On the bus or playground, for instance, where laptops are awkward, students can easily access applications on a cell phone. Because there is no boot-up delay, people can use a cell phone during “micro time slots,” such as while waiting in line or walking to class (Jones & Wallace, 2007).

One reason the use of these new time slots may benefit learning is that they support spaced learning. Studies of Japanese college students, for instance, find that learning gains for vocabulary are greater when students receive regular emails via mobile phone, compared to those who access the vocabulary lessons on the Web via the PC ((Thornton & Houser, 2005). In a study of Taiwanese students attempting to learn English, students were randomly assigned to receive their vocabulary lessons as text messages on their mobile phones, or on paper. Post-test scores for the group using mobile phones were significantly better (Lu, 2008). Although the groups showed no differences when tested again in three weeks, an analysis of the actual cases suggested that those who used their cell phone infrequently, and thus did not benefit from spaced learning, were more likely to forget the vocabulary.

**Support for Individualized, Multi-Modal Learning**

The cell phone can offer support for individualized learning, much like web-based applications designed for laptops or desktops. But because of their special features, from cameras and camcorders to GPS capabilities, they can be used in innovative ways, both in the classroom and outside of it.

Consider, for example, a “mobilized” lesson for elementary students studying prepositions (Looi et al., 2009). The lesson begins with the teacher introducing six new prepositions, including on, over, under, and below.
Working in groups of three, the students next go outside to take photos that illustrate the spatial relationships. Some groups find scenes that easily fit the task, and others improvise a scene themselves -- holding a hand over a classmate's head, for instance. The children return with their photos and the teacher displays them to the whole class by linking each group's device to the projector. They also use their devices to create sentences with the prepositions, complete fill-in the blanks, and draw pictures to illustrate their work. The mobile phone's versatility combined with imaginative lesson design and thoughtful use of authentic, multi-modal learning strategies, create a powerful and memorable learning experience.

**The Challenges of M-Learning**

Like any new technology, mobile phones present difficult challenges for educators, but these are not always the ones we expect. For example, many thought the explosion of texting might hinder literacy development, as children substitute clever abbreviations to speed typing. “Textisms,” such as CUL8R (see you later) or u (you) are examples. However, research suggests that texting does not negatively impact literacy development, and in fact may even improve it. Textism use is positively related to some literacy skills, especially spelling (Wood, Jackson, Hart, Plester, & L.Wilde, 2011). One plausible explanation is that phonetic textisms, such as GR8 (great), tend to increase a child's phonological awareness (Plester, Wood, & Joshi, 2009).

Nevertheless, school administrators have reasons to be concerned about mobile phones. Some key areas that must be addressed to reap any benefits from m-learning include:

- Technical Challenges
- Usability and Accessibility Issues
- Multitasking, Distractions, and Inappropriate Use

**Technical Challenges**

Developing effective m-learning applications is challenging from a technical point of view for a number of reasons. First, unlike computer operating systems, where Windows dominates and Mac and Linux have small market
shares, cell phone operating systems vary considerably. The field is very competitive, and major players include Apple’s iPhone, Google’s Android, Blackberry, Palm, Windows Mobile, and Symbian. This diversity means that developers who want to create an m-learning “app” must make difficult choices. To some extent, they play smartphone roulette when they choose just one platform, and some will probably become extinct. But creating multiple versions is costly. Developers may choose to bypass this dilemma, and instead develop mobile friendly web sites.

M-learning is also an unwitting player in some industry battles, notably one between Apple and Adobe. Adobe owns the Flash platform, which is widely used by educators to create interactive learning applications and videos. But Apple has refused to allow iPhones and iPads to run the Flash player, citing security concerns. Though the two industry giants may resolve this issue, it leaves m-learning application developers in a quandary about which development tools to use.

Another challenge involves the cellular network itself, which carries most of the data traffic for mobile phones. While these networks continue to expand capacity, rapid growth in traffic, caused by video downloads and other bandwidth hogs, creates bottlenecks that can be very frustrating for users. To better manage their networks and control traffic, some carriers are eliminating their unlimited data plans, or throttling download speeds for customers who exceed monthly limits. This shift introduces more uncertainty about the monthly costs of m-learning. It will likely trigger debates about who should pay the bill when students use their devices 24/7 for entertainment and personal use, and not just m-learning. Many smartphones can also access the internet via wifi access points, so schools that already offer wifi may want students to connect that way when they are on campus.

**Usability Issues**

The tiny screen size, miniscule QWERTY keyboards, and the 12 button numeric keypads, combine to make usability one of the key challenges for m-learning. Engineers are developing frameworks for evaluating usability on these devices, drawing on common tasks that users will likely want to
accomplish (Heo, Ham, Park, Song, & Yoon, 2009; Seong, 2006). Navigating the menu, opening applications, and entering text are examples. Users want common tasks to be intuitive and easily accomplished without having to read technical manuals. Students will have little patience with cumbersome user interfaces for m-learning applications.

Drawing on progress in usability for e-learning applications -- those that are designed to be presented on a computer -- will also be helpful. Much has been learned about features that help make an e-learning environment successful, and also how to test their usability with students.

**Distractions, Multitasking, and Inappropriate Use**

A major reason that so many schools chose to prohibit cell phones on campus is that they present a distraction to students, and interfere with both classroom time and study time. A ringing cell phone does indeed impair academic performance. In one study, students were asked to view an educational video, take notes, and take a short quiz afterwards. Randomly assigned students whose video viewing was interrupted by a ringing cell phone in the backpack of another person in the room performed significantly worse on the quiz compared to students who did not experience that distraction (End, Worthman, Mathews, & Wetterau, 2010).

Multitasking is also a concern. Research indicates that attempting to attend to more than one task at a time, or trying to process multiple sensory inputs simultaneously, are challenges for human cognition (Marois & Ivanoff, 2005). Yet young people report considerable multitasking involving media, such as listening to music while doing homework, or sending/receiving text messages while studying (Roberts, Foehr, & Rideout, 2005). Heavy multitaskers actually perform worse when trying to switch tasks compared to those who do not often multitask, apparently because they are less able to filter out irrelevant stimuli (Ophir, Nass, & Wagner, 2009). About 60% of a sample of academically able students agree or strongly agree that “Doing more than one thing at a time is faster,” suggesting they are unconvinced by the research (Wallace, 2011).

Inappropriate use of cell phones in educational settings includes
cyberbullying, a form of social aggression that can be enormously damaging. Students may capture embarrassing videos or photos of classmates, and post them online. They may also harass a classmate via text messaging. Even without malicious intent, people become disinhibited when they communicate using text-based media channels, and their messages are more perceived as more abrupt or aggressive than they intended (Wallace, 1999). Other kinds of cell phone use of concern to educators include access to inappropriate web sites outside the control of the school’s filtering software, and also excessive texting.

**Forging Ahead**

The discussion of promises, perils and challenges points to measures that educators can take as m-learning develops to avoid the landmines this technology presents. Major pilots are already underway in the United States and other countries (Koszalka & Ntloedibe-Kuswani, 2010). Haverstraw Middle School in Garnerville, NY, for instance, turned to m-learning, partly because the cost of electrical and network upgrades for their 80 year old buildings was prohibitive. The smartphones they distributed to students and teachers rely on cellular networks, so students and teachers could use them to access the internet wirelessly (Tomko, 2010).

Schools in St. Marys City, Ohio, also purchase and distribute mobile devices to students and teachers. Though this approach has higher start up costs, it ensures a standard platform for all students and simplifies training and support. It also provides internet access to students who otherwise wouldn’t have it outside of school. Parents and students sign a usage agreement that clarifies their responsibilities, and teachers receive training on how to “mobilize” their lessons. Results so far are encouraging, with students more engaged in learning, teachers better equipped to differentiate lessons and meet individual learners’ needs (Menchhofer, 2010; Norris et al., 2010).

Some educators argue that computers are overhyped and underused, and that providing laptops to each student is pointless unless teachers can creatively leverage their rich, interactive capabilities for learning in new ways. This critique may also apply to mobile learning if applications focus mainly on drill and practice or static text. Yet e-learning has taken off.
Students are already using mobile devices to access their online courses, now widely available to K-12 students (Means, Toyama, Murphy, Bakia, & Jones, 2009; Olszewski-Kubilius & Lee, 2004; Wallace, 2009).

At the Johns Hopkins Center for Talented Youth, students enrolled in the CTY Online program can access their course materials through mobile devices. These courses feature videos, interactive exercises, quizzes, discussions, blogs, and other features, most of which work reasonably well for mobile users. Figure 1 shows a video of a critical reading course for elementary students, using the Motorola Android phone, the Flash-based interactive glossary word game is accessible, including sound effects.

**Figure 1:** Quests and Challenges using the Motorola Android phone
View at [http://education.jhu.edu/newhorizons/educational-technology-resources-1/index.html](http://education.jhu.edu/newhorizons/educational-technology-resources-1/index.html).

Figure 2 shows some examples of mobile access to the Computer Security Fundamentals course, for students in grade 7 and up, using the Safari
browser on the iPhone. The touchscreen interface is intuitive to use and responsive, but clicking on one of the Flash-based lectures results in a white screen.

*Figure 2: Computer Security Fundamentals using the iPhone and Safari browser*

View at [http://education.jhu.edu/newhorizons/educational-technology-resources-1/index.html](http://education.jhu.edu/newhorizons/educational-technology-resources-1/index.html).

For Droid users, these videos appear, though load time will vary (Figure 3). Entering text using either the onscreen or physical keyboard is time consuming, though not impossible for short phrases.

*Figure 3: Computer Security Fundamentals using Motorola Droid*

View at [http://education.jhu.edu/newhorizons/educational-technology-resources-1/index.html](http://education.jhu.edu/newhorizons/educational-technology-resources-1/index.html).
The road ahead for m-learning is bound to be bumpy, but mobile phones are already in most teachers’ and students’ hands -- and their hearts, as well -- so the journey may be shorter than we think.

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