

Using m-Learning Technologies to Support Tertiary-level Education in the Caribbean

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Abstract

m-Learning technologies can potentially deliver education at significantly reduced costs by leveraging the relatively cheap mobile infrastructure available throughout the Caribbean. Mobile devices also have a strong appeal among young adults that can be exploited to provide flexible learning opportunities regardless of the time or the location of learners. m-Learning technologies are a perfect complement to Open and Distance Learning (ODL), allowing communication with learners beyond their traditional places of learning. They can also support face-to-face learning by reaching out to learners outside the traditional classroom.

Even though m-Learning is still in its infancy, in this paper we show how it can be used to support blended learning in both traditional face-to-face formats and ODL, using technologies such as context and location awareness, mobile learning management systems, and mobile RSS. As an example, we consider an advanced course at The University of the West Indies. We show how classroom learning can be supported with m-Learning technologies that deliver concise course notes, summaries, assignments, and tutorials directly to individual learners after each class or topic is covered. The technology supports polls, opinions, and other forms of student interaction and communicates information on timetables/schedules, deadlines, news, alerts, etc. to an entire class.

INTRODUCTION

Advancements in the state of wireless technologies and the global commercial success of mobile devices have heralded an era of ubiquitous mobile computing. With the liberalization of telecommunication markets across the Caribbean, the cost of owning a mobile phone has dropped significantly, sending market penetration to an unprecedented high. Everyone from doctors and lawyers to businessmen and farmers, and perhaps more importantly, young adults and teenagers own a mobile phone.

Caribbean mobile network carriers, such as Cable & Wireless and Digicel, have implemented wireless communications infrastructure which has wider reach and appeal to the public than terrestrial lines. It is cheaper to leverage this wireless communications infrastructure to provide a range of services since it bypasses many principal physical development phases encountered in the region such as power grids, fibre optic backbones, and roads.

It is primarily this low cost and ubiquity that makes mobile computing particularly suitable to meeting development goals in the Caribbean, especially in the education field.

Bridging the Divide

The United Nations Development Programme (UNDP) has been mandated to track the progress of achieving Millennium Development Goals (MDG) by member nations (UNDP n.d.). Among these goals are to develop a global partnership for development and to achieve universal primary education. The United Nations (UN) has also commissioned a task force on bridging the digital divide, aiming at closing the gap between those with regular and effective access to digital technologies and those without (UN News, 2005). The Economic Commission for Latin America and the Caribbean (ECLAC) is the body responsible for coordinating regional efforts in meeting these development goals (Machinea, Bárcena & León, 2006).

The high costs associated with the delivery of conventional education together with inaccessibility in rural areas and other parts of the Caribbean have deterred many individuals from gaining a formal education. Since its inception in 1996, the University of the West Indies Distance Education Centre (UWIDEC) has taken up the task of expanding access to tertiary level education in the region through its distance certificate programmes. UWIDEC uses a blended learning approach incorporating mostly printed instructional packages and face-to-face tutorials with some audiovisual-conferencing. UWIDEC also uses CD-ROMs and to a lesser extent, information and communications technology (ICT) in the form of the learning management system (LMS) Moodle (UWIDEC n.d.). These alone however, are not enough to give ODL the critical mass it needs to achieve development goals in the Caribbean. Pervasive computing is a key factor in providing widespread, flexible access to education.

Enriching the Experience

In essence, mobile learning (m-Learning) is e-learning using mobile equipment and can be defined as "the point at which mobile computing and e-learning intersect to produce an anytime, anywhere learning experience" (Harris, 2001). Learning can now take place away from the classroom, while on the go, or at geographically disparate locations. According to Attewell (2005) the use of mobile devices lends more privacy to users who can work at their own pace, increasing self esteem, confidence, and focus. It also fosters collaboration outside the classroom and supports face-to-face interaction with peers, tutors, and lecturers. Further enriching the learning experience are systems that adapt the learning content based on the learner's location, current time, and environment variables.

This paper illustrates how the blending of mobile and learning technologies produces a richer and enhanced learning experience which is effective in creating digital equity, and addressing regional development goals in education.

TECHNICAL INFRASTRUCTURE FOR M-LEARNING IN THE CARIBBEAN

m-Learning exists today because of the abundance of mobile devices and mobile technologies and in particular, because of the popularity of mobile devices among young adults. Market analysts indicate that for the first time, this year one billion handsets will be sold worldwide (BBC News, 2006). In Trinidad and Tobago there is a very high mobile penetration rate with 0.97 million handsets (NationMaster n.d.) for a 1.07 million population (CIA, 2006). This is a pattern repeated throughout the Caribbean.

Devices for M-Learning

Mobile devices fall into the following classes:

Class	Functions		Example
	Voice	Data	
Mobile phone	Yes	Limited	Nokia 1100
Smart-phone	Yes (primary function)	Yes	Sony Ericsson P900
PDA-phone	Yes	Yes (primary function)	HTC TyTN
PDA	No	Yes	Dell Axim

Table 1: Mobile device classifications

Popular mobile operating systems and development platforms in use today include Windows Mobile, Palm, Symbian, Linux, .NET Compact, JME, and Flash-lite.

Software developers refer to mobile devices as constrained devices in relation to contemporary personal computers; despite the fact that on average, mobile devices have computational powers comparable to a ten year old personal computer (Prensky, 2005). The constraints of a mobile device are primarily screen size and resolution, data input methods, physical form factor, battery life, storage, and processing power. Prensky (2005) noted that young adults and children, who are most likely to be the recipients of m-learning, are quite adept at looking past these constraints and embracing the technology.

Network Infrastructure for M - Learning

Mobile connectivity is vital if m-Learning is to take root in the region since most mobile learning content is delivered by an underlying wireless network. A large array of mobile networking technologies is in use today in the Caribbean including 2G-3.5G, GSM, CDMA, WLAN, and GPS. With the relatively inexpensive infrastructure and large consumer base, it is no surprise that wireless Internet access and phone calls are becoming cheaper than fixed-line DSL and dialup access and calls, especially Trinidad and Tobago where terrestrial lines are expensive to lay and are often subject to vandalism and weather damage. The mobile network infrastructure set in place by the regional network carriers ensures that there is sufficient access to a high quality network.

BENEFITS OF M-LEARNING TECHNOLOGIES IN THE CARIBBEAN

Using m-Learning technologies on top of the Caribbean's existing mobile infrastructure will foster flexible learning opportunities in both ODL and face-to-face instruction. Examples of such m-Learning technologies are outlined below.

Really Simple Syndication (RSS) is a concise way of broadcasting metadata over a network using XML. It is heavily used today to provide news headlines and alerts. In an e-learning context, RSS can broadcast metadata about learning objects in repositories thus assisting in their discovery (Levine, Lamb & Norman 2003). Though not typically viewed as a mobile technology, mobile RSS readers are becoming a standard feature on high-end mobile appliances. A prototype mobile RSS system has been developed by the first author leveraging the openness and maturity of the RSS standard in an m-Learning context.

A screenshot of concise course notes as viewed on a mobile phone emulator using this system is shown in Figure 1.

Figure 1: Content delivered via mobile RSS system

With this system, course-wide administrative tasks such as issuing news alerts and updates, communicating schedules and deadlines, and delivering grades are accomplished by creating RSS feeds. Students can subscribe to the feeds on their mobile device, or even their personal computers, to be kept up-to-date. Course content, concise notes, tutorials, assignments, quizzes, session summaries, and links can be broadcasted to an entire class and viewed on a typical mobile phone running the mobile RSS client. This system can be extended to allow for better classroom interaction via polls, discussions, and remote question & answer sessions.

A LMS is software designed to manage learning content. Mobile learning management systems (mLMS) are extensions of LMS to provide access, management, and manipulation of learning content in a mobile context. Porta-bile is one such extension under development aiming at providing cross-platform mobile access to the LMS, E-Leaf (Colazzo et al., 2003). With UWIDEC embracing Moodle as their LMS of choice in blended ODL, a similar mLMS extension would prove useful in bringing the LMS services within reach of a wider audience.

Location and context adaptable systems are aware of the location of learners, the current time, and the environment and they adapt in a way best suited to these variables. For example, the mobile user interface may change depending on whether one is at work or in class, or the learning content may vary depending on whether or not one is likely to be distracted or is short on time.

An open learner model allows the student to see information about their knowledge state held by the tutoring system (Bull, McEvoy & Reid, 2003). Making this accessible from an m-Learning system would encourage students to reflect on their understanding of a topic, skill level, or misconceptions. This also makes for more effective monitoring of the success rates of m-Learning in ODL.

Most mobile phone users are familiar with Short Message Service (SMS) as a means of communication via text. Teleios Systems is a company based in Trinidad and Tobago that leverages SMS to offer competitions, news, and information services to mobile users. Their MessageCentral platform (Teleios Systems Limited n.d.) could be utilized to provide learning services across the region, not unlike the MobilED initiative where articles can be requested by SMS (MobilED n.d.).

Voice-based m-Learning is a useful learning delivery method to provide language training, information services, playback of articles, and multi-way conferencing, and is ideal for the visually impaired in the Caribbean region. The MobilED server is an example of a hybrid SMS/voice system where users can request an article via SMS or a phone call and the server will play it via a call-back service.

USING M-LEARNING IN AN ADVANCED UWI COURSE

To further highlight the potential benefits of m-Learning in the region, we now discuss a prototype system where it has been integrated into a tertiary-level course at the University of the West Indies (UWI). The course, CS24E (Object Oriented Programming), is an advanced undergraduate course at the UWI, and is typically delivered via classroom lectures. While face-to-face lectures have been effective in its own right, several issues have come to light over the years. Course enrolment has increased significantly and so too has the proportion of students who are employed. Working students are occasionally absent from lectures that conflict with their work schedules and it has become increasingly difficult to administer the large class. In addition to this, students have expressed interest in interacting with peers, tutors, and lecturers beyond the confines of the classroom as is evidenced by their frequent use of an online forum that was set up for the course. The following scenarios illustrate how the various m-Learning technologies, when used in the course, could benefit both the classroom and the ODL experience.

Scenarios

Working Student - Genie is a full time bank employee completing her degree in Computer Science. She spends up to three hours daily in traffic en route to work, school, and home. At work she receives a RSS alert on her smart-phone reminding her of a quiz scheduled for later that day. After work, while on the bus, she uses her smart-phone to review summarized notes about the topic being tested. She does a Web search using her smart-phone to look up an unfamiliar term. At class, the quiz is deployed on the course mLMS and Genie uses her smart-phone to complete the questions. Her grade is emailed securely to her smart-phone. At home she receives another RSS alert with a link to a learning object for the next session.

Full-time Student - Anaar is a freshman at the Faculty of Science and Agriculture and resides on campus. During the first week of orientation at the university, she roams about campus guided by a map on her PDA. When she arrives at a highlighted location her mobile agent fetches interesting facts about the site. Part of the course is done on lab computers; however since she lacks one in her dorm she downloads revision materials to her PDA for later use. At the cafeteria, while waiting for her friends to arrive

for lunch, she decides to do some practice questions. Detecting the time of day, location, and high probability of being disturbed, the m-Learning system presents to her multiple choice revision questions on the topic of *Java keywords* as opposed to more complex and time consuming questions on the topic of *polymorphism*. At the dorm Anaar views her learner model on the PDA and is comforted that she is progressing well.

ODL Student - Devon lives in a rural part of the island and has enrolled in the course at an ODL centre about 25 miles away, where he has weekly face-to-face sessions. His village does not have a reliable power or telephone service but does have a reliable mobile service. Devon uses his mobile phone to supplement his face-to-face sessions by communicating with his tutor and colleagues via voice and SMS. With his phone he receives learning content via SMS and audio by sending a request SMS to the mLMS. m-Learning has reduced his need for supplemental course materials and visits to the ODL centre, and is more economical because he does not have to invest in a personal computer.

Tutor - Bailey is a teaching assistant for the course and because of its large enrolment he often has trouble scheduling a room for tutorials. To keep his students well informed of the next class location he sets up an RSS feed. Figure 2 shows such an alert, sent by the mobile RSS system, as viewed from a mobile device emulator display.

Figure 2: *Scheduling alert sent by mobile RSS system*

Recognizing that large classes result in limited out-of-classroom interaction with students, Bailey uses the mLMS from his computer to communicate with his students via SMS messages. Bailey has taken the initiative of making the course Website mobile-friendly and developing mobile learning course content.

These examples illustrate not only how m-Learning supports learners outside their normal places of learning by providing mobile learning content and services, but also how it supports interaction among learners and instructors.

DISCUSSION AND CONCLUSION

m-Learning holds much promise for revitalizing face-to-face and open and distance learning in the Caribbean and increasing the appeal of ICT usage in education. However, there are several challenges to its successful deployment throughout the Caribbean. These include:

- Integration with current e-learning systems (LMS/ITS) and refactoring learning software with mobile extensions
- Lack of mature content development tools and cross-platform incompatibilities
- Inherent physical device constraints and the problem of being disconnected
- Social issues such as mobility being a distraction to learners or making users feel pressured to learn anytime, anywhere

m-Learning is a natural complement to contemporary face-to-face delivery of instruction and is the next step for ODL in the region. The Caribbean has the physical mobile infrastructure but is lacking in regional initiatives to pursue the development of ubiquitous learning and computing, similar to Europe's MOBIlearn Project (MOBIlearn Project n.d.) and the Leonardo Da Vinci Programme (Ericsson Education Online, 2006). Innovation in mobile computing and m-Learning is indeed very relevant towards achieving regional development goals.

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Figures

Figure 1: Content delivered via mobile RSS system

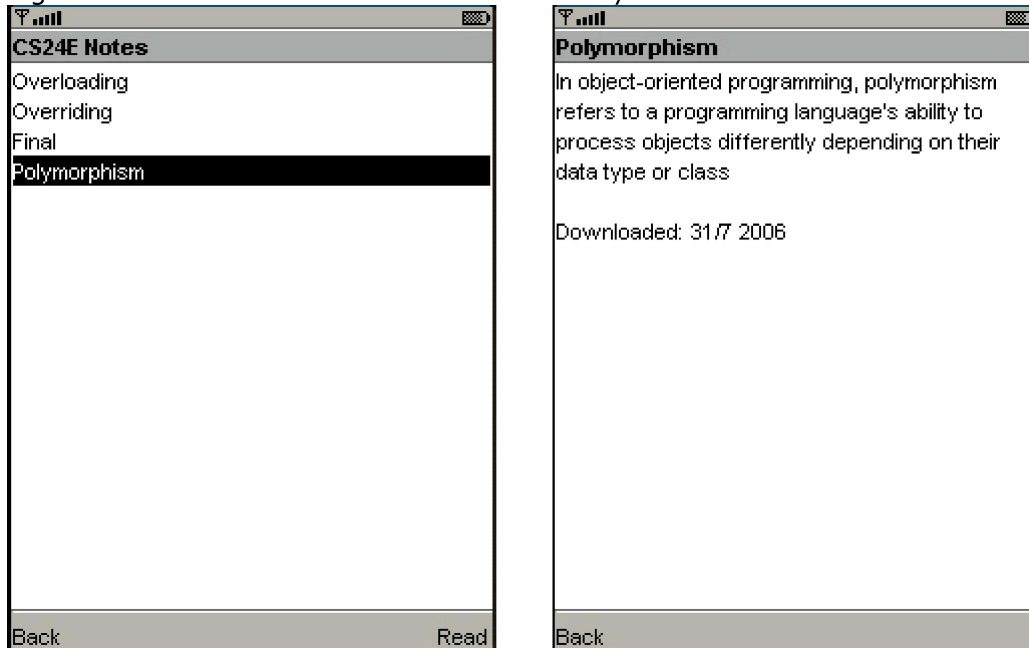
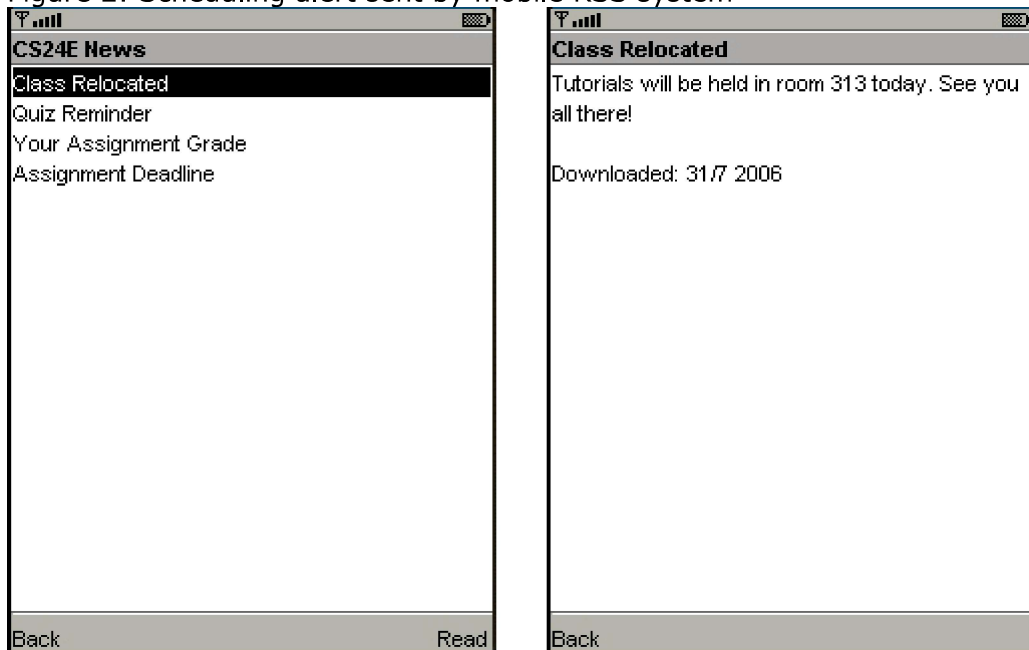


Figure 2: Scheduling alert sent by mobile RSS system



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