Implications of utilising mobile handheld devices in teaching undergraduate programming learners in a developing country

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Abstract: This paper presents a preliminary study conducted at the Cape Peninsula University of Technology (CPUT) on the use of mobile handheld devices (PDAs) in an undergraduate computer programming subject.

The primary objective of this study was to investigate the wide reaching implications of utilising mobile technology as an alternative technology for teaching an undergraduate programming subject. This study explored the possible advantageous alternatives mobile handheld devices can provide to traditional programming instruction in teaching predominantly previously disadvantaged learners in a developing country, and the potential barriers to its use.

This study was conducted mainly within the qualitative paradigm, although quantitative methods were also used. Results indicate that mobile devices can be utilised as an acceptable additional technology in an undergraduate programming subject and that learners’ reactions toward these devices are positive and may increase their enthusiasm and motivation to work and learn.

Keywords: mobile handheld devices, mobile technology, programming, developing country

1. Introduction

A global assessment of the use of mobile learning (m-learning) in higher education has brought into sharp focus the ever increasing use of handheld devices in higher education across the world, including developing countries like South Africa. Despite its increasing popularity, relatively little research has been conducted in computer programming subjects at higher education institutions. Continuous developments in mobile technologies offer the potential to support learners studying in a variety of subjects (Scanlon et al., 2005). Currently, there is sparse literature on how mobile technologies can be utilised in programming subjects, especially in developing countries. Vast amounts of research have been found on educational research such as SMS education (Botha, 2006; Hartnell-Young et al., 2008; Librero et al., 2007; Louw, 2005; Pettit et al., 2007; Thornton & Houser, 2005), field studies (Bradley et al., 2005; De Crom & De Jager, 2005; Kukulska-Hulme & Traxler, 2005) and medical studies (Baumgart, 2005; Berglund et al., 2006; Walton et al., 2005) however, no published literature has been found on programming with mobile devices.

As the capabilities of mobile handheld devices increase, its value as a potential teaching and learning aid is increasing exponentially, especially in subjects such as programming. It is therefore imperative to identify different ways in which these devices could be introduced into programming subjects to contribute and add value toward the enhancement of the learning environment.

During the last few years it has become evident that undergraduate computer programming learners in the Financial Information Systems (FIS) course at the Cape Peninsula University of Technology (CPUT) find it difficult to complete and electronically submit programming assignments due to the unavailability of Internet access at home/residence and more importantly the unavailability of the Visual Basic 2005 application on their personal computers. This has a significant impact on learners’ practical performance, because programming assignments represent a large portion of their final mark. As a result a relatively large number of learners achieve unsatisfactory practical marks and it is increasingly becoming apparent that it would be prudent to diversify and improve the learning experiences of these learners.
According to Ford and Botha (2007), there is “a need for new approaches to integrate technology into the classroom, particularly in an African environment”. Therefore, in an attempt to address the abovementioned practical problem, this study focused on a design experiment in which programming learners made use of mobile handheld devices to supplement the information and support they need to complete practical programming assignments devised by the author. The benefits and constraints introduced by these devices were assessed and attempts were made to find out how this can be used to support and enrich the learning environment of learners.

2. Methods

In order to understand the implications of utilising mobile handheld devices in a programming subject, a design experiment was conducted over a four-week period. Funding was secured from the National Research Foundation (NRF) in South Africa for purchasing 32 personal digital assistants (PDAs). Learners were provided with these devices preloaded with the Basic4PPC application for use at university and home. Even though only 50% of the learners indicated that the Basic4PPC application does not require much training, it enabled and encouraged learners to design, develop and electronically submit mobile applications in the Visual Basic programming language anytime, anywhere without the necessity of a computer.

A total of 53 full-time first year learners enrolled for an undergraduate computer programming subject as part of the FIS course at the CPUT. Learners were academically and culturally diverse and to the majority of these learners English was a second or third language. Only 4% of these learners had previous programming experience. A questionnaire was given to learners (n= 53) after using the mobile devices during the intervention period. Forty two questionnaires were completed of which two could not be used. The response rate was 79% with 12 (30%) men and 28 (70%) women (age range 18-25). In addition, learners were also observed during this period while utilising the mobile devices.

2.1 Questionnaire

After the four-week intervention, learners were asked to complete an anonymous questionnaire to evaluate learner satisfaction with the m-learning environment as well as the usefulness and usability aspects of mobile handheld devices as a learning tool in a computer programming subject. Questions were formulated to evaluate different aspects of usability, learner attitude, general experience, satisfaction with PDAs, and the impact PDAs had on their teaching and learning experience.

2.2 Observation

Learners were observed, photographed and video recorded whilst participating in this study. Information was gathered on learners’ attitudes and how they use and interact with mobile handheld devices.

3. Results and discussion

3.1 Questionnaire

From the 40 learners who have completed the questionnaire, 40% did not have access to a personal computer at home or at their residence. With respect to Internet access, only 30% of these learners reported having access to an Internet connection. However, none of these learners have the programming language Visual Basic 2005 installed on their personal computers which is required in the programming subject in the FIS course. This implies that all learners (100%) are unable to complete and electronically submit assignments from home/residence and are thus dependent on campus computer laboratories whose access are not always practical due to time, distance and location constraints.

Additional analyses on mobile technologies showed that 95% of learners have access to a mobile phone and only 20% have access to both a mobile phone and laptop/notebook. All learners indicated that they do not have access to PDAs (100%).
A relatively small number of learners (30%) indicated the importance of travel periods for engagement with mobile devices. These results are in contrast with research conducted by Pettit et al. (2007) and Thornton and Houser (2005). These authors found that a significant number of learners used the travel period to access learning material on their mobile devices. When the programming learners were probed about why they would not use mobile devices while making use of public transport, the main reason was the possibility of theft. All learners indicated that they use the PDA at home and 55% use these devices on campus outside scheduled programming classes.

Learners were also requested to state at least one advantage and disadvantage of PDAs in relation to their learning. The mobility of mobile handheld devices (being able to use it anywhere, anytime) was highlighted to be the most important feature. Learners pointed out that the ability to work in their own time and at their own pace motivated them. Overall, results obtained from the questionnaire on learner perceptions of the use of mobile handheld devices were encouraging. Learners felt that they became productive quickly and that they feel in control when using the device. One learner even mentioned that he “feels cool” when using the device. Furthermore, 95% of learners indicated that the PDA was helpful to their learning, and that it added value to the subject. The ability to complete and submit assignments by means of these devices were highly rated by the learners and attributed to an increase in their enthusiasm. In general the learners responded with eagerness, and found the PDAs non-threatening and easy to use. It proved to be popular with both male and female learners.

The majority of learners indicated usability problems of which the small screen size and fragility of PDAs were the most prevalent disadvantages. Other problems experienced were the sensitivity of the PDA screen, the stylus that is difficult to use and that it cannot be utilised as a mobile phone.

### 3.2 Observation

Learners have shown a lot of enthusiasm when the mobile handheld devices were handed out to them for the first time. Learners were briefed beforehand on their responsibility towards the devices and its fragility. This resulted in learners handling the device with great care. Though some learners were cautious to use the mobile device, others were more confident and gave devices their own personal feel (i.e. changing the start-up picture, colour scheme etc.).

Learners were introduced to the basic functions/capabilities of the PDA before using the Basic4PPC application. Learners were shown the different input methods by means of the stylus and all of them preferred using the keyboard even though they complained that it was too small. Several learners were intrigued by the new mobile technology and immediately started exploring other functions (i.e. Bluetooth, Wi-Fi and Internet connectivity). The prospect of being able to connect to the Internet from home/residence via their mobile phones - something none of them has done before - made learners even more enthusiastic to use these devices.

Because learners had to share mobile devices (two per group) due to its limited availability, it was clear that one learner was always in control of holding and operating the device. After a few minutes learners (those not using the device) became bored and started playing games (Solitaire), accessing the web (Facebook) or sending e-mails. This however changed after a few weeks when learners experienced fewer problems and were less distracted while using the mobile devices. In group context learners collaborated more and started to exchange mobile devices every few minutes, thus becoming more productive quickly.

### 5. Conclusions and future work

Based on preliminary data gathered from learners, they encounter numerous barriers to successfully complete their programming assignments, of which the lack of access to technology (computers and the Internet) and programming applications (Visual Basic 2005) are the two major stumbling blocks. The possibilities offered by mobile technologies, allowing learners to be connected 24 hours/7 days a week, independent of time and location, is considerable and can overcome many of the difficulties that learners are facing in getting access, for example, to programming software, practical assignments, lecture notes, syllabus, etc.
Providing learners at CPUT with access to remote resources while on the move, has increased their capability to physically shift/transfer their own learning environment as they move, thus enabling them the opportunity to take the learning experience outside the boundaries of the classroom. Key findings from this preliminary study show that mobile devices can be utilised as an acceptable additional technology in an undergraduate programming subject. The results of this study further indicate that learners’ reactions toward these devices are positive and may increase their enthusiasm and motivation to work and learn. However, this study has some limitations. First, as with any new technology that is introduced in a learning environment, there is always a novelty effect (Swan et al., 2005). Learners are likely to be more motivated to use new technology for learning because it is a novelty. This increase in motivation can be partially explained by the novelty of using a mobile handheld device. It might be possible that after the novelty of the new device has worn off, learners might come to view the device as a working tool (Belt, 2001). Whether this will always be the case remains to be seen. Second, the use of the mobile devices was studied for a relatively short period of time. Further study is needed to determine the critical success factors of mobile devices, the patterns of use of these devices when utilised by learners in a wireless study environment and any other location of choice, as well as the extent to which these devices can add value in teaching programming learners.

Despite the vast number of advantages of mobile technology, it is important to recognise that PDAs cannot replace traditional methods of instruction. It is important to ensure that mobile technology is used in a pragmatic way by focusing on the advantages of these devices, rather than to try and replicate the functionality of a computer. Therefore, traditional instruction and the utilisation of mobile technology should complement each other.

References


