Students learning with mobile technologies in and out of the classroom

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This chapter addresses the research question of how learners utilize hand-held mobile technology (e.g., iPods, iPads, BlackBerry™ devices) for learning at varying levels in education. Mobile technology is an “anywhere, anytime”, creative learning tool that has the potential to support the development of self-regulated learners. The chapter examines user-defined utilization of the mobile technology in both higher education settings (Wood, Mueller, De Pasquale, & Cruikshank, 2011) through two separate studies. The first study is a longitudinal examination of the implementation of BlackBerry™ devices in a graduate business administration program. The second study is a comprehensive examination of the integration of digital mobile technology in the form of iPods and iPads in an elementary school. Specific student use, independent of prescribed teacher use, is considered in examining the self-regulated learning supported by the mobile technology.

Keywords: learning and technology; computers in the classroom; mobile devices; informal learning; self-regulated learners

1. Introduction: Understanding the Connection between Learning and Mobile Technologies

Mobile technologies, especially newer, very portable, handheld devices, are pervasive features of everyday life. These technologies are used by a large number of people for business and social purposes. Recently, however, the reach of mobile technologies has extended to educational contexts. Specifically, mobile technologies are beginning to be considered as potential teaching and learning tools both within the classroom and beyond. The sudden appearance of these mobile devices as possible technologies in educational contexts is, in part, due to the quick and substantial uptake of mobile technologies throughout society as well as the technological advances that have moved mobile technology from relatively limited devices to complex and flexible tools. In particular, the functions available through information communication technologies (ICTs) have increased dramatically from their beginnings as simple call-only devices to current versions which include functions allowing the user to text, email, access the Internet, as well as utilize an array of multimedia services and applications that allow the user to personalize the use of the device (Lefèvre, 2009). Given the popularity, affordability, portability and flexibility of such devices, it is not surprising that educators have considered harnessing these devices within and beyond the classroom for educational purposes (Crippen & Brooks, 2000; Liu, 2007; Motiwalla, 2007).

The integration of digital technology at all levels of education is a current and ongoing topic of interest for students, parents, practitioners and researchers alike. As new technologies emerge or as new advancements become available for existing technologies, new opportunities for application to the educational environment become available. Most recently, emerging research is examining the impact of digital mobile technology for learning. The following information explores new research that examines how learners utilize hand-held mobile technology (e.g., iPods, iPads, BlackBerry© devices) for learning.

2. Introducing Technologies in the Classroom and Beyond

In part, the desire to incorporate new technologies as part of instructional practice is a function of their ability to motivate students, encourage persistence on challenging tasks, and personalize the learning environment (Gee, 2008; Hartnell-Young, 2009; Looi et al., 2009; Specht, 2010; Specht, Howell, & Young, 2007). In addition, the capabilities of these devices offer the potential for “anywhere, anytime”, creative, and collaborative construction of knowledge (Chen & Kinshuk, 2008; Evans & Johri, 2008; Hoppe, Joiner, Milrad, & Sharples, 2003; Norris & Soloway, 2008).

The potential for learning with mobile technology has been equated with “21st century learning skills”. Although multiple components constitute 21st century learning skills, many frameworks identify creativity, collaboration, construction of knowledge, and an inquiry approach to learning (Dede, 2010) as key or critical components. Mobile technologies also provide the opportunity for students to develop self-regulated learning skills (e.g., Paris & Paris, 2001; Pintrich, 1995; Zimmerman, 1989). Self-regulated learners know how to learn and are equipped with the cognitive skills and tools that allow them to learn. First, in the learning skills repertoire of self-regulated learners that make them effective learners, is their desire to learn—that is, they are intrinsically motivated to learn. In addition, they
acquire and possess high domain knowledge, as well as a variety of sophisticated strategies that allow them to learn effectively and efficiently. Finally, they engage in meta-cognitive behaviours that allow them to monitor their behaviour and performance, set goals, and use effective strategies to maximize learning (Perry, VandeKamp, Mercer & Norby, 2002; Willoughby, Wood, & Khan, 1994, Willoughby, Wood, & Kraftcheck, 2003). Together this constellation of cognitive skills prepares students to learn. When the model of the self-regulated learner is extended to include mobile technologies as a learning tool, the skill set also includes the ability to learn in collaborative contexts as well as being able to engage in construction of knowledge with access to the Internet at their fingertips.

Self-regulation is a complex process that occurs over many years (Pressley, Hogan, Wharton-McDonald, & Mistretta, 1996). Although self-regulation takes time to achieve, educators can foster its development by designing the instructional content and choosing an instructional style to encourage learners to acquire the domain knowledge, strategies, and meta-cognitive skills needed to learn independently. At the same time, learning contexts must allow students the opportunity to learn from others and with others as well as from the myriad of information sources available to the learner through the Internet.

The potential of mobile technology for encouraging “self-regulated learning” and supporting constructivist pedagogy needs to be measured using learning outcomes that match the self-regulation theoretical framework. Constructivist pedagogy leading to “self-regulated learning” involves the following characteristics: it is student-centred; group dialogue leads to shared understanding; formal domain knowledge is introduced, both planned and unplanned; there are opportunities for students to challenge existing beliefs through engagement in structured tasks; and, there is development of meta-awareness of the student’s own learning processes (Richardson, 2003). Digital technology has enormous potential to be used as a cognitive tool to support all of these characteristics (LaJoie, 2000). In order to assess whether mobile technologies have indeed supported self-regulated learning, gains in knowledge construction, learner motivation and satisfaction, and collaboration need to be evaluated along with student achievement levels (Lai, Yeng, Chen, & Chan, 2007; Wang, 2003).

Along with the potential promise of mobile technologies as an educational tool, there are concerns regarding the practicality of introducing these devices in educational environments. For example, evaluation of mobile technology use has identified potential difficulties associated with the slow transmission of data, small screen and keyboard, and limited functionality in comparison to more traditional desktop systems (Chen & Kinshuk, 2005). In addition, there are concerns that some of the functions that make mobile technologies so very attractive are the same functions that might inhibit or be detrimental for learning. For example, recent research found that students reported learning decrements when they engaged in multi-tasking with Instant Messaging at the same time as trying to do school work activities (Junco & Cotton, 2011). There are also concerns that over time, the functions that appear attractive to learners may become less attractive. For example, younger students demonstrated decreased persistence in engaged observation as part of the instructional task when asked to do photo-taking with PDAs (Lai et al., 2007).

Overall, however, there is limited research examining how learners actually use mobile technologies. The remainder of this chapter will describe recent research that explicitly tests users’ experiences with these technologies.

### 3. Examples of Mobile Technology Use

#### 3.1 Higher Education and Use of the BlackBerry

A recent study (Wood, Mueller, De Pasquale & Cruikshank, 2011) examined the introduction of the BlackBerry™ device as a new teaching and learning tool for adult learners in a higher-education, graduate-level, business program. In the year this study was conducted, every student and professor in the first year of the graduate business program received a BlackBerry™ device with an unlimited data plan and optional voice plan to foster the introduction of this technology as an instructional and learning tool. Students were given an initial group session on the basics of the device and a dedicated technical support staff member was available for the first several weeks of the program. From the week before students received the BlackBerry© devices, to the end of their first term four months later students’ use of the technology was documented through surveys. These surveys provided “snapshots” regarding students’ experiences and attitudes towards the devices.

##### 3.1.1 How was the mobile technology used?

At the outset it was clear that the BlackBerry™ technology being introduced was a novel technology for the majority of the participants. However, students found the BlackBerry™ device easy to use, and were optimistic regarding its potential role as an instructional tool. Despite the initial optimism of the students, use of the technology as an integrated, regular part of their instructional programming was less frequent than they had initially expected. In fact, approximately half of the students indicated that there were no teacher-led activities that they experienced regarding the use of the devices. This outcome is consistent with numerous studies which report that despite widespread access and possible learning advantages (e.g., Blok, Oostdam, Otter, & Overmaat, 2002; Mayer, Mautone, & Protecho, 2002),
computer technology remains under-utilized in education and the potential of computer technology is not being realized (Mueller, 2009; Mueller, Wood, Willoughby, De Young, Ross, & Specht; 2008; Abrami, 2001; Muir-Herzig, 2004).

Interestingly, even though students did not experience high levels of teacher-led use of the BlackBerry™ devices, students own self-directed learning using the BlackBerry devices was a key tool for in-class learning. Indeed, the vast majority of students reported using the mobile devices during class time to support their own learning. In addition, all participants indicated that they used their mobile devices outside of the classroom to facilitate their learning. Clearly, motivation to use the devices and opportunities to use the devices to learn were not the problem as students found ways to use them within and outside of their classroom even when specific uses were not provided by instructors.

Students indicated that the tool was especially important for communication and organizing tasks, specifically where group work was involved. Although the BlackBerry™ devices were introduced as a learning tool in the present study, they may also have offered an unintended social support system for students by allowing students to develop and sustain relationships beyond the in-class contact time. This finding is consistent with other research that suggests that social support provided through these technologies may be important for promoting engagement and retention in academic programs (e.g., Junco & Cotten, 2011).

There also appeared to be an important shift in the use of the BlackBerry™ as students started to see it more as a tool for learning tasks than non-learning tasks. This change in perceived use suggests that over time students can begin to see the tool as an instructional one and to orient the tool toward achieving their own instructional goals.

Given the potential for the mobile devices to be a distraction during class time, it was important to assess the use of the devices for non-learning based activities. When students were asked to identify how frequently they used their mobile devices for non-class related activities, the majority of students indicated that they used their devices for non-class related activities during their class time. While it is possible that the reported off-task behaviour with the technology could simply reflect that the BlackBerry™ devices replaced off-task behaviour of another kind, it is also possible that the many functions available on the BlackBerry™ devices made distractions more readily available. Off-task behaviour, and multi-tasking with technologies in learning contexts can inhibit learning and distract the leaner from the task at hand (Junco & Cotton, 2011; Mayer & Moreno, 2003). Clearly, we need to know if the introduction of these technologies introduced new distractions and we also need to develop mechanisms that reduce such distractions when they are present.

Overall, the results, although supporting a modest positive view toward this mobile technology as a learning tool, were not overwhelming and the BlackBerry™ devices were not used at a high level, especially in the classroom. As mentioned earlier, the limitation of use was predominantly seen as coming from the instructors, as students evolved ways to use the technology both beyond and within the classroom walls. The limited use may reflect pedagogical limitations as perceived by the instructors and lack of professional training and support around the implementation of mobile technology as a learning tool.

As might be expected for a mobile device, students used their BlackBerry™ devices more frequently outside the classroom than in the classroom. These findings suggest that students found the devices to be useful for some learning activities, especially in contexts where other students were not readily available for interaction. Much of the research that suggests positive outcomes from mobile technology, has examined e-learning or distance learning situations where the potential of mobile technology to connect across time and space is utilized, rather than in a face to face situation that existed for these graduate students (e.g., Chen & Kinshuk, 2005; Motiwalla, 2007).

In summary, the potential advantages of the BlackBerry™ device may be less connected to in-class use and more directly related to the applications that participants listed as effective for learning, including collaboration and communication tools.

### 3.2 Elementary School and Use of the iPod

A second very recent study involved a comprehensive examination of the integration of digital mobile technology in the form of iPods in elementary schools. Combining both quantitative and qualitative data provides a picture of use from both teacher and student perspectives. Specific student use, independent of prescribed teacher use, is considered in measuring the self-regulated learning supported by the mobile technology.

Research was conducted at 2 elementary schools that used and accessed the mobile technology in different ways. At one school the iPods stayed in the classroom and were only given to students at specific times for specific tasks. The school was well-equipped with technology with interactive white boards, document cameras and sound systems in each room, a set of computers in a common pod area for groups of 3 classrooms, as well as a fully functioning computer lab in the library/resource centre. At the second school, each student received their own individual iPod for the year, which they had with them at school and at home used as much or as little as they wanted. There was limited technology available in the rest of the school but a digital projector, document camera, and several computers were present and used in the participants’ classroom.

At the first school 7 classes (one grade 1 class, one congregated enrichment class, one congregated special education junior class, and 4 junior classes ranging from grade 4 to 6) were involved in the study. Before the formal study began, the students in the grade four class kept journals where they could write their thoughts and ideas about the mobile technology.
technology and what they expected to experience. At the beginning of the study, students filled out a survey assessing their attitudes, use, and knowledge of technology. The survey examined specifically their experience with mobile technology and how they used it outside of school. During the intervention with the mobile technology, class observations were conducted during lessons with and without the mobile technology on a weekly basis. Classes were videotaped and researchers kept a running record of the actions by the students in the classroom. Students also completed several online surveys on a semi-weekly basis, which asked about their iPod use, enjoyment and whether or not the technology helped their learning or made it more difficult. At the conclusion of the study students were interviewed and asked about their views on the technology, specifically the mobile technology, and the impact it had on their learning.

At the second school, students from a congregated grade 7 and 8 enrichment class were able to take the devices home. These students typically had full access to the iPods to use however they decided, rather than having any structured lessons that revolved around iPod use. Students filled out initial surveys about their attitudes toward mobile technology as a learning tool. Focus group interviews with the students were conducted and recorded in groups of 5 to 7 students at the end of the intervention period. During the interviews students were asked about their use of the iPods both at home and at school. They were also asked about the difference it made to their learning and whether or not they would recommend it to other students.

The variety of learning contexts across the study (several different classes and grades in two different schools) resulted in three general levels of access for students: limited access within class; full-time access within class; and full-time access within class and beyond. The three different contexts afforded students with unique learning opportunities and they utilized the mobile technology in different ways.

### 3.2.1 How was mobile technology used?

In general, students’ use of technology fell between “some” and “a lot” over the weekly surveys. Four general categories or types of use in the classroom were extracted from the qualitative survey data.

i) **Reference tool**: Students used functions of the device (e.g., calculator), online editing and reference tools (Dictionary.com), as well as specific Apps (e.g. thesaurus). The students who had full access to the mobile device (grade 7 and 8) more often indicated in the weekly surveys and in their interviews that the mobile technology was used as a reference tool and that all of their “tools” and work could be housed in “one place.”

ii) **Curriculum Resource**: The mobile technology was also used off-line, that is, with specific applications that had been downloaded by their teacher and/or requested by students. The Apps provided information or an activity related to specific curriculum content, e.g. Planet Apps in science, musical instrument Apps in music, translation Apps in French, drawing apps in Art, calculation games in Math, etc. Teachers in classrooms with limited access often presented activities that utilized the apps either individually or in pairs as either a component of a lesson (e.g., creating a Martian that they then described in a creative writing activity) or as the entire activity (e.g., writing vocabulary using Use Your Own Handwriting app). In the junior classes (grades 4 to 6) the set of devices was more often used as a whole class activity, whereas the primary class (grade 1) often used the devices with a small group in a centre rotation.

iii) **Research Tool**: Both full access and limited access provided opportunities to use the mobile device as a research tool for “locating information”, “answering questions”, and “searching for pictures”. Information was said to be “right there” without the need to travel to the library or start up a computer, providing the opportunity to answer questions immediately.

iv) **Strategic Learning Tool**: Students also reported using the mobile technology for a multitude of purposes beyond curriculum and research. The technology was used to create and produce as well as to assess and assist in learning. Students used the devices to take pictures, record voice memos, listen to music, search for images, plan their day, generally help them learn, drawing, writing stories, typing, back-channelling, telling time, chatting, making a poster, and several other uses. The strategic use of the mobile technology as a learning tool was more apparent and available in classes that had ongoing, individual access either at school or at home. Some students even indicated that they had stopped using the iPod as much near the end of the year as they would soon be losing access.

### 3.2.2 What were student attitudes and beliefs?

The semi-weekly surveys indicated that students found using the iPods to be enjoyable with mean scores all greater than 3 on a 5 point scale from 0 (not at all) to 4 (a lot). In the same surveys, junior students included benefits of the iPods to be speed and fun, e.g., “saves time”, “not going to the library”, “faster”, “quicker”, “fun”.

The interview data indicated that the technology made learning more engaging than books and teacher directed instruction. Some students indicated that the tool created social isolation in that “everyone is looking down at the little screen” and “it is very quiet” when the iPods were in use, while other students indicated that students were “excited to share what they were doing and what they found on the iPods.” Students who were using the tool in a whole group setting for a specific activity shared information, links, and appropriate sites more often than individuals using the iPod
as a strategic tool for a specific purpose other than searching. Classroom observations indicated that teachers included explicit opportunities for students to share to encourage collaboration but many students also did this spontaneously. When asked to explain how the technology supported their learning, students repeated their references to “ease” and “time” from the survey. Students also indicated that the “just-in-time” feature of the mobile technology meant that they had the information at their finger tips and that it was searchable, in comparison to a book that has set content which could be outdated. Students who took the technology home were less enthusiastic about its potential outside the classroom, indicating for the most part, that they preferred a laptop if it was available. They did speak to the portability of the device and that they used it on bus transportation to listen to music and play games. Students in the special education class expressed their engagement with the mobile technology that in this case, was offered as one component in a suite of Web 2.0 collaborative tools and in-class computers.

3.2.3 What were barriers and support for student learners?

Students identified some issues and concerns with the technology, indicating that the small size posed some problems in viewing and typing but most qualified that by stating that it was overcome by the benefits of the device. The older, enrichment students who had full time access were not as positive, noting both benefits and drawbacks, analyzing when it was appropriate to use and when it was not. In that context, students also mentioned the “addictive potential” of the device and the responsibility of monitoring appropriate content and maintaining the technology (i.e., charging it, syncing it, not losing it, etc.). Classroom observations and interviews indicated that students were generally flexible in trouble shooting the devices, getting a different device if necessary, sharing with a partner, asking a friend to assist, and following short, visual and written instructions for entering Apps and search engines. When a problem occurred, it was not unusual for students to solve it individually or with other students before approaching the teacher. In fact, there were several instances where students demonstrated aspects and functions to the researchers/observers!

3.2.4 What are the implications for learning?

The variety of contexts and degree of access, as well as the variety of grades and learning needs, connected with the positive response across the majority of participants, suggests that mobile technology, such as the iPod, is a versatile, engaging technology for students. It is flexible in its use and moves from a curriculum resource to a strategic learning tool as access increases. Differences between students who had full access and those with more limited access suggest that for the technology to be an integrated learning tool, it must be available and used on a regular basis. More limited access does allow for curriculum connections and easy, fast connections to searchable information.

Although students were engaged with the technology, this was less apparent with the grade 7 and 8 students who had full time access outside the classroom as well. It appears that these students did not see the need for the smaller device outside the classroom when a computer was available. It was, however, seen as a useful device in areas where a computer was not an option, for example, on the bus. For this group of students the mobile device was perceived as one of many learning tools available.

The immediacy and ease of access to information and reference tools was perceived to be a strong benefit. Students demonstrated collaborative inquiry when using the mobile device to search for information and when trouble shooting around the device and its operation. The assistive features of the technology, e.g. voice memo or note taking Apps, served as scaffolds for students with learning challenges and supports for independent learning for all students. The flexibility of the device in terms of purpose and the variety of Apps available, suggest that it is capable of differentiating the learning process for students at different developmental stages, with different needs, and in different contexts.

4. Summary

Unlike much of the existing recent research which examines one-time use of mobile technology outside the classroom on field trips (e.g., Huan, Lin, Cheng, 2009; Lai, Yang, Chen, Ho, & Chan, 2007; Vavoula, Sharples, Rudman Meek & Lonsda, 2009) or extended use for learning at home (Sandberg, Maris, de Geus, 2011), the present chapter provides an extended examination of mobile technologies at two levels of education. Within both of these contexts, student learning using mobile technology within the classroom and beyond, indicates that learners are inquisitive, enjoy learning with the technology, and use the technology for a variety of purposes. In both contexts, over time, the learners used the technology to support their learning in a way consistent with the self-regulated learner model. That is, learners used the technologies for research, searching out information and as a resource while working on tasks which allowed them to build and extend existing domain knowledge. They also used the devices for what they felt were the most meaningful purposes and often resorted to other technologies or resources when the mobile devices were not the right tool for the task. This strategic use of technologies is evidence that learners were monitoring their learning and adopting what they perceived to be the most useful tools to achieve particular learning tasks. In organizing their learning while using the devices, learners were demonstrating meta-cognitive awareness of the potential benefits and limitations of the
technology. Together, with the clear enjoyment in having the technology as a learning tool, this constellation of skills suggests that mobile technologies can enhance self-regulated learning.

Interestingly, the two different educational and technological contexts also highlighted unique outcomes. Specifically, for adult learners, the BlackBerry™ primarily served as a tool for communication and collaboration outside the classroom, whereas use of the iPod was better characterized as promoting inquiry and differentiated learning within the classroom and limited use beyond. These differences in outcomes clearly indicate that understanding the educational potential of mobile devices is not a “one size fits all” consideration. Instead, learners may be best served with a range of digital technologies that allow them to move seamlessly from one environment or task to another. In addition, instructors may play a key role in helping students to realize the potential that technologies have in the traditional classroom learning environments and beyond. As types of mobile technologies become increasingly available in schools and home contexts, learners and instructors will need to explore and define the most optimal contexts for mobile learning tools.

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