

Learning tools in resource constrained environments: Learning from e-learning in the time of m-learning

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ABSTRACT

Developing countries such as South Africa have underdeveloped human resources. Teaching with information communication technology (ICT) as enabling technology has often been proposed as an approach to maximize the development of human resources. Mobile phone features such as limited dependence on permanent electricity supply, easy maintenance, easy to use audio and text interfaces, and affordability has made the mobile phone the most important networked knowledge exchange technology in the developing world. Due to this accessibility, usability and universality mobile phones have unmatched potential for innovation of education delivery in the developing world. Unfortunately the potential to address human resource development through ICT is restricted by the level of technology adoption and resource constraints in the South African tertiary education context. Firstly, the level of technology penetration in Africa is low compared to other developing countries and this lack of technological development has a detrimental effect on the education sector. Secondly, students at Higher Education Institutions (HEIs) are often constrained in terms of financial resources and academic preparedness for entering a HEI. The financial and educational constraints that hinder the adoption of ICT and specifically mobile technology in developing countries need to be prioritized for resolution rather than accepted as inevitable.

This highlights the importance of proper planning to ensure the selection of appropriate technology for teaching and learning in resource constrained environments. The purpose of this paper is to investigate students' actual use and preferences of e-learning tools as a point of departure for predicting students' preferences for m-learning tools and functions. The study was done at the Tshwane University of Technology where most students come from formerly disadvantaged population groups. The research strategies include lecturer observations, interviews with students and an online survey. The contribution of the study is to propose a set of usage spaces for m-learning based on the opinions of students who have had all had the same minimum exposure to the technology. The findings should be of value to researchers, policy-makers and practitioners in the fields of e-learning and mobile technologies towards rethinking approaches to information access and dissemination in Development Informatics.

KEYWORDS

E-learning, m-learning, usage spaces

1. Introduction

According to Jonston, Tufvesson and Johnston (2010) developing countries such as South Africa have underdeveloped human resources and therefore education is recognised as a national priority. Teaching with ICT as enabling technology has often been proposed as the best approach to maximise the development of human resources. Complicating factors include the fact that access to information technology is constrained by cost and infrastructure in developing countries (Donner 2004). Therefore information is comparatively more expensive to produce, gather, store, and share. Furthermore the level of technology penetration in Africa is low compared to other developing countries. This lack of technological development has a detrimental effect on the education sector (Barker, Krull et al. 2006). Considering the tertiary education context in South Africa, students at Higher Education Institutions (HEIs) are often resource constrained in terms of finances and academic preparedness for entering a HEI (Gregson and Jordaan). Resource constraints manifests in living off-campus and problems with transport to the university campus, which means that students regularly miss class. Another problem is the high cost of textbooks, which results in many students relying on study guides, notes taken in class, or incomplete copies of textbooks rather than purchasing the books. However, mobile and wireless technology adoption in South Africa is challenging this low adoption rate (Botha and Ford 2008) and mobile phones have been hailed as the savior technology for addressing the development of human resources in South Africa (van Biljon and Renaud 2009).

Mobile phones have remarkable potential as knowledge exchange devices in the developing world due to their accessibility, usability and universality. Mobile phone features such as limited dependence on permanent electricity supply, easy maintenance, easy to use audio and text interfaces, and affordability has made the mobile phone the most important networked knowledge exchange technology (Van den Berg, Botha et al. 2008). Furthermore, the prolific adoption of mobile phones in developing countries and specifically South Africa create an opportunity to use mobile technology for disseminating information (Botha and Ford 2008) and specifically m-learning.

Given the fact that m-learning developed out of e-learning, it is important to consider the adoption history of e-learning. E-learning literature shows a 'rise-fall-plateau-rebirth' progression that has been likened to the mythical Phoenix bird that is supposed to die by fire in order to be reborn from its own ashes (Romiszowski 2004). To avoid a repetition of this adoption pattern of terminating, before re-emerging later it is necessary to gain an understanding of the considerations associated with the use of wireless technologies and identify the pitfalls that could sabotage the m-learning adoption process. Furthermore, adoption of learning innovations are context specific and therefore solutions from developed countries cannot be applied without due considerations of social and cultural context. Traxler(2005) sounds the warning that m-learning has consistently failed to live up to its expectations and thereby supports the argument for a proper investigation of the factors that could influence the adoption of m-learning. Students' prolific acceptance of mobile technology and technology related information dissemination platforms strengthens the argument for the increased use of technology in teaching and learning.

In summary, developing countries have financial and educational constraints that hinder the adoption of ICT. This does not mean they can afford to ignore the remarkable potential of mobile phones as knowledge exchange devices in the developing world but rather highlights the importance of proper planning required to ensure the selection of

appropriate technology for teaching and learning. Furthermore, this justifies the goal of this research namely to learn from e-learning adoption as a more mature technology. Obviously the differences between the technologies have to be taken into account. The purpose of this paper is to investigate students' actual use and preferences of e-learning tools as a point of departure for predicting students' preferences for m-learning tools and functions. This comparative study investigates student's preferences for information technology tools by comparing their feedback on the use of mailing lists, blogs, online mark management tools, Box.Net (file storage service), Turn It In (plagiarism checking service), WebCT (online learning management system) and Twitter (microblogging). The study was done at the Tshwane University of Technology where most students come from formerly disadvantaged population groups. The tools were chosen with mobile phone technology in mind. The tools examined were thus chosen when possible to be useful over this channel.

The adoption of information technology tools in e-learning are influenced by various factors that include infrastructure, perceived usefulness, perceived ease of use and social context (van Biljon and Renaud 2009), this makes it difficult to discern the individual factors and therefore a selection of tools were used, some offering similar functionality to identify the information students used rather than the adoption of the tool. The literature survey identified a number of surveys on student preferences regarding information technology toolset. However, the flaw in most of the current studies is the lack of evidence on controlled exposure to the technology. This means that students may be answering questions on technology that they have not actually used or have not had the same exposure to. To ensure that the students had an informed opinion about the technology they were exposed to in the course of two semesters where students were required to use the technology and the survey was conducted at the end of the second semester. The paper is organised as follows: the literature study in Section 2 provides a discussion of the tools used followed by a discussion on mobile information usage spaces. The research design is explained in Section 3 and the results from the online survey are presented in Section 4. The findings regarding e-learning are discussed in Section 5. The paper concludes with the implications for m-learning in Section 6.

2. Literature Study

The structure of the literature study represents the two tiers of the study, namely e-learning and m-learning. In Section 2.1 the e-learning information tools are discussed, compared and also evaluated from the viewpoint of the lecturer. Literature on the architecture of mobile information functions is reviewed in section 2.2 where the concept of usage spaces is introduced. This concept allows the abstraction of information usage on a level where e-learning and m-learning usage can be reasonably compared.

2.1 Learning Tools

The use of technology in teaching includes, using the internet to find information, using learning management software to manage courses, using learning management software to write exams, using social networking sites such as Facebook or Twitter to communicate and question, using laboratories as classrooms, using podcasting to get material to students. The tools examined here are mailing lists, blogs, an online mark management tool, Box.Net, Turn It In, WebCT and Twitter. The major benefit of these tools is that they are asynchronous. While they were not

used to replace lectures, they did increase the flexibility of the course by providing additional support for students who needed help with the material. In addition, they allow students' who have missed lectures to get up to date without contacting the lecturer or other students. For additional benefits of asynchronous communication methods in the context of online learning, refer to (Weller 2002).

Mailing List

A mailing list is a method for creating an online community based on the exchange of emails. All participants register via sending a registration email to a server. Mailing lists are usually created around a particular theme. Registration is usually automated and fast. Some mailing list management software allows registration via a web interface. After users have registered with a mailing list, they can send email to the mailing list, and all members will receive a copy. A mailing list has an administrator that can block inappropriate messages. At TUT Yahoo! Groups was used to manage the mailing list (<http://groups.yahoo.com>). The reasons for using Yahoo! Groups was primarily because its free, the lecturer is familiar with it and it runs on a network external to TUT so would not be affected if TUT experienced network problems. The mailing list was used for a number of purposes. It could also be used to inform students of changes in venues and so forth, but more importantly it could be used to distribute study material, web links, answer questions raised in class, and distribute marks and so on. In addition, students could ask questions at any time and receive answers either from other students or from the lecturer.

Box.Net

Box. Net is a file hosting service that can be found at <http://www.box.net/>. It allows anyone to upload files for distribution to either anyone, or a restricted subset of people. Lecturers can use it to upload course material and other files, and students to download the files via a convenient web interface. The reason for using an external file hosting service was in case of network problems at TUT. In addition, many students claimed not to be able to access TUT's file hosting application (WebCT). The higher usage statistic of Box.NET, coupled with no complaints about non-availability of files, suggests that there might have been a grain of truth to this. A low management secondary file hosting service is a good backup, allowing access to material promptly. While Box.Net charges for storage, they do have a free option that allows enough space to easily run several classes. At the time of writing, Box.Net allows 1 GB of free storage, with a restriction on file size of 25 MB.

Engrade

Engrade is a simple mark tracking application. Lecturers can use it to track marks for assignments, tests and so forth. Students see a web-based report of their performance. It is generally agreed that students who have access to grades quickly feel more engaged with the learning process (Brown, Knight 1994). Engrade can be found at <http://www.engage.com>. The reason for using Engrade is its user-friendly interface. The interface is based on that of a spreadsheet, so the time taken to learn how to use Engrade is low. The system is flexible, allowing for different numbers of different types of assessments to be tracked, per class. Another consideration was that it is hosted outside of TUT, and thus is not affected by network problems. It is also a tenet of educational practice that rapid feedback is important. Cost is always a consideration, and Engrade, being free, was an easy choice to make.

WebCT

WebCT is a set of online tools that allows teachers to create, teach and manage online courses. The company is now owned by Blackboard (<http://www.blackboard.com>) and the name WebCT is being phased out.

TUT used WebCT as its primary online teaching tool for both full-time and part-time students. Study material would typically be uploaded for students to download. Marks could also be tracked, messages sent, and discussion via forum could be enforced. Online tests could also be set using WebCT. Of particular interest is the facility whereby courses could be prepackaged, and distributed via CD or DVD for creating the same course on different institutions' WebCT installations. Often these CDs or DVDs are supplied with lecturer's support material for text books.

While WebCT caters for file hosting, forums and messaging, problems with the TUT network would mean that students lost access to all these services.

Blog

A blog is "short for web log, an online, regularly updated journal or newsletter that is readily accessible to the general public by virtue of being posted on a website (Answers.com 2010). Blogs typically report and comment on topics of interest to the author, and are usually written and posted using software specifically designed to facilitate blogging; they include hyperlinks to other website and, often, photos, video clips, and the like. The most recent entry by the blogger is posted at the beginning of the blog, with earlier entries following in reverse chronological order; comments and other responses to the blog by readers are often posted after each entry". The lecturer used a blog for three purposes. The first purpose was to answer difficult questions that arose again and again, on a forum that allowed the lecturer to answer once and then students registered during any semester could browse at their leisure. The second purpose was to post current news about the subject topic from industry. The third was to post links to websites, videos and podcasts that provide the same, supporting or additional material as found in the textbooks. For some subjects, especially the multimedia ones, many students could not afford the textbooks. While the university policy is that it is compulsory for the student to purchase the textbook, in practice many simply did not. Rather than exclude these students, it was thought that the approach used in the blogs would help alleviate the problem by directing students to resources which were philosophically and pedagogically aligned with the textbook, while providing additional material for students who did purchase the textbook.

Richardson (2006) provides a list of benefits that blogs have been shown to exhibit in the field of education. They are:

- Promote critical thinking and analysis
- Be a powerful promoter of creative, intuitive and associational thinking
- Promote analogical thinking
- Be a powerful medium for increasing access and exposure to quality information
- Combine the best of solitary reflection and social interaction

Richardson goes on to provide a number of interesting methods for using blogs in the classroom. He does not restrict the use of blogs to lecturers, but also suggests students make use of the. He provides more than 40 possible uses of blogs for education (Richardson 2006).

Turn It In

TurnItIn (2010) allows educators to check students' work for improper citation or potential plagiarism by comparing it against continuously updated databases, other students work and the Internet. Every originality report provides instructors with the opportunity to check the work towards teaching students proper citation methods and safeguarding students' academic integrity. Plagiarism was a major problem at TUT, with some classes handing in assignments which were all plagiarized. *TurnItIn* is a valuable tool that identifies plagiarism and shows the source. While this service is obviously useful to lecturers, students reported that they found it valuable to ensure they didn't "accidentally" plagiarize someone else's material.

Twitter

Twitter is a micro-blogging tool. Posts are limited to 140 characters. This makes Twitter ideal for mobile phone integration, because Short Message Service (SMS) message are limited to 160 characters. Users can access Twitter via the WWW at <http://www.twitter.com>. There are also a variety of desktop applications for all major operating systems. The majority of modern phones, and certainly all smart phones, can access Twitter either via surfing to the Twitter website, or by installing a custom application. A number of applications also integrate Twitter with other social networking applications such as Facebook and Buzz.

Users typically follow other Twitter users, and receive a constant stream of updates. Users are in turn followed, and post short messages on a variety of topics. At TUT Twitter was used to post reminders to students regarding due dates for assignments and exams. In addition it was used to quickly disseminate links to interesting web sites. Perhaps its most important function was to inform students of a change in venue, or alert them in case of the lecturer missing class. Twitter's ubiquity and ease of access makes it an ideal tool for these purposes.

2.2 Mobile learning and information usage

Mobile learning is more than just about using portable devices to learn as the mobile usability, network capabilities and e-learning components has to be considered (Mostakhdemin-Hosseini and Tuimala 2005). The definition of mobile learning seems to evolve as the technology evolves and also according to the researchers' perspective. Sharples(2006) note the following broad categories of current perspectives on mobile learning:

- Technocentric where mobile learning is viewed as learning using a mobile device, such as a PDA, mobile phone, iPod, PlayStation Portable etc.
- Relationship to e-learning which characterizes mobile learning as an extension of e-learning. This stream of thought tends to place mobile learning somewhere on elearning's spectrum of portability (Traxler 2005).
- Augmenting formal education. In the mobile learning literature, formal education is often characterised as face-to-face teaching, or more specifically, as a stereotypical lecture. However, it is not at all clear that this perspective is wholly correct as forms of distance education (for example, distance correspondence) have existed for over 100 years.

In summary mobile learning can be defined as any type of learning that occurs when the learner is not at a fixed predetermined location, or learning that happens when the learner takes advantage of the learning opportunities

offered by mobile technologies. Bruno Zuga, Ilmars Slaidins, Atis Kapenieks and Armands Strazds(2006) describe m-learning as a mobile extension of e-learning technologies and approaches and see mobile knowledge management (mKM) as building on knowledge management technologies and approaches. They see the fields as diverse, complex and overlapping as can be graphically represented in Figure 1.

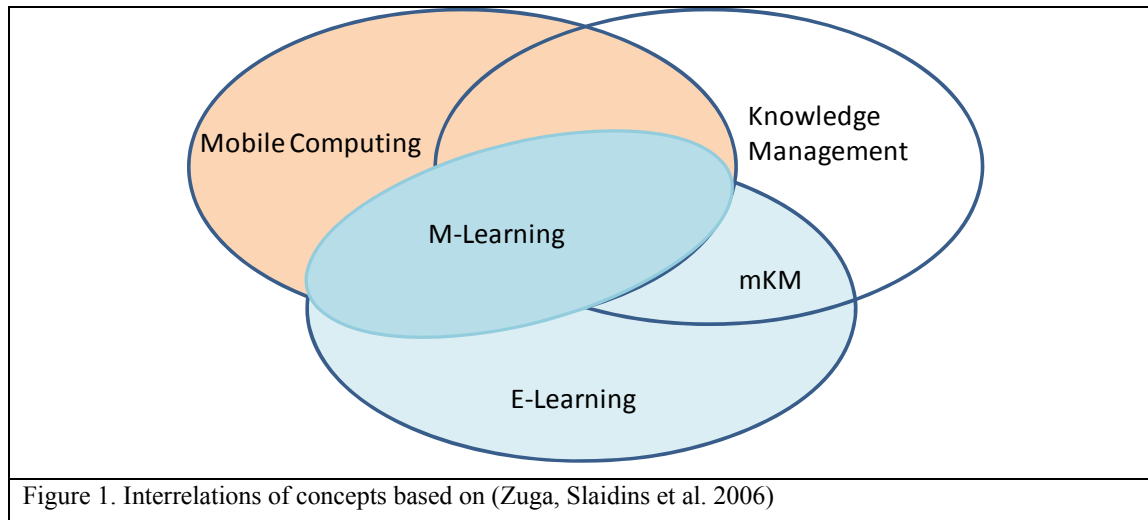


Figure 1. Interrelations of concepts based on (Zuga, Slaidins et al. 2006)

To understand user needs in the m-learning context it is useful to consider their motivations and the type of content they would use. Regarding personal mobile phone use of university students, Van Biljon, Kotze and Marsden (2007) distinguished two groups of spaces, the core spaces which a user expects to have and the additional spaces that enhance user experience in using the mobile phone. The individual components of the spaces include:

- core: namely relationships, personal information, organisation, safety, security
- additional: entertainment, m-commerce, expansion, non-personal information, personal history, image.

Taylor, Anicello et al. (2008) classified the motives for mobile information access into utilitarian and hedonic, where each component includes the following mobile phone usage motivations:

- utilitarian : need to use for convenience, restrictions at work, computer occupied by someone else
- hedonic: curiosity, social connection, and social avoidance.

Although not exactly the same this classification resonates with the structure of the usage space model presented by van Biljon, Kotze and Marsden (2007) by also having two sets of spaces with the one core and the other additional. Focusing on mobile learning, Cui and Roto (2008) identified the following taxonomies on mobile Web information usage: Information (fact) finding, information gathering, browsing, communication, transactions, maintenance. These can be abstracted further into the following mobile web usage space categories: information seeking, communication transaction, and personal space extension (Cui and Roto 2008).

In African countries, mobile phone usage takes on a new role as people access information through mobile devices because they do not have Internet connected desktop computers (Donner and Gitau 2009). Mobile cellular phones bring communication where there was none especially in communities that were sidelined by the digital divide (Botha, Van der Berg et al.). The context of the mobile phone user includes the physical, social, mental and

technological (Jones and Marsden 2005). Focusing on the user’s physical relation to space and time, Botha, van Greunen and Herselman (2010) describe high context as interactions and situations where the physical relation to space and time are less significant to the interaction . Their context-mobility matrix depicted in Figure 2 presents the stance of the user and how the user engages with the mobile technology in different contexts versus different mobility possibilities, detailed as follows:

- **Low Mobility:** Low Mobility interactions refer to the static use of mobile technology. The potential mobility of the device or the user is not essential for these interactions and the mobile technology is primarily being used as a result of other factors like low cost, availability, convenience and restricted connectivity. These factors are typical characteristics of mobile phone use in developing countries.
- **High Mobility:** High Mobility interactions are viewed as interactions in which the mobility of the technology or user is an essential element to the activity. This is often not the case in developing countries, as the mobile phone is used as a computing and communication device while mobility is incidental rather than essential.
- **Low Context :** In a low context scenario, users do not actively use the surrounding context. This holds true for most mobile interactions in developing countries where there are few wireless areas or other facilities that can feed into the mobile interaction.
- **High Context:** High context interactions are viewed as interactions in which the context feeds directly into the interactions. This refers to both the context of the user and the physical context of the interaction.

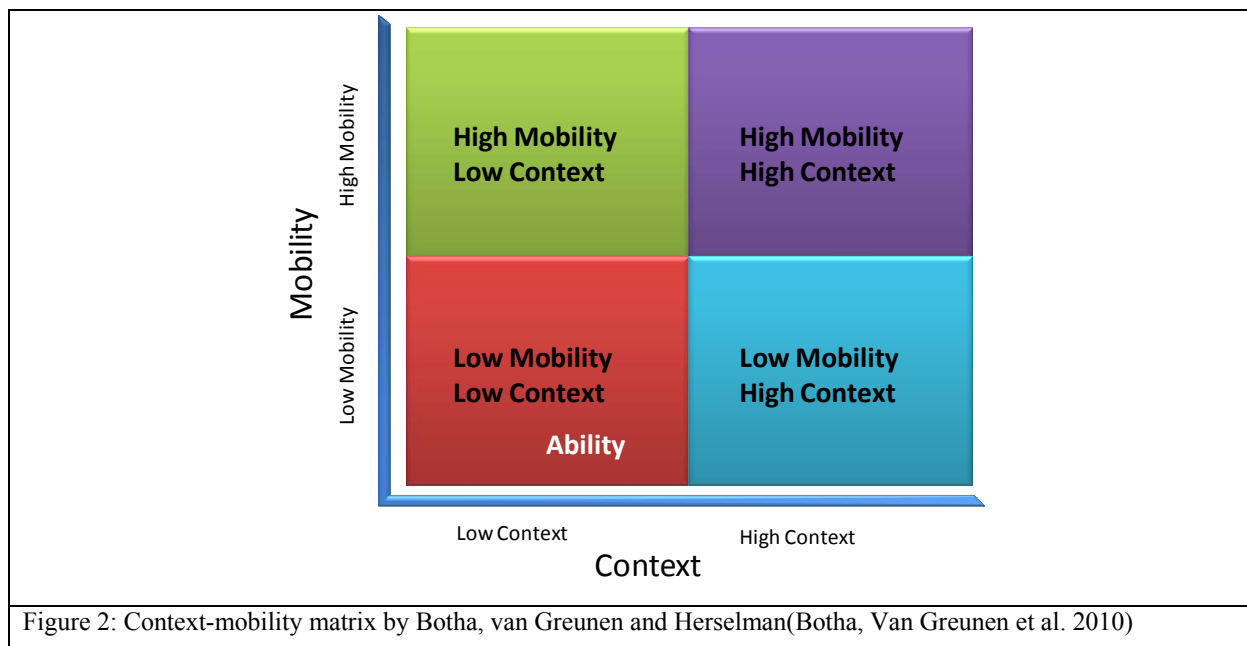


Figure 2: Context-mobility matrix by Botha, van Greunen and Herselman(Botha, Van Greunen et al. 2010)

According to this matrix developing countries have a low context and low mobility. For example, access to the Internet as a platform for learning, has remained limited in Africa due to lack of infrastructure, together with reliability, affordability and performance issues (Botha, Van der Berg et al.). Barriers to using mobile phones in education have been identified and ranked as follows (Gregson and Jordaan): 1. Cost, 2. Coverage, 3. Theft, 4. Reliability, 5. Damage, 6. Power supply. Therefore mobile learning usage spaces for developing countries will be a subset of the spaces mentioned as determined by the context of the students in the developing world and the barriers

identified. The information usage spaces identified from this e-learning study in a developing country will be used to propose usage spaces for m-learning in developing countries. In the next section we will discuss the research design and strategies used to capture and analyse data.

3. Research design

Considering the tools discussed in section 2.1, we identified the following main information uses:

- social networking,
- study information dissemination (and storage),
- mark checking,
- plagiarism checking.

Currently learning management systems may offer all of these services but the prioritizations of these services remain important when selecting services for mobile learning. With sections 1 and 2 as background the following research questions emerge:

1. What are the primary functions that students use information tools for?
2. What are the m-learning usage spaces for developing countries?

To ensure that the students had an informed opinion about the technology, the online tools were implemented for semester classes at TUT for a minimum of two semesters. Students were required to use the technology and the survey was conducted at the end of the second semester. Some students had used some of the tools before, giving them multiple semester experience with the tools, but no student had less than 5 months exposure to each online tool. During this time we conducted multiple discussions about the tools with the students. An online survey was conducted near the end of the second semester to determine if the anecdotal impressions gleaned from the discussions were accurate. The questions were available for 2 months. Students were asked to respond on the following scale: 1 = Not helpful at all, 2 = Somewhat helpful, 3 = Helpful, 4 = Without it I would not manage.

The following questions were asked on the online survey given to the students.

1. Do you find Twitter to be useful in my classes?;
2. Do you find the class blog useful in my classes?
3. Do you find Box.Net useful in my classes?
4. Do you find WebCT useful in my classes?
5. Do you find the mailing list useful in my classes?
6. Do you find Engrade useful in my classes?
7. Do you find TurnItIn useful in my classes?
8. Which is the most useful tool in my classes?
9. What is the LEAST useful tool in my classes?

Participants

The 35 participants were between the ages of 19 and 27. Their home languages included Sotho, Zulu, Setswana and Xhosa. All demonstrated a good command of English. They were mostly South African students from previously

disadvantaged communities but there were a few overseas students as well, two from Angola and four from Nigeria but all from African countries.

4. Results from the e-learning study

The responses regarding the usefulness of each individual tool is depicted in Figure 2 which shows the average and the mean of the responses to questions 1 to 7 in the online survey. Through discussion with students, it become apparent that the mailing list was more useful to students than the other tools, and generated more opportunities for online discussion, file-sharing and lecturer-to-student communication.

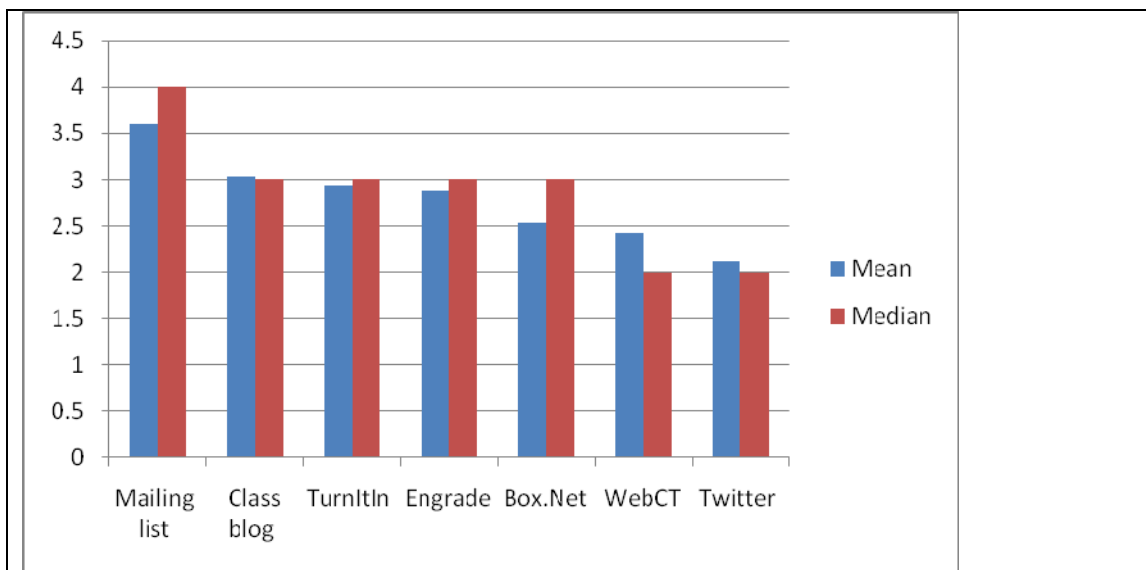


Figure 2: Responses to questions 1 to 7 in online survey

The responses from the online survey question 8 regarding the relative usefulness of the tools (as depicted in Figure 3) confirmed the anecdotal evidence that the most favoured tool is the mailing list.

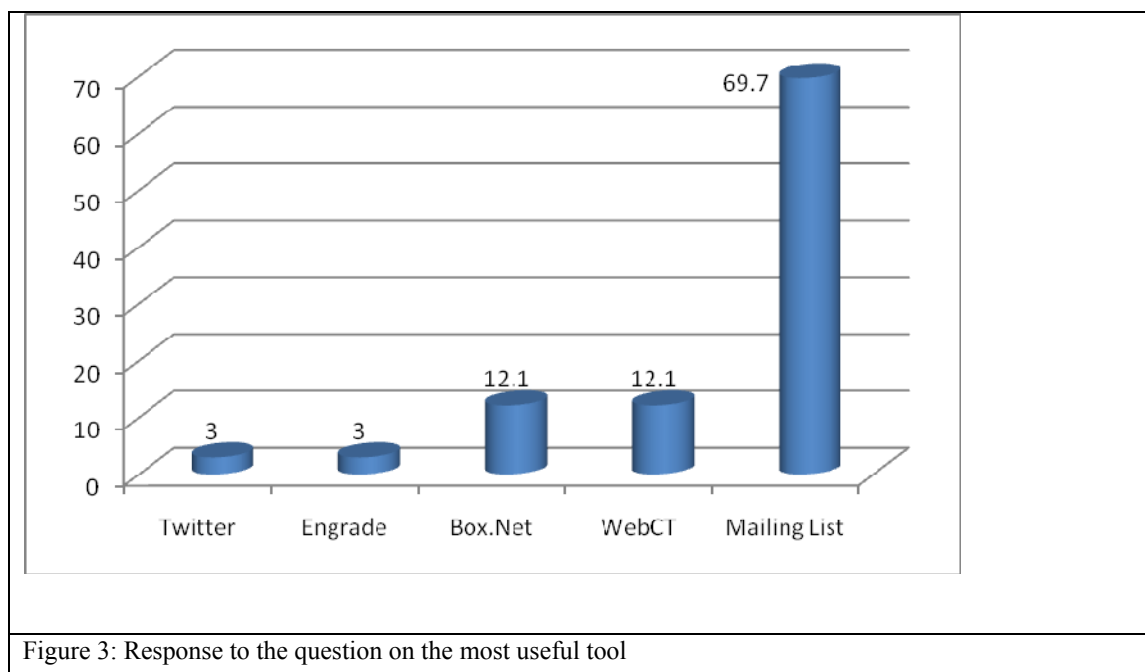


Figure 3: Response to the question on the most useful tool

One possible explanation is that the mailing list is comprehensive; that means it is used for administrative and academic announcements and queries, posting information, answering questions and interacting outside of the lecture hall. In a sense, the mailing list performs the functions of most of the other tools, using an interface (email client) of the respondent's choice. Despite attempts to use an online forum and Facebook as an alternative to the mailing list, the mailing list remained the most popular. The online forum proved so unpopular that it was discarded. It is not clear if this was due to the nature of forums in general or the particular forum that was used. It was expected that due to factors such as the high cost of textbooks, that the blog would be popular. However, only one respondent indicated that it was the least useful tool, and no respondent indicated that it was the most useful tool. The fact that 80% of respondents indicated the blog is helpful or indispensable suggests that the respondents do not view the blog as a value-added service, but rather as a baseline service. Another interesting result was the relative disinterest in the use of Twitter where Twitter was found the least useful tool in the response to question 9. Looking at the Twitter user demographics, college students and lower income people are the biggest users of Twitter (DigitalSurgeons 2011). These statistics, combined with the suitability of Twitter to the South African environment, raised the expectation that it would be a popular tool. Perhaps a clue can be found in the age demographic, with only 13% of Twitter users falling in the respondent's age group. Students were not questioned on the use of Facebook but 11% (4 of the 35) participants recommended Facebook as a service they would like to be included in an e-learning platform (in response to the open-ended question on what they would like to add). However, from the informal interviews with students it seemed as if Facebook was not used for academic purposes. This finding is supported by who confirms the notion that students differentiate between social communication as a "fun" activity for socialising and talking to friends about work and actually doing work (Madge, Meek et al. 2009).

5. Discussion

The investigation of students' use and preference for e-learning tools provide evidence that the students' use of technology for learning is not necessarily related to non-academic consumption of ICT, otherwise the social networking tools (blog and Twitter) would have scored higher in usefulness. Returning to our research questions on the primary functions that students use information tools for, it was found that information dissemination and communication tools were the most used while practical constraints such as access to the technology and cost influence of adoption. Considering the mobile phone information usage spaces named in section 2.2 we now propose the identification of mobile learning usage spaces for developing countries based on the results of the e-learning functions and services usage evaluated. The usage spaces for m-learning seems to fall into two categories namely, the core and then the additional spaces as was the case with personal mobile phone usage (van Biljon, Kotzé et al. 2007; Taylor, Anicello et al. 2008). The core spaces (baseline services) for m-learning are proposed as:

- Information dissemination (seeking): In e-learning this refers mainly to the uploading, downloading and storage of files. Mobile phone constraints currently limit the scope of disseminating files but the phone is used to find and gather information. Capturing content objects from the Web for personal use is probably the essence of this category, while mobile phone constraints limits the scope of the usage technology is continually evolving and therefore it should not be seen as a permanent obstacle. The identification and prioritization of this category is based on the importance attributed to the tools: Mailing list, WebCT and Box.Net as depicted in Figure 2 and Figure 3.
- Academic communication: mostly between lecturers and students including announcements and queries, posting information, answering questions, using the Web to participate in chat rooms or discussion groups but excluding personal social networking. The identification and prioritization of this category is based on the importance attributed to the mailing list, WebCT and the blog.

The additional mobile learning usage spaces would then include:

- Social communication (includes social networking): using the Web to participate in chat rooms or discussion groups. The identification and prioritization of this category is based on the relative unimportance of social networking (Twitter) and literature evidence on the distinction between social communication as entertainment on the one hand and academic communication and work on the other (Madge, Meek et al. 2009).
- Transaction: this refers to maintaining content objects online for personal access like in checking marks and checking plagiarism. The identification and prioritization of this category is based on the usage of Engrade and Turnitin.

6. Conclusion

This paper investigated students' actual uses and preferences of e-learning tools as a point of departure for predicting students' preferences for m-learning usage of tools and functions. Based on the findings from the lecturer's observations, informal interviews with students and the online survey it is concluded that practical constraints such as availability, reliability and cost are still playing a big role in students' preference for learning

tools. This is important when considering the adoption of tools and information for m-learning. Furthermore, students showed a need for reliable, cost-effective tools for information dissemination, another challenge for m-learning. Certainly this does not diminish the usefulness of the communication, transaction and personal space extension uses but it highlights that constraints need to be recognized in planning m-learning.

The contribution of the study is to propose four mobile information usage spaces for m-learning in developing countries. Information seeking and academic communication are the core spaces with social communication and transactions as the additional usage spaces. Reluctance to use social networking tools such as Facebook for academic purposes was surprising and led to the differentiation into academic communication and social communication usage spaces. As a communication device the mobile phone is superior to pc-based communication services evaluated here, therefore more research is required specifically using mobile devices. These mobile phone information usage spaces are proposed as a point of departure and more research is needed to verify these findings and refine the usage spaces proposed.

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