Harnessing Mobile Technology for Classroom Learning

David Johnson, Ismail M. Bhana and Florian Urmetzer

The University of Reading, UK

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Abstract:

Educational institutions are reluctant adopt mobile computing and Wireless technologies. This is because this technology remains relatively expensive compared to traditional computing technologies, mobile devices are inherently personal and can be difficult to use as a teaching tool to groups of learners, and Short Message Services and Multimedia Message Services (SMS/MMS) are expensive and limited in functional scope despite their popularity amongst young people. In this paper, we describe a component of a prototype learning environment named 'Quest' where we propose a new way of harnessing mobile technology for learning that negates these drawbacks. In Quest we have demonstrated that the information gathering capabilities of mobile phones can be harnessed to aid learners' research.

1 Introduction

In this paper we describe a component of a prototype classroom learning software named 'Quest'. This component suggests a new way of harnessing mobile technology for learning that negates the problems associated with developing expensive network infrastructures. Although mobile technology is designed to enable communications, much of the emphasis on the use of mobile technology is centred and designed around the notion that applications must use networking facilities such as GPRS and 3G. Another common assumption is that mobile phone applications and services are limited to SMS/MMS. Although at present the use of mobile phones is discouraged and indeed prohibited in many schools, the technology encompassed within a mobile phone can be utilized. More and more mobile phones now include media gathering capabilities. These include video capture (including still image capture), voice recording along with textual input. These capabilities can be harnessed to aid learners' research. In Quest we have demonstrated the exporting of surveys designed on a desktop PC to a Java 2 Micro Edition (J2ME) [1] application and the use of still-image captures transferred from a phone to a desktop PC as a proof-of-concept. This has shown that the information gathering functions of a phone can be used in the learning process.

2 Quest – A Prototype Learning Environment

In December and January 2004, we participated in the NESTA (National Endowment for Science Technology and the Arts) FutureLab Design Challenge 2005 [2]. The idea behind the design challenge was to bring together multidisciplinary teams made up of the creative and technically skilled with educational experts. These teams were given the task to create a prototype piece of interactive learning software which would be ultimately judged by a panel

of design, education and media experts, and children from the target age group. Our team consisted of three postgraduate Computer Science students (the authors of this paper) from the University of Reading, and a primary school teacher and an educational consultant, both from London.

The Design Challenge 2005's brief was to create a learning resource or activity targeted at Key Stage 2 (ages 7-11) and Key Stage 3 (ages 11-14). The theme for this task was to develop software that would aid in teaching subjects that are difficult to teach, and in particular, subjects areas where visual, interactive and playful computing resources would certainly benefit in promoting problem solving and creativity.

During a preliminary brainstorming session, our team formulated an idea to fulfill the design brief. We decided to develop a learning environment that helps support the development of a learner's research and thinking skills. We proposed a generic framework that guides a learner or group of learners through a series of research tasks where the software is used for managing and guiding its users through formulating suitable answers to any research question. This framework is loosely based on concepts described in the cognitive domain of Bloom's Taxonomy[3]. We believe these concepts are important in developing a learner's thinking skills and equips them with skills to apply learned knowledge to the real world.

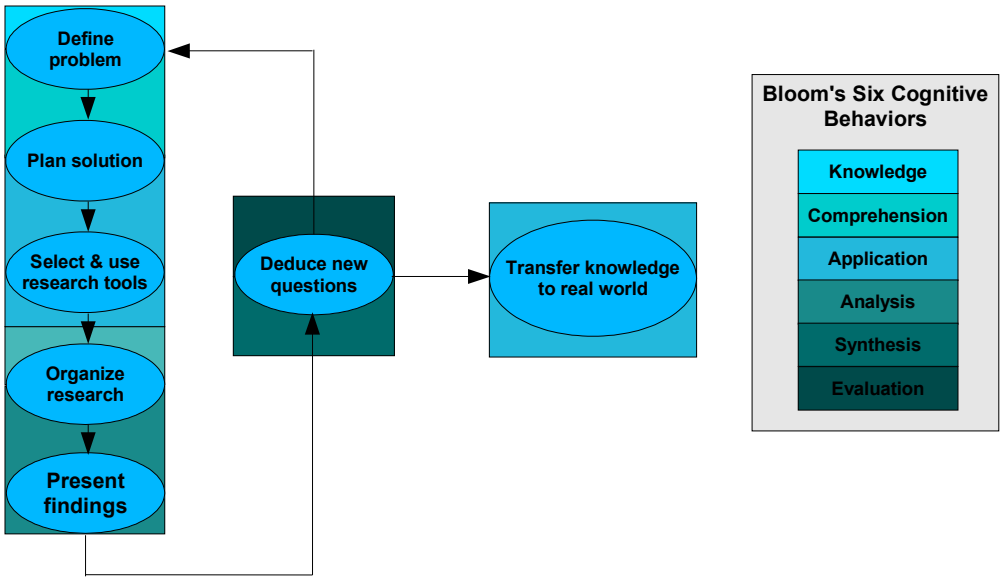


Figure 1: **The Quest framework.**

Figure 1 shows the framework that we used to develop Quest around and how it takes learners through developing each of Bloom's six cognitive behaviors. We aimed for Quest to be used as a classroom-based learning environment that supports the teaching of research and thinking skills – i.e. The teacher still actively guides and supervises the learners through the tasks. In addition to this it encourages learners to explore the real-world environment. It is not intended to singly immerse the learners into the interactive environment. It also encourages groups of learners to work through each of these stages enhancing learning by encouraging collaboration and the sharing of ideas and skills, much like with Vygotsky's Social Constructivism theorem [4]. In this paper we will focus on the task in our framework involving the selection and use of research tools and just one of these tools. In the Quest software we presented the users with a range of information gathering tools. These included simple things such as using email, telephoning sources and going to the library. Each choice is accompanied with a description of what and why each tool is appropriate for. In Quest, we present a mobile phone as a universal information gathering tool.

3 Mobile Technology in the Classroom

3.1 Effective use of Mobile Technologies

Mobile technologies are currently sparsely used for learning, but the advent of more hardware capable mobile phones and hand held computers such as PDAs has seen a rise in interest. A 2005 Pew Internet & American Life Project study on 'Teens and Technology' has found that almost half of all teenagers in the United States (about 11 million teenagers) own a mobile phone [5], and statistics show that almost nine in ten of all 15-24 year olds own or have access to a mobile phone in the United Kingdom [6]. This highlights a trend that younger people are increasingly having access to and actively using mobile technology.

However there is some reluctance in education to adopt these technologies for learning. The reasons for this are that mobile computing and Wireless networked computing remains relatively expensive compared to traditional computing technologies, mobile devices are inherently personal and can be difficult to use as a teaching tool to groups of learners, and SMS/MMS are limited and expensive despite their popularity amongst schoolchildren.

Much research has been carried out into the benefits of mobile technologies in education. An extensive study carried out by the m-learning Project [7] developed learning materials including downloadable visual and audio resources, J2ME quiz games, collaborative activities using camera phones and SMS based learning materials. The m-learning project had some very positive results where the majority of participants of the study (all aged 16-24) felt that using mobile technologies in learning was beneficial. But there are drawbacks to their study:

- The m-learning project targeted hybrid PDA/mobile phones and hybrid mobile phone/PDAs (also known as smart phones). These are expensive and many learners will not have this caliber of device.

- Diverse platforms of mobile technology will cause certain user groups to be isolated. The m-learning project showed this, where Pocket PC and Symbian operating system platforms could not both view the same materials due to platform specific productions.

- All the learning materials assume network connectivity. Internet based material is easily accessible from desktop PC's. From a mobile device, Internet based material is expensive to download through GPRS and 3G services. It is not likely a learner will want to bear this additional cost.

- SMS/MMS material again pushes cost onto the learner, and only provides limited media and interaction. For schools, setting up an SMS/MMS service infrastructure is also infeasible.

- The resources produced by the m-learning project are intended for learning outside of the classroom. However mobile technologies can also compliment learning in the classroom.

- The participants in the m-learning project were all not in full time education and were at an age where their schooling may have completed. Therefore the learning materials produced would not have complimented classroom learning.

In the short term, schools with little funding will not be able to build the appropriate infrastructures required for deploying such learning material. As the cost of some of these services are also pushed onto the end users directly, it is likely that learners may be discouraged from using them.

3.2 Classroom Learning with a mobile phone in Quest

To overcome these problems associated with the high cost of using and setting up a networked infrastructure to deliver learning material to devices, we have looked at how a mobile phone can be used in a highly disconnected state. In particular, we make the assumption that a mobile phone cannot communicate at all with a remote data repository unless it is in the immediate vicinity. As already discussed, most m-learning services utilize phone network communication services. These include SMS/MMS, GPRS or 3G data communication. However, mobile phones already have the ability to communicate with other devices through wireless Bluetooth and Infrared Data Access (IrDA), and by data cable. Figure 2 shows the three methods by which mobile phones can communicate with a desktop PC without using phone network services.

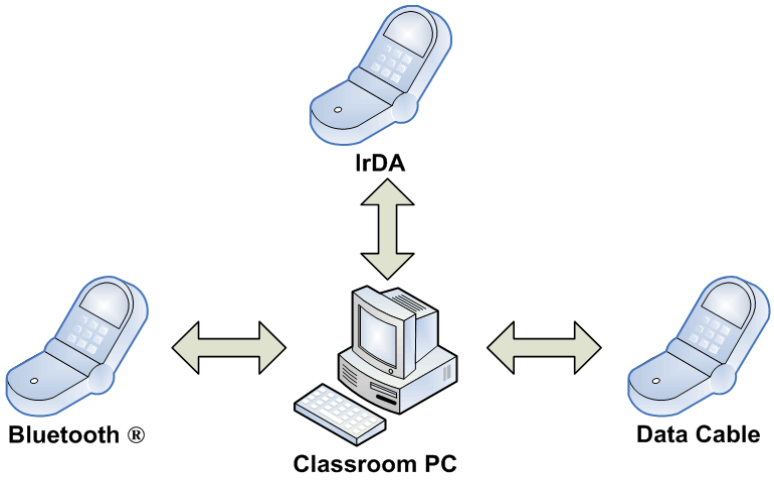


Figure 2: **Modes of communication between a mobile phone and a PC that circumvent phone network services.**

When designing Quest, we decided to demonstrate how to exploit these communication technologies in our software with the aim of supporting classroom learning. Most modern mobile phones also include the ability to gather media data. This includes video capture (including still image capture), voice recording and textual input. By presenting detailed information and instructions on how to use a mobile phone for media gathering with Quest, the learning environment allows learners or groups of learners to use a mobile phone (their own or one provided by the school) actively as an information gathering device. The information gathering tasks Quest presented to the learners include:

- *Taking notes* – Simple textual or voice input into the mobile phone to take notes and ideas whilst on a field trip, for example, can be recorded. Many schoolchildren are proficient at using the text input on mobile phones, and simple voice recording is straightforward.

- *Taking pictures* – Most mobile phones in the current 2005 market have cameras that can take still and moving images. A presentation can be greatly enhanced with pictures and video clips.

- *Interviews* – An interview can be planned within the desktop software of Quest where questions for the interviewee are prepared in advance. This is then exported to a mobile phone, where the interviewer can read the questions on the phone screen whilst the phone records the interviewee's answers using a phone's voice recording functionality.

- *Surveys* – Creating surveys is a common task in research where categorizing items could be an example of this. In Quest, users can create their survey on the desktop PC and not only print out a paper copy of it, but also export it to a mobile phone where they can save the data without pen and paper. This allows for a quick, tidy and paperless method for gathering data.

With each of these tasks, Quest allows for the information to be downloaded back to a desktop PC, where it is added to the user's portfolio. Equipping a PC with Bluetooth, IrDA or a data cable is relatively cheap compared to long term use of a phone network service. As the number of young people who own mobile phones grows, it also allows learners to use their own mobile phones possibly reducing the cost of equipping a classroom with Dictaphones and digital cameras for example. The prototype implementation in Quest demonstrated the concepts of building surveys and exporting them to a mobile phone, and of being able to send pictures back into the Quest software, running on a desktop PC. J2ME has also been shown to be a viable near-term technology for mobile learning [8], and we chose to implement the mobile functionality on this platform because of it's integrated networking and user interface components.

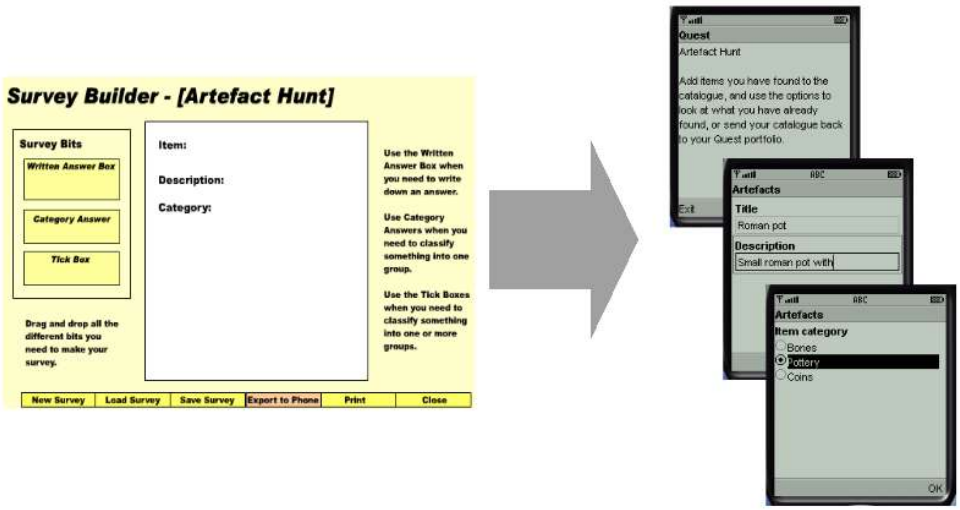


Figure 3: **Quest Survey Builder (left) and screenshots of the exported survey for a mobile phone (right).**

Figure 3 shows the 'Survey Builder' component of Quest. On the desktop PC in the classroom, users can build their own surveys using components loosely based on HTML forms. The survey components include text entry, multiple choice groups, and exclusive choice groups. In the prototype, the completed survey is exported to a small file that is transferred over to a mobile phone. On the mobile phone a J2ME application loads the representation of the survey from the file as a set of pages where the user can then input data. When the user has completed their research using the survey, the data gathered on the phone can be transferred

back to Quest into the user's portfolio.

Our software also demonstrated how media can be easily transferred from a mobile phone into a learning environment. In the Quest prototype, still pictures taken on a mobile phone can be transferred into the users portfolio. Users can then edit the pictures and incorporate them into a presentation such as a report or slide show.

The prototype software developed during the course of the NESTA FutureLab Design Challenge 2005 demonstrated both of these concepts as part of a learning environment. Using Bluetooth to transfer survey data and pictures from a Nokia 6210 Java-enabled camera phone to a Sony Vaio laptop running the Quest software, proved that mobile phones can be incorporated into learning environments without great cost.

4 Concluding Remarks

In this paper we have described our efforts in creating a learning environment software, 'Quest', that can aid classroom learning of research and thinking skills. We have described a component of this software that overcomes problems associated with networked mobile computing, in particular the high cost on both schools and users in using an infrastructure dependent on mobile phone networks. We have looked at how mobile phones can be utilized in a highly disconnected environment, where the use of such devices can possibly reduce equipment costs in the future by using learners' existing phones.

Instead of thinking of a mobile phone as a communication device, in Quest we encourage learners to look at a mobile phone as an information gathering device. Harnessing media gathering capabilities of modern phones allows for richer forms of media to be gathered without using additional equipment such as Dictaphones and digital cameras. We have also shown that the transfer of data between a phone and desktop PC need not use expensive phone network services such as GPRS and 3G, where existing Bluetooth, IrDA and data cable access can build a more local network infrastructure in the classroom environment.

Feedback from the NESTA FutureLab Design Challenge 2005 panel was very positive and the mobile aspect of Quest was seen as a novel and interesting approach as a research tool. A detailed evalutation of the effectiveness of both Quest and harnessing mobile phones for classroom learning has yet to be completed and a detailed study will be published in the near future.

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Authors:

David Johnson
The University of Reading, ACET Group
School of Systems Engineering
Reading, Berkshire, RG6 6AY
United Kingdom
d.johnson@reading.ac.uk

Ismail M. Bhana
The University of Reading, ACET Group
School of Systems Engineering
Reading, Berkshire, RG6 6AY
United Kingdom
i.m.bhana@reading.ac.uk

Florian Urmetzer
The University of Reading, ACET Group
School of Systems Engineering
Reading, Berkshire, RG6 6AY
United Kingdom
f.urmetzer@reading.ac.uk