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Practices and challenges in an emerging m-learning environment

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ABSTRACT

This study reports an interpretative case study investigating practices and challenges in an emerging m-learning environment at Makerere University in Uganda. The research was part of the MobiClass pilot project. Data was collected by means of observations and interviews with teachers and various m-learning support staff, including teacher trainers, systems administrators and a software developer. The Framework for Rational Analysis of Mobile Education (FRAME) is used as an analytic framework. The research focuses on how learning content management systems (LCMS) are implemented and used for m-learning purposes. We observed teacher training and m-learning content development practices and found that teacher skills for developing educational content, institutional m-learning policies and training programs are crucial success factors. The main finding is the importance of the support staff; it takes a long time to implement new technology and change teaching practices, support staff is needed to manage, inspire and support student and teachers.

Keywords: M-learning; Emerging M-learning Environments; M-learning Content Management Systems; Instructional Design; Framework for Rationale Analysis of Mobile Education

INTRODUCTION

Information and communication technology (ICT) presents opportunities for transforming both formal and informal education. In schools, use of ICT for teaching and learning is a contested issue that divides education reformists and people accustomed to traditional teaching and learning methods. Reformists argue that ICT offers flexibility and the ability to collaborate with others in learning (Sharples 2013), creates personalized learning environments, makes learning seamless (Denk 2007), and helps schools to track and assess portfolios of teachers and students to improve performance (Talebian et al. 2014). In distance education ICT can lower cost barriers for travel, administrative (labour), printing and infrastructure (Bhuasiri et al. 2012; Ruth 2010). Ruth (2010) also argues that ICT helps to increase productivity in terms of performing learning tasks faster, collaborating and communicating.

The literature also reports challenges. Fozdar et al. (2006) note that ICT often reduces face-to-face interaction among students, which is one reason for the high dropout rates in distance education. Studies on digital divides also indicate that marginalized students (such as impaired and economically disadvantaged ones) may be further excluded from educational practices when ICT is used in learning because they cannot afford the technology if it is not free or subsidized (Wei & Hindman 2011). Marginalized students are also often unable to use the ICT due to institutional failures to comply with legal and technical requirements for impaired students (Seale 2013). In a literature review of ICT use in education, Andersson and Grönlund (2009) found challenges on four levels; course, individual, technological and context. Among other things they conclude that in many developing countries teaching methods need to be transformed into a

pedagogy more focused on learner activities, self-learning and motivation. Player-Koro (2012) argues that there is "a lack of evidence that ICT has actually enhanced educational standards" (p.94) in terms of improving student learning. But in particular education contexts, it offers alternative approaches to learning for both students and education providers.

Using mobile technology in the context of education is sometimes named m-learning, which Kukulska-Hulme and Traxler (2005) define as:

> *"a person[a]l, unobtrusive, spontaneous, anytime, anywhere way to learn and to access educational tools and material that enlarges access to education for all" (p.1).*

It is a mode of e-learning that offers a greater flexibility in terms of location. Mobile learning is considered to have potential due to its accessibility, flexibility, ease of assessment and feedback, and access to online repositories (Han & Shin 2016). It enables flexible collaborative means of learning as students and teachers easily interact and communicate (Gikas & Grant 2013). More interestingly the interactions occur outside the formal learning settings (Cheon et al. 2012). Sung et al. (2016) note that mobile devices are seen as tools for stimulating motivation, strengthening engagements and delivering content.

There is also the dark side of mobile learning. Cheon et al. (2012) discuss some of the limitations of mobile learning including; technical limitations of mobile devices (i.e., [small screens, inadequate memory] of mobile devices, slow network speeds because of wireless connectivity, and standardization and comparability challenges), psychological and pedagogical limitations such as facing interruptions from social media which affect students' focus during class activities. Moreover adapting to mobile learning practices requires teachers to change their previous teaching methods and design teaching instructions that suit mobile learning settings (Fleischer 2012). Elias (2011) and Sharples (2006) list more challenges, which include, privacy and security, multiple technical standards emerging as a result of continuous advancement in mobile technology and non-compliant user interface designs of learning platforms. Parsons (2009) highlights another major challenge that is not widely discussed in m-learning literature, namely poorly designed learning material. According to Elias (2011), poorly prepared learning material is a challenge linked to instructional design, that is, the technical actions taken to improve access to educational resources which involve planning and formulating teaching and learning activities (Isman 2011; Clark & Mayer 2003). The challenges highlighted above are more prevalent in least developed countries (LDCs), with poorly funded educational systems and limited infrastructure resources such as Internet connections. LDCs are also accustomed to traditional teaching and learning practices where students largely depend on teachers in terms of obtaining learning materials and managing classroom setups and activities.

The aim in this paper is to investigate practices and challenges affecting an emerging m-learning environment from the perspective of teachers and m-learning support staff. The research aimed at creating interventions at a higher institution of learning. We further discuss how the practices and challenges affect use of m-learning content management systems in terms of access to and use of electronic learning resources. The use of mobile learning management systems in formal learning settings is a relatively new technological advancement and few studies have explored this area of research (Han & Shin 2016). Our contribution is not only sharing practical experiences which can serves as examples for practitioner in LDCs but we also contribute to literature by discussing some of the challenges and practices. The study is part of an action research project (MobiClass) that took place at Makerere University in Uganda during the academic year 2013/2014.

CASE DESCRIPTION

In 2013 the Centre for Teaching and Learning Support at Makerere University in collaboration with the Informatics department at Örebro University, Sweden, initiated the MobiClass project. Makerere University had 142 undergraduate and 131 postgraduate programmes with a registered student population of 56,671 and 1,354 academic staff as of 2013/2014 academic year[1]. The main objective of the MobiClass project was to fully implement m-learning at Makerere University and develop a mobile learning content management system (m-learning application) by means of enhancing the university's existing learning management system to support mobile devices, especially mobile phones (both feature phones and smart phones). A mobile learning content management system is a learning platform that can be used to create, store and disseminate learning content to mobile devices and to perform tasks and services performed by other electronic learning platforms (Asiimwe & Grönlund 2014).

The objective of the MobiClass project was to be attained through:

- Developing a quality assurance framework for m-learning to improve the existing Makerere University Electronic Learning Environment (MUELE[21]) and re-designing it to include m-learning tools.
- Training teachers and students on how to use MUELE and the developed mobile application.
- Training teachers on how to create accessible content (course material).
- Study challenges and opportunities related to the use of mobile devices and assess the impact on learning (learning outcomes).
- Create and strengthen m-learning policy and strategy for the university.

MUELE is an online learning management system (LMS) used as the default electronic learning platform at Makerere University. The system is a customization of Moodle (Modular Object-Oriented Dynamic Learning Environment) which is an open source LMS developed and supported by the Moodle Project[3]. MUELE provides tools to manage and support learning in a virtual environment. Functions of the system include learners' activity reporting, creation of online quizzes, content/learning material management, chat rooms, discussion forums, wikis, communication (e-mailing), course creation and management, and user management (teachers, students and administrators). The tools are available in both mobile and desktop versions. MUELE is hosted and managed locally on campus by the Directorate of Information and Communications Technology Support[4] (DICTS), which is responsible for ICT implementation and support services at Makerere University. Use and implementation of MUELE is an ongoing activity and the implementation is monitored and evaluated by DICTS through performance and system usage reports. It is updated regularly in accordance with Moodle updates. At Makerere University, more than 53,000 people (teachers and students) are registered users of MUELE.

In the MobiClass project MUELE was improved to support both desktop and mobile devices. A mobile learning application was developed (Figure 1), and teachers were trained to meet various needs of learners. Twenty-four teachers and sixty-four students were directly involved in the implementation of the project for purposes of assessing user needs and challenges related to using the new technology. Various issues were studied during the pilot project, for example, perceptions of teachers and students towards the developed mobile application, their preferences (needs) and what affected them from the perspective of user needs and support (technical and infrastructural), training and policy. The MobiClass project started in 2013 and lasted for one year. The researchers participated in several project activities such as planning, evaluation and

providing feedback reports on how to improve MUELE in terms of functionality to meet user needs. The project was thus an action research endeavour, but this paper reports only an interpretative study based on interviews with teachers and m-learning support staff conducted in May and December 2014.

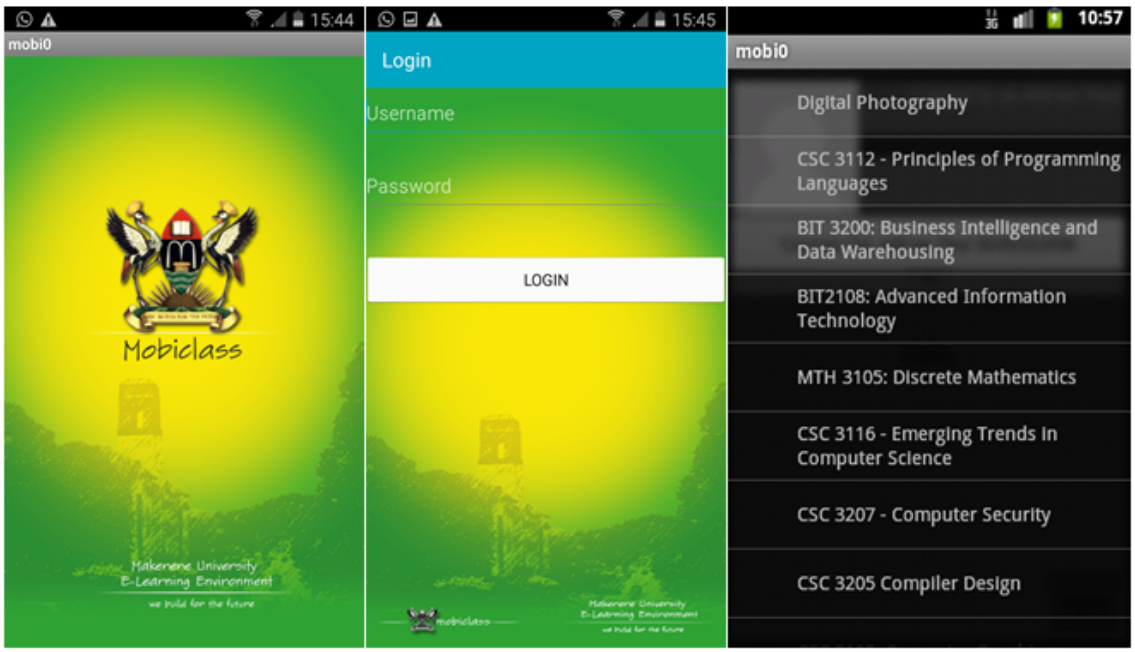

Figure 1: *Screen shots of the mobile app developed by the MobiClass project*

THE FRAMEWORK FOR RATIONAL ANALYSIS OF MOBILE EDUCATION

The Framework for Rational Analysis of Mobile Education Model (FRAME) created by Koole (Koole 2009; Koole & Ally 2006) was used to evaluate the m-learning environment. The framework includes three interconnected dimensions, the *device aspect*, the *learner aspect,* and the *social aspect* (Figure 2). The intersections create three micro dimensions, *device usability*, *social technology,* and *interaction learning.* The proposal is that when requirements for each aspect are met and all dimensions are balanced, a conducive environment for m-leaning is created. Koole (2009) suggests that “practitioners may use the model to design more effective mobile learning experiences” (p.27).

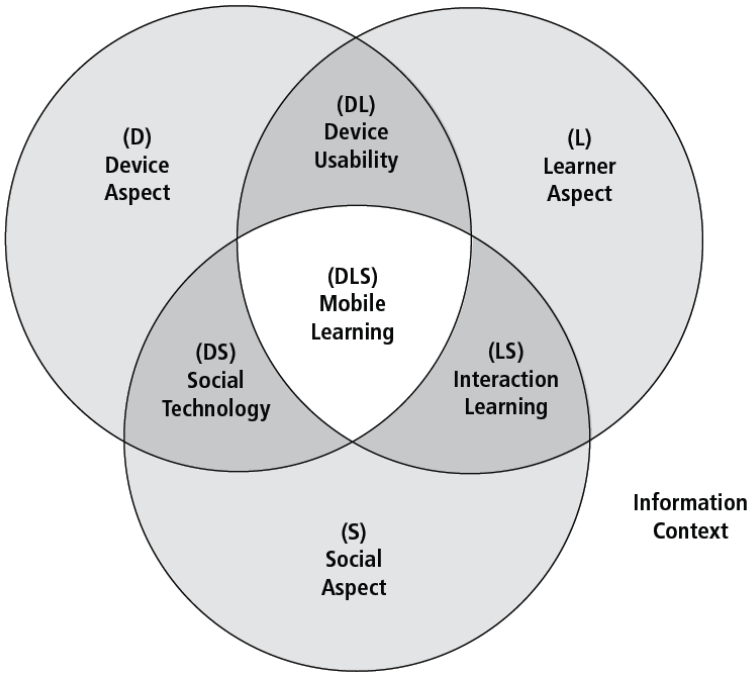

Figure 2: *The FRAME model (Koole 2009, p.27)*

The *device aspect* describes aspects of technology artefacts and infrastructure and how they affect actors and performance in a mobile learning environment. The goal is to eliminate the technical barriers and take advantage of m-learning opportunities.

The *learner aspect* describes the learner's learning processes and individual characteristics that affect that process, such as motivation to learn, beliefs, learning contexts, strategies, and personal experiences. The learner aspect addresses how the learner can be technologically and pedagogically facilitated and motivated.

The *social aspect* refers to a socially constructed environment that allows interactions, for example student-student, teacher-teacher, teacher-student, and student-content. It concerns factors that affect social interactions, collaborations, and conversations and how a social, interactive and engaging environment can be created for mobile learners.

The intersection of the device and learner aspects (*Device Usability*) explains technology characteristics that make it easy, or not, to use technology, such as portability, accessibility, and ergonomics. The intersection of the device and social aspects (S*ocial Technology*) describes the social affordances of mobile technology, for example the qualities of technology that allow learners to socialise at an individual or group level, such as supporting communication and collaboration among multiple individuals. The intersection of the learner and social aspects (*Interaction Learning*) addresses theoretical concerns of collaborative and interactive learning which pertain to unique cultural contexts and abilities of individuals to interpret and comprehend ideas.

The intersection of all aspects (*Mobile Learning Process*) is perceived to be the epitome of m-learning environments. It combines all the intersections and dimensions. The mobile learning process intersection is where technology mediates learning processes to make knowledge

navigation, information access, interactions and collaborations productive. For instance areas of focus include how mobile devices support interactions among learners and communities of practice, independence of learners during learning tasks (individual learning) and how the roles of leaners and instructors change (Koole 2009). It concerns both practical and theoretical perspectives of the technology, social, informational and human aspects (pedagogy).

The *information context* concerns the information exchanged. Learning occurs through exchanges of information. The device and the learner are both actors in this exchange and it occurs through social arrangements designed for each learning situation. The information context includes issues pertaining to making the information accessible, for example how to tailor and provide course content to achieve minimal cognitive load implications for learners, or designing instructional based learning content with rich interaction possibilities between 'learner' and 'device' (Koole & Ally 2006).

Researchers and practitioners have used FRAME to explain the dynamics of a mobile learning environment. For example Bachman & Gannod (2011) propose to use FRAME with additional characteristics and refer to their model as Augmented FRAME. Their contribution details the model with more characteristics that affect the device, learner and social aspects in m-learning. Some of the suggested characteristics include situated, authentic and individual experiences and authoring capability for the learner aspect; type of device, a supportive infrastructure and mobility capability for the device aspect; and "reading, writing speaking/listening and teaming" (p.311) for the social aspects. Studies that discuss or use FRAME, for example Porumb et al. (2013), Laohajaratsang (2013), Park (2011), and Hostler (2015), use and explain the model as an evaluation framework and demonstrate how it can be applied in m-learning studies. Porumb et al. (2013) note that information technologies, especially the mobile ones, have created a didactic gap because design and development of m-learning applications is mostly technology-driven. They use FRAME as a conceptual model to design and develop an LMS application. They argue that using the FRAME model in design and development "can bring together the technical perspective and the didactical perspective" (p.96). FRAME is also used as a reference model for evaluation in a pilot study by Laohajaratsang (2013) to design tablet-based learning activities for pre-service teachers. The study addresses aspects of motivation, engagement, and independence during learning, and collaborative learning.

While the current FRAME model is useful for assessing m-learning, m-learning can be further explained by relating it to different actors involved in a mobile learning environment. In this study we focus on teachers and m-learning support staff. We investigate the challenges they face in introducing m-learning and relate their m-learning practices to the FRAME model.

Teachers and support staff

While the FRAME model focuses on students there are clearly other people involved in m-learning. To begin with, the technical infrastructure requires considerable regulation and organization, all of which involve people other than teachers and students. Second, in newly established m-learning environments there is a need for support to teachers and students from the educational institution. Third, as a part of the learning is technology-mediated, the role of the teacher changes compared to traditional classroom teaching. M-learning requires teachers to do different things, and to do them in different ways. Teachers need to re-think their instructional design since both instructional materials and delivery methods need to be put into a format that the mobile technology can handle and that is flexible towards different use environments and situations. This means both restrictions and new opportunities (Pliner & Johnson 2004; Elias 2011). Students will work in partially new ways, e.g. in different locations. Content needs to be adapted to learners' different abilities and needs. Clark & Mayer (2003) present six principles that explain how content challenges could affect students; merging multiple media, keeping a mode of

presentation coherent across different media, keeping content coherent, avoiding unnecessary information in tutorials, using simple tutorials that are strictly focused on learning goals, and personalizing content.

While the teacher is the "intellectual centre" of all the above, there is also a need for technical facilitation in terms of making suitable technical tools, design skills, and technical support readily available to both teachers and students; all of which make it necessary to have assistance from support staff.

At Makerere University and with the MobiClass project in particular, the support staff included systems administrators, a software developer, and teacher trainers. Their role was critical to m-learning implementation and included a number of tasks for example formulating policy, financial and implementation plans, providing technical and infrastructure support, training teachers and students on the use of technology, evaluating m-learning projects and programmes, providing advisory services to faculty, and developing and maintaining the technology. The role of m-learning support staff thus entails creating a functional technical and organizational m-learning environment.

Many of the above-mentioned tasks are not trivial. Hence m-learning support staff is not necessary just for devising quick solutions to immediate technical problems, but play a significant role in building mind-sets and attitudes of students and teachers towards the use of learning technology (Selim 2007; Vanderlinde et al. 2012). Some software applications for m-learning are available off the shelf but others have to be developed or customized locally; this is another task for support staff.

A final role for support staff is evaluation. Evaluation is often done for purposes of improving service quality and/or performance for an institution or a project. In m-learning environments suggested measures include performance, success and participation levels (Tanrikulua et al. 2010). Hersh (2014) mentions four main types of evaluation that can be applied to evaluate electronic means of learning, and each evaluation type serves a different aim;

> *"formative evaluation to improve tool design during development; summative evaluation to help users make decisions about what technologies to use and for what applications; illuminative evaluation to reveal unexpected important issues; and integrative evaluation to help users make the best use of a particular tool." (p.31).*

Evaluation often also includes policy making regarding standards and methods.

METHOD

This study is qualitative and follows an interpretative case study methodology (Walsham 1993; Walsham 1995; Walsham 1996). The study is part of an action research project (MobiClass). Data was collected by means of face-to-face interviews and observations. We investigate practices and challenges facing m-learning support staff and teachers in a newly implemented m-learning environment at Makerere University in Uganda.

Respondent sample and data collection

Interviews were conducted with twenty-seven teachers and five support staff (two teacher trainers of pedagogy and technology use, two systems administrators and one software developer). The teacher trainers were the project facilitators. The systems administrators and the software developer also served as trainers for particular technical aspects and were responsible for

managing MUELE. All teachers are required to use MUELE. The sample was selected from the most active teachers i.e., those who most frequently used MUELE. The MobiClass project coordinator extracted names of the active teachers based on activity reports from MUELE. The m-learning support staff were included in the whole set of people involved in the m-learning implementation project tasks at Makerere University. All respondents that were included in the study had experience of using the web-based version of MUELE in their respective roles. However, their experience varied from two months to seven years. Some of the teachers also had experience with the use of other learning management systems such as Blackboard[5].

The interviews were conducted at Makerere University between May and December 2014. The average interview time was one and a half hours, ranging from fifty minutes to three hours. The interviews were semi-structured and guided by relatively open questions (Appendices A and B). The questions were based on literature on m-learning implementation experiences and the MobiClass project objectives. When the interviewee allowed, interviews were voice recorded (n=8). In the other cases notes were taken.

In addition to the interviews we also observed three teachers during three different activities. On two occasions the observations involved two teachers demonstrating the process of preparing content and instructions for students with considerations of knowledge obtained from the project trainings and personal learning initiatives. The third observation featured the teacher who had least experience of MUELE undergoing teacher training on how to use the system. The training was carried out by one of the teacher trainers.

Data Analysis

Interpretive analysis was used to analyse the data and two questions were formulated to guide the analysis process. The two questions are based on the two aspects the paper aims at, i.e., practices of teachers and m-learning support staff and challenges that affect them:

- What practices do teachers and m-learning support staff engage in so as to understand and meet learners' expectations in terms of accessibility to course materials, technology requirements, and achieving a collaborative m-learning environment?
- What challenges exist for teachers and m-learning support staff in an emerging m-learning environment?

The analysis process included four steps:

- Transcribe and anonymize the interviews. All the recorded interviews were transcribed and the field notes were organized. Anonymization was done by giving each respondent a code.
- After the interviews had been transcribed and organized. We categorized the responses based on the two guiding questions, i.e., if the respondents' statement represented a practice or a challenge (or both).
- After the initial coding we re-analysed the data to categorize the responses based on the three main categories in the FRAME model.
- Finally, we interpreted and described the findings that emerged from each category.

RESULTS

Table 1 lists the various practices and challenges found in the analysis of the interviews.

Table 1. *Practices and challenges*

FRAME Aspect	Practices	Challenges
Device	- Use of open source mobile learning applications. - Use of interoperable applications. - Use of social media applications. - Provision of hardware and Internet infrastructure.	- Poor mobile infrastructure. - Lack of resources (high infrastructure cost).
Learner	- M-learning Instructional design practices. - Multimodal learning. - ICT support for learners.	- Poor m-learning instructional and content design practices. - Low awareness of m-learning opportunities.
Social	- Means of socialization, interactions and collaborations. - Teacher education and support.	- Non-collaborative, interactive and irresponsive learning platforms. - Weak mobile learning policies and lack of awareness of existing policies. - Insufficient teacher training.

Practices

Device aspects

Use of open source mobile learning applications: Makerere University preferred to use open source mobile learning authoring software applications and learning management systems. During the interviews one of the systems administrators noted that, "the university migrated from Blackboard to MUELE to avoid massive costs. MUELE is developed on open source software" (sa1). In addition to use of MUELE two teachers (t7 and t19) mentioned that they used another open source application called eXe to create content before uploading the content to MUELE. The goal of using eXe is to "make the content responsive" (t19). T7 noted, "It took me two days to learn how to use eXe authoring software and it makes content more accessible, that's why I use it." The use of various content authoring tools appeared to result from deficient utilities in MUELE, noted respondents t19, t7 and t24.

Use of interoperable applications: All respondents noted that there is a shortage of computers at the University (low computer-to-student ratio) but as mentioned by one of the teachers (t1), "most students have smart phones". Besides students with smart phones, there are also those who had feature phones that could be used to access the Internet. Tr2 noted that developing applications that would span across the different devices "would expand the access spectrum." Meaning that by making learning content and tools accessible on mobile phones and other devices such as desktops, iPad, laptops, etc. the students would use their existing technology for educational purposes. Therefore, through the MobiClass project MUELE was redesigned to support various devices and also a mobile app was created to broaden the scope of access to learning content. It was also important that as many users as possible could access and use the app, so the mobile app was developed for iPhones, iPads, Android smartphones and tablets, and Blackberry mobile phones.

Use of social media applications: Some of the teachers used social media platforms (such as Facebook and YouTube) external to the MUELE mobile application to engage the students and to disseminate information and learning content. Teachers who used social media platforms for teaching did so because students already frequently use social media for various reasons, such as social networking and learning through discussion groups. “Students are into social media. Social media tools are easy to use and can be accessed by everyone, even those with low ICT skills” (t18), and “some of my students have groups on Facebook where they discuss course related issues” (t3). Hence, they preferred to use the platforms that the students already used instead of introducing them to new tools and platforms. T1 also proposed to integrate social media platforms into MUELE and have social media as another channel for engaging students.

Provision of hardware and Internet infrastructure: The current practise for accessing the Internet at the campus is through computer labs and electronic learning labs at the University. Although “e-learning training labs are used for training, students use the labs when there are no training activities taking place” (tr2). To access MUELE on mobile devices the students need access to mobile Internet or a wireless network which is provided by the university. The system administrator (sa2) noted that Wi-Fi helps to reduce congestion in the labs despite the poor wireless Internet coverage and speed at the University; “At the moment we are trying to make people (students and teachers) use their mobile phones. We think it is the way forward because computer labs cannot serve the entire student population including serving as classrooms for courses that require lab activities.” So while the current practise is to use computer labs for Internet access they are aware that they also need to provide a stable wireless network to better support the use of mobile devices.

Learner aspects

M-learning Instructional and content design practices: The majority of the teachers used the LMS mainly as a content repository. For example they prepare and upload teaching materials to the LMS in document formats such as MS word, pdf or PowerPoint. One of the teachers said that he and his fellow teachers “were not familiar with the mobile part of MUELE” and that “I personally do not apply any particular techniques to create mobile content, neither do I think about the user aspect when I create content” (t13). Only two teachers (t7 and t19) structured electronic content (teaching material) in a responsive way and aligned it with their course goals and routine classroom activities. Some teachers believed that, as long as the students did not complain about the teaching material then the material was accessible; “I don’t consider any instructional design aspects because I assume the content is accessible and as long as I ask students and they say they receive it then I don’t need to do something more” (t22). The majority of the teachers noted that they seldom support students but when they do, their support is not particularly directed to m-learners but e-learners in general, for example t1 and t26 who narrated their teaching actions and how they perform all necessary tasks to meet student’s needs except m-learning content design; “We [teachers] take everything into consideration, but m-learning is a new phase at this University and we have not [adapted] to it” (t1). Another teacher stated that “for general e-learning material I take everything into consideration because I went through training at Makerere university and also took an e-learning course for professionals at open university in [the] UK. I know instruction design for m-learning is necessary in a way because mobile phone penetration is high here but I haven’t felt the need to do it [re-design course material to suit mobile learners]”. The current practice regarding instructional design is hence focused on making e-learning content accessible via computers rather than designing content specifically for mobile devices. Lack of knowledge on how to develop mobile content was mentioned as one of the reasons why some teachers are unable to customise teaching material for mobile users. Other teachers thought it was the role of m-learning support staff to make the course contents within the learning management system responsive. “I have never really bothered…it is the work of the LMS software developers to make

the platform compliant to the teaching material" (t16). Nevertheless some of the teachers are aware that the content also needs to be re-designed for mobile devices although it is not something that has been put into practice.

Multimodal learning: At the university, teaching and learning mainly takes place in physical classrooms. In the online environment, the learning management system mainly provides functions for exchange of text information and files. Live video conferencing on MUELE and uploading of long videos was not possible due to issues with the Internet infrastructure and university cloud storage limitations. However, through personal means of access to the Internet, external media resources such as YouTube are used for learning. The majority of the teachers said that they embedded or shared YouTube videos and video links within their teaching material. Most of the teachers also had used Skype to meet with students.

ICT support for learners: The university has a self-service website called *Makerere Answers*[6] which serves as a knowledge base for all ICT users at the University. The website provides information on how to use information technology resources including how to access and use MUELE. However, the website primarily serves desktop computer users as written on one of its web pages: "this self-service website covers desktop computing and other information technology topics supported by Makerere University's DICTS (Directorate for ICT Support)". The systems administrator explained the kind of support that is rendered to students; "We [systems administrators] provide documents [MUELE user manuals], promote the culture of using mobile tools and [provide] a guidelines course, but we started to fully implement m-learning in 2013 so the process is still on a small scale and no impact has been measured" (sa1).

Social aspects

Means of socialization, interaction and collaboration: Mobile devices were not used for interaction between the teachers and students in formal learning. The common practice through which students and teachers interacted were face-to-face interactions. When asked how the teachers interact with the students, one of the teachers answered that "we [teachers] usually meet with students in classrooms, unless a student has a question. He or she can send an email or ask in class but we hardly ever meet online" (t5). Another teacher said that "students usually organise their own group discussions but not on MUELE, maybe another website or face-to-face group discussion" (t14). The interviews however revealed a need for more collaborative and interactive approaches. Some teachers suggested the use of social media tools and integrating them in the learning management system; "the university should introduce tools that improve collaboration and interactions among students, for example there is a chat in MUELE which could help to provide support to students in real time but it is hardly accessible on mobile phones. We [teachers] miss social media" (t10). On the other hand, some teachers were sceptical about interactive and social media tools because students would spend too much time on social media rather than on learning and suggested that they should "only introduce tools that don't evade private life" (t23). The divergent responses about interactive and social media tools indicate that the use of such tools has not yet found a place at the university. Interactivity also applies to content (student-content). Some teachers were interested in creating interactive content; "we [teachers] should be provided with animation software to create interactive content for our students. This could popularize the teaching tutorials" (t8).

Teacher education and support: Some of the teachers received m-learning training and some of the trained teachers applied the skills in practice. The training was provided by m-learning teacher trainers and systems administrators. The m-learning teacher trainers and systems administrators further provided training guidelines for teachers online. However, some teachers claimed they were not informed about the training guidelines and had not received enough training; "there are no guidelines or support from course managers, at least I have not seen any"

(t15), “I received e-learning training sometime back provided by DICTS but the training was not for m-learning and the focus was on how to make PowerPoint presentations” (t11), “I received training for e-learning. I also got an invitation for m-learning training but I didn’t have time to attend” (t2), “I don’t know if there are guidelines from course managers” (t18). One of the two teachers who had converted their course content to suite mobile learners also noted that he (t19) had received “basic training for two days for example to learn how to use content authoring software applications and the difference between e-learning and m-learning”. On the other hand the m-learning teacher trainers noted, “MUELE is based on Moodle and Moodle has standard guidelines and it is these guidelines that we mainly follow. Teachers are advised to read these guidelines as well and they [the guidelines] are published on [the] Moodle website” (tr1). Another trainer (tr2) further stressed that all teachers will be trained because “the number of students [both computer and mobile phone users] who use MUELE has increased over time.”.

Challenges

Poor mobile learning infrastructure: The learning platform was inconsistent in terms of interface design and display on feature phones. The software developer with support from systems administrators and m-learning teacher trainers developed a mobile app and improved the design of MUELE to improve responsiveness across different mobile devices. “One of the reasons for creating the mobile app was to overcome the problem of limited infrastructure facilities since the app would offer mobile services and reduce the burden of sharing the few available computers in computer labs” (sa1). One of the m-learning teacher trainers noted that, “Connectivity [mobile and Internet] is key to changing people’s perceptions. It is a motivation factor and we hope that the mobile app increases connectivity” (tr1). Both systems administrators agreed that the university has limited Internet infrastructure facilities; sa2 stated that, “We [the university] have not met Internet demands and we need to build the infrastructure”. All teachers commended the project developments on developing a mobile app as part of the solutions to connectivity hence one of the teachers said, “Students will technically be ahead of teachers in IT use once they are availed with better infrastructure” (t4). However, achieving a fully effective and efficient learning management system for mobile users still remains a challenge and certainly there is a need to carry out an evaluation study to assess the impact the mobile app will have to students and teachers; “no impact in terms of user benefits has been measured. Impact assessment needs to be done” (sa1).

Lack of resources (high infrastructure cost): Although the university is equipped with various ICT resources such as the Internet and computer labs, comments from respondents suggest these resources are not considered sufficient. “There is no specialized lab (studio) on the main university campus that teachers can use to record multimedia tutorials or be assisted to create and produce tutorials” (t3), neither do they have the necessary equipment to record the tutorials by themselves. One trainer (tr2) also noted that, “the cost of acquiring the required e-learning or m-learning technology is huge”. The cost of infrastructure is thus one of the main obstacles affecting the implementation of e-learning and m-learning in particular at Makerere University.

Poor instructional and content design practices: The majority of the teachers admitted to having been recruited to university service based on academic merit (good degree grades) without teacher training. One of the teachers mentioned that “some of us [teachers] are not teachers by profession and we don’t receive internal [in-service] university teacher education” (t20). Therefore some of the teachers receive e-learning as well as m-learning training, but have no pedagogical or theoretical knowledge of teaching and learning. Thus serving students’ pedagogical needs becomes a challenge since the content supplied to students in the LMS is neither tailored for mobile access nor has guiding instructions for mobile users.

Low awareness of m-learning opportunities: The available support information on access specifically for learners is scarce. “Some students and teachers are not aware of the benefits of using MUELE” trainer (tr1). In fact one of the teachers narrated that, “I have had conflicts with some students who reported me to the head of department claiming that I was using the learning management system too frequently on my course. Students reported me to my superiors for telling them to use MUELE to access teaching material. They [students] expected me to always give them printed hand-outs in [the] classroom to photocopy. This means that they are unaware about the benefit of MUELE because when they photocopy they spend money but MUELE is free [access to teaching material online is free]” (t19). More stringent information for mobile users is required to promote awareness of m-learning and to motivate users.

Non-collaborative, interactive and irresponsive learning platforms: The learning management system (MUELE) is used as a repository and the main practice is content creation and dissemination without guided policy or standard procedures. The teachers do not engage students in interactive activities using the available interactive technical tools such as discussion forums. Only two teachers (t7 and t19) mentioned having used discussion forums and web-based quizzes to engage with students. The learning management system was mainly accessible through desktop computers and therefore interaction or collaboration using mobile devices was minimal.

Weak mobile learning policy and low awareness of existing polices: The mobile learning user support and guidelines provided for helping teachers in technical aspects of using the learning management system are weak. These guidelines focus on e-learning in general with minor considerations of m-learning. Although the guidelines are available online, the majority of teachers are not aware of them or did not know how to find them. Most of the teachers were not aware of the available guidelines. MobiClass project increased the awareness through training workshops but the existing m-learning policy measures remain weak in terms of implementation. For example, teachers are not committed to or abiding by the existing policy. In addition, the working time invested in creating e-learning and m-learning material is not acknowledged as part of teaching hours. One of the teachers (t23) noted that, “this leaves us [teachers] with [an] increased workload and we end up avoiding any activities required to adopt m-learning, for example redesigning course material which requires a lot of time”. Another teacher (t11) also mentioned that “teachers are sometimes assigned courses on a short notice ([a] few weeks before the course starts); in this case we have limited time to develop course material in a way that meets all student needs”. The administrative weaknesses in areas of course planning and management are thus part of this challenge.

Insufficient teacher training: The training of teachers has been focusing on how to create teaching material and upload it online and how to use various tools within MUELE. Teachers thus, “mainly use MUELE as a repository, to post lecture notes” trainer (tr2). The actions taken to create and deliver instructions and the nature of the content created by teachers are not pedagogically developed. Tr2 further noted that “some teachers have not received e-learning training or m-learning training but we [the university] have a need to train everyone and with time we will do it”. There is no systematic follow-up or planned program for continuous in-service training (m-learning training) for those who have received training and this could be a setback for teachers and the university as the training for all teachers goes on. For example most of the teachers who were trained in the MobiClass project had not re-designed their course materials to serve mobile learners.

DISCUSSION AND CONCLUSION

This paper discusses the practices and challenges in an emerging m-learning environment using a case study of the MobiClass project.

As a general note, there are various opportunities and motivations for using m-learning management systems but in emerging m-learning environments the challenges are prevalent. Instructional and content design practices are not adapted to the new medium. The most common teacher practice is use of the LMS as a repository for teaching materials. Teachers disseminate non-adapted (to the mobile devices) and non-responsive course materials which affect mobile learners in different ways depending on the type of mobile devices they use. Content issues have been cited also in other studies. Fisseha (2011) found learning content to be one of the challenges that affects integration of ICT in education; “Content development is a critical area that educators overlook” (p.24). To try and solve the issues of insufficient skills in instructional and content design practices, the MobiClass project engaged teachers on content development issues through teacher trainings.

Training was a pressing need among teachers particularly in areas of m-learning content creation and pedagogical skills. Teacher training mainly focused on generating instructional design skills, but in order to make best use of the electronic medium the training must also include how to use interactive teaching and learning methods with support of online tools such as discussion forums.

Implementation of m-learning should be guided by policy. The current policy mainly focuses on e-learning and most teachers do not abide to the available policy guidelines as they are not compulsory in practice. Policy enforcement streamlines ICT use in m-learning environments by making use of technology a requirement for teachers and learners. Tondeur et al. (2008) examined ICT policy integration in schools and found that electronic learning policies in schools are seldom developed and utilized. The study further notes that applying policies strengthens capacity building for change management which serves to increase effectiveness and quality of education services. Policies related to “ICT plan, ICT support and ICT training have a significant effect on class use of ICT” (p.212). Policies set performance standards which can be used to enforce and regulate electronic learning modalities (interactive media use, social media use, Internet use, m-learning, etc.). For higher education institutions with emerging m-learning set-ups, it is important to develop programs for popularizing m-learning policies among teachers and students and make policy documentations to guide their use and practices.

The study found that the practice of providing a sound technology infrastructure freely or at low cost creates less frustrating experiences for teachers in m-learning environments and might be a motivation factor for adopting m-learning. For example teachers who had smart phones freely provided by the MobiClass project were more active in m-learning and put in more effort to learn and re-design course materials than teachers who did not receive smart phones. However, limited m-learning infrastructure facilities were one of the challenges identified by the teachers and support staff alike. This study is not the first to highlight such infrastructure challenges as an issue. Most studies that discuss challenges facing ICT use in education, for example Fu (2013) and Andersson (2008), mention infrastructure as a major problem, mainly caused by lack of financial resources to acquire and maintain the technology (Phiri et al. 2014). Andersson (2008) shows how poor infrastructure affects access to learning resources by noting that, with limited infrastructure resources, for example lack of computers and unreliable Internet connections, difficulties to access learning materials are encountered. Infrastructure limitations also affect teachers. Teachers can act as catalysts for ICT use in learning institutions if technology equipment and support are provided to them (Fu 2013). Thus without adequate technology equipment and support, teachers’ activities are affected. Nevertheless, there are alternative options for minimising infrastructure challenges, for example use of open source technology and

sustainable models, and strategy for acquiring and implementing affordable technology. At Makerere University, support towards building ICT infrastructure has been provided through different partnership initiatives. When it comes to supporting students directly, a scheme was created to provide devices, specifically laptops, to them under a low payment plan.

Another common practice that was identified is the use of open source tools. Open source tools were used due to limited technology resources, and such tools minimised technology costs. Open source education tools have been widely publicized as one sustainable option for education institutions when it comes to use of learning software applications. Moreover, open social networking tools have manifested as alternative ways of engaging students in terms of collaboration and interaction. Lwoga (2012) studied how Web 2.0 technologies such as Facebook and Myspace are utilised to support learning and teaching in universities and found that such tools transform higher education in various ways, for example assisting in preparation of learning materials, facilitating digital storytelling, time management through planning and scheduling, and creating collaborative projects. Lwoga further notes that Web 2.0 technologies provide socially situated learning environments with creative ways of communication, interactivity and engagement. There are also other studies that have researched the use of social media in learning. For example Pimmer et al. (2012) show that social media tools are frequently accessed and used. They found that Facebook was one of the most intensively used tool in communication compared to other communication tools, and concluded that tools accessible on mobile devices such as Facebook can be catalysts for transforming communication practices. In addition to the use of social networking and open source tools, multimodal forms of teaching such as the use of videos for eye contact, interactive text, etc., should be emphasized. Combining different forms of methods and media have been advocated to be pedagogically enriching and have a greater impact on learning.

Most research on m-learning focuses on the learner and the challenges that affect the learner within the learning environment. However, it is equally important to assess issues that affect other stakeholders, for example teachers, systems administrators, developers of learning applications, teacher and student trainers, etc., and how different roles can be consolidated to overcome various challenges.

There are various theories and models that explain m-learning as a form of e-learning. This paper contributes to such existing research by broadening the understanding of fundamental aspects of a mobile learning environment. We explain the roles of teachers and m-learning support staff in relation to the FRAME model. Teachers and m-learning support staff play a vital role in implementing m-learning programmes within technology mediated learning environments. For example m-learning support staff were instrumental in building mind-sets and attitudes of students and teachers towards the use of m-learning technology through awareness. They were also responsible for developing new m-learning as well as e-learning solutions and artefacts, for instance software applications, evaluating m-learning programmes and developing policy. These roles and how they affect the learning environments are seldom discussed in most studies. Most discussions focus on learners. Thus we suggest that further studies should use the FRAME model to investigate all actors within the m-learning environment.

This study has showed that in order to move beyond putting material online to making that material adapted to the various mobile technologies through which it is disseminated, there are a number of challenges. We have discussed alleviating challenges pertaining to training teachers and students on technology use m-learning benefits, strengthening policy, building robust infrastructures, integrating social media in learning platforms where is it deemed relevant for teachers and leaners, promoting sound practices for instructional and content design, providing constant technical support for teachers and students, and promoting the use of open source applications to minimise costs. There is no doubt that emerging m-learning environments in a

developing country would be implemented over a long time. As this project has showed, m-learning support staff is crucial for sustaining the efforts and keeping up the pace through the inevitably long development process.

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APPENDICES

Appendix A: Interview guide for teachers

1. What is your gender (note: Male or Female)
2. Which courses do you teach?
3. How long have you used MUELE in your teaching? (state in years/months)
4. Do you consider the aspect of mobile users (students) when you create content?
    a. What measures do you take so as to design learning material in a way that allows students to access content easily on their phones?
    b. What is it that you do? (if yes or no)
5. Have you received training on instruction design for m-learning?
6. Do you have guidelines or support from course managers on how to do it (5, above)?
7. Do you think instruction design for m-learning is necessary; can it make content access any better? In what way? (If yes), why not? (If no).
8. Since the MobiClass project started, have there been any improvements in regards to m-learning content creation?
9. From your personal experience, make any recommendations for positive improvements for designing good learning material through better m-learning instruction design
10. What challenges do you face?

Appendix B: Interview guide for m-learning support staff

1. What is your gender (note: Male or Female)
2. Do you support/provide Instructional Design guidelines for mobile learning to the teacher?
    a. Yes: state which guidelines/support (*you can refer to a formal document*)
    b. No: state why not?
    c. Mention, since when you started doing so (for 2.a)
3. Have guidelines/support worked out for m-learners in terms of learning content access?
4. Do you have m-learning access guidelines for students?
5. Has the MobiClass project provided any solutions in regards to improving m-learning at the University? Mention any activities they have done to promote m-learning.
6. Comment on the support you provide to m-learners and teachers in general!
7. What challenges do you face?

ENDNOTES

[1] Facts about Makerere (2013/2014): http://pdd.mak.ac.ug/sites/default/files/archive/Mak%20Fact%20Book%202013-2014-.pdf

[2] Makerere University Electronic Learning Environment: http://muele.mak.ac.ug/

[3] Moodle Project: http://moodle.org

[4] DICTS: http://dicts.mak.ac.ug/

[5] Blackboard: http://uki.blackboard.com/sites/international/globalmaster/

[6] Makerere Answers: http://answers.mak.ac.ug/support-and-training/student-tutorial-accessing-and-using-muele