

Impact on Social Change: Benefits and Barriers to School Culture and the Integration of M-Technology

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Abstract—This paper examines benefits and barriers of m-technology in its growing use in education through a survey conducted at a Canadian teacher education institution (n=350). Topics included are the types of mobile technology devices and how their uses have been rejected and accepted as a socially-situated construct for learning in schools. Issues for new teachers range from the dollar cost of using the devices to the cost of time in learning about these devices. The paper concludes with a central issue of why some devices do not remain in the social construct but are adopted for short periods of time and do not last because barriers prevent their sustainability. The research for this paper was supported in part by a grant from the Imperial Oil Academy for the Learning of Mathematics, Science and Technology.

Index Terms—education, mobile technology, handhelds, global connections

I. INTRODUCTION

A new wave of technology use is coming in the school doors. We used to think only about desktop computers as the standard for technology integration in schools. Now that concept is changing to embrace the wide-spread use of mobile technology outside of schools. Along with this, new ways of teaching and learning are being adopted. The term for this is mobile-learning or m-learning and it goes hand in hand with the way technology has become more mobile (m-technology) in the past decade. When we talk about m-learning, we refer to m-technology devices such as cell phones, personal digital assistants (PDA's) and programmable calculators.

“For better or worse, handheld devices and laptops are now seen as essential back-to-school supplies for students... and many schools have only begun to weigh their educational benefits against their potential for text messaging, photo swapping, cheating and chatting.” (Associated Press, 2003, np)

Thomas Friedman (2005) in his book entitled *The World is Flat* refers to the ten forces that flattened the world. Force #10, called “the steroids”, (digital, mobile, personal and virtual) is described as “revolutions” which we cannot continue to ignore but must rapidly adapt. He further states that “. . . the steroids - are going to amplify and further empower all other forms of collaboration” (p.170).

The Advisory Committee for online learning similarly states that:

“In a global society based on expanding knowledge, Canada’s health as a civil society and its economic competitiveness, as well as the success of individual Canadian’s, will hinge on having the best possible education and access to lifelong learning opportunities” (2001, p. ix)

Today’s post baby boom generation, the boom echo generation, has been exposed to an assortment of technological devices. They attend classes with the latest mobile technological communication devices such as: cell phones, iPods, Personal Video Players (PVP’s), MP3 players, digital-video cameras, CD players, Personal Digital Assistants (PDA’s) and programmable calculators. A number of these wallet size devices are flourishing and can be found extensively used in corporate training, medicine, maintenance departments, hospitality industry, logistics, law, science and sales (Caron and Gely, 2004; Falon, 2002; AvantGo, 2002). Some researchers (Naested, Potvin, & Waldron, 2004), believe that we cannot afford just to stand by, but must harness this opportunity for “...technology has complicated schooling while creating many possibilities for designing learning experiences for young people” (p.278). Education in Canada has been slow to adapt, but the increase use of mobile learning technology cannot be ignored. This paper contributes to the growing literature that looks at m-learning. This review further expands our understanding of how handhelds (PDA’s), programmable calculators, and cell phones impact on teaching, learning and school culture. It also looks at the potential implications of this technology for teachers and schools.

II. MOBILE LEARNING AND PERSONAL DIGITAL ASSISTANTS (PDA’S)

Mobile learning or m-learning as cited in Robson (2003) is defined by Clark Quinn as:

“...the intersection of mobile computing and e-learning: accessible resources wherever you are , strong search capabilities, rich interaction, powerful support for effective learning, and performance-based assessment, e-learning independent of location in time and space”.

Mobile learning is rapidly gaining a foothold in education. There are both fears and fantasies about how this technology will be actualized as a regular part of learning in schools in the next five years- much the same as there were fears and fantasies about graphic calculators and the Internet as it was rapidly integrated into school culture and learning (Smith, Cap, & Welsh, 2005). M-learning has emerged as a powerful and transformative

means to meet these needs, as well as to enrich traditional instruction. It is moving our information age classrooms towards inquiry-based learning supported by new technological tools such as PDA's and cell phones.

Culture impacts on everything that occurs in school. The term school culture has been used synonymously in the education domain with concepts such as, *saga ethos* and *climate* (Deal, 1993). School culture (Doerger, 2002) is not only multidimensional, but technology is changing our perception of school culture. How the culture of schooling is being reshaped by the infusion of technology in the school process was explored in some detail by Carolan (2001). He further states that "technological tools can be used in the schooling process in a manner that encourages producers and consumers of cultural products to contest meaning, beliefs and practices" (p.2).

Current PDAs can be traced back to two former devices: Apple Newton Message Pad and the U.S. Robotics Palm Pilot (Finn and Vandenharn, 2004). The former was made available in 1993, while the Palm was released in 1996. Since that time this technology is dramatically reshaping (Friedman, 2005) many of our industries including e-learning (Valentine, 2004). The report entitled *Learning with handhelds: findings from classroom research* (Vahey and Crawford, 2003) indicates that handheld technology with tangible peripherals has the capability not only to transform teaching and learning, but can result in more student engagement. The report further states that: "Teachers have found that the most important peripherals are scientific probes (such as pH probes, dissolved oxygen probes, and acceleration probes), keyboards, and digital cameras" (p. 8).

Peripherals with appropriate software enable participants to collect and interpret data in real-time measurements from various environments. This includes classes extended into informal learning milieus such as zoo's, aquariums, rivers and botanical gardens. Handheld computers and probe ware according to Vonderwell, Sparrow and Zachariah (2005) "...have the potential to support inquiry-based science projects in K-12 education". Another good descriptive account of handhelds use by four different schools in the State of Michigan can be found in the proceedings of the IEEE international workshop on wireless and mobile technologies in education (Curtis et al, 2002).

The researchers found that such devices have enabled "... seventh graders to create a nearly paperless science class where students have ready-at-hand access to information and tools, as well as increased opportunities for collaborative work (p.7)". Singh, G., Denoue, L. and Dash, A. (2005) in their article entitled "Collaborative note taking PDA's" state that PDA's are severely under-utilized despite PALM supporting over 19,000 applications. Fritz (2005) completed a qualitative ethnographic case design study investigating how first grade pupils used handhelds to learn with one another. One of her conclusions was that handhelds facilitated collaborative learning and helped students learn content. An independent e-learning researcher Elizabeth Valentine (2004) states that:

"To leverage the advantages of mobile, especially digital technology, will require that learning professionals extend their views and applications of learning models

and theories... to address the needs of an increasingly mobile and unplugged society." (p. 4)

She further reminds us that:

"...mobile devices are already being used in education and corporate training to connect expertise with remote learners; to engage otherwise disenfranchised groups of learners; to contextualize research projects and support action learning." (Valentine, 2004, p.5)

In her detailed report she examined differences that exist between e-learning and m-learning, potential scenarios for m-learning, several trends in mobile technology and key issues for m-learning. Key issues raised are the location of m-learning within education and training, connectivity and usability concerns, impact on teachers and students and the lack of policy in this domain.

III. GRAPHIC CALCULATORS

An important milieu where mobile devices have been effectively integrated for a number of years was in traditional classes (summer, 1978), especially in quantitative subjects (i.e., sciences, mathematics). This phenomenon according to Robson (2003) began with the availability of Casio's graphing calculators in 1986 and is poised to have even a greater impact on teaching and learning (Rodd and Monaghan, 2002) because of the more powerful and pedagogically versatile hand-held devices. Since the introduction of the graphic calculator in 1986, "we have seen a steady flow of research on graphic calculators in mathematics classrooms" (Durham, nd). However, handheld devices now have the capabilities of microcomputers (Pogue, 2005) and can compete price-wise with programmable calculators and laptops.

As a result, school districts are finding it more affordable to provide PDA's to every student (Brown, 2001; Norris & Soloway, 2003). Some institutions, such as The British Columbia Institute of Technology (Palm One, 2004) and Palm One have come together to replace the dedicated calculators that were once a required purchase for classes. They currently use Palm One handhelds that incorporate a powerful scientific graphic calculator. Furthermore, we find that established curriculum standards which once included graphic calculators, probe wares and microcomputers, now are updated by various stake holders such as national councils, teaching associations, and governments and are beginning to include m-learning tools.

IV. CELL PHONES

We are currently experiencing a new revolution in telephone technology. This could be considered a major historical development in modern communication since the initial invention of the telephone. Canadians sent, in the month of March alone (Staples, 2005), some 115.2 million text messages via their cell phones. It is expected that they could be on track to send approximately 3.7 million messages a day. As of June 28, 2005 it will be even easier for Canadians to send by cell phones Multimedia messages or MMS files. The EDUCAUSE Center for Applied Research (2005) indicates that as of 2003, 82% or 13.3 million Netherlanders utilize a mobile phone. While the International Telecommunications Union (ITU) recently indicated that global cell phone

usage has doubled over the past four years, to approximately 1.5 billion customers.

In a telephone survey of 802 Americans, age 16 and older conducted by Kelton Research (2003), it was found that the younger generations would select mobile phones in contrast to the older generation. Reasons given is that it enables them to “stay better in touch with friends and family” and that they are more cell savvy than the older population. It is expected that this generational divide will close rapidly as these devices become even more user friendly.

Mobile phones are establishing themselves as an extension of the individuals in terms of their appearances, particular sounds and applications. Mobile phones are handheld units which enable one to send messages by way of text, voice and multimedia. The Pew Internet and American Life Project, Associated Press, AOL cell phone survey (Rainie, 2006) of 1,503 adults age 18 and over provides us some insight into how Americans use their cell phones. Some of the cell phone features they identified include: sending and receiving text messages, taking still pictures, playing games, sending and receiving e-mails, performing Internet searches, trading instant messages, playing music, recording video clips, obtaining mobile maps and watching video or TV programs. Ling (2000), in his detailed literature review, examined the impact of mobile technology on democracy, bureaucracy, education and the adolescent. He also focused on qualitative and quantitative work done in Norway on this topic. A common thread that he sees is that the cell phone “provides a more immediate, independent and point-to-point communication channel”.

Yerushalmy and Ben-Zaken (2004) in a document entitled *Mobile Phones in Education: The Case of Mathematics* identified and reviewed several opportunities for using the cellular phone in education, particularly for teaching and learning mathematics. The authors claim that “in general, students are willing to use their cellular phones for educational purposes”.

Mobile phone applications can also be found in Japan such as the “snippets of news or two minutes video” which can be accessed by the owner when he has some free time (The New Media Consortium and the EDUCAUSE Learning Initiative, 2006). Could you imagine what we can accomplish with such a technical possibility related to an educational course? In a section entitled “Educational use of mobile phones” (Nakahara et al, 2005) indicate that as of May 2003 the mobile phone penetration in Japan was at 84.4%. They further state that in Japan, there are at this time, three categories of educational uses for such units. Students are able to:

- 1) perform course evaluation and provide comments via their phones;
- 2) run English language study material such as drills & educational games (examples can be found at <http://www.moetan.jp/online.html>);
- 3) obtain class cancellation notices, changes in course schedules and possible employment seminars.

Mobile phones are also very popular devices in Thailand. Whattananarong (September, 2004) from the King Mongkut’s Institute of Technology, North Bangkok in Thailand decided to explore the use of this device. He designed an experimental study to obtain data from 56

graduate students’ performance when tested by using mobile phones and traditional pen-paper methods. In this study, students were required to send their answers via Short Message Service (SMS) to a designated telephone number. One of the conclusions mentioned by the investigator was that “In spite of the plethora of research in the area of testing and the use of technology for testing, there is no testing designed to use mobile phones. Most of the testing is based on abilities rather the use of technology for testing” (p. 6).

V. TACKLING M-TECHNOLOGY: IMPLICATIONS FOR TEACHERS AND SCHOOLS WORLDWIDE

There are a number of issues that need immediate attention when it comes to implementing m-learning in schools (Pownell & Bailey, 2001; Powell, W.D., 2002; Fruchterman, 2003; Finn & Vandenharn, 2004; Valentine, 2004). They are as follows:

- Leadership & Change - Individuals must be familiar with this technology, have change a vision and be familiar with change
- Teaching & Learning - Price and portability are factors which compete with regular desktop units
- Professional Development - Professional development opportunities must be available for staff
- Technology Support - Services must be provided. (e.g., help desks, maintenance)
- Planning - Technology plan must be created & incorporate m-learning
- Infrastructure - Decisions relating to software and other peripherals must be given attention
- Safety - Issues aware of the impact this technology has on staff and students (i.e. vision concerns due to the size of screen, hand cramps)
- Ethics - The need to design a curriculum that includes and teaches digital ethics
- Research & Evaluation - Establish mechanisms for collecting and disseminating information regarding its use, effectiveness and impact
- Security - Since these units are small and portable-establish written policy on its use or misuse
- Curriculum - Determine where mobile technology fits in the curriculum and what subjects are well suited for handhelds
- Equity and Access - Create equitable access to greater number of students and provide opportunities for challenged clients/schools with limited funds
- Sustainability – Systematize long-term, lasting effects to sustain development of organizational systems

VI. SUMMARY

M-learning is rapidly gaining a foothold in education, yet research on m-learning is just starting to move in that direction. This paper contributes to the growing literature that looks at m-learning (PDA’s, graphic calculators and cell phones). It further expands our understanding of how handhelds (PDA’s), programmable calculators, and cell phones impact on teaching, learning and school culture.

Education in Canada has been slow to adopt the use of handheld devices in schools, yet these powerful devices are used in most social capacities outside of school. Today's generation of students comes to class using handhelds, cell phones and other small mobile technology devices. The potential implication of this wave of technology for teachers and schools is something that should not be ignored.

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