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Unleashing mobile phones for research supervision support at Makerere University, Uganda: the lessons learned

Paul B. Muyinda* and Jude T. Lubega

Faculty of Computing and IT
Makerere University
P.O. Box 7062
Kampala, Uganda
E-mail: mpbirevu@iace.mak.ac.ug
E-mail: jlubega@cit.mak.ac.ug
*Corresponding author

Kathy Lynch

University of the Sunshine Coast
Maroochydore
Queensland, Australia
E-mail: kathy.lynch@usc.edu.au

Abstract: This paper provides the lessons learned in an m-learning initiative to support distance learning students undertaking a field research project. Learner survey and staff interview data revealed that m-learning overcomes the odds that inhibit the implementation of 'conventional' e-learning and creates a platform for regular interaction. M-learning creates a *customer care* attitude and intimacy between the interacting parties, hence removing the phobia that students attach to lecturers. It encourages active learning, paces learners and improves learner satisfaction and motivation. On the contrary, m-learning creates cognitive overload for a lecturer facilitating a large group of students and introduces a strange vocabulary.

Keywords: innovation; learning; research supervision; mobile phones; m-learning; Uganda; Mobile Research Supervision Initiative; MRSI; developing countries; Makerere University; innovative learning.

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Biographical notes: Paul B. Muyinda is an academic and a Doctoral student at Makerere University, Uganda. He specialises in e-learning with special interest in mobile learning. His PhD research focuses on developing a pedagogical model for the effective deployment and utilisation of mobile learning objects in developing countries. His research and PhD work are inspired by the need to integrate ICTs in the distance student support systems of developing countries in general and Makerere University in particular.

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Jude T. Lubega holds a PhD in Computer Science (E-learning) from the University of Reading, UK. He is a member of the British Computer Society and Hong Kong Web Society. He is a Deputy Dean in charge of Graduate Studies and Research and a Lecturer at the Faculty of Computing and Information Technology, Makerere University, Uganda. His research interests include tracking and assessment in e-learning, content authoring, multimedia content authoring, multi-agent systems, data warehousing, knowledge representation, ICT for development, web-based systems and mobile learning. He has authored numerous papers in international journals and conferences in the mentioned areas.

Kathy Lynch (PhD) is a Researcher at the University of the Sunshine Coast, Australia. Her research interests are in the application, development and evaluation of ICTs within the local, national and global contexts. She was the Editor-in-Chief of IJIKM (Volumes 2 and 3), is on the Editorial Board of IJICR and is a Conference Track Chair and Reviewer for numerous academic conferences and journals.

1 Introduction

The use of mobile devices in education is attracting increasing attention from researchers, educationist and policy makers. Mobile education applications are increasingly being developed as mobile devices technology evolves (Caudill, 2007). The use of mobile devices in delivering pedagogical and andrological services has been termed 'mobile learning' or 'm-learning'. Indeed, mobile devices present another form of platform on which learners can interact, collaborate and share knowledge (Fisher and Baird, 2006–2007; Goh and Kinshuk, 2006). Consequently, several authors have defined m-learning differently. While considering a mobile device as an enabler of learner mobility, Traxler (2007) defined m-learning as learning which takes place at anytime in anyplace using a mobile device. Similarly, Luis de Marcos *et al. (*2006) defined m-learning as a form of e-learning which employs wireless, tiny, handheld and portable devices to extend and deliver learning to learners. E-learning is learning using an "educational environment which utilizes any electronic media tool as a part of the instruction" (Caudill, 2007, p.3). M-learning is a subset of e-learning (Brown, 2005). A close examination of the various definitions of m-learning will focus one onto a central point of enabling learner mobility using mobile devices. M-learning is taking a centre stage in education because of its ability to provide learning across different contexts (Laurillard, 2007; Uden, 2007). In this paper, we conceptualise and define m-learning as supplementary learning support extended to the learners via their m-learning devices.

M-learning devices are in three broad categories, namely: mobile phones, PDAs and MP3 players (Caudill, 2007; Traxler, 2007). M-learning devices support the three canonical functions of ICTs in education, that is, access, support and communication (Nakabayashi *et al.*, 2007; Yang, 2007; Toledano, 2006). The choice of a particular mobile device to be employed in m-learning and its level of usage depend on its availability and technical capability.

Due to the high cost and infancy of mobile telecommunications technologies in developing countries such as Uganda, mobile phones are more pervasive than PDAs and MP3 players (Muyinda, 2007). Moreover, the available mobile phones in these

countries are mainly of first and second generation order, thus confining m-learning applications to basic text and voice communication. The foregoing discussion provides the reasons why the mobile phone is the m-learning device of choice at Makerere University in Uganda. Mobile phones are used to extend academic, social and administrative support to distance learners hence working as a student–student and student–tutor communication platform.

Building on the student–student and student–tutor communication support afforded by the mobile phone, some research supervisors at the Department of Distance Education, Makerere University, devised an initiative which they dubbed, the Mobile Research Supervision Initiative (MRSI), to support distance learning students completing a final year field research project. Thus, we particularly report on this initiative in this paper. Elsewhere, Kajumbula (2006) has reported on the SMS Broadcast System Project which was initiated by the Department of Distance Education to provide administrative, academic and social support to all the distance learners at Makerere University. In particular, the MRSI was motivated by the need for physical and/or virtual presence of the research supervisors to their research students in the field for consultation. The MRSI aimed at enhancing student–student and student–supervisor collaboration. Mobile research supervision involves the supervisor guiding the research student (using a mobile phone) as he/she carries out his/her final year field research project. It ensures that guidance is provided to the student at anytime in any place in the field. "… accounts of mobile distance learning are still infrequent" (Traxler, 2007, p.3) hence the MRSI contributes a grain to this endeavour. MRSI is an application of m-learning.

2 MRSI at Makerere University

Before providing the genesis of the MRSI, it is important to understand Makerere University's distance learning context. Makerere University is a dual mode university (Aguti and Fraser, 2006). This means that it uses both the traditional classroom and distance delivery models. Distance learning is delivered through the Department of Distance Education (hereafter referred to as the Department). This Department was established in 1991 (Aguti and Fraser, 2006). The Department's programmes are run on a collaborative venture with other academic units in the university which run similar programmes using the traditional classroom method (Aguti and Fraser, 2006). Distance learning at Makerere University has traditionally been provided using print-based modules that are supplemented with specific numbers of residential sessions in a semester at the main campus. There are two residential sessions each of two weeks, in a semester of 17 weeks. The two residential sessions are separated by a period of 11 weeks. During residential and non-residential periods, academic, administrative and social support is extended to the distance learners. The support is extended either through electronic or non-electronic media. Electronic support is extended through e-mails, mobile phones, internet and radio. The use of the mobile phone is however more prominent than any other support media because 97% of the distance learners at Makerere University own mobile phones as opposed to only less than 1% who use internet and e-mail (Kajumbula, 2006). Non-electronic support is provided through handouts, brochures, fliers and face-to-face meetings. Research supervision is one of those activities that were, prior to the MRSI, wholly done via face-to-face meetings.

This proved to be a big inconvenience to distance learners who had to travel long and costly distances to consult even on minor issues solvable on a mobile phone. With the MRSI, face-to-face research supervision meetings are supplemented with mobile phone research supervision support. M-learning allows "students to exploit small amounts of time and space for learning, to work with other students on projects and discussions, and to maximise contact and support from tutors" (Traxler, 2007, p.8). M-learning thus comes in handy for the 'busy' and 'lonely' distance learners.

3 Undergraduate research and MRSI at Makerere University

As a partial fulfilment of the requirements for the award of a bachelor's degree from Makerere University, undergraduate students in their final year of study are required to undertake an independent field study in an area contributing to knowledge in any of their Department's specified research themes. As is the practice everywhere, each student is allocated a supervisor, who is supposed to collaborate (through face-to-face or otherwise) with the student on a regular basis. However, supervisors who initiated the MRSI felt that the face-to-face meetings between them and the students were inadequate, let alone being *ad hoc*. Prior to the MRSI, it was common to find research students 'looking for' their supervisors at the main campus as there were no mechanisms for making appointments. In many instances, research students would travel long distances to come and meet their supervisors at Makerere University but would fail to meet them. This meant that students' face-to-face interactions with their supervisors were only limited to a few occasions. This led to frustration and demotivation on part of the students. Also, the limited consultation made the research paper to appear to be 'difficult' for some students. Continuous collaboration between the learner and the teacher encourages active learning (Caudill, 2007; Laurillard, 2007; Uden, 2007). The perceived difficulty of the research paper and students' frustration and demotivation emanating from the limited student–supervisor collaboration has long been apportioned as one of the causes of students' failure to complete their research paper in time (Otto and Wrightson, 2005). By corollary, failure to complete the research paper in time implies failure by a student to complete his/her programme within the stipulated minimum duration. Other factors inhibiting programme completion at Makerere University emanate from work, financial, academic and social pressures (Otto and Wrightson, 2005). A throughput of 60% has been reported in an evaluation of distance learning programmes at Makerere University (Otto and Wrightson, 2005).

To increase the student–supervisor collaboration and supervisors' availability (physical and virtual) to their students so as to make the research process a rewarding, active and exciting experience, the supervisors chose to integrate the widely used mobile phone into the research supervision process. With mobile phones, it was possible to make face-to-face meeting appointments and guide students via SMSs and voice calls.

Thus, it was hoped that the additional text and voice collaboration on the mobile phone would help minimise the perceived negative impact of lack of face-to-face interaction. This would encourage the development of 'a personal touch' between the students and their supervisors and consequently motivate students (Laurillard, 2007; Uden, 2007; Stead *et al.*, 2006) to complete their research project in time. Further, it would enable students to graduate on time.

Whether the said expectations were fulfilled was a major research question. We evaluated the MRSI to establish its exact value to the Department of Distance Education and students. An evaluation is "the systematic investigation of the worth or merit of some object" (Commonwealth of Learning, 2007, p.37). However, m-learning evaluation techniques have not yet stabilised. In Traxler's (2007) view:

> "… there are problems with the epistemology and ethics of evaluating mobile learning; there are also challenges in developing suitable techniques to gather, analyse, and present evaluation. Nevertheless, the credibility of mobile, including distance learning as a sustainable and reliable form of educational provision rests on the rigour and effectiveness of its evaluation." (p.9)

As an infant field, m-learning has not yet seen its fully dedicated evaluation criteria as its application in a number of institutions is still in pilot or trial phases. Further, the criterion for evaluating m-learning depends on the conceptualisation and definition of m-learning in a given institution (Traxler, 2007). In this paper, we triangulated the traditional information systems quality metrics espoused in Gafni (2008) and Traxler's (2007) m-learning evaluation guidelines to evaluate the MRSI. This was done within the social constructivist (Brown and Campione, 1996) and the conversational (Pask, 1975) learning frameworks. This ensured that the evaluation was consistent with m-learning's attributes of being personal, contextual and situated (Laurillard, 2007; Muyinda, 2007; Traxler, 2007).

The evaluation was aimed at producing mobile research supervision lessons for Open, Distance and e-Learning (ODeL) practitioners and policy makers in developing countries. It answered the general question – 'Is it worthwhile to continue with mobile research supervision and should we invest more resources and effort into it or not?' Specifically, the study has answered and provided lessons to the following questions:

- What were the mobility characteristics of students?
- What research supervision aspects were most effectively handled through mobile research supervision?
- What influence did mobile research supervision have on students' throughput and research quality?
- What were the constraints faced by the students during mobile research supervision?
- What were the cost implications of mobile research supervision to the student, supervisor and Department?
- What other academic and administrative components could be delivered via mobile phones to distance learners at Makerere University?

4 MRSI theoretical framework

Evaluation criteria for m-learning are still evolving (Traxler, 2007). Hence m-learning evaluation is still dependent on the adaptation of evaluation techniques from similar fields that have matured. Traxler (2007) has criticised several m-learning evaluation studies which used focus groups or interviews or questionnaires or observation or system logs or a combination of these as data collection techniques that do not take into account the special tenets of m-learning technologies and ethical issues. As an information

system, m-learning can be evaluated using information systems quality metrics by looking at ease of maintainability, minimum complexity, lack of faults and mean response time (Gafni, 2008). In order to incorporate ethical considerations in the evaluation, the m-learning evaluation guidelines proposed by Traxler in 2002 can be handy. The guidelines cited in Traxler (2007, p.9) suggest that a 'good' m-learning evaluation could be:

1 rigorous, meaning roughly that conclusions must be trustworthy and transferable

2 efficient, in terms of cost, effort, time, or some other resource

3 ethical, specifically in relation to the nuances of evolving forms of provision, in terms of standards from:

- legal
- to normative

4 proportionate, that is, not more ponderous, onerous, or time-consuming than the learning experience or the delivery and implementation of the learning itself (bearing in mind earlier remarks about the learners' experiences of mobile learning)

5 appropriate to the specific learning technologies, to the learners, and to the ethos of the learning – ideally built in, not bolted on

6 consistent with the teaching and learning philosophy and conceptions of teaching and learning of all the participants

7 authentic, in accessing what learners (and perhaps teachers and other stakeholders) really mean, really feel, and sensitive to the learners' personalities within those media

8 aligned to the chosen medium and technology of learning

9 consistent across:

- different groups or cohorts of learners in order to provide generality
- time, that is, the evaluation is reliably repeatable
- whatever varied devices and technologies are used.

Gafni's (2008) and Traxler's (2007) evaluation criteria can be triangulated within the social constructivist (Brown and Campione, 1996) and the conversational (Pask, 1975) learning frameworks to produce lessons from the MRSI.

The social constructivist learning theory required the students to act and reflect within their social environment (Brown and Campione, 1996). The messages sent and calls made to the students required them to act by solving a given research problem and reflect on the derived solution(s) with the aim of enriching their experiential knowledge. The conversation theory suggests that successful learning requires continuous two-way conversations and interactions between the teacher and learner and amongst the learners themselves (Pask, 1975). The MRSI embraced these two theories because text and voice messages sent to a student's mobile phone could be saved for future action and reflection. The students could also use their mobile phones to converse/collaborate with fellow students or with their supervisors hence abetting m-learning.

M-learning is a subset of e-learning which in turn is a subset of distance learning, which also is a subset of flexible learning (Brown, 2005). The portability of mobile devices makes it possible to deliver e-learning at any time in any place. E-learning is learning using an "educational environment which utilizes any electronic media tool as a part of the instruction" (Caudill, 2007, p.3). Thus the mobile phone could be the electronic media tool in e-learning. Indeed, the mobile phone increases flexibility in distance learning (Fagerberg and Rekkedal, 2004). However, as 'conventional' e-learning technologies increasingly become wireless, some proponents of m-learning are struggling to draw the line distinguishing m-learning from e-learning (Laurillard, 2007; Traxler, 2007). M-learning is more personal, contextualised and situated than 'conventional' e-learning (Laurillard, 2007; Traxler, 2007).

As is advised by Keegan (2005), recent technological innovations in education must be thoroughly understood by all the stakeholders before deploying them for learning or learning support. Pedagogical issues must be born in mind (Muyinda, 2007). The costs of the technological innovation have to be evaluated *vis-à-vis* the anticipated benefits and the limitations of such technologies must also be known in advance so as to be mitigated (Graham, 2004). For instance, while considering delivering content on mobile phones with small screens and low memory, Zhang (2003) proposed to use Wireless Access Protocol (WAP) gateways, agent profilers and caching proxies to deliver content to users of the mobile phone in a combination of push and pull mechanisms. Hence careful integration of a new learning technology into the educational system is vital.

5 MRSI evaluation methodology

There are no fully developed m-learning evaluation criteria. In absence of such criteria, Traxler (2007) has suggested the triangulating of data collection techniques that are consistent with m-learning technologies and evaluation ethics. Hence in this evaluation research, a mixed methods approach using quantitative and qualitative data collection techniques that were informed by information systems evaluation guidelines provided in Gafni (2008) and m-learning evaluation guidelines provided in Traxler (2007) was adopted.

Distance learners who had completed their research project (herein referred to as students), research project supervisors (herein referred to as supervisors) and administrators in the Department (hereafter referred to as administrators) formed the target population of the evaluation study. Using simple random sampling, 100 students were selected from the Research Report Submission Register found in the Research Office at the Department. Phone calls were made to the respondents to recruit the students for their voluntarily participation in the study. The phone calls to respondents also helped us to determine the most convenient mode for delivering the research instrument. Of the 100 students selected, 86 agreed to participate in the research and provided postal mail addresses or physical locations.

A semi-structured self-administered questionnaire was mailed or delivered physically to the students with a request to them to return the filled in responses to the Department. To ensure anonymity, there was no provision on the questionnaire for filling in one's personal details. Further, the list of selected students was threaded after the distribution of the questionnaires. The questionnaire asked standard sets of questions including mobile phone ownership, mobile phone connectivity issues and use of mobile phone in research

supervision. The questionnaire enlisted answers to questions from the measurement and understanding perspectives. In the research supervision section of the questionnaire, students were given freedom, to express their opinions and views about the conduct and experience of mobile research supervision. By the deadline of questionnaire submission, 71 responses had been returned.

Data was also collected using in-depth interviews. Five supervisors and two administrators provided views, opinions, experiences and understanding about the MRSI. The in-depth interview participants were purposively chosen as key informants. The interviews were semi-structured and as such enabled us to obtain detailed answers to non-standard questions that were paused.

The data gathered was analysed using descriptive statistics, and are presented in table and text forms in the section that follow.

6 Lessons learned from the MRSI

6.1 Category 1 lessons: M-learning and learner mobility

- M-learning permits mobility of distance learners.
- M-learning costs affect students' ability to freely interact with colleagues and supervisors.
- M-learning overcomes the odds that prohibit 'conventional' e-learning from taking place in infrastructure deficient areas.

Ease of maintainability and minimum complexity of an information system have been singled out as 'good' quality characteristics of an information system (Gafni, 2008). The presences of these attributes in a system can be determined from the ownership, ease of use and availability (access) of such a system. Within Gafni's (2008) framework we derive category 1 lessons by determining mobile phone ownership (Table 1), student–supervisor collaboration (system use) and mobile phone connectivity (access to the system). These findings are important for determining learner mobility since several definitions of m-learning (Traxler, 2007; Fisher and Baird, 2006–2007; Goh and Kinshuk, 2006; Sharples *et al.*, 2005) emphasise the need for learner mobility.

6.1.1 Mobile phone ownership

Respondents were asked to indicate whether they had a personal mobile phone or not in order to determine the proliferation of and access to the mobile phone. The results are indicated in Table 1 below.

Table 1 Mobile phone ownership

Mobile phone ownership	*Frequency*	*Percent*
Owned a mobile phone	68	96
Did not own mobile phone	3	4
Total	71	100

The mobile phone is highly pervasive among distance learners in Uganda. Of the students surveyed, 96% owned mobile phones and all supervisors and administrators interviewed had mobile phones. This indicates a high penetration of the mobile phone among the students, supervisors and administrators. The ease to acquire and maintain a mobile phone was one of the reasons for this impressive statistics. The astronomic growth rate of mobile phones ownership across Africa has also been reported in Brown (2005). The statistics of mobile phone ownership in this study (96%) is comparable with Kajumbula's (2006) statistics (97%) of mobile phone ownership among distance learners in Uganda. This positive trend provides a fertile ground for developing m-learning applications for students support.

6.1.2 Mobile phone research collaboration

Students who had a personal mobile phone were asked to indicate whether they had used it to collaborate with their supervisors or amongst themselves during the research process. The data collected indicated that the mobile phone enabled 93% (n = 63) of the students to collaborate on research related issues with fellow students and supervisors using their mobile phones while 7% (n = 5) did not use their mobile phones for research collaboration. This latter group collaborated with fellow students and their supervisors using face-to-face meetings. The big proportion of students collaborating on research issues via their mobile phones indicates that students are ready to learn using their mobile phones since it is easy to access and operate. Pedagogically, collaboration and interaction present vast amounts of benefits to learners (Uden, 2007; Pask, 1975). Students were able to share research information with each other and get guidance from their supervisors in synchronous and asynchronous ways.

6.1.3 Mobile phone connectivity issues

We wanted to establish whether a student could send/receive a text message or make/receive a call wherever he/she was, at anytime and whether he/she could afford the cost of mobile communication. Sixty-nine percent of the students never had any disruptions in network connectivity, 30% sometimes had disruptions while only 1% always had mobile network connectivity problems. The less disruption in mobile network connectivity could be attributed to the fact that the majority of respondents (67%) were located in the central region of Uganda which has a high concentration of mobile telecommunication companies. The wide mobile telecommunication network coverage in developing countries has also been reported in Gray *et al.* (2006).

There were a significant number of students (71%) who got disruptions in communication due to lack or insufficient airtime credit on their phones. Twenty-nine percent never ran short of airtime credit. This implies that universities wishing to embrace mobile research supervision support services will have to set aside a budget to cover mobile phone costs or work out a mechanism for toll-free communication. "ICT development, especially for education, must … compete with other sometimes 'more important' budgetary issues" (van Brakel and Chisenga, 2003, p.479). In Traxler (2007) the need for financial, human and infrastructural resources for m-learning is articulated. In other words, ICTs must appear as priority cost centre items for universities wishing to offer virtual learning and support.

Other connectivity challenges considered related to phone battery life. Students reported having no disruptions to communication arising from phone battery power. Phone batteries were charged using multiple sources of energy, including: the national power grid (UMEME – 97%), generators (7%), solar power (3%) and cars (3%). The batteries were charged either at home (82%), place of work (18%), commercial charging vendor (4%), by a neighbour/friend (6%), or a combination of power sources (18%). This indicates that the mobile phone could be used in rural (with no national grid power) and urban (with national grid power) areas. This confirms the emergence of a special category of m-learning, the "remote/ rural/ development mobile learning" (Traxler, 2007, p.3) which overcomes the odds prohibiting 'conventional' e-learning from taking place in infrastructure deficient areas.

6.2 Category 2 lessons: Research aspects that were effectively handled through the MRSI

- Mobile research supervision creates a platform for regular virtual collaboration.
- Mobile research supervision works best if it is blended with face-to-face meetings.
- Mobile research supervision enforces the 'customer care' concept in universities.
- Mobile research supervision increases intimacy between the university and its alumni.
- Mobile research supervision breaks the phobia students have towards supervisors.
- Mobile research supervision creates a high cognitive load on the part of the supervisor who may be required to respond to many messages at the same time.
- M-learning is evolving with a new form of vocabulary because of the 160 character limitation on SMSs.
- M-learning should be integrated with PC-based learning management systems.

In arriving at category 2 lessons, we sought to establish, the aspect of research supervision that were adequately handled through mobile phones. We began by establishing whether, on being assigned to a particular supervisor, a student sought that supervisor's mobile phone contact, the reason for seeking or not seeking the phone contact, the feelings of students and supervisors when they received a phone or SMS communication and mechanism of collaboration during the research process. These were important aspects for determining response time as per Gafni's (2008) information systems evaluation framework, Pask's (1975) conversational framework, Vygotsky's (1978) collaborative learning and Brown and Campione's (1996) social constructivistic learning.

Ninety-seven percent (n = 69) of the students sought to get their supervisors' phone contacts in order to:

- fix appointments for face-to-face meetings (96% (n = 68))
- seek guidance in the field and report progress (90% (n = 64))
- communicate with supervisors to create intimacy that could breed better academic working relationship (56% (n = 40)).

By communicating with their supervisors, students broke the phobia that usually affects them in student–teacher relationships. This enabled them to freely express problems and challenges encountered in the field. The mobile phone can reduce the 'loneliness' associated with distance learning by inculcating collaborative learning (Nie, 2007; Naismith *et al.*, 2006).

Three percent (n = 2) of the students did not seek phone contacts of their supervisors because they could physically meet them in face-to-face meetings at any time they wished. The small percentage of students being able to physically meet their supervisors confirms the students' outcry of limited face-to-face supervision hence the need for innovative mechanisms to increase supervisors' 'availability' to the students. This evaluation research has shown that use of the mobile phone for research supervision collaboration is one of such mechanisms as 90% (n = 64) of the students were at liberty to use it to call their supervisors. In Traxler (2007), m-learning is seen as delivery model that maximises contact between the learner and the tutor. Eighty-seven percent (n = 62%) of those who called their supervisors received positive responses. In some instances, students (7% (n = 5)) reported having been discouraged by their supervisors from making calls to them. When asked why they did not encourage calls from students, one supervisor said, "… sometimes students call at awkward hours of the night. Besides, it is costly to the student, so it would be right and fitting for us or the Department to bear the costs by calling our students." Indeed, 52% (n = 37) confessed having received a research supervision call from their supervisors or the research administrators at the Department.

When asked to tick off only one option which was closest to the feeling experienced as soon as they received a call or text message from their supervisors or administrators in the Department, students generally felt that they were cared for. Table 2 provides the different students' feelings.

Table 2 'Single most experienced' feeling when a student received a call or text message from the supervisor/department

Feeling	*Frequency*	*Percent*
Felt good/gratified	10	28
Felt sense of care by supervisor	6	18
Was encouraged/motivated to accomplish my research	6	18
Felt sense of responsibility by the department	6	18
Was excited and surprised	3	9
I was tensed up	3	9
Total	34	100

Table 2 indicated that students were gratified (28%) by the MRSI. Indeed 18% of the students felt the supervisors had practiced a high level of customer care. Students who were called or sent a text message expressed gratitude (18%) to the responsible and motivating supervisor/department action. Others were simply surprised (9%) because they never expected such a thing to happen. In other instances, the call/text message tensed up some students (9%), who felt they were so 'insignificant' to receive such a 'first class' treatment from their university or supervisor. Such feelings rejuvenated the at-risk students. M-learning motivates learners by encouraging active learning

(Laurillard, 2007; Uden, 2007; Stead *et al.*, 2006). Being excited, surprised and tensed up by the call/text message received from their supervisors is an indication of lack of prior knowledge about the MRSI on the part of the students. The administrators in an interview confirmed that students were not generally briefed about the initiative.

On receiving a call or text message from a student, supervisors and administrators had this to say. "I felt my students were working and instantly attended to any calls and SMSs that came during office hours and postponed, to the next day, those that come in at night," said one supervisor. "I sympathised with students on the cost, because at times, I could explain a research aspect for over ten minutes," said another supervisor. "I responded to students' queries immediately if I had the answer at my fingertips or responded later after receiving the appropriate answer," said one of the research administrators. These messages show that supervisors and administrators where committed to the MRSI because they initiated it. They also confirm the two-way conversation espoused in Pask's (1975) conversational theory.

When asked to write down some of the SMS messages received on their mobile phones from either their supervisors or fellow students, students gave a number of messages some of which are reproduced below. It should be noted that the 160 character limitations of text messages dictated the use of abbreviations and symbols in some messages:

> "… come with Chapter one we shall meet at the Common Room at 2:00pm. Come for feedback from your work. We are meeting the supervisor at the Institute. The supervisor is not around. Please find out if supervisor is in office. How far have you reached? Can we meet at campus? We are meeting at the Institute at 10am – supervisor. Please come 4 feedback on sat 23 June 2007 at 9:00am. Deadline 4 handing in research reports is July 15 2007. Come for supervision meeting from 9-5pm. Have you typed the questionnaire, lets discuss them 2moro. Will not be available, meet 2gther next week same time. Come for your research questionnaire. Research supervision meeting is on sat 17th feb 2007 starting at 9:00am-prepare to travel. Kindly confirm whether you have completed your research or not, I am updating my workload. Please hurry the supervisor is about to leave. SoP is that problem whose answer calls for research…." (Sample of messages received on students' mobile phones)

Students received messages from either their supervisors or fellow students. This shows that collaborative learning (Vygotsky, 1978) and conversations learning (Pask, 1975) took place in the research community of practice. Consequently, the MRSI abetted Brown and Campione's (1996) social constructivist learning paradigm. The messages sought to:

- fix face-to-face research supervision meeting appointments
- motivate and pace the 'lonely' student in the field
- provide a two-way communication mechanism
- establish and monitor students' progress
- inform students about deadlines and important dates
- provide students with some useful research tips.

The research supervision aspects mentioned above could as well have been provided using the internet or e-mail. However, to ensure that the majority of students get the aspects and respond in good time, the mobile phone was used. Studies conducted by Aguti and Fraser (2006) and Kajumbula (2006), estimated that 97% of distance learners at Makerere University owned mobile phones and less than 1% had access to internet and e-mail. In this study, we have also established an almost equal number (96%) of students owning mobile phones. This state of affair favoured the use of mobile phones in extending those research supervision aspects.

In synchronous or asynchronous way, students responded to the SMS messages or calls sent or made to them by their supervisors and fellow students. Again we reproduce some of the messages in their raw form in order to emphasise the need to learn a new form of vocabulary for SMS messaging in m-learning:

> "…. I will be waiting 4 the instructions as u promised. I was ur rsch student and I am requestg u 2 B my referee. Mai RESEARCH was gven 2 da RECEPTIONIST. "*THAXS FR DE MSG AM SORRY I HV BN AWAY. I'M CONFIRMING THAT I WILL HAND IN MY DRAFT REPORT AT DE END OF FEB 2007 YR STUDENT"*. "*Am realy very sorry sir! I got an accident dt almost put me 2 death but now i've just dropped mi report in ur off, kindly act as a parent & tel me wn 2 mt"*. I'm finalizing with the last bit of the research a hope to travel any time this week to present it. I still have adv.a/c to retake next sem.my resch work wil be handed over to yu soon for oct gradtn. Thks so much…." (Sample of messages received on supervisors' phones)

The above messages indicate that synchronous or asynchronous collaboration took place between students and their supervisors and amongst students themselves. Further, the messages reveal a sense of intimacy that developed between the students and their supervisors and amongst students themselves. This intimacy is depicted in the relationships that developed between students and their supervisors even after the research process. "I was ur rsch student and I am requestg u 2 B my referee", read one of the messages. The collaboration also paced students and helped supervisors to monitor their progress. "THAXS FR DE MSG AM SORRY I HV BN AWAY. I'M CONFIRMING THAT I WILL HAND IN MY DRAFT REPORT AT DE END OF FEB 2007 YR STUDENT," read another message. Prompting messages also brought hope to those who had almost given up with research due to one reason or another. "Am realy very sorry sir! I got an accident dt almost put me 2 death but now i've just dropped mi report in ur off, kindly act as a parent & tel me wn 2 mt." Here, the student was responding to a call made to him by his supervisor trying to find out his whereabout after a period of over 12 months in the field without the supervisor hearing from him.

The collaborative text messages and calls kept the supervisor in the know about what was happening to his/her students out there in the field. However, space limitations of the supervisors' mobile phones only allowed a given number of messages to come through. Supervisors reported a cognitive overload especially when many messages required instant responses. This presents a need to develop a system which can automatically route 'to be answered later messages' to a messages database in learning management systems. This comes from the realisation that mobile devices are constrained by limited memory, size, bandwidth; battery life and tiny keyboard and yet are pervasive (Trifonova and Ronchetti, 2006).

6.3 Category 3 lessons: Influence of mobile research supervision on students' throughput and research quality

- Mobile research supervision increases students' throughput
- Mobile research supervisions improves research output quality and learning experience.

A research project paper is a partial fulfilment for the award of a bachelor's degree at Makerere University. It is by regulation supposed to be accomplished in the second and last semester of the final year of study. A semester is 4 months or 17 weeks long. By implication it means that once a student uses more than four months to complete his/her research project, he/she will not be able to graduate with his/her cohort hence affecting a given cohort's throughput. In Otto and Wrightson (2005), throughput of distance learners at Makerere University was put at 60% with failure to complete the research project in time being blamed as one of the factors leading to the low throughput.

In Table 3 below, we used Pearson chi-square test to determine whether mobile research collaboration had any significant effect on the research paper completion duration.

Table 3 Pearson chi-square test of mobile research collaboration versus completion duration

Statistics	*Value*	*df*	*Asymp. Sig. (2-sided)*
Pearson chi-square	43.459(a)	28	0.031
Likelihood ratio	23.530	28	0.706
Number of valid cases	71		

Notes: (a) 40 cells (88.9) have expected count less than 5. The minimum expected count is 0.04.

At a level of significance of $p \leq 0.05$ and 28 degrees of freedom, $p = 0.031$. This means that mobile research collaboration significantly affected a student's completion duration. This revelation collaborates with that received from administrators who said, "… students that used mobile phones and face to face meetings to collaborate with their supervisors and fellow students completed their research projects in time [4 months] as opposed to those who infrequently collaborated using face to face meetings only". Internet and e-mail collaboration was not used due to limited access (Aguti and Fraser, 2006; Kajumbula, 2006). The administrators presented a case of a student who had only depended on face-to-face research supervision meeting and consequently used 30 months to accomplish a research paper that should have been finished after four months. The reason given by the student in the letter explaining why he had used 30 months was, "… whenever I came to see my supervisor, he was busy in meetings or was simply not around. I somehow gave up until the Department wrote threatening to discontinue me." The case of a student using 30 months to complete a research paper does not necessarily mean that all students who collaborated only in face-to-face meetings did not complete their research in time. We were shown face-to-face only supervised cases that had completed in time, but the administrator emphasised that they had held regular supervision meetings. These revelations confirm the fact that when students are paced, they work hard to complete a task (Kurubacak, 2007; Laurillard, 2007; Uden, 2007; Stead *et al.*, 2006).

Regarding the quality of the research output, the administrators revealed that the quality of research work produced by students who had participated in mobile research supervision was excellent. "These students interact a lot with their supervisors, fellow researchers and officials in the research office and as such receive a lot of guidance. I am not surprised that most of them score 65% and above," said one of the research administrators. These findings reveal the viability of mobile distance learning. They provide some answers to Traxler's (2007) call to contribute to accounts of mobile distance learning and confirm Otto and Wrightson's (2005) causes of low throughput. The results also re-emphasise the importance of student support in distance learning (Otto and Wrightson, 2005; Fagerberg and Rekkedal, 2004).

6.4 Category 4 lessons: Mobile research supervision: challenges to students

- Quality assurance benchmarks can be set and strictly adhered to in mobile research supervision.
- Challenges of ICT-supported distance learning can be solved through blended learning.
- M-learning traverses the electricity constraints which inhibit 'conventional' e-learning in remote areas.

In an open ended question, students were asked to list the challenges faced during the mobile research supervision process. Table 4 provides a tally of the challenges mentioned. The challenges are ranked using frequency counts from the most frequent (ranked as number 1) through to the least frequent (ranked as number 11).

Table 4 Challenges faced during mobile research supervision

Challenge	*Percentage of students faced with the challenge (N = 71)*	*Ranking as per most frequent*
Rigour of the research process	45 (n = 32)	1
Busy schedule of the students	42 (n = 30)	2
Non-availability of the supervisor at certain times	40 (n = 28)	3
Costly research process	33 (n = 23)	4
Limited time allocated to the research project paper	32 (n = 22)	5
Limited guidance	20 (n = 14)	6
Long distance travelled to come and meet the supervisor	18 (n = 13)	7
Need for word-processed manuscripts	17 (n = 12)	8
Non-response/respondents being suspicious	11 (n = 8)	9
Using e-mail and internet to communicate	9 (n = 6)	10
Electricity load shedding	2 (n = 1)	11

In Table 4, the most important challenge reported was the rigour of the research process. As a way of maintaining quality, supervisors were strict on many issues including: the research methodology and writing style. "I do not entertain mediocrity," said one of

the supervisors during an interview with him. Evidence of the reported rigour is attested to in the responses the students gave to the question – What major research supervision challenges did you encounter during your research?:

> "… I disliked a lot of criticism to my work. I was unable to put up a clear research problem for five consecutive times. The supervisor made me rewrite the report several times due to mistakes I had made. My supervisor wanted me to be as knowledgeable as him in research method, something I was not able to cope up with in the little time given…" (Field data)

The responses above point to the fact that there was strict emphasis on quality of the research work. They also show that the research process was not entirely based on mobile phone support. Supervisors read hard copies of students' manuscript and gave inputs and comments. The MRSI was carried out within the Makerere University's quality assurance framework and did not in any way compromise on research quality standards. Thus the MRSI was "consistent with the teaching and learning philosophy and conceptions of teaching and learning of all the participants" (Traxler, 2007, p.9). Blending of ICTs with traditional teaching methods is also reported in van Brakel and Chisenga (2003).

Electricity load shedding presented the least challenge (2%) because there were a number of alternative power sources which could be used to charge mobile phones' batteries. There were also a number of secretarial bureaus where students could word process their work. Electricity load shedding not being a major challenge in m-learning confirms the emergence of a new form of m-learning called the "remote/rural/development mobile learning" (Traxler, 2007, p.3) which overcomes the odds prohibiting 'conventional' e-learning from taking place in infrastructure deficient areas. Insufficient power supply has been a long standing constraint to the thriving of ICTs in education in Africa (van Brakel and Chisenga, 2003). Other important challenges included: busy schedule of the students (n = 30), non-availability of the supervisor at certain times (n = 28), costly research process (n = 23) and limited time allocated to the research project paper (n = 22).

Whereas van Brakel and Chisenga (2003) see ICT as being an integral part of distance learning, some of the challenges final year students at Makerere University are reporting are: the requirement to produce word-processed manuscripts (n = 12) and use internet and e-mail for communication (n = 6). This is not surprising considering the low level of computer literacy in African countries (Brown, 2005). This calls for concerted effort in providing basic ICT literacy to all university students in Africa.

Most of the challenges above, present a need for a robust mechanism to aid students and their supervisors to keep in constant touch. Constant collaboration will pace and motivate students (Laurillard, 2007; Uden, 2007; Stead *et al.*, 2006) to carry on with the so-called 'difficult' research paper.

6.5 Category 5 lessons: Suggestions for improving research supervision process at Makerere University

- Students will pick interest in using learning technologies that have been encouraged or introduced to them by their lecturers or facilitators.
- ICT-based student support requires a huge upfront investment and maintenance costs.

- M-learning costs affect students' ability to freely interact and collaborate with colleagues and supervisors.

Students were asked in an open ended question to give ICT-based solutions for solving the challenges mentioned in Section 6.4. Table 5 summarises the responses given and uses frequency counts to rank them from most important (as number 1) to the least important (as number 8).

Table 5 ICT-based suggestion for improving research supervision process at Makerere University

ICT-based suggestion	*Percentage of students making the suggestion (N = 71)*	*Ranking as per most frequent*
Encourage use of internet/e-mails in research supervision	92 (n = 65)	1
Improve on the mobile/internet communications infrastructure	87 (n = 62)	2
Train students in use of ICTs	81 (n = 58)	3
Entrench mobile phones in student support services	81 (n = 58)	3
Use mobile phones to give guidelines to students	79 (n = 56)	4
Send regular SMS reminders to students	71 (n = 50)	5
Establish subsidised call centres at regional offices	52 (n = 37)	6
Partner with phone dealers so as to provide low cost phones to students	50 (n = 36)	7
Messages, calls and e-mails should be sent/made to students in good time	50 (n = 36)	7
Distance education should forge a partnership with secondary schools for sharing ISP fees	40 (n = 28)	8

Generally speaking, Table 5 brings out a high desire for ICT integration in distance learning. This is inline with van Brakel and Chisenga's (2003, p.476) declaration that "no distance learning programme is feasible without the interactivity provided by the internet…". Students even in developing countries such as Uganda are desirous to embrace the digital age (Fisher and Baird, 2006–2007) lifestyle. Many students (65 out of 71) wished to have online supervision through internet discussion forums and e-mails. However, there was recognition that the infrastructure and capacity to enable this preferred mode of supervision is not yet available and needs to be put in place. When asked why those with access to internet services did not utilise it during research supervision, 75% said their supervisors did not encourage them to use internet and e-mail. This implies that uptake of mobile and online supervision can be deeply entrenched if the universities encouraged staff to adopt its use through provision of the necessary facilities and capacity building.

6.6 Category 6 lessons: Cost implication of mobile research supervision

- MRSI should be institutionalised as a student support mechanism and catered for in Makerere University budget.

- Mobile student support encompasses three stakeholders, namely: the students, the university and the mobile telecommunications providers. These need to come together and work out a cost sharing mechanism for m-learning.

Already, it has been reported that financial pressure on the part of the students was part of the factors that inhibited students' completion rates at the Department (Otto and Wrightson, 2005). We therefore wanted to determine whether MRSI was an addition to the financial pressure. It should however be noted that our evaluation did not do a cost/benefit analysis of mobile research supervision but sought to get mobile research supervision cost experiences from students, supervisors and administrators. Supervisors and administrators singled out airtime credit as the major cost of maintaining a mobile phone. This was confirmed by the responses generated from the question which required students to state whether they had received any disruption in collaboration due to lack of or insufficient airtime credit. Lack or insufficient supply of airtime credit sometimes disrupted communication of 62% of the students, 8% were always constrained while 30% communicated without any airtime constraints. For the supervisors, they only communicated (using their mobile) to students on goodwill since the Department did not provide them with any airtime credit for supervision purposes. Some supervisors used the Department's landline phone to communicate to the students. This, according to supervisors and administrators, was neither sustainable nor convenient. The supervisors suggested that a proposal be developed and presented to mobile telecommunications service providers for them to consider giving a concession in communications charges to distance learners as one of their social responsibility package. This will be an enforcement of the public-private partnerships highlighted in van Brakel and Chisenga (2003).

6.7 Category 7 lessons: Other academic and administrative services that can be delivered via mobile phones to distance learners at Makerere University

- The scope of m-learning applications depends on the institutions creativity and innovativeness.

Other than the text and verbal collaboration, supervisors and administrators indicated the need to use mobile phones for delivery of content to learners and providing links to useful study materials. The distance education administrators felt that the mobile phone could be used to remind students about registration, examination and face-to-face dates, in addition to giving them motivational messages. M-learning motivates and actively engages learners (Laurillard, 2007; Uden, 2007; Stead *et al.*, 2006). Mobile devices applications in distance learning are just beginning (Traxler, 2007). Thus further imaginations and innovations in m-learning will yield numerous mobile distance learning applications.

7 Policy recommendation from the study

The study has unearthed a number of lessons from which we draw the following policy recommendations:

- Student support through m-learning is undisputedly vital. Makerere University should institutionalise m-learning by revisiting their e-learning policies and strategies to incorporate m-learning.
- Staff and students at Makerere University need to be sensitised about the emerging field of m-learning and encouraged to utilise and undertake research in m-learning.
- Today, provision of education that meets international standards, hinges so much on producing graduates who can apply ICTs in their respective professions. Makerere University should make ICT investments and capacity building a top priority.
- Makerere University should embrace the public–private partnerships especially with ICT vendors and telecommunications companies so as to benefit from their corporate social responsibility.

8 Conclusion and future work

The evaluation study has showed that the mobile phone is an engaging and effective device for facilitating collaborative/cooperative learning in distance learning. However, for one to deliver education to geographically dispersed students in a large populated and developing country such as Uganda, there is a need to invest more time and resources in developing m-learning solutions geared towards providing learning support to learners at anytime in any place.

Further research needs to be conducted to determine the actual unit cost of implementing m-learning and how this cost could be negotiated between the learner, the institution, and the telecommunications carrier. Additionally, there is a strong need and requirement for the development of m-learning policies and pedagogy for learners in developing countries.

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