PROCEEDINGS OF THE 14th ANNUAL CONFERENCE ON WORLD WIDE WEB APPLICATIONS

7-9 November 2012
Durban
South Africa

Editors:

A. Koch
P.A. van Brakel

Publisher:

Cape Peninsula University of Technology
PO Box 652
Cape Town
8000

Proceedings published at
http://www.zaw3.co.za

ISBN: 978-0-620-55590-6

TO WHOM IT MAY CONCERN

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Pretoria

Prof D van Greunen
School of ICT
Nelson Mandela Metropolitan University
Port Elizabeth

Further enquiries:

Prof PA van Brakel
Conference Chair: Annual Conference on WWW Applications
Cape Town
+27 21 469 1015 (landline)
+27 82 966 0789 (mobile)

Mobile learning in higher education: a study of the technology readiness of students at a South African higher education institution

N. Naicker
Durban University of Technology
Durban
nalindrenn@dut.ac.za

T. M. van der Merwe
University of South Africa
Pretoria
South Africa
vdmertm@unisa.ac.za

Abstract

Recent accessibility drives and price wars between the major SA cell phone companies suggest that the landscape for the adoption of mobile learning (m-learning) at Higher Education Institutions (HEI's) level may be changing. As such there is a need to gauge the current mobile technology readiness of students for m-learning, where mobile technology readiness refers to the extent to which students have access to mobile devices (and not only handsets), and can afford data bundles that meets or exceeds the requirements of a base set of currently available m-learning applications. This paper presents and discusses data gathered from a questionnaire distributed under students at a HEI in South Africa, the explicit purpose to determine the technology requirements of currently available m-learning applications and the extent to which student mobile devices comply with those requirements. Our findings show that despite a high level of ownership and a reasonable compliance with application requirements, data costs remain prohibitive. In discussing the results, we present several data views to guide HEI's in their m-learning decisions.

Keywords: Mobile learning, mobile learning applications, technology readiness, mobile device ownership, internet connectivity, data bundle costs

1. **Introduction**

Statistics show mobile handset ownership in many parts of the world to outweigh that of personal computers sometimes by as much as five or ten to one(Prensky 2004). This global trend is particularly evident in Africa, where mobile handset ownership is amongst the highest in the world (Andaleeb et al. 2010). For the reason that ownership of mobile devices opens up opportunities to reach a wider audience for higher education (Zawacki-Richter et al. 2009), most higher education intuitions (HEI’s) have taken an active interest in m-learning solutions.

In South Africa (SA), however, m-learning has yet to progress to the point where it can be considered a conventional teaching and/or learning approach. Two reasons are advanced for this status quo. Firstly, m-learning is a relatively new phenomenon, with its theoretical, pedagogical and technical structure still in development (Brown 2004). As such, there is a research fixation on resolving the "how" of m-learning. Secondly, as Esselaar and Stork

ISBN: 978-0-620-55590-6

(2005) and (Ford & Batchelor 2007) note, the rapid growth of mobile handset ownership in SA is at least partially due to the immense popularity of prepaid subscriptions and low-cost phones. Despite a high level of mobile handset penetration, SA remains a developing country and issues such as affordability and accessibility result in the average mobile handset having basic functionality only. The inferences we draw from their statements are that students do not own or have access to advanced mobile handsets and/or data bundles to purposefully engage in m-learning activities.

However, recent accessibility drives and price wars between the major SA cell phone companies suggest that the landscape may be changing. Not only are advanced mobile devices such as smart phones and tablets available on competitive contract terms, but the cost of data bundles are also decreasing at a rapid rate.

As such there exists a need to gauge the current mobile technology readiness of students for m-learning, where mobile technology readiness refers to the extent to the which students have access to mobile devices (and not only handsets), and can afford data bundles that meets or exceeds the requirements of a base set of currently available m-learning applications. Implicit to a mobile device in the context of m-learning is the ability of the hardware to achieve internet connectivity.

This paper thus focuses on answering the following two research questions as it relates to the technology readiness of students for m-learning:

> *What are the technology requirements of currently available m-learning applications, and to what extent do student mobile devices comply with these requirements?*

This paper is structured as follows. In the next section, a review of the literature as it relates to the technology requirements of currently available m-learning applications is presented, the purposes to motivate technology readiness in the context of this paper, and to define a base set of currently available m-learning applications, together with their technology requirements. In the sections thereafter a programme of research that was undertaken to measure the technology readiness of students at a SA HEI is presented and discussed.

2. **Literature review**

In line with the research questions, we firstly review the extant literature as it relates to the term "technology readiness" as used in this paper, and then on the technology requirements of currently available m-learning applications.

2.1 Technology readiness

As a point of departure, it is acknowledged that the decision to implement m-learning is far more complex than what the two research questions suggest. The m-learning literature abounds with frameworks and indexes to gauge many forms of technology readiness, as well offering many research streams as it relates to technology adoption. It is apparent that the term technology readiness holds different meanings for researchers. For example, Parasuraman and Colby (2001) provided the original taxonomy of technology readiness in the form of a Technology Acceptance Model (TAM) that focuses on the propensity to adopt or embrace technology in home life or work. For Wagner (2005) technology readiness means the provision of technology and support to educators, as well as a need to assess and consider awareness of and acceptance of m-learning. Basole and Rouse (2007) propose a Mobile Learning Technology Readiness Index (MLRI) that refers to the ability of the underlying technology infrastructure (network services, hardware, software, and security) to support the adoption and implementation of mobile Information and Communication Technology (ICT). As a final example, Trifonova and Georgieva (2005) offer a Mobile Learning Operational Readiness Index (MLORI) that measures students' awareness and attitude towards m-learning, and the level of support that they require.

The position that this paper take is in line with Abas et al. (2009) and Andaleeb et al. (2010), who described device ownership as an important first requirement for m-learning readiness. Although this appears a rational requirement at first, device ownership does not necessarily imply that the device is m-learning ready. Device readiness, as embodied in our use of the term "technology readiness", stresses the capacity of a mobile device to run a required (or defined, depending on the m-learning approach followed) base set of available m-learning applications, as well as owner means to afford the data bundles required by m-learning approaches. For this reason, the establishment of the technology requirements of a base set of currently available m-learning applications is an important first requirement.

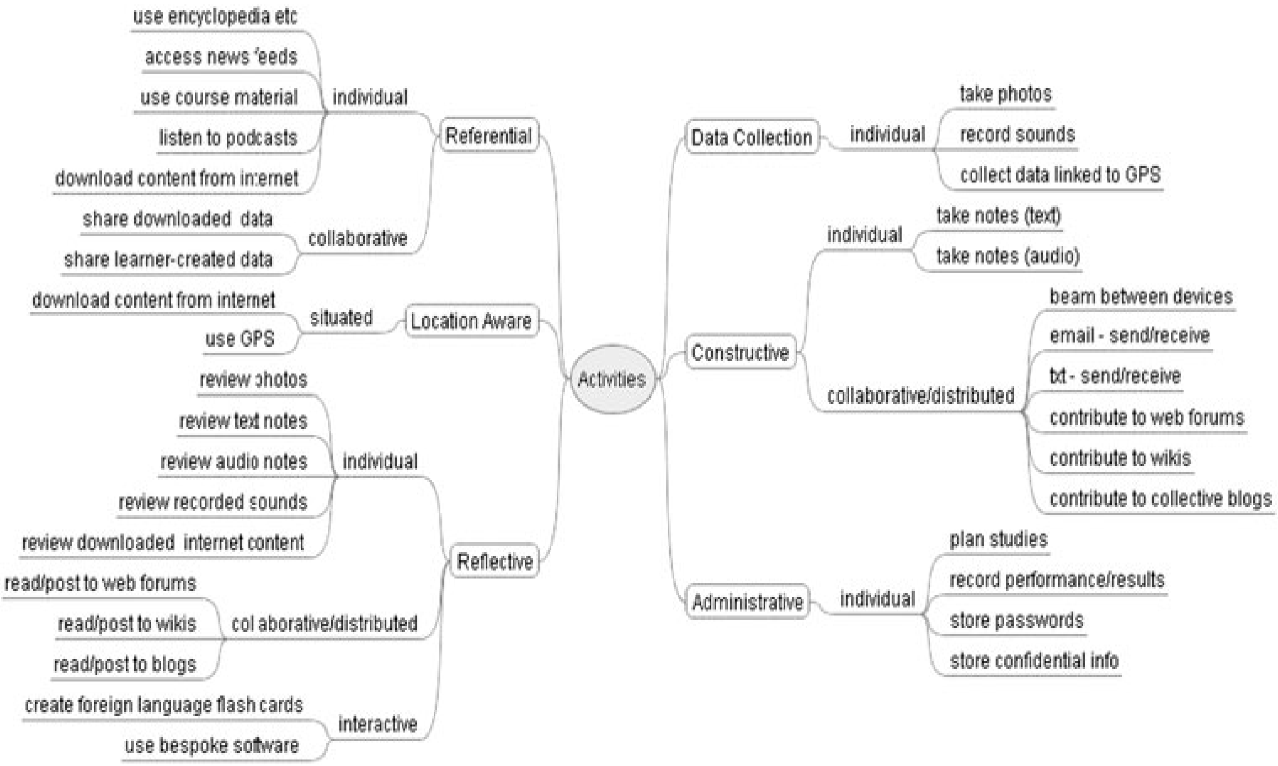
2.2 Technology requirements of available m-learning applications

Rapid advances in mobile device technologies have resulted in a continuous development of diverse and advanced m-learning applications, inclusive of collaborative learning applications, learning management systems, multimedia applications, assisted language learning, social applications, learning activity management, proactive learning management applications, mobile context-aware applications and mobile data collection applications (Trifonova et al. 2006).

Clough et al. (2008) propose a framework for categorizing mobile applications in terms of their ability to support formal and informal learning. They place m-learning applications into six categories based on their pedagogical function. The main categories they identified (see Fig. 1) are referential, location aware, reflective, data collection, constructive and administrative. They further identified five qualifiers within each category, namely: individual, collaborative, situated, distributed and interactive, with each category having a combination of qualifiers embedded in it. Qualifiers have informal learning activities associated with them.

ISBN: 978-0-620-55590-6

Figure 1: Clough et al framework for categorizing mobile applications



We extend their framework by considering various types of m-learning applications required to participate in the stated activities, as well as the data bundle costs a basic m-learning approach, that incorporates these applications, will require. These will be mapped onto their framework after a review of relevant literature.

2.2.1 Types of m-learning applications

The literature review of m-learning applications is ordered according to our own classification scheme, harvested from various literature resources, and which we order under "types of m-learning applications".

The first type of m-learning applications, *mobile collaborative learning applications,* aims to promote learning by fostering cooperation among students (Martin et al. 2010). Students use mobile collaborative tools extensively to support intentional informal learning (Clough et al. 2008). Applications required are email clients, Instant Messaging (IM), Short Message Services (SMS), wikis, blogs, chats (Martin et al. 2010).

The second type of m-learning applications, *mobile learning management systems,* is ubiquitous. It interoperates with electronic learning platforms (Martin et al. 2010) by accessing an institutions' Learning Management System (LMS) functionalities through a specific application or a mobile web browser (Trifonova & Ronchetti 2003). Forment (2009) et al. as cited in (Goh 2009) outline the following technologies required for a mobile LMS such as mobile Moodle, Blackboard, Sakai, namely: Java 2 MicroEdition (J2ME), mobile web browser, email clients, text messaging and Multimedia Message Service (MMS).

The third type, *multimedia mobile applications*, is memory intensive applications and the memory capacity and the speed of the mobile device are important for the applications performance (Pocatilu & Pocovnicu 2009). The memory is seen in terms of Random Access Memory (RAM), video and storage. Pocatilu and Pocovnicu (2009) confirm that smart phones tend to be better suited to mobile multimedia applications. Mobile multimedia applications technology requirements are mobile web browsers, mobile content media players, sufficient device memory, additional storage, internet connectivity and large enough screen sizes (Pocatilu & Pocovnicu 2009).

The fourth type of mobile application is *mobile learning language applications* which create interaction between the user and the learning content by allowing the user to listen to sound tracks, watch short video clips and read electronic-books (Liu 2009). Mobile language applications require the following technologies on mobile devices, namely: text messaging, MMS, Wireless Application Protocol (WAP), email clients, internet connectivity, media players and access to the institutions mobile web portals (Liu 2009).

The fifth m-learning application type is *mobile social software applications*. m-Web 2.0 or Mobile Web 2.0 is the current era of m-learning that has emerged from traditional approaches that focuses on m-learning through Mobile Social Software (MoSoSo) applications (Guy 2009). m-Web 2.0 has a wide range of educational value and marks the trend towards lifestyle learning (Guy 2009). It conveniently satisfies learning ‘anytime and anywhere’. Popular examples of such mobile applications are facebook, twitter, blogs, wikis and podcasts.

The sixth type of m-learning application is *mobile context-aware applications*. One major application of context aware applications is to act as personal guides to support tours through various venues (Raento et al. 2005). Museums could use these applications and allow users to take personalized tours seeing any exhibits desired in any order (Long et al. 1996). Walking tours of cities or historical sites could also be assisted by electronic guidebooks. Context aware mobile applications require the following technologies on the mobile device (Raento et al. 2005): Connection to external services via standard internet protocols using General Packet Radio Service (GPRS), Bluetooth transfers, SMS, MMS and Global Positioning Systems (GPS).

The final type of m-learning application is *mobile data collection applications*. Unlike bulk messaging and general information services that are targeting the general public as recipients of standardized messaging, mobile data collection applications are often used internally in an organization, customized to fit with existing organizational processes (Loudon 2009). A mobile solution can either replace an existing paper-based process or constitute an entirely new organisation process. As an example, flexible forms with different types of fields represent a data collection set and are stored in a repository as templates. On the mobile device these templates can be queried and opened for data collection. During an outdoor activity, for example, students fill the forms and the results are stored on the mobile device. The collected data are then uploaded into the HEI repository and used for further processing (Loudon 2009). Mobile data collection applications require the following technologies on the mobile phone (Giemza et al. 2010): internet connectivity, Java Micro Edition Platform (J2ME) application, SMS, Bluetooth and GPS.

Based on the above review and on our perception of data bundle requirements per activity/application, Table 1 offers an updated version of the Clough et al. (2008) framework, here presented in tabular format.

Table 1: Updated version of Clough et al. (2008) framework

Category	Qualifier	Activities	Applications	Data bundle requirements
Referential **Type:** ***collaborative mobile application***	Individual	Use encyclopaedias, access news feeds, use course material, listen podcasts etc.	*PDF-readers,* *e-book readers,* *audio player,* *dictionaries*	*Medium data bundle,* *Medium data bundle,* *Medium data bundle,* *Medium data bundle*
	Collaborative	Share downloaded data, Share learner created data	*email facilities,* *Bluetooth,* *SMS*	*Medium data bundle,* *Low data bundle,* *None*
Location aware **Type:** ***context aware mobile application***	Situated	Download content from internet, Use GPS	*GPS,* *media player*	*Large data bundle,* *None*
Reflective **Type:** ***collaborative mobile application, mobile learning language applications***	Individual	Review photos, Review test text notes, Review audio notes, Review recorded sounds, Review downloaded internet content	*Adv. Graphic Display,* *Audio recording,* *Audio player,* *Memo pads,* *Presentation Program*	*None,* *None,* *None,* *None,* *None*
	Collaborative/ Distributed	Read/post to web forms, Read/post to wikis, Read/post to blogs	*MMS,* *Mobile Web 2.0 tools*	*None,* *Large data bundle*
	Interactive	Create foreign language flash cards, Use bespoke software	*e-book readers,* *memo pads*	*Large data bundle,* *None*
Data Collection **Type:** ***mobile data collection applications***	Individual	Take photos, Record sounds, Collect data linked to GPS	*Audio recording ,* *Camera facility,* *Java Support*	*None,* *None,* *Medium data bundle*
Constructive **Type:** ***multimedia mobile applications, mobile social software***	Individual	Take notes(text), Take notes(audio)	*Audio recording,* *Memo pads*	*None,* *None*
	Collaborative/ Distributed	Beam between devices, Email-send/receive, Contribute to web forums, Contribute to wikis, Contribute to collective blogs, Use bespoke software	*Email,* *Instant messaging,* *SMS,* *Video conferencing,* *Conference Calling,* *Mobile Web 2.0 tools,* *bespoke software*	*Large data bundle,* *Large data bundle,* *None,* *Large data bundle,* *None*
Administrative **Type:** ***mobile learning management systems***	Individual	Plan studies, Record performance/results, Store passwords, Store confidential information	*Calendars & Contacts,* *Memo pads,* *Spread sheets,* *Presentation Program*	*None,* *None,* *None,* *None*

Our interpretation of the data bundle requirements is based on our experiences in using the majority of applications presented here on smartphones, tablets and personal computers in non m-learning settings. We acknowledge that the m-learning approach

ISBN: 978-0-620-55590-6

selected ultimately determines final data bundle requirements. For example, requiring students to download a Word document as opposed to a compressed PDF file greatly increases data usage and thus cost. For this reason, the data bundle requirements stated here presents an absolute minimum.
Device readiness furthermore stresses owner means to afford data bundles. In the next section we examine the cost of locally available data bundles.

2.2.2 Data bundle costs

Correlating the data bundle requirements in Table 1 to cost, Table 2 shows medium to large data bundle costs from available network operators in SA as extracted from the Hellkom (2012) website. Hellkom provides statistical, financial and factual information in an effort to educate the South African and international public of the current telecommunication situation in SA. Shown are the network operator, the bundle offered, the type of data bundle (1, 12, 24 months or prepaid), the size of the bundle (Cap), the network speed, the price of the bundle, the Out of Bundle Rate (OOB), the In Bundle Rate (IBR), and the number of megabytes available per day if the bundle is to last for 30 days (spread).

Table 2: Data bundle costs

Network	Bundle	Type	Cap	Speed	Price	OOB	IBR	Spread
8ta	**8ta-Internet 1** No device included.	1	650MB	3.6Mbps	R150.00	R0.30	R0.23	21.67MB
8ta	**8ta-Internet 1** Includes 3G USB Modem. Free SIM and connection.	12	650MB	3.6Mbps	R165.00	R0.30	R0.25	21.67MB
Cell C	**Cell C-Smartdata 250MB** Data bundle for Contract, Top-up and Prepaid customers.	prepaid	250MB	21.6Mbps	R100.00	R0.40	R0.40	8.33MB
MTN	**MTN-300MB** Includes 3G USB Modem.	24	300MB	21.6Mbps	R149.00	R0.50	R0.50	10.00MB
Neotel	**Neotel-NeoConnect Prime 1GB**	prepaid	1GB	2.4Mbps	R279.00	R80.00	R0.28	33.33MB
Telkom	**Telkom-Do 3G 500MB**	prepaid	500MB	7.2Mbps	R149.00	R0.30	R0.30	16.67MB
Telkom	**Telkom-Do 3G 500MB + Huawei E220 Modem**	24	500MB	7.2Mbps	R178.58	R0.30	R0.30	16.67MB
Virgin Mobile	**Virgin Mobile-Prepaid 250MB**	prepaid	250MB	21.6Mbps	R150.00	R0.60	R0.60	8.33MB
Virgin Mobile	**Virgin Mobile-Prepaid 500MB**	prepaid	500MB	21.6Mbps	R300.00	R0.60	R0.60	16.67MB
Vodacom	**Vodacom-MyMeg 250 Standard** Out of bundle rate on prepaid is R2/MB.	prepaid	250MB	21.6Mbps	R99.00	R2.00	R0.40	8.33MB
Vodacom	**Vodacom-MyMeg 175**	24	175MB	21.6Mbps	R129.00	R0.74	R0.74	5.83MB

ISBN: 978-0-620-55590-6

	Advanced In-bundle and out-of-bundle rates are the same. Contract, Top Up and Prepaid customers pay the same rate per bundle.							
Vodacom	**Vodacom-MyMeg 175 Advanced** In-bundle and out-of-bundle rates are the same. Contract, Top Up and Prepaid customers pay the same rate per bundle.	prepaid	175MB	21.6Mbps	R129.00	R0.74	R0.74	5.83MB
Vodacom	**Vodacom-MyMeg 500 Standard** Out of bundle rate on prepaid is R2/MB.	prepaid	500MB	21.6Mbps	R149.00	R2.00	R0.30	16.67MB

We will return to the information presented in this table later. For now, we note that the spread appears to be extremely low across bundles, with the exception of Neotel, which, besides a limited coverage area, is the most expensive bundle. Our immediate concern, based on personal data usage experience, is that the daily bandwidth available (spread) is severely limited. Keeping with our example of a PDF file, and despite best efforts at optimization, it is not uncommon for file size to approach 5MB when complex images are included - more than two-thirds of the spread available on the most inexpensive package.
Having defined the context of technology readiness as used in this paper, the next section describes a programme of research aimed at determining the technology readiness of students at a SA HEI.

3. Setting and methodology

The research setting this paper reports on was a residential HEI based in KwaZulu-Natal. Based on the updated Clough et al. (2008) framework as presented in Table 1, a survey questionnaire was constructed. The questionnaire comprised of three sections namely Section A, which consisted of five demographic information questions; Section B, which consisted of four questions on accessibility and affordability; and Section C, which consisted of twenty-one questions to gauge the mobile device profile.

A total of 372 questionnaires were randomly distributed to students across 5 available faculties. A response rate of 89% was achieved. The quantitative data generated by the questionnaire was captured and analyzed for descriptive and inferential statistics using the Statistical Package for Social Science (SPSS) software. Cronbach's alpha coefficient, which is based on the inter-item correlations, was used to measure internal reliability.

Focus group interviews with 7 students presented a secondary qualitative data gathering tool, its use to confirm or strengthen the statistical results obtained.

In the next section we report on, and discuss, the results achieved.

4. Results and discussion

We first present and discuss the student profile, inclusive of mobile device ownership and internet connectivity patterns.

4.1 Student profile, mobile device ownership and internet connectivity patterns

Ninety percent (90%) of the respondents were below the age of 25, of which 47.3% where male. Approximately 84% of the respondents were registered for National Diplomas, which was representative of the institution's ratio. Respondents were spread amongst the faculty of Accounting and Informatics (24.1%), Engineering and the Built Environment (21.1%), Management Sciences (25.9%), Applied Sciences (7.5%) and Arts and Design (12.0%). Mobile handset ownership and internet connectivity are presented in Table 3 below.

Table 3: Mobile handset ownership with internet connectivity

			I own a mobile handset		Total
			Disagree	Agree	
I own a mobile handset with internet connectivity	Disagree	Count	6	39	45
		% of Total	1.8%	11.7%	13.6%
	Not sure	Count	0	11	11
		% of Total	0.0%	3.3%	3.3%
	Agree	Count	0	276	276
		% of Total	0.0%	83.1%	83.1%
Total		Count	6	326	332
		% of Total	1.8%	98.2%	100.0%

Handset ownership stood at 98.2%, which is consistent with the opening statements of this paper. It exceeds Kreutzer (2009) figure of 77% ownership under low-income urban SA youth, and approaches the 100% ownership under Malaysian distance education students reported by Andaleeb et al. (2010), and Corbeil and Valdes-Corbeil (2007), who reported 90% handset ownership under United States of America students.

A total of 83.1% of students indicated their handsets to have internet capabilities. This reduction from 98,2% is meaningful in that 17.9% of students are immediately excluded from m-learning approaches that require internet connectivity.

Mobile devices are not limited to handsets only, and Table 4 shows other types of mobile devices students own or have access to.

Table 4: Ownership: Other types of mobile devices students own or have access to

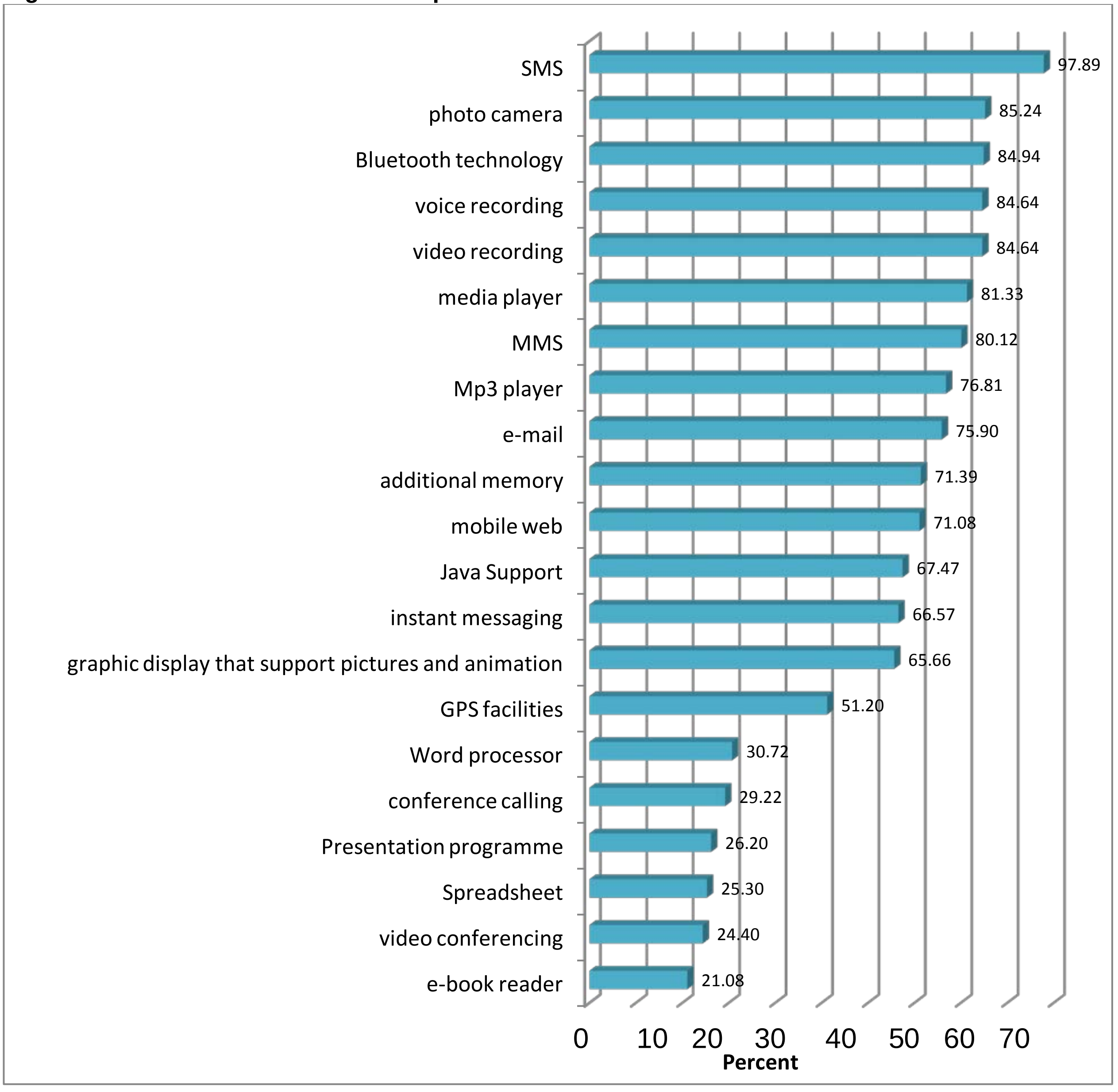
Mobile device	% ownership
iPad/Tablets	3.3%
iPod	6.9%
iPhone/smart phone	21.0%
mp3 player	12.7%
Personal Digital Assistant (PDA)	0.6%
Other device not listed here	13.0%
No Other device	42.5%

More than half of students (57.5%) have access to, or own, other types of mobile devices. Of these devices, 20.2% do not require data bundles for use (iPod, mp3 player, PDA), but are potentially useful in novel m-learning approaches. A further 24.3% have access to advanced mobile devices like iPads, tablets and smart phones. These devices are intuitively more suited and configurable to m-learning approaches than handsets, particularly given the rapid growing market for, and availability, of secondary mobile device applications, many which are free for download.

4.2 Device compliance

The extent to which student mobile devices complied with the requirements as contained in our updated framework is presented in Figure 2. Cronbach's alpha coefficient (0.960) was significantly higher than the 0.70 considered as "acceptable", indicating a high degree of acceptable, consistent scoring.

Figure 2: Student mobile handset compliance



Proceedings of the 14th Annual Conference on World Wide Web Applications
Durban, 7-9 November 2012 (http://www.zaw3.co.za)
ISBN: 978-0-620-55590-6

The results show less than one third of students' mobile devices having the following features and functionality: Word processor; spreadsheet; video conferencing and e-book readers. More than two thirds of the students indicated that they have the following technology features available on their mobile phone: SMS; photo and video camera; Bluetooth technology; MMS; Mp3 player; email client; internet connectivity; additional memory slots; IM; advanced graphics displays and java support. More than 50% also reported GPS facilities.

Table 5 presents these results in combination with the Applications and Activities columns as extracted from Table 1.

Table 5: Mobile applications and activities available to students ranked

Applications	Activities	Percentage
SMS	Share downloaded data, Share learner created data	97.89
Photo camera	Take photos	85.24
Bluetooth technology	Share downloaded data, Share learner created data	84.94
Video recording	Record sounds	84.64
Voice recording	Record sounds, Take notes(audio)	84.64
Media player	Download content from internet	81.33
MMS	Read/post to web forms, Read/post to wikis, Read/post to blogs	80.12
Mp3 player	Review audio notes, Review recorded sounds, Review downloaded internet content	76.81
E-mail	Share downloaded data, share learner created data	75.9
Additional memory	Use Multimedia Applications	71.39
Mobile web	Contribute to web forums, Contribute to wikis, Contribute to collective blogs, Social Networking, Use Email, Download Content	71.08
Java support	Collect data linked to GPS	67.47
Instant messaging	Collaborate with others	66.57
Advanced graphic display	Review photos, Review test text notes, Review audio notes, Review recorded sounds, Review downloaded internet content	65.66
GPS facilities	Use GPS	51.2
Word processor	Plan studies, Record performance/results, Store passwords, Store confidential info, Take notes(text) , Use bespoke software	30.72
Presentation programme	Create foreign language flash cards	26.2

ISBN: 978-0-620-55590-6

Spread sheet	Record performance/results	25.3
Video conferencing	Use bespoke software	24.4
E-book reader	Use encyclopedias, use course material	21.08

Table 5 is self-explanatory, and serves as a useful sliding scale of the type of m-learning activities that can be incorporated into any m-learning approach. For example, whereas most mobile handsets have SMS capability, a low percentage of students has access to an e-book reader – the latter ostensibly more useful for both advanced m-learning approaches as well as basic learning activities such as reading an electronic text book. Conversely, a tablet may have an e-book reader but no SMS capabilities.

The principle of technological minimalism advanced by Collins and Berge (2000) here dictates that readily available mobile applications such as SMS clients (98%), photo camera (85%) and Bluetooth (85%) should thus be targeted. Such minimalistic approaches have been used with success in the past. For example, (Andaleeb et al. 2010) quoted research conducted by the University of Pretoria on students based in remote South African rural areas where SMS's were effectively used when providing basic administrative support in three teacher training programs. In contrast, Corbeil and Valdes-Corbeil (2007) confirm greater popularity for email (98%) as compared to SMS's (45%). Email, as a more advanced and cost effective mobile application, is thus preferred over SMS's. Whereas the table suggest that fewer students have access to email facilities, it must be borne it mind that email is not exclusively available as a mobile application. Table 5 thus requires careful consideration, and is not an absolute guide.

In the next section mobile connectivity affordability is explored.

4.3 Mobile connectivity affordability

Table 6: mobile connectivity affordability patterns

Amount available	%
< R100	67.2%
R101 – R300	21.4%
R301 – R500	5.7%
R501 – R1000	2.7%
> R1000	3.0%

Table 6 shows the mobile connectivity affordability patterns of students.

The majority of students (67.2%) can afford a maximum R100 towards mobile connectivity; 21.4 % can afford R101-R300; 5.7% can afford R301-R500; 2.7% can afford R501-R1000 and 3.0% can afford more than R1000. The total amount of R100 was confirmed by the focus group.

However, the amounts presented here include allowance for voice call and text messaging costs – the first and most important uses of mobile handsets. Given that the cheapest data bundle available is R99 for 250 MB, it is evident the majority of students (67,2%) will not be in a position to afford data bundles over and above their voice call and text messaging costs. In the next bracket (R101 – R300 and 21,4%), students are able to afford data bundles in the range of 175 – 500 MB. However, the spread available (5.53 – 16.67 MB

ISBN: 978-0-620-55590-6

per day) is modest in terms of data usage, even if services such as internet and email are used sparingly. The data suggests that for the majority of students, data bundles are too costly. The other alternative is a more expensive out of bundle rate, which is not feasible either as it offers less data than bundles.

Only 11.4% of students thus appear to be in a position to afford data bundles that will fulfill the promise of m-learning as intended.

Does the data then imply that m-learning is not feasible? Not necessarily. Cost cutting practices in m-learning could mean the design of m-learning programmes using non-paying mobile services such as recording, or playing audio and videos, taking or viewing photos, or taking notes and using calendars. Making electronic resources available via Bluetooth broadcasting on campus, for example, appears a particularly workable solution. Although not an explicit purpose of this paper, Table 6 offers a few suggestions on m-learning approaches based on the available data. In particular, it suggests various combinations of applications, which together, form meaningful m-learning strategies - at a maximum cost of R15 to the student (prices are as extracted from the Vodacom (2012) website).

Table 7: Applications that can combine to form meaningful m-learning approaches under a maximum cost of R100

Application	%	Mobile Learning Strategy	Cost
Bluetooth technology Media Player/ MP3 player	85% 81% 77%	They can download content with Bluetooth in class. Maybe a sound file of the lecture as presented and recorded and made available immediately after the lecture. Students can exchange diary dates, telephone numbers and other contact information from one device to another. Lecturers can share files and information with students (Meighan et al. 2007).	Nil
Photo camera MMS	85% 80%	Students can take a picture, type a long message, record sound or send an animation – or do it all at once. A standard sized MMS (300 KB or less) costs just 80 cents (Lin et al. 2010).	25 MMS's bundled at the cost of R15.00
Voice recording Media Player MP3 Player	85% 81% 77%	Language assisted m-learning	Nil
Video recording Bluetooth technology Media Player	85% 85% 85%	Make a video of some practical task/demonstrations on complicated procedures and allow students to view. The iPod portable media player from Apple allows users to download music, audio books, podcasts, photos, and video. (Corbeil & Valdes-Corbeil 2007)	Nil
SMS	98%	SMS can be used in direct or indirect teaching. Useful to provide feedback, updates and reminders (Lominé & Buckhingham 2009).	20 SMS's bundled at R10.00
SMS/MMS Additional Memory	98%8 0%	Make a video, take a picture, type a long message, record sound or send an animation – or do it all at once. Feedback can be given via SMS. MMS's utilize phone memory so additional memory can be used. Multimedia form of presentation having a great potential in motivating the learners and helping them to better understand the content (Lin et al. 2010).	25 MMS's bundled at the cost of R15.00 20 SMS's bundled at R10.00
Bluetooth Media Player Advanced Graphics Display	85% 81% 67%	Download Multimedia content from a PC and use media player to display on phone with advanced graphic display.	Nil
Java support & Advanced Graphics Display	67% 67%	Mobile games using advanced graphic display.	Nil
GPS Word processor	51% 31%	Use GPS for location aware exercises. Make notes on memo pad and share information or receive feedback via SMS/Email	20 SMS's bundled at

ISBN: 978-0-620-55590-6

SMS	98%	(Lominé & Buckhingham 2009).	R10.00

5. Conclusion

Technological advancements have brought many positive changes in the way we learn. The availability of more advanced mobile devices capable of using currently available m-learning applications appears to have placed HEI's in a strong position to benefit from m-learning as a form of academic support.

This paper set out to answer the following two questions as it relates to the technology readiness of students for m-learning: what are the technology requirements of currently available m-learning applications and to what extent do student mobile devices comply with these requirements? Based on the data gathered and presented we have to conclude that any m-learning endeavour is bound to fail if the answers to these two questions are unknown. In particular, our findings show that the technology requirements of currently available m-learning applications, the extent to which student mobile handset devices comply with these requirements, and the extent to which students are able to afford the data bundles required to effect advanced m-learning strategies, is, at best, unfavourable.

This does not imply that there is no space for novel m-learning approaches using best and most cost-effective approaches. But whereas there is a tendency to "throw" technology at students" in an attempt gain a competitive advantage over competing HEI's, we suggest that regular – if not yearly - surveys targeting the technology readiness of students are held before any decision on a m-learning strategy is implemented.

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ISBN: 978-0-620-55590-6