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MLCMS actual use, perceived use, and experiences of use

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ABSTRACT

Mobile learning involves use of mobile devices to participate in learning activities. Most e-learning activities are available to participants through learning systems such as learning content management systems (LCMS). Due to certain challenges, LCMS are not equally accessible on all mobile devices. This study investigates actual use, perceived usefulness and user experiences of LCMS use on mobile phones at Makerere University in Uganda. The study identifies challenges pertaining to use and discusses how to improve LCMS use on mobile phones. Such solutions are a cornerstone in enabling and improving mobile learning. Data was collected by means of focus group discussions, an online survey designed based on the Technology Acceptance Model (TAM), and LCMS log files of user activities. Data was collected from two courses where Moodle was used as a learning platform. The results indicate positive attitudes towards use of LCMS on phones but also huge challenges which are content related and technical in nature.

Keywords: Mobile learning; LCMS; MUELE; TAM; Mobile phones

INTRODUCTION

Information and communications technology (ICT) mediated learning has increasingly become important in higher education (Simkova et al. 2012; Fu 2013). Electronic learning tools, especially online tools, allow teachers and learners to share educational resources, work on assessments, communicate and collaborate smoothly (Lonn et al. 2011; Lonn et al. 2009; Liaw et al. 2008). Increasingly, mobile technologies are being used for ubiquitous access in learning. There are various meanings of mobile learning. Tagoe and Abakah (2014) demonstrate how mobile learning has been defined over time and further shows that, some of the definitions are technology oriented, e-learning oriented, location oriented, or learner-centered, and are contextualized based on social and cultural perspectives. Wang et al. (2009) takes a technology stand to define mobile learning as:

> *"the delivery of learning to students anytime and anywhere through the use of wireless Internet and mobile devices" (p. 92).*

Considering the perspectives in this paper, the above definition was expanded to encompass the divergent views on mobile learning that are cited in Tagoe and Abakah (2014), we use "mobile learning" to mean the process of exchanging and acquiring knowledge, and delivering learning instructions and content to students through the use of wireless Internet, mobile devices, web and mobile applications.

The backbone for mobile learning includes a mobile communication infrastructure and mobile devices such as cell phones which can support technologies that assist individuals and groups to learn anywhere anytime (Sharples et al. 2002). Johnson et al. (2011) name mobile devices as a priority technology for next generation learning and note that they:

> *"enable ubiquitous access to information, social networks, tools for learning and productivity...are capable computing devices in their own right — and they are increasingly a user's first choice for Internet access" (p. 5).*

Mobile learning uses supporting applications such as Mobile Learning Content Management Systems (MLCMS). Such applications provide simplicity in content management, and ensure proper display and functionality for various mobile devices to enable efficiency in data transmission (Simkova et al. 2012). Gleason (2002) and Mohmoud (2008) suggest that learning system components should include MLCMS that support downloading and managing repositories for mobile content. Besides other m-learning application solutions available, MLCMS solve device constraints such as size that limit content access.

Attractive factors of mobile devices include mobility and portability that provide the capability to carry or move the devices easily. Sariola et al. (2001) describe mobile learning from technological and educational theorist perspectives and note that mobility is the most interesting aspect since matters of who is moving (tutor or learner), where they are moving (environment) and why they are moving are important in understanding the context of learning. The mobility factor, for example, comes along with convenience, faster communication, flexibility and full time connectivity (Ducut & Fontelo 2008). Alvarez et al. (2011) note that such opportunities have made mobile learning attractive to educational institutions.

Therefore, in terms of flexibility, collaboration and communication, mobile technologies can play a critical 'freedom of choice' role regarding how and where to learn, which is core in distance education (Parsons 2009). However, there is a need to re-conceptualize learning for the mobile age through understanding the essential role of mobility and communication in the learning process (Sharples et al. 2005). Understanding the importance of context in establishing meaning and supporting virtual communities that transcend barriers of age and culture is equally important.

In pursuit of the "anywhere and anytime" ideal, different researchers have investigated issues related to mobile learning. Most areas addressed in the literature are problems of use, access, design and infrastructure (Westera 2011; Chu et al. 2005), communication and collaboration (Alvarez et al. 2011), content delivery (Macdonald & Chiu 2011), and many more. However none of these researchers discuss the technical aspects of MLCMS. Research either discusses mobile phone use in learning or learning management systems separately, but not together (Asiimwe & Grönlund 2014). We define MLCMS as LCMS that can store and deliver learning content and services to mobile computing devices. The aim is to identify ways of adapting LCMS services for mobile phone users. This aim is pursued by:

- Studying actual use, perceived ease of use and usefulness of MLCMS (mobile LCMS)
- Investigating challenges involved in use of MLCMS and suggest remedies

The main research questions of this study are:

- What are user perceptions and actual experiences of MLCMS use on mobile phones?
- What affects MLCMS use?

There are various theories that discuss use of technology. This study uses TAM (Technology Acceptance Model) as a reference model (Davis et al. 1989; Venkatesh et al. 2000). TAM helps to explain perceived usefulness and usage intentions of an information system.

There are several models that have been created for analyzing the relationship between technology and users; TAM is one of the oldest and most used. While models differ in details and scope, they all in some way or another draw on the idea that ease of use and usefulness, as perceived by the user, are the basic factors that lead to use of information systems. We therefore used the TAM general framework to formulate our research instruments.

Factors affecting actual use of learning technology

Information systems research that discusses technology adoption and acceptance e.g., Davis et al (1989), retain that perceived ease of use and perceived usefulness determine use. Task performance is stimulated when a system is easy to use; at the same time for the user to be at all interested in using it, s/he must see some point in doing so – the system must be perceived as being potentially useful. Perceived ease of use is further linked to intentions to use (Venkatesh 1999). The linkage is both direct and indirect via its impact on perceived usefulness (Venkatesh & Davis 2000, p.192).

The TAM framework focuses on particular aspects, which in this paper are referred to as "TAM keywords" i.e., "behavior intentions," "attitudes," "usefulness," "ease of use" etc., all seen in the context of a "system," an information system. From a perspective of learning and pedagogy, this focus of user-to-system may be criticized as many learning studies suggest a rather different direction i.e., focusing on the learner (Ramsden 2003; Light 2001). Although some of the contemporary Information system studies have re-constructed TAM, it should be remembered that TAM was constructed in the 1980s when computer use was very different from now. Then, most use was professional and task-oriented; today computer use is more open; a palette of tools is available, the user often has a choice, and many design features supporting ease-of-use are incorporated in industry standards as well as in the thinking and experience of users. Even so, any new technology requires revisiting the interaction between users and technology as the preconditions change. Mobile technologies are very much an example of such change. While many general functions of mobile technology are already well established, many specialized ones are not. One of the yet unexplored functions is the integration of mobile technologies in teaching and learning environments and processes. For this reason we revisit the TAM factors in the context of m-learning.

User experience of information and communication technology (ICT) is an enabling factor for continuous use of ICT (Liu, et al. 2010). Past online learning experience, for example, shapes perceived interaction and perceived usefulness of online learning programs which subsequently motivates intentions for using online learning resources, thus,

> *"the greater the online learning experiences of users, the stronger their intention to use an online learning community" (p.603).*

Experience is also mentioned as an empowerment tool in terms of enjoyment and concentration during learning discourse. Learning requires a focused and attentive mind driven by interest – what Csikszentmihalyi (1997) describes as a "flow state"; a feeling of complete involvement in an activity. This learning state of mind can be affected by user skills and ambitions as well as by perceptions of ease of use and usefulness of the system.

Faith in ICT efficacy is a significant factor shaping intentions to integrate technology in learning and teaching (So et al. 2012; Fanni et al. 2013). ICTs emerge as effective, efficient and productive tools for supporting the performance of a variety of tasks, and this perception can be improved by training (Fanni et al. 2013). Ming-Chi Lee (2010) empirically validates the hypothesis that confirmation of expectations of users is positively related to perceived usefulness of e-learning tools. ICT efficacy raises expectations and when expectations are met it leads to positive learner experiences and satisfaction. Empirical studies by Sun, et al. (2008) and Lee & Lehto (2013) show a positive relationship between perceived usefulness and user satisfaction on electronic learning. Conversely, unsatisfactory perceptions hamper students' motivation. User satisfaction has,

> *"...a direct impact on the formation of behavioral intention. In educational settings, it is considered a prerequisite for the users' intent to use a learning system"* (Lee & Lehto 2013, p.195).

Thus behavioral intentions or attitude shapes perceived usefulness and ease of use (Venkatesh et al. 2003) leading to increased ICT efficacy.

There are also other factors that affect ease of use and usefulness, including good interface design, good content design, and technical support (Cheung & Vogel 2013).

Content and interface design affect learners' perceptions, particularly mobile learners as mobile systems introduce more restrictions to the design. User Interface Design (UID) is an important factor in computer applications development (Liu et al. 2010). Good UID enforces compatibility across different devices. Compatibility has an "influence on ease of use associated with a new technology" (Cheung & Vogel 2013, p.165).

All in all, both system and content design affect users' perception towards technology acceptance and use.

MLCMS technology: impact and challenges

Several advantages and challenges of mobile phone use with LCMS are discussed in the literature. An empirical study on course content distribution using mobile technology by Mohmoud (2008) used a case to show how access to online learning resources via mobile phones is a preferred learning solution, but notes that the solution requires fast Internet connections and must be affordable. Mohmoud also notes that mobile technology is "the most complex solution" (p. 281) since a website has to be designed for different screen layouts and file formats.

Parsons (2009) categorizes challenges of using mobile devices into three fields:

- specification and usability i.e. qualities of the device such as screen size, battery life, storage space, flash application capabilities etc.;
- lifecycle of the devices; and
- diversity and lack of standards.

The lifecycle of the device refers to the continuous development of new devices that leads to demand of responsive applications, which is challenging in that content creation is also affected and new requirements must be met. This rapid process of making changes, however, affects the ability to create and adhere to standards and may or may not prompt learning content creators and e-learning website designers to follow standards and instructional design guidelines. Casany et al. (2012b) mention challenges such as lack of teacher confidence and training on technology use and technical difficulties with mobile devices which affect the attitudes towards use. These limitations can be overcome by user training and providing supporting information in the form of a manual.

Mobile learning also faces challenges with integrating mobile applications with mainstream e-learning applications. Casany et al. (2012b) suggest that these challenges can be overcome by integration of learning content management systems. This integration can facilitate interoperability improvements across various devices. However, Casany et al. (2012a) note that integrating external m-learning applications into the learning content management systems is a disadvantage due to difficulties in maintaining and extending the integrated external systems.

Despite the challenges, literature suggests the existing challenges are contemporary and can be overcome given constant advancements in technology. Thus, MLCMS remain necessary tools for e-learners due to their positive contribution towards learning performance and collaboration.

THE MUELE CASE

MUELE is an online learning management system used as the default e-learning platform at Makerere University (http://muele.mak.ac.ug/). MUELE is customized based on Moodle (Modular Object-Oriented Dynamic Learning Environment). Moodle is an open source learning management system (LMS) developed and supported by the Moodle Project (http://moodle.org). 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 forum, wikis, communication (e-mailing), course creation and management and user management (teachers, students and administrators).

MUELE was set up at Makerere University in 2009 because it is open source and hence served to avoid license costs that were incurred on the LMS that was previously in use (Blackboard; blackboard.com). The main purpose of having an LMS is to facilitate e-learning. Most users are students and teachers at all university campuses. The system is hosted and managed locally by DICTS (Directorate of Information and Communications Technology Support; http://dicts.mak.ac.ug/). DICTS is responsible for ICT implementation and support services at Makerere campus. Use and implementation of MUELE is an ongoing activity with no specified timeframe, and the implementation is monitored and evaluated by DICTS through performance and system usage reports. The system is updated regularly in accordance with Moodle updates. The university has 145 undergraduate programmes and 139 postgraduate ones. The estimated number of MUELE registered users is 53,000 but the actual (active) number of users was 30,000 as of April 2014.

We conducted an information search on the university intranet and webpages and found that there was no information for students and teachers on how to use MUELE on mobile devices specifically mobile phones. The information was created for desktop users. User support is given when requested. Training on how to use the system is provided for teachers only. Within the system settings, different display templates have been installed to support information access across various devices, but not all devices are supported. Besides perceptions of use, this study took the MUELE case to investigate challenges faced by users so that we could find solutions for mobile users.

METHOD

This study used focus group discussions (FGD) and an online questionnaire as the primary methods to collect data. We further examined activity logs of participants which were extracted from the learning platform. Informants in both surveys were students and teachers.

The informants were divided in three focus groups and handed the same questions (in appendix B). The groups discussed the questions and wrote down their shared views as guided by the facilitator (one of the researchers). After 90 minutes, the three groups convened for 60 minutes to share and discuss their answers to the questions. Answers from each group were recorded by the appointed group leader and answers from all groups were recorded by one of us (the researchers).

After the focus group discussions, a link to the online survey (appendix A) was sent to all participants.

System logs covering six months of user activity were reviewed. A descriptive analysis of the data collected was made, and then data from the three sources – focus groups, survey and log files were contrasted and compared.

Demographics

Survey data was collected from twenty-eight students and two teachers. Three respondents were females, 27 males. Respondents were students and teachers of two particular Information Technology (IT) courses offered during the 2013 fall semester at Makerere University main campus. These IT courses are offered to second year students in the Bachelor of Information Technology programme. The courses include BIS2104 (Introduction to Database Systems with 550 students) and BIT2108 (Advanced Information Technology with 1320 students). The courses run for a full academic semester which is six months. Respondents were between age 20 and 34 and had experience of using Makerere University Electronic Learning Environment (MUELE) on mobile phones. Table one shows the number of respondents in the online questionnaire. The survey link was sent to all 30 respondents. Reminders to fill in the questionnaire were sent to all 30 respondents and eventually 23 (77%) responded.

Table 1: *Gender and age groups of online respondents (n=23)*

		Age Group			
		18-24	25-29	30-34	35++
Gender	Female	2	0	0	0
	Male	18	0	3	0

Selection of respondents

Students and teachers in BIS2104 and BIT2108 courses were invited to participate in the survey. Teachers were included in the study because they had previously taken the same courses as students and had used the same learning platform during their studies; they thus had their individual experiences with the system as previous students despite their current teacher roles.

One requirement for participation was having a mobile phone (of any kind) that could access the Internet. Those who did not have mobile phones that could access the Internet were excluded. Many students were interested in taking part in the survey but were excluded by this criterion, which led to a sample of twenty-eight respondents. Participants who met the criterion were registered and briefed on the aim of the research and on how to access and use MUELE on their mobile phones. Among the selected participants, some had smart phones while others had semi-smart phones (mobile phones with basic functions and Internet capabilities).

Data collection

Data were collected from FGDs and an online survey. The FGDs included thirty respondents who were divided in three groups, each with 11, 10 and 9 respondents respectively. The FGDs lasted for 90 minutes in each group.

The web link to the online questionnaire (Appendix A) was sent to everyone who participated in FGDs. Twenty-three out of thirty participants responded as shown in Table 1.

We further examined respondents' activity logs (Figure 1) mined from MUELE. The purpose of examining activity logs was to identify what kind of information and tools the respondents accessed. For example, did they access and use the discussion forums, chat rooms, web mail, assignments, course content, etc.?

Course	Time	IP	User	Action	Information
BIS 2104	2013 februari 8 12:24	19	calvir	folder view	Assessment
BIS 2104	2013 februari 8 12:24	19	calvir	folder view	Lecture Notes
BIS 2104	2013 februari 8 12:24	19	calvir	course view	BIS 2104: Introduction to Database Systems
BIS 2104	2013 februari 8 10:45	19	anita	folder view	Lecture Notes
BIS 2104	2013 februari 8 10:45	19	anita	course view	BIS 2104: Introduction to Database Systems
BIS 2104	2013 februari 8 10:41	19	SILU:	course view	BIS 2104: Introduction to Database Systems
BIS 2104	2013 februari 7 18:23	19	Domi	course view	BIS 2104: Introduction to Database Systems
BIS 2104	2013 februari 7 17:49	19	sylvia	folder view	Lecture Notes
BIS 2104	2013 februari 7 17:49	19	sylvia	folder view	Lecture Notes
BIS 2104	2013 februari 7 17:49	19	sylvia	folder view	Other Resources
BIS 2104	2013 februari 7 17:49	19	sylvia	folder view	Other Resources

Figure 1: *Sample respondents' activity logs. Internet Protocol (IP) addresses and usernames are hidden for ethical purposes*

Data analysis

This paper uses descriptive analysis. Respondents' opinions and some of the TAM factors are used to analyze correspondences in opinions regarding perceived ease of use and usefulness. Descriptive analysis interprets information patterns that might emerge from data and summarizes the findings in a meaningful way. The descriptive analysis was used mainly because most of the data was qualitative. The comparisons of opinions from the online questions were compared to the views from FGDs so as to serve as a measure of triangulation (using different methods to obtain data on the same phenomenon).

The frame of reference for the study was the Technology Acceptance Model (Davis et al. 1989; Venkatesh & Davis 2000), which has been used widely by information systems researchers to explain factors that lead to acceptance of information systems (Lin & Fang 2011). The model includes six essential factors; (1) external variables such as demographic ones; (2) perceived usefulness (personal belief that a system will enhance a task performance); (3) perceived ease of use (personal belief that a system will be simple to operate); (4) attitudes towards use (personal desires to use the system) which are solely determined by perceived usefulness and perceived ease of use, and significantly affects behavioral intention (Thomas 2013); (5) behavioral intention to use the system resulting from attitude towards use and perceived usefulness; and (6) actual use of a system resulting from behavioral intention (van Biljon & Renaud 2009).

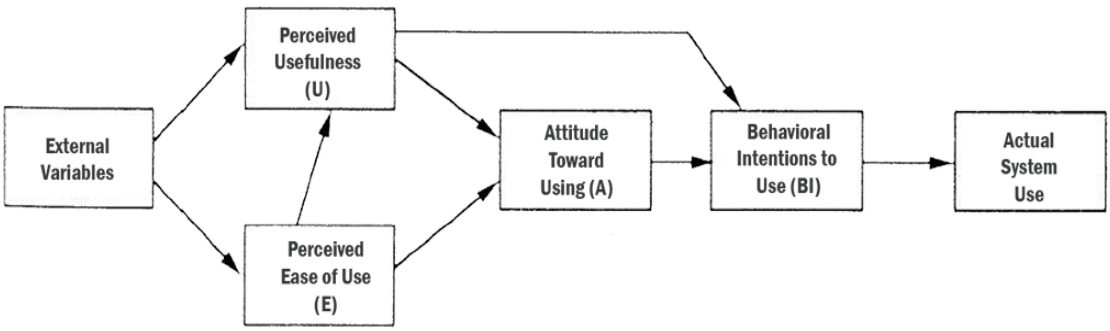

Figure 2: *Technology Acceptance Model (Davis et al. 1989, p.185)*

In this study TAM was used to frame some of the questions in the online survey. The framework helped to relate answers from the online survey to opinions discussed in FGDs as shown in results and analysis section. Subsequently we were able to analyze both responses on perceived ease of use and perceived usefulness and assess the assumption that the two factors are the primary factors that lead to actual system use. Davis et al. (1989) acknowledges various studies that discuss other factors linked to attitude and use of information systems and considers usefulness and ease of use of technology as "statistically distinct dimensions" (p. 185). In this study therefore, we identified factors linked to use as those mentioned by van Biljon and Renaud (2009).

RESULTS AND ANALYSIS

In this section we present the findings and discuss the various factors that affect perceptions on ease of use and usefulness and that influence the use of LCMS on mobile phones.

Usefulness and ease of use

In the online questionnaire, students were asked how they perceived the usefulness and the ease of use of the MLCMS functions on mobile phones. The questions were grouped under "perceived usefulness" and "ease of use" and the responses from each category were compared with the opinions expressed in the FGDs and the other answers from the online questionnaire. It is the combination of these given responses that are considered the determinants of LCMS use on mobile phones. The responses from the online questionnaire on "perceived usefulness" and "ease of use" are presented in Figure 3 and the following reflections were made on these responses in relation to focus group discussions:

Use, interaction and access difficulties affect attitudes toward and behavioral intentions to use the system. However, such difficulties do not avert continued actual system use. More than half of the respondents (53%) noted that it was frustrating for them to use and operate MUELE on mobile phones and that they could not do every task on mobile phones. However, this did not deter them from using the system because there was demand and benefits (external factors) such as "cheap costs and portability of mobile phones, instant access to Internet resources," that were mentioned by most of the respondents. Moreover, most respondents perceived the use of MUELE on phones improved their productivity (85%), gave them greater control over their learning activity (90%) and increased access to course material (100%).

The system can still attract users even if the intentions to use are not fulfilled. Although most students could not perform all tasks in MUELE on mobile phones (94%), FGDs show that they still preferred mobile phones for particular reasons. For example, one student said that "I use MUELE on my phone if I want to quickly see what updates are available from the teacher such as course materials and assignments" while most of the students recited "access to Internet" as a necessity.

Task knowledge and experience have an effect on use. Knowing how to perform a task requires knowledge i.e., 'how to,' thus an effort is needed to attain such experience (on 'how to'). Knowing how to use is crucial for users. More than half of all respondents (53%) noted that it requires a lot of effort to know how to perform tasks while 29% stated that it requires an effort to become skillful at using the system. Results on experience from the online survey further show that most of those who frequently used MUELE and had used it for more than four months indicated having had less difficulty in using the system and regarded the system to be most useful.

System efficacy shapes attitude towards use. All respondents (100%) perceived MUELE use on phone to be useful. Many reasons were given as to why MUELE on mobile phones was

perceived to be useful and continued to be used despite the challenges learners faced. Even the person who had not used MUELE on phone before considered it useful; “I think it is more flexible to use a phone compared to a PC.” This particular response shows that efficacy can shape attitude. Most perceived benefits that respondents strongly agreed to were increased access to learning materials (70 %), ability to accomplish learning tasks quickly (50 %), ability to communicate and improved productivity (45 %).

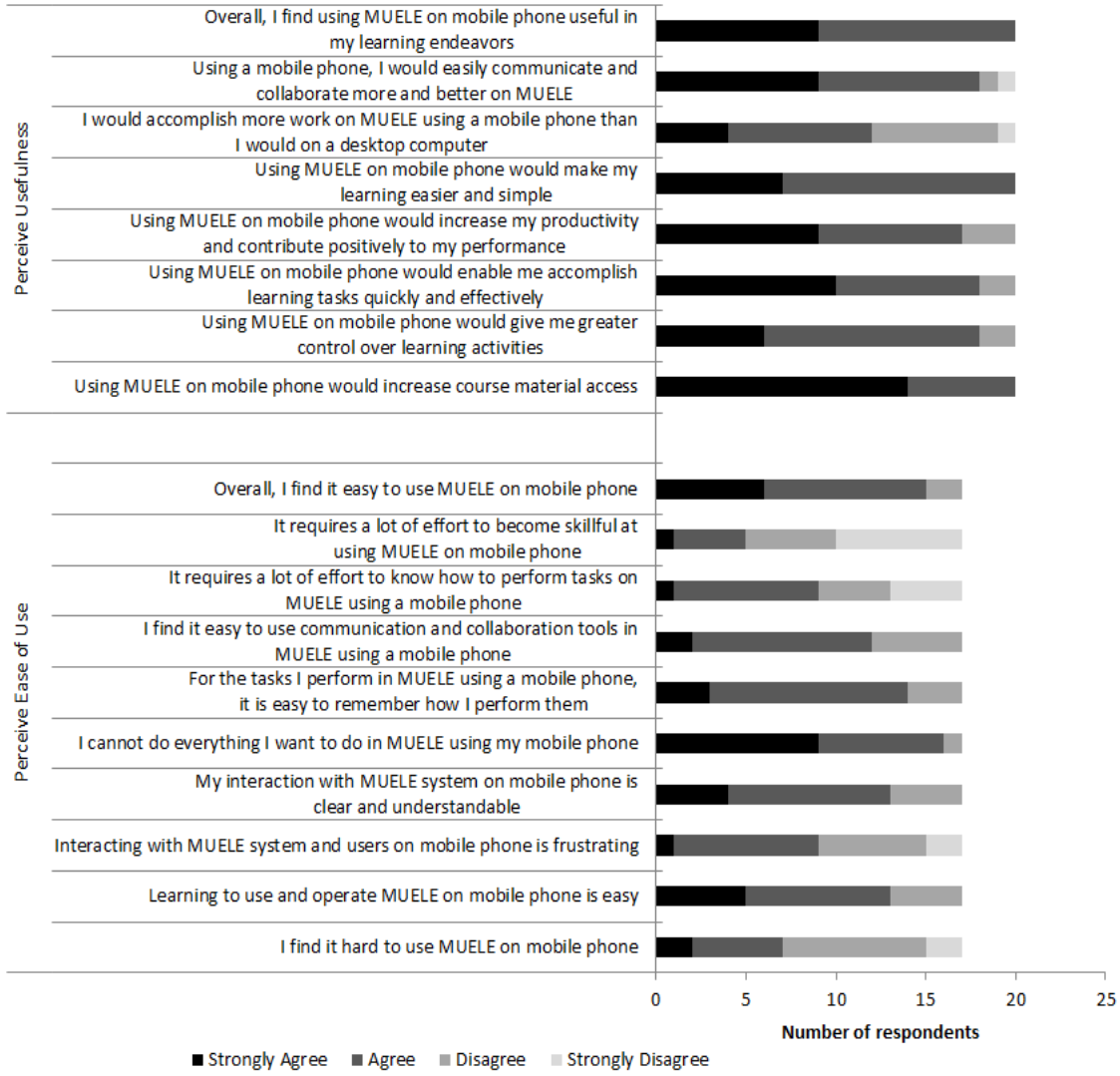

Figure 3: *Students’ perceived ease of use (n=17) and usefulness (n=20) of MUELE on mobile phone*

Overall, 45 % strongly agreed and 55 % agreed on MUELE’s perceived usefulness. As for overall ease of use, 35 % strongly agreed, 52 % agreed and 11% disagreed. Given the different responses received, the highly perceived benefit of MUELE on mobile phones was access to learning materials.

Design and Technical challenges

In FGDs respondents mentioned challenges faced when using MUELE on their mobile phones. The challenges included: (1) *ineffectiveness* i.e., the system is perceived to be too slow to load pages on mobile phones; (2) *poor design* leading to poor system pages optimization on phone screens. Students noted that, "pages become so compact on the screen and the words get mixed," (3) *need for a lot of virtual and physical memory* for the phone; (4) *upload restrictions and compatibility problems* i.e., "difficulty to attach files, images …and receiving files that are not in formats supported by the phones," (5) *high costs.* For example it was mentioned that, "it is costly to access the system using mobile Internet," (6) *communication problem,* for example course updates were not sent to students automatically, "the system lacks automatic notification functions."

It emerged that technical challenges affect perceptions of use, but do not affect use. For example, despite the technical problems students mentioned, they were confident they would continue using the system for the purposes it served. Students' desires were more focused on the user benefits rather than the technical difficulties.

Other Use Dimensions

Frequency of use

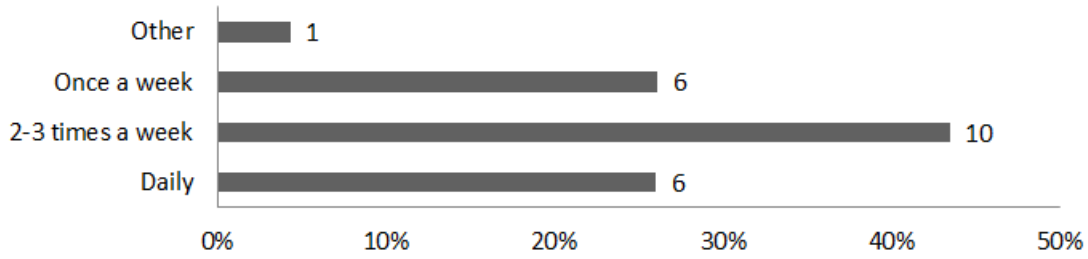

Figure 4: *Frequency of MUELE use on mobile phone (n=23)*

Frequency of use converts to experience due to navigation knowledge regularly acquired. Most of the students had used MUELE on their phones less than six months while three had used it six months or more. Figure 4 shows how often students used MUELE on their mobile phones. It also shows the "Other" category where one respondent noted not to have used MUELE on the phone on a weekly basis. Six students used it daily.

In the FDGs as well as in the online survey, respondents listed the tasks they performed in MUELE using their phones. These included (1) reading course material and downloading course content, (2) checking for communications from the students and lectures and any updates from the lectures regarding their respective courses, (3) participating in discussion forums and chat rooms, (4) accessing assignments and, (5) web-mail services. These tasks were at least performed once a week, except for forums and chats which were only used infrequently (once a month) and only by some of the students. The responses were coherent with the activity logs that were extracted from the learning platform. The logs showed that students mostly accessed course material. There were also other activities that were not mentioned, but appeared in the activity logs. For example, searching and viewing users' profiles (students viewing other students' profile information) and forum searching.

Experience affects user perceptions. Impact as well as MUELE-specific access challenges were inquired and explained during FDGs. Some students had personal experience of and knowledge on how to effectively utilize the system tools. A few students clearly said they had noticed most of the problems associated with MUELE, "so we know simple ways to overcome some of the problems, but there are other issues we have to avoid such as video." Such experience and technical know-how lead to continued use of the system. Therefore experience can affect perceptions positively or negatively, i.e., lead to continued and expanded use or to hampered use depending on the interaction experiences with the system.

Access to Internet

Students were asked what means they used to access Internet on their mobile phones and how frequently they accessed Internet on mobile phones. The access patterns varied with the largest share of students (48 %) accessing MUELE anytime of the day while others accessed it in the morning (24 %), afternoon (10 %) and evening (19 %). The variations, as mentioned in FGDs, depended on Internet peak and off peak times, and the urgency to access the learning platform.

Respondents mentioned two wireless Internet connections as the means used to access MUELE on mobile phones i.e., Wi-Fi (wireless Internet via hotspots) or mobile Internet (data packets provided by telecom service providers). All respondents used mobile Internet while ten of them mentioned they used both Wi-Fi and mobile Internet. Mobile Internet was cited as the most preferred Internet connection even though it is more costly to the users. This is probably because of the availability factor; Wi-Fi is not available everywhere. Respondents mentioned the following driving factors for LCMS use on mobile phones:

- Availability and flexibility: It is flexible to access learning material from anywhere at any time using a mobile phone.
- Improvement in communication: Chat rooms and discussion forums are great tools for interaction. Instant messaging and interactions are easily available when using a mobile phone and wireless Internet.
- Simplicity in learning: The process of sharing and accessing learning resources is convenient and user friendly depending on the phone being used, but also sharing resources is made easy by mobile Internet.
- Portability: The nature of mobile phones creates a ubiquitous environment that provides networked workspaces.
- Cost: Cost in this context refers to the affordability of bandwidth subscription and usage (management). It solely depends on the data plan a person has subscribed for.
- Efficiency: With full time access to Internet the learning platform can be accessed all the time from anywhere; "A lot of time is saved since one can use the phone to access the system from anywhere," one of the respondents noted.

The dynamics of Internet access also affect perceptions on use. Internet provides the communication infrastructure and it is one of the most expected assets for users. Depending on the kind of access such as mobile Internet, broadband and Wi-Fi the user has, access to an information system is affected. For example, students made Internet connection choices based on cost, speed, availability, location (figure 5), etc. In reference to the speed of mobile Internet, one student noted that, "When MUELE takes long to load, Internet is wasted and it is costly." For such reasons, other solutions would be sought such as using desktop computers. Therefore infrastructural assets such as Internet connections may positively or negatively affect use. For example 45 % of respondents stated that it is easy to communicate and collaborate in MUELE using a mobile phone. This perception reveals both the high dependence on Internet connectivity and capacity as well as the poor availability of that good.

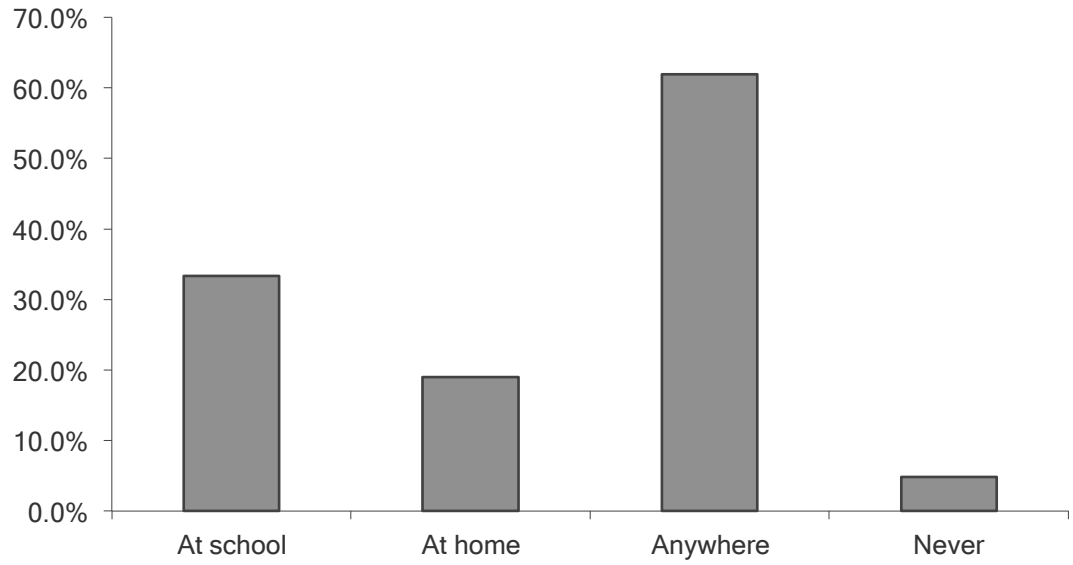

Figure 5: *Locations of access to MUELE on mobile (n=21)*

Desktops versus mobile phones

In this section we discuss the pros and cons of phone use compared to computers. The study specifically focused on mobile phones because of the mobile phone penetration rates and their potential to transform education institutions compared to other mobile devices. Despite the perceived usefulness of phone use with MLCMS, respondents noted the pros and cons of phone use as compared to computers. Convenience in terms of full time access to learning platform, low cost (for handset, and freedom to access free Internet hotspots) and portability i.e., the ability to move to different places with the mobile handset were mentioned as positive factors. Mobile Internet was considered a prelude to flexibility i.e., a means of full time access to learning resources from anywhere at any time. One of the students noted that, “Computers require many peripherals such as Internet modems.” These peripherals are acquired at an extra cost.

On the other hand, negative factors reported include; inability to read some course content due to incompatible file formats, low device memory which slows down performance, and too much scrolling due to small screens. The learning platform was reported not to be optimized for mobile devices.

In the FGDs respondents further reported situations in course tasks where desktop computers are most preferred compared to mobile phones especially in terms of learning material access, task performance and use. Desktops were perceived to be better at performing tasks that requires massive typing for example writing assignments and also better at Internet browsing and page navigation especially when multiple tabs are opened. Downloading and uploading files, especially big files via mobile phones, was mentioned as a difficult task compared to doing so using desktop computers. Students further noted that, multitasking is at times required. For example chatting and reading text from the learning platform at the same time on the same screen. Multi-tasking was perceived to be simple on desktop computers in comparison with mobile phones. Viewing videos shared on the learning platform and

performing laboratory work such as coding in computer programming were perceived to be difficult on mobile phone as compared to desktops.

There are many advantages of mobile phones that make them a preferred choice for users. However, amidst failures associated with mobile phones, for many tasks other alternatives appear more practical. Other options such as desktop computers are perceived more applicable which affects user perceptions of mobile phones. Therefore, alternative user devices affect perceptions on use of mobile phones for learning.

Improving MUELE for mobile phone use

The respondents suggested numerous solutions, both in the FGDs and in the online survey, to improve MUELE for mobile phone users so as to overcome the challenges highlighted above. Suggestions include:

Access to online resources: Allowing online viewing of all learning resources without downloading the resources. Students expressed disappointments on Internet connection speed and mentioned that "downloading files takes much Internet…mostly when the connection is slow." Some students had phones that have less memory capacity and could not read certain data files. In such cases, reading the material directly from MUELE website was the most preferred option. However, this requires optimization of the learning platform for mobile phones and designing responsive learning material that can be easily displayed on various mobile phones. Improving template design for mobile devices can also improve the system view on mobile phones as well as the navigation structure; navigation links to MUELE pages were reported to be invisible on some mobile phones.

User training: The university should provide guidelines and make users more aware of how to use the system on mobile phones. This guidance would involve creating training manuals and training users. At the time the study was undertaken, no guidelines were available for mobile phone users. FGDs respondents noted, "We need guidelines on how to use MUELE." Guidelines are very important for teachers to help them create accessible teaching material.

Access to offline material: Provide tools that allow MUELE users to access and browse through course material without Internet connection. The "Internet at campus is not available all the time" respondents mentioned. For this reason, learners suggested having an offline version of the platform or tools such as apps that can allow them have access to previously accessed resources when there is no connection. However, this may be difficult to achieve considering the various mobile devices in use.

Multi-modal communication: Enable or provide video conferencing to improve communication in chatrooms and forums. Most of the respondents noted that although they could share video links, they could not communicate to each other through video conferencing in MUELE. Whereas students expressed being comfortable with text chats and interactions, they expressed optimism in use of video as an additional tool for synchronous interactions. Therefore, multimedia (video, text, sound and images) interactions are considered to have an added value in communication.

Online storage: Increase the storage and file size capacity for uploads. Users were not allowed to upload files that are more than 5MB; "you cannot upload files bigger than 5MB. We have complained about this before" one student mentioned. This kind of restriction on file uploads is common also in other universities. This challenge can be overcome by use of free cloud services such as Google drive, Google docs, etc. and share the links to the documents instead of files.

Security and privacy: Provide security measures for controlling online discussions. Apparently, students were unable to prevent fellow students from joining private group discussions; "when you are in online discussions, other students can join the group without

permission. This would interrupt activities in the group during discussions", one of the respondents noted. Therefore more group privacy restrictions for the learning platform are required. Beside security, additional features were also proposed such as automatic notifications on course activities to those enrolled in the courses: students could not be notified once there are new course updates unless they logon to the learning platform.

Internet and technology performance: Improve Internet speed and MUELE performance, and integrate the learning platform with other knowledge management websites like Wikipedia and other websites that are frequently accessed such as Facebook, YouTube, twitter, etc. The Internet seemed to be a key factor for LCMS access, but due to the limited Internet infrastructure and the MUELE fragility, the system would become inefficient at peak hours. Students wished to have other websites such as Facebook and YouTube which they reportedly considered "simple and easy to use" to be incorporated in the learning platform enforce efficient sharing of learning resources.

DISCUSSION

The results indicate that mobile learning and specifically mobile phone use with learning content management systems has a place not only in the future, but also in today's learning activities. Users are very intent on using the mobile, to the extent that they endure several hardships in order to do so. The intention to adopt and use LCMS on mobile phones results from several factors. This section highlights these factors and relates them to those mentioned in the literature.

We identified a relationship between perceived ease of use; perceived usefulness and actual use of learning technology (MLCMS) through analytically reflecting on both responses from FDGs and the online questionnaire. Specific factors that can be considered as indicators for determining the aforementioned relationship include:

- Experience and frequency of use: How long has the user used the system?
- Accessible content: Is the content accessible/designed to suit the media and users including those with special needs?
- System simplicity: Is the system easy to use (in terms of the user interfaces and task operations)?
- Productivity: Expected and actual support (in terms of results) in task performance. Does the learning system meet the expectations of users?
- Efficiency and effectiveness: How fast and adequately functional is the system?
- Simplicity to learn and operate: How easy is it to learn and operate the system? Are there training guidelines for users?

The majority of users had only used MUELE for a short period of time, but used it frequently and found it relatively easy to use. However, they also found it hard to learn how to use it on the phone and frustrating when it came to interacting with others. Despite frustrations, all respondents perceived the technology to be useful and expressed strong desire to use it. These responses suggest that experience and user challenges can affect actual use, but may not change usefulness perceptions. This is in accordance with the findings of Al-Adwan et al. (2013) who explored acceptance of e-learning systems in universities. The authors show that students are willing to adopt and use e-learning systems based on the benefits of the systems despite any challenging experiences they may encounter.

Even though respondents clearly mentioned that they cannot do everything they want in MUELE using mobile phones, the majority liked the system because of its perceived productivity, efficiency and effectiveness. Faith in ICT efficacy is one of the factors mentioned in literature and it was confirmed in this study; ICTs are perceived as productive tools especially in areas of communication and collaboration. Technology acceptance studies that explain ICT efficacy mostly use performance expectancy as a factor that affects behavioral

intention to use a system. Mtebe and Raisamo (2014) for example studied behavioral intention to adopt and use mobile learning and note that, the more faith students have, the more increase in their behavioral intention to adopt and use m-learning. In addition to ICT efficacy, Miller and Khera (2010) add self-efficacy, which refers to the faith individuals have in themselves to use a system. The authors note that self-efficacy affects perceived ease of use because less self-efficacy translates into less positive attitudes towards use and more pessimistic behavioral intentions.

User training on how to use a system can also affect use. When users are trained and given support they get access to information that would help them to master the system. For example, some respondents noted that, they did not get any training on how to use MUELE on a phone and for this reason they often had technical problems. Such a challenge hindered their actual use, despite their motivation. They further expressed interests in user training and guidelines as a means of improving their skills (leading to ease of use) and their knowledge on the importance of the application (usefulness). Thomas et al. (2013) studied m-learning adoption in higher education and point to the importance of acquiring appropriate skills to use e-learning systems; training improves attitudes of students. Al-Adwan et al. (2013) similarly found that it helps to,

> *"encourage users (students) to more readily identify the benefits of e-learning and explore the opportunities it offers them to improve their performance. Consequently, this will motivate greater participation in e-learning with a positive and creative attitude" (p. 14).*

Beside the six factors listed above, there are other factors that can affect actual use and perceptions on ease of use and usefulness. These include: privacy and security, use of multimedia content and resources, and Internet speed. The students in our study were uncertain if their privacy was protected. It was mentioned that other users could access information of a particular online private discussion group in MUELE. In cases of ongoing assignment discussions from teachers, this would cause examination malpractice. Because of this privacy breach, students preferred not to meet online. This particular exhibit demonstrated that the perceived privacy intrusion hindered their actual use.

One of the needs mentioned in FGDs was integration of external learning or web applications and resources. Websites such as YouTube, Wikipedia and Facebook were suggested. Students mentioned that such websites would widen information access if "moved close" to them via the learning platform. Students further claimed that they could take advantage of the simple sharing tools within these web applications and websites which are rather easy to use on mobile phones, to collaborate more with their colleagues. Integration of other web applications into learning platforms can therefore be a leading factor to perceived usefulness and actual use.

Lastly, Internet dynamics such as speed affect actual use. MUELE users were precise to mention that they preferred desktop computers when it comes to Internet connection. The desktop computers are on the university's local area network which has a faster and reliable Internet connection than other wireless networks the respondents used. Reliable broadband connection is one of the necessary resources or facilitating conditions that affect students' behavioral intention to adopt m-learning (Mtebe & Raisamo 2014). Mobile broadband is thus a requirement that m-learning institutions should meet.

CONCLUSION

There are few studies that have done research on the use of LCMS on mobile phones. This paper makes a theoretical contribution in mobile learning literature by identifying and discussing factors that lead to use of LCMS on mobile phones and desktop computers through studying perceptions and experiences of MUELE users. Experience and frequency of use; accessible content; system simplicity; productivity; efficiency and effectiveness; and

simplicity to learn and operate were some of the factors identified. These factors can further be investigated for experimental purposes. As shown in results, we further make a practical contribution by identifying ways of transcending LCMS services for mobile phone users given the case of MUELE.

MUELE is perceived as useful, flexible and productively helpful for collaboration and communication. Despite these perceptions, there are many challenges for mobile phones users. These include access and ease of use, infrastructure issues, privacy and security, poor content design and lack of user knowledge about system use. The respondents in this study reported that these challenges affect actual use and perceptions on ease of use and usefulness, but the users' needs and intention to use the system still remain affirmative. Hope (of future improvements) is more important than system flaws. The intention to use mobile devices is strong.

The study was carried out at a time when respondents had not used the learning platform (MUELE) on mobile phones for a long time. We therefore believe that lack of experience is one of the factors that affected their perceptions on use and usefulness. For example, students who do not use the system often do not get to learn all the various functions or the many purposes the system can serve.

The results show that creating solutions to the mentioned problems as suggested by respondents could increase use of MUELE mobile phones compared to desktop computers and further help students in their learning activities in terms of learning material access and bridging the communication gaps. It is not mainly system usefulness and ease of use that drives the learners or users to the learning platform but also the primary reasons leaners seek to address i.e., the ambition to learn and the generally positive attitude towards mobile technologies, no doubt inherited from positive experiences of use for other, often private, purposes.

A limitation of this study is that factors such as gender and age, which previous research has found to be important, could not be investigated due to the small size and skewed age and gender balance of the sample. This in turn depended on the fact that there were very few mobile phone users of MUELE available. The study also focused on mobile phone users only, further research can study all mobile device users.

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APPENDICES

Appendix A: Online Survey Questionnaire

Demographics

1. Age Group: a.18-24 (0) b.25-29 (1) c.30-34(2) d.35++(3)
2. Gender: a. Female(0) a. Male(1)

Actual use

3. How long have you used MUELE?
4. How often do you use MUELE on your Mobile Phone?
   a. All time (0) b. Daily (1) c. 2-3 times a week (2) d. Once a week (3) e. other (4)
5. What MUELE services do you use/what do you use MUELE for? (list)
6. From where do you access MUELE?
   a. At school (0) b. At home (1) c. anywhere (2) d. Never(3)
7. How do you access MUELE on your mobile phone? (Rate your access options on a 1-10 scale)
   i. I use wireless Internet (Wi-Fi via hotspots)
   ii. I use mobile Internet (data packets provided by Telephone service provide)
   iii. Other (please specify with a rank)
8. What times do you access MUELE?
   a. Anytime (0) b. Morning (1) c. Afternoon (2) d. Evening (3) e. Never(4)

Perceived use: Perceived usefulness and ease of use [answered with ***strong agree***--***strongly disagree***]

9. Usefulness

Using MUELE on mobile phone would increase content access
Using MUELE on mobile phone would give me greater control over learning activities
Using MUELE on mobile phone would enable me accomplish learning tasks quickly and effectively
Using MUELE on mobile phone would increase my productivity and contribute positively to my performance
Using MUELE on mobile phone would make my learning easier and simple
I would accomplish more work on MUELE mobile than I would on desktop
I would easily communicate and collaborate more and better with MUELE
Overall, I find using MUELE on mobile phone useful in my learning endeavors

10. Ease of use

I find it hard to use MUELE on mobile phone
Learning to use and operate MUELE on mobile phone is easy
Interacting with MUELE system and MUELE users on mobile phone is frustrating
My interaction with MUELE on mobile phone is clear and understandable
I cannot do everything I want to do in MUELE using my mobile phone
For the task I perform in MUELE using a mobile phone, it is easy to remember how I perform them
I find it easy to use communication and collaboration tools in MUELE
It requires allot of effort to know how to perform tasks on MUELE using a mobile phone
It requires allot of effort to become skillful at using MUELE on mobile phone
Overall, I find use of MUELE on mobile phone easy use

Appendix B: Questions for focus group discussions on *Impact and challenges* (*n*=30/3)

11. State the impact and challenges of MLCMS (MUELE) use (i.e., list the challenges you face and the impact of MUELE use in your learning activities)
12. Suggest usability improvements for MLCMS? (state/list functions)
13. What are the pros and cons of using MUELE on mobile phone compared to desktop environments? And in what situations do you prefer the desktop environment? (state reasons and make any other comments you would like to mention)

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