Co-Designing of a Mobile Educational Tool for Innovative Teaching and Learning at the College of Business Education, Tanzania

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ABSTRACT
Mobile technologies are increasingly becoming tools for enhancing access and smooth sharing of information, products, and services. In this realization, this study used a design science research users' participatory approach to co-design a mobile application prototype known as CBE Mobile Educational Tool (CBEMET) to enable lecturers of the College of Business Education (CBE) in Tanzania to share educational materials. The co-design of the prototype involved 3 researchers, one application developer and 25 lecturers of CBE. The testing of the CBEMET prototype shows that downloading and uploading of education resources to the system is adequate. The results also indicate that the prototype enables the access of uniform departmental-related materials by lecturers of the same department at different locations and, in so doing, it increases the quality of teaching and learning at the college. Furthermore, the testing of the prototype revealed that the design meets the requirements of the lecturers and has brought a significant change in their teaching and learning practices. The impact of the study is that it sets a groundwork for future studies involving lecturers in higher education and developers in co-designing and co-developing mobile education tools for innovative teaching and learning in Tanzania and in other emerging economies.

KEYWORDS
CBE, Tanzania; innovative teaching and learning in higher education institutions; educational technology; co-design and development of mobile educational tools; mobile education tool usage; DSR.

INTRODUCTION
Mobile education tools are regarded as one of the means to enhance innovative teaching and learning. It simplifies, adds value to the way education is delivered, enhances collaboration in learning and is a source of innovative teaching and learning process (Filippo, Barreto, Fuks, & Pereira de Lucena, 2006). With mobile education technologies, teaching and learning can contemporarily be done anywhere, anytime ubiquitously (Virvou & Alepis, 2005; Quinn, 2001; Sharples, 2000; Patten, Arnedillo, & Tangney, 2006; Ryu & Parsons, 2009; Porter, et al., 2016) In other words, technologies have got rid of the need for fixed classrooms and lecture rooms (Lee & Salman, 2012) which were the prerequisite in the past. ICTs technologies, in particular, have improved information accessibility; electronic file exchange; and most importantly enhanced the exchange of information between learner-tutor or learner-learner (Sife, Lwoga, & Sanga, 2007; Abouelenein, 2017) extended learning beyond the classroom (Fullan, 2011). A study by (Heath, Herman, Reeves, Vetter, & Ward, 2005) provide a highlight on how mobile learning application can be used to solve problems of retention of science and mathematics students in universities. Moreover, the new pedagogical method of learning through mobile devices has prominent benefits that other educational media cannot present, such as personal engagement, satisfaction, and high motivation regarding the learning process (Ryu & Parsons, 2009).

Increased application of mobile tools in education in HEIs relates to a concept of innovative teaching, learning, and assessment using social media technologies (Kivunja, 2015). Several studies (Mtega W. P., Bernard, Msungu, & Sanare, 2012; Mtebe J. S., Kondoro, Kisaka, & Kibga, 2015) show that the mobile phone is a useful tool for teaching in higher education solves many previous challenges. Mtebe and Kandoro (2016), specifically write that the Moodle learning management system (LMS) via mobile phones enables instructors and students to view courses, view grades, view notes and be able to hold discussions very efficiently than ever before. Research, therefore, point out that the use of innovative educational technology in teaching should be one of the

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requirements for accrediting a higher education institution (Borisova, Vasbieva, Malykh, Vasnev, & Bírová, 2016)

In Tanzania, the growth and advancement of Information and Communication Technologies (ICTs) are changing the mode of teaching and learning (see, Lee & Salman, 2012; Ryu & Parsons, 2009). According to Kazoka (2017) ICTs has enabled 300 teachers from primary schools to higher education institutions in Tanzania to attend teleconference seminars that improve their teaching of science in public schools. Further, the technology has enabled lecturers to teach in more than one school at the same time

Despite this development in using ICTs in Tanzania, many higher learning institutions have not taken the full advantage of the possibilities offered by the information and computer technologies in improving teaching and learning processes. Mwandosya and Suero Montero (2017), for instance, investigated the usage pattern of mobile devices for teaching and learning among teachers and students at the College of Business Education in 2017. They reported that the usage of such gadgets for education was stubbornly low among the participants of the study. It was also found that a substantial number of CBE lecturers only knew WhatsApp, electronic mails (e-mails), and normal text messages. As a result, CBE administration would fail to acquire uniform coverage of syllabi for the same subjects in their dispersed campuses of Dar es Salaam, Dodoma, Mwanza, and Mbeya[1]. This is because WhatsApp, which was the most preferred application, failed to cater for the idionsyncratic communication needs of CBE teachers and students. According to Mwandosya and Suero Montero's study (ibid), CBE lecturers and students needed a mobile device to enable them to share educational resources and discuss the same issues across the campuses. CBE lecturers supposed that such mobile educational tool would enable lecturers and students to share ideas, and educational resources among themselves, and in so doing, facilitating innovative teaching and learning process.

Building on the findings of Mwandosya and Suero Montero in 2017, this study set to co-designed and develop CBEMET prototype by involving stakeholders through interviews, focus group discussions, and participation in design workshops conducted with lecturers of CBE.
The study set to fulfill the following objectives:

1. to identify the mobile education tool's design features and functionalities for innovative teaching and learning at CBE.
2. to co-design design and co-develop a mobile education tool prototype incorporating CBE lecturers' requirements
3. to demonstrate and use the CBE mobile education tool prototype to the CBE lecturers after its development.

The study intended to lay a groundwork for future co-designing and co-developing mobile software for contextualized innovative teaching and learning in higher education institutions in Tanzania and elsewhere.

MOBILE LEARNING THEORIES AND RELATED WORKS

Mobile learning theories

Mobile technologies contributions to the education sector have yielded a number of theories. In their Theory of Mobile Learning, (Sharples, Taylor, & Vavoula, 2005; Pea & Maldonaldo, 2006) consider a technology-mediated mobile learning as a personal and situated activity mediated by technology. The theory clearly explains the convergence between learning and technology, where learning is conducted in a mobile situation away from traditional classrooms and lecture halls through the use of mobile education tools. One of the aims of the Theory of Mobile Learning is to inform the design of new environments and technologies to support mobile learning. The theory is important in this study and has been applied in the sense that the co-designing and co-development of this mobile devices for CBE will enable teachers to share educational experiences and materials for the innovative teaching and learning irrespective of their location and time.

Further, the study applied the Activity Theory. This is a theory which gives insights on how designers can develop mobile tools using mobile technologies to better understand the social and material relations that affect complex human learning and the learners' interaction with others as mediated by mobile education tools (Uden, 2007). The Activity Theory emphasizes the involvement of users in the development of an application, in this case, the CBE teachers. It moves away from teacher-centered or student-centered learning approaches. In line with the theory, the participants move through the activities and progress from being partial participants who are

[1] Distance in kilometers from Dar es Salaam to Dodoma is 584 km, Dar es Salaam – Mwanza is 1145.58 km, and Dar es Salaam – Mbeya is 829.53 km.

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heavily dependent on the material mediation of tools, to full participants, who are able to more flexibly use the cultural tools of the narrative practice (Gifford & Enyed, 1999). That is, a mobile technology in this perspective is not perceived as the object of learning, but as a tool to support students' learning activities which are applied in the study involving teachers' aspects in own teaching and learning activities using a mobile technology. Instead of designing mobile learning applications in isolation, the Activity Theory suggests the consideration of important features of human endeavor at large through the participation of the concerned users. This allows us to focus on the context of use. It maintains that mobile technology artifacts can only be understood in their context of use, as embedded in meaningful activity.

These two theories (the Theory of Mobile Learning and the Activity Theory) offered this study an initial framework for theorizing about mobile learning. Similarly, they highlighted and put forward the ground for carrying out further studies about the use of mobile technologies in higher educational environment for sharing teaching and learning activities, among other functions. They rationalized the need to grab opportunities offered by mobile learning to promote innovative teaching and learning. The following sections extend the base obtained from the mentioned theories by looking at multiple studies relating to innovative teaching and learning, collaborative learning, design, and development of mobile applications, and the user experience in the co-design and development of mobile education tools.

Innovative teaching and learning

Teaching innovation is when the appropriate strategies and skills are applied to technology use, making it a favorable tool for teaching, fostering effective learning (Bruce, 1989). Innovative teaching is both the practice of teaching for creativity and of applying innovation to teaching (Ferrari, Cachia, & Punie, 2009; Mtega W. P., Bernard, Msungu, & Sanare, 2012). Fullan, (2011) identified three innovative teaching practices namely: 1. Students' centered pedagogies including knowledge building, self-regulation assessment, collaboration, and skilled communication; 2. Extending learning beyond the classroom including problem-solving and real-world innovation; 3. The ICT use in the service of specific and concrete learning goals.

Research point out that innovations enhance competitiveness in a wide variety of sectors including the education sector. Khurshid and Ansari (2012), for example, separated two groups of students of grade I. One of these groups was the control group and was taught using conventional teaching methods, while the other group was the experimental group and was taught using innovative methods. The innovative methods applied were team projects, individual projects, field trips, flash cards, real objects, audio-visual aids, internet access, computer-assisted instructions, role play, worksheets, smart boards, group discussions, quizzes, and mind maps. A test was administered after one month of the teaching and the result showed that students taught using innovative means scored significantly higher than those taught using conventional methods did.

This confirms that innovative teaching improves learner's capability and that teaching has to be innovative (Lee, 2011; Borisova, Vasbieva, Malykh, Vasnev, & Bírová, 2016). .

With regard to mobile education, technologies now make innovative teaching and learning easy and real. According to (Kaliisa & Picard, 2017), mobile technologies make it possible for someone to learn efficiently in anytime and almost anywhere. This study is therefore informed by the key role of technologies in the innovative teaching and the need to encourage the design and development of innovative curriculums, and mobile education applications designed in a collaborative way to involve the learners, lecturers, and experts in curriculum and application developers (Naismith, Lonsdale, Vavoula, & Sharples, 2004).

Co-designing and co-developing mobile applications

Co-designing and co-development of a mobile application refers to focusing on the users of the system rather than the developers of the system in order to obtain features and functionalities which will be compatible to the users' needs and in so doing to obtain maximum benefits of learning innovatively. Though the users of the mobile tool might not be technically oriented in designs of the mobile technologies, their contribution to the design is very important as they may observe out the functionalities of the application. Involvement of the users may lead to an application tool with ideal features for users. Co-designing and co-development of mobile applications ensure the success of the application in question at the implementation stage. This is because all problems with the application are early noticed by users of the application and are thus corrected during the design stage. A study by (Nielsen, 2017) elaborates ten usability heuristics for user interface design. Similarly, (Millard, Howard, Gilbert, & Wills, 2009), showed steps involved in co-designing and co-deployment of an innovative mobile learning system as: *scoping; sharing understanding; brainstorming; refining; and implementing* in this study, each of the five stages of Millard, Howard, Gilbert, & Wills' were followed through workshops and meetings with technical and domain experts in the design team.

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Mobile educational tools – features and functionalities

A study by Filippo et al., (2006) described a mobile device as a tool for coordinating 'conferences' or 'forums' where learners and mediators' messages could smoothly avail collaborative learning. The usefulness of any mobile application is associated with factors such as the quickness in searching and accessing the mobile learning materials and smooth coordination of contents shared by learners and mediators – lecturers at case study of CBE (Filippo, Barreto, Fuks, & Pereira de Lucena, 2006). A number of research have been done on how mobile learning tools can be developed and be applied in different teaching and learning environments.

A four-year project in three European countries to research and develop a practical, easy to use mobile learning toolkit specifically for lecturers, by (Attewell, 2005) produced three toolkits: the first one was a short messaging system (SMS, text message) known as quiz authoring tool, the second one was media board authoring tool, and the third one was pocket PC authoring tool useful for lecturers. The three toolkits suggested by the project study provide an insight on how to design and incorporate a bundle of tools in a mobile application to be used by teachers for effective and innovative teaching. A study by (Li, 2010) worked on a search tool for users to quickly access mobile phone data such as applications and contacts, by drawing gestures. The search tool was found to be useful in searching contents. A study by (Alzahrani, 2017), which was intended to enable students learn through discussion forums reveals the effects of using online discussion forums on students' learning indicating a positive result for enhanced innovative teaching and learning at one of the leading University in Saudi Arabia. It established that many users of mobile applications face slowness in sending requests and receiving feedback. They thus marked this factor as an important aspect to be looked at in the design of any mobile application. A study by (Foti & Mendez, 2014) focused on how students use education-related applications such as Quizlet by LLC a company which creates study tools enabling students to join through their website. The students were able to log in to the app where they found easy to collaboratively learn, do quizzes and some exercises in preparations for examinations. In a study by (Virvou & Alepis, 2005) features of a mobile education tool known as "The Mobile Author" made learning interesting and useful to students and their instructors.

Xie & Parsons (2009) found that functionalities of mobile tools depended on the available portion of the total bandwidth that a user is using. The bandwidth challenge can be solved by developing an application using, for example, the asynchronous JavaScript and XML (Ajax) which is an approach to Web application development that uses client-side scripting to reduce traffic between client and server and provides seamless user application experience (Xie & Parsons, 2009). A study by Ahmad et al., (2004) suggested the importance of learning users' requirements of the interface. Furthermore, according to (Ahmad, Basir, & Hassanein, 2004), the interface of the tool should be easily adapted for different types of users with differing intelligence capabilities.

Gathering from the aforesaid studies, the need to engage users in the design of the mobile applications as a way of motivating them to collaborate is emphasized. In designing CBEMET prototype for the College of Business Education, therefore, lecturers were involved to come up with a system with features and functionalities that meet their requirements.

METHODOLOGY

In order to define the interface design requirements and contents specifically for the CBEMET prototype about how it will look and work, four workshops involving one application developer, 25 CBE lecturers, and three researchers (one based in Finland at the University of Eastern Finland, and two based in Dar es Salaam at CBE), were conducted at Dar es Salaam Campus of CBE. The workshops followed the design science research (DSR) framework which emphasizes the involvement of users (lecturers) from the onset in the design process of an artifact (the CBEMET prototype). By involving the lecturers, and the designers learnt about what to incorporate in the design.

Design Science Research

The DSR users' participatory approach in designing the CBEMET prototype have been pivotal in this study. A participatory design approach is an approach that attempts to bridge a gap between researchers and designers and users by organizing co-operation between them (Muller, 2002). The DSR method is a methodological approach concerned with devising artifacts that serve human purposes (Dresch, Pacheco, & Antunes, 2015). DSR entails a systematic approach to studying a practical problem in order to develop a practical solution for an environment in a real world (Hevner, March, Park, & Ram, 2004; Hevner, 2007; Peffers, Tuunanen, Rothenberger, & Chatterjee, 2007). An important outcome of this type of research is an artifact that solves a domain problem, also known as a solution concept, which must be assessed against the criterion of value or utility. In the present study, DSR Framework by (Johannesson & Perjons, 2014) were adopted and modified (see Figure 1).

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In applying the DSR at CBE, the task involved lecturers (ultimate users of the application), the developer (a former student, an ICT diploma graduate at CBE and a member ICT innovation group), and 3 researchers (2 based in Dar es Salaam and 1 in Finland.
In the CBEMET prototype co-designing phase, the prototype features and functionalities were designed through iterative discussions, interviews, observations. After the prototype demonstration and agreement on the proper interface design of the MET. Finally, after the demonstration phase, the MET prototype was presented to users to test its features and its effectiveness for sharing different contents. Figure 1 illustrates the co-designing and co-development process applied in this study.

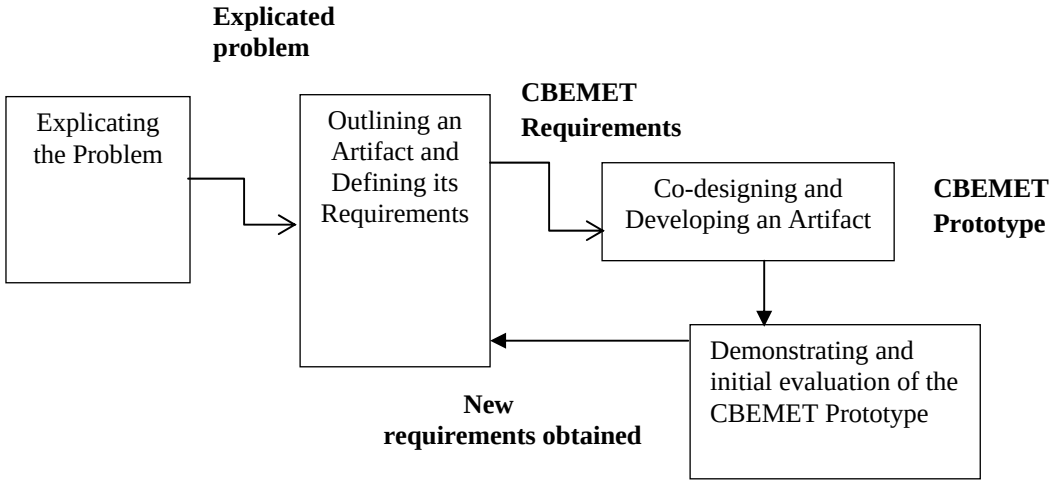

Figure 1. Design Science Research Framework adapted from (Johannesson & Perjons, 2014).

Participants
The population of the CBE academic staff as per the year 2017 records from human resource department is 161 lecturers. Out of 161 CBE teaching staff, whereby; 83 are based in Dar es Salaam Campus, 38 are based in Dodoma Campus, 31 are based in Mwanza Campus, while, 9 are in Mbeya Campus. In this study, 25 lecturers were purposively selected: 10 from Dar es Salaam Campus and 5 from each of the remaining 3 campuses. The purposive sampling was used because the target was the participant with the sought information (Bryman, 2012; Saunders & Philip, 2009; Denscombe, 2003).

Data collection method
Data for this study were collected in two phases. Phase I data aimed to gain an understanding and experience of CBE teachers in using mobile devices for educational related matters (see Table 1). Phase II data targeted soliciting views of the lecturers of the features and functionalities that MET need to possess (see Table 2). Data was collected through four interviews, one at each campus, and one FGD involving 8 teaching staff 2 from each campus. Observation on the working of the MET prototype was done in each campus and notes of the observed and interviews were taken and recorded for improving the application.

After the demonstration of the initial CBEMET prototype, the second phase of an interactive design discussion on the functionalities of the prototype together with the lecturers was undertaken. Table 1 shows sample questions used to probe the design features and functionalities of CBEMET in focus groups and interviews.

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Table 1. Sample questions on the features and functionalities of the CBEMET Prototype

Demonstration of MET Prototype	Phase II – MET Prototype Experience
Features expected: 1. Log in interface 2. Available services 3. Navigation through 4. Access to different services 5. Arrangement of icons The demonstration will pave way for the look on the following: 1. Access to the services of the MET 2. Features of the MET 3. Functionalities of the MET **Outcomes:** 1. Testing of the services, features, and functionalities of the MET. 2. Lecturers' suggestions for improvement of the MET	1. What is your overall reaction to the observed functionalities of the MET prototype after using the initial design for two days? Please respond also to the following coming questions in this part: - How do you feel about sharing your contents online? - How do you feel about the arrangement of icons? 2. In terms of functionalities, what is missing? How can it be improved or changed? Why? 3. What is your opinion of the MET in terms of minimizing the educational-related challenges found at CBE? 4. In terms of features found on the screen, what do you think should be improved or changed? Why? 5. Briefly explain if the MET will be a solution to your personal development in your T & L environment and the innovative teaching. If NOT, please elaborate on your reaction.

Data coding and analysis

Data obtained from interviews and focus group discussions were subjected to content analysis while data obtained from observations and discussions, after the demonstration of the application, were used to re-design and develop the MET prototype to generate features of the mobile education tool that fully meets the needs of CBE teachers. The results of the observations and feedback obtained on the features and functionality of the tool are discussed in the results section of this paper.

CO-DESIGNING AND DEVELOPING CBEMET PROTOTYPE

The second objective of this paper was to co-design and co-develop a mobile education tool prototype incorporating CBE teachers' requirements. This was achieved through a series of iterations as presented in the subsequent subsections.

1st Iteration of co-designing and developing CBEMET Prototype

This was motivated as a result of a study by Mwandosya and Suero Montero, (2017) who identified the need for co-designing a mobile educational tool that meets lecturers' requirements of innovative teaching and learning at CBE.

In line with this need, the first phase of workshops for co-designing CBEMET prototype involved 10 teachers from Dar es from Dar es Salaam Campus and 5 from each of the remaining 3 campuses. Figure 2 is a sample of such workshops at Dar es Salaam Campus.).

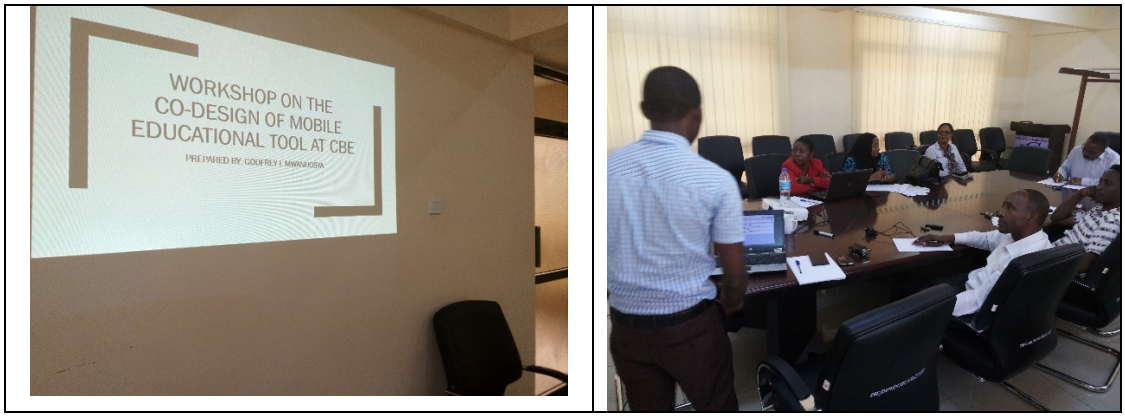

Figure 2. The first batch of lecturers' workshop at CBE, Dar es Salaam Campus

In these workshops, the developer and the researchers introduced the aim of the gatherings to lecturers for them to own the design of a mobile educational tool tailored for them before the start of the workshops.

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Outcomes of the workshops:
The following feedback were obtained from CBE lecturers from Dar es Salaam Mwanza, Dodoma, and Mbeya campuses as the initial design requirements for CBEMET prototype

1. The login to the CBEMET prototype should be for CBE as a whole, not by campus-wise
2. The administrator of the system should be able to filter messages so that unwanted messages are blocked or sent to junk mails
3. The contents of the shared educational tool should be arranged by department-wise to minimize time to search and to realize a systematic approach to shared materials of the department in question
4. A lecturer should be able to delete a sent file in case it was wrongly picked or it is irrelevant
5. The CBEMET prototype should allow lecturers to record and post videos, audio presentations
6. CBEMET prototype should store videos and audio presentations for future use
7. CBEMET prototype should allow lecturers to change their passwords at next login
8. The CBEMET prototype should have its logo bearing the colors of CBE
9. It should be mandatory for user to register their first name, last name and e-mail address when logging in. Other particulars such as users' title, education background should remain optional until when users have started accessing the CBEMET prototype
10. Frequently asked questions (FAQs) should be presented somewhere in the system to make it friendlier to users
11. There should be an arrow to direct the user on where go next after logging in to the CBEMET prototype
12. There should be as little information as possible on one window. Only compulsory information should be portrayed at a time

2nd Iteration of the of the Co-design and development of the CBEMET Prototype
The second iteration came after the researchers and the developer of the CBEMET prototype had worked on the observed feedback from lecturers from all the four campuses and produced an initial design of the CBEMET prototype. This was an iterative process as lecturers had produced remarkable ideas for the designing each time they had a chance.

Another workshop was called upon in early December 2017 to proceed with the designing of the CBEMET prototype after obtaining the initial feedback on the design of the CBEMET prototype. In this workshop, the participants were presented the version of CBEMET prototype that considered the feedback they had stipulated in the first workshops. Figure 3 shows the initial design presented to the lecturers during the workshop.

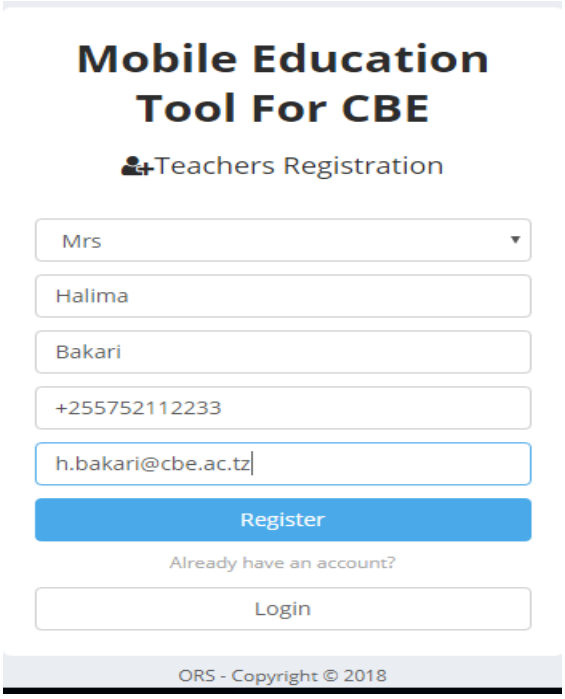

Figure 3: The initial design of the CBEMET – registration, login menu

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Activities that took place in this workshop were:

- the installation of the CBEMET prototype in the smartphone and mobile devices of the lecturers
- the navigation through the CBEMET prototype to see what has been done after the requirements

After the above activities, each of the lecturers were given two days to explore all features of CBEMET prototype to determine their usefulness. The findings of the observation would be presented in the following workshop as detailed in the subsequent subsection.

3rd Iteration of the Co-designing and development of the CBEMET Prototype

The next workshop was held in early January 2018 at Dar es Salaam Campus after each of the participating lecturers from all campuses had accessed the CBEMET prototype. Each of the participating lecturers in the co-designing activity had demonstrated a good command of using the CBEMET prototype by going through all the functionalities of the different menu items found.

A number of challenges were revealed during the discussions in this co-designing workshop. First, some of the lecturers had encountered access problem. They reported that the system did not work in their smartphones and other mobile devices their network bundles were small – which was noted by the researchers and the developer for future improvement of the system. Furthermore, it was reported that power saving options caused the screen of their devices to go to lock mode. Another challenge was the difficulty to select more than one file to download. At the post notes menu, it was not possible to upload contents. However, the menu items of the CBEMET application were found suitable. It was thus agreed in the workshop that all the challenges observed be rectified before the following workshop scheduled for June 2018.

Outcomes of the co-designing iterations

In a nutshell, all participants were largely satisfied with the outlook and the running of CBEMET prototype. The lecturers were excited in accessing CBEMET prototype online – they likened the application with the WhatsApp, but said the good thing with CBEMET prototype is that they owned it and are thus able to suggest further modifications they feel appropriate. In a nutshell, they felt really empowered in their work as lecturers. The lesson learnt by the researchers, the developer and lecturers during and after the re-designing sessions was that each participant learnt different ways to access, upload and download documents from and unto the CBEMET prototype.

Few suggestions for improvement raised were keenly recorded for the re-designing the CBEMET prototype so that if fully meets the requirements of the lecturers. Such suggestions were such as:

- in the registration part of the MET, the title should include Prof, and Dr. Initials, not only Mr., Mrs., Miss as the CBE institutions is ever expanding, and had 3 professors, 6 Ph.D. staff, and about 20 staff in Ph.D. programmes
- the function for changing the password received through email needs to work properly to enable lecturers to change their passwords for security reasons
- after logging in, a name of the logged in person should appear in the window
- the main menu or the login menu or both should have a logo that clearly indicates that the application belongs to CBE to ascertain copyright and visibility issues. This is because the application is will be accessed online through the Google Play Store.

At a discussion part, a name and photograph of the lecturer who is posting should also appear.

Re-designing CBEMET

The re-designing CBEMET prototype was done in consideration of feedback from the workshops. The re-designing involved the addition of a provision for each department to share their own notes. There was also the insertion of a CBE logo in the main menu window. Another improvement was the inclusion of titles of Dr. and Prof. in the registration window – as it was recommended by participants of the earlier workshops. Further, there was the inclusion of “News and updates” icon on the main menu, instead of inside one of the menus. The news and updates will remind users of important announcements on shared resources especially new modern technology and innovation inventions.

The third objective was to demonstrate the use of the CBE mobile education tool to CBE teachers after its improvement. In line with this objective, a training intended to demonstrate the modified version of the CBEMET prototype to the 25 lecturers was organized at CBE Dar es Salaam Campus for all 25 lecturers from all campuses who had smartphones. The training aimed to make lecturers own the CBEMET prototype, familiarize themselves with the application and providing feedback for improvement. The researchers and the developer were closely monitoring the process to make sure that CBEMET prototype is working properly and that lecturers

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do not get stuck at any point. The activities that took place in the demonstration phase are summarized as follows:

Accessing CBEMET Prototype – the participants of these training would access CBEMET prototype through their smartphones using a provided domain. The process started by visiting the website **meducbe.ac.tz** and pressing "**Enter**" key. This opened a log in Window as shown in Figure 4:

Figure 4. The screenshot for login

With a registered e-mail (CBE e-mail) and a correct password one can log in and access the MET prototype.

Grouping lecturers – 25 lecturers were grouped into 5 groups consisting of 5 lecturers each. The objective was to get them collectively check how the CBEMET prototype works and thereafter give feedback for improvement.

FINDINGS

Focus group discussions – the FGDs were conducted after the demonstration phase to solicit the views of lecturers on the running of MET and to explore their suggestions for improvement. Major outcomes of the FGDs was a proposal to include video conferencing function into the system to enable lecturers to converse online. For example, one participant said, *"even the meetings can be done online between members of the management, instead of members of the management team traveling all the way from Mwanza, Dodoma, and Mbeya to Dar es Salaam just for a 2 hr meeting."* This was taken up for further improvement of the system. also, the lecturers during the discussion revealed that training program should be prepared for all the lecturers of CBE to start using the prototype immediately.

Interviews–interviews were also held to solicit views of lecturers after the demonstration of CBEMET prototype phase. The interviews equally realized fruitful feedback which were taken on board in the improvement of CBEMET so that it enhances the teaching and learning in HEIs. One of the participants who had an issue with the security said, "*I am worried about sharing my documents online, what about if someone accesses them and use it in another institution*?"

Observation of lecturers' reaction to CBEMET Prototype

The developer and the researchers simultaneously observed the reaction of lecturers to CBEMET. Generally, they were happy about the design of the MET prototype, especially because it enabled them to transfer experiences of using other social media contents to the system.

Agreements – to make sure that CBEMET is owned by all parties involved in its design, it was agreed that every suggestion on the improvement of the design and modifications of the CBEMET is dully checked by all the participants and the final agreement documented thereof was produced.

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Documentation of how the system works, what were observed and resolved during the demonstration of the MET was done for future reference and maintenance of the application.

This section presents the features and functionalities of the version of CBEMET prototype which considered the requirements of 25 lecturers from all the four campuses of CBE. We start the presentation with the technical description of the CBEMET prototype and ends with the observed challenges and future plans for the similar works.

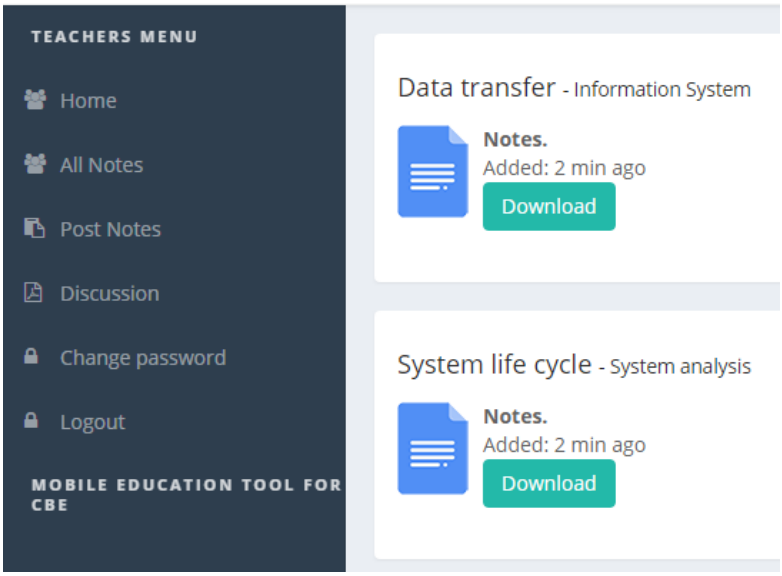

Figure 5. The main menu of the CBEMET prototype

Technical Description of the CBEMET Prototype
The application was developed using the framework Laravel v.5.4, Bootstrap 4. The front-end interface was developed using the HTML, CSS. The Server-side script being PHP (Object-oriented Programming). On the part of the Client-side Script, JavaScript, Ajax, and JQuery were used. This was done purposely due to their efficiency in developing applications. User's data is stored in an SQL database using MySQL for Android App and Java, JSON API for data retrieval. The MET prototype has 3000 lines of code.

A brief explanation of the CBEMET Prototype characteristics
The development of CBEMET prototype comes at a time when HEIs in Tanzania needs changes in the teaching and learning to match the technological changes that are taking place in world. Briefly, the characteristics of the CBEMET prototype is that it can run in mobile devices (smartphones, tablets, PDAs), laptops, and desktops as long as there is an internet connection. It is an application that is mobile in nature, it can be applied anywhere, anytime. Also, the CBEMET prototype involves only those who have CBE's email that is, members of staff in the emailing system of CBE.

The initial observations on the impact of the features of the CBEMET prototype have shown that teachers have abundant academic resources at their disposal which were not known and can now share them very easily through CBEMET prototype. Secondly, MET prototype has opened chances to teachers to collaborate in different projects. For example, one lecturer from the Business Administration department has shared his new project named "*Entrepreneurship sensitization for entrepreneurs doing business around the College of Business Education*" and has called for teachers to join and collaborate with him in writing project proposals. This suggest that the interaction among the teachers has tremendously increased through CBEMET.

Brief explanations of the functionalities of the CBEMET

The MET prototype starts with:

i. registering by entering details such as title (Mr., Mrs., Prof, Miss. Ms., and Dr.), first name, surname, telephone number, and an email address
ii. Login to CBEMET using an email address as a username and a password that is automatically brought to an email address the user registered. This automatic password enables the user of the CBEMET prototype to access the application and can be changed after accessing.

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iii. After logging in the system, the user will automatically be directed to a window with menus such as *Home page, All notes, Post Notes, Discussions, Change Password and Logout.*
iv. On this page, users have an option to select the function they want.

A brief explanation of the menu items
Home- provides information about the MET prototype and a starting point to different menu items **All Notes** - is designed for viewing and downloading notes shared by lecturers for enhancing the shared experience in innovative teaching and learning. It thus enables lecturers to teach and learn at the same time
Post-Notes - this is designed for posting notes, innovations, PowerPoint presentations, multimedia resources, etc. It is designed to meet the requirements of the lectures as stipulated in (Mwandosya & Suero Montero, 2017).

Discussion - at the discussion menu, it is expected that lecturers will be able to post issues and interact online on issues that need quick responses ubiquitously. That is why the MET prototype is known as a mobile education tool!

Change Password – this is a feature for changing a temporary password supplied during the registration through the registered email of the user. The feature is meant to ensure the security of the users and content in the system.

Logout - after using the CBEMET the features allow user to leave the system safely.

DISCUSSIONS
The first objective of this paper was to identify mobile education tool's design features and functionalities for innovative teaching and learning at CBE. This objective was clearly realized because the 25 lecturers were able to give feedback and suggest a number of design features during the workshops held at different times.

The second objective was to co-design and co-develop a mobile education tool prototype incorporating CBE lecturers' requirements. Interesting design skills were observed during this stage, lecturers were able to pinpoint some design suggestions as if they were real application developers. They felt they own the prototype and were satisfied by the involvement. The third objective was to demonstrate the use of the mobile education tool to the CBE teachers after its development for feedback and suggestion for improvement before it was taken to the whole community of 161 lecturers. This objective was clearly met through focus group discussions, observations, workshops and interviews whereby a number of constructive feedbacks was collected to improve the working of the CBEMET prototype.

Earlier activities of the study focused on outlining the artifact and defining its requirements. The requirements were divided into two parts. The first part was about the contents to be included in the CBEMET prototype. The second part was about the functionalities and features of the CBEMET prototype itself. The activities in this stage were successful in the sense that they brought curiosity among lecturers that is, the manner in which they were enthusiastic to discuss how the system can enable them to share their innovative teaching and learning issues, anytime and anywhere. The ability to post notes and hold discussions with fellow lecturers and students online fostered teamwork and trust among themselves, analogous to this is a study by Cheong et al., (2012) who designed a Mobile-app-based Collaborative Learning System known as *myVote,* which was designed to support social interaction in order to promote higher-order thinking skills an objective that was highly attained whilst CBEMET prototype was primarily meant to promote innovative teaching and learning. The design stage of the CBEMET prototype generated a number of interesting design ideas from the participating lecturers, the researchers, and a developer which were used to improve the system, see for example, (Ford & Leinonen, 2006). The design stage proved that co-designing the CBEMET prototype with the lecturers, developers and researchers result in a technology that suits users' contextual background and needs for example Mramba et al., (2016). Contrary to a study by Oyelere et al., (2016) who in their study designed a mobile learning application for computing education (MobileEdu) which was tested through an experiment with 142 third year undergraduate students mainly for checking if MobileEdu improved their learning experience and not the design of MobileEdu. The main aim of their experiment was therefore to assess if the students who learned through MobileEdu attained improved learning engagement, results, and had better pedagogical experiences than those who learned by following the traditional face-to-face method. The students as users were not involved in the design of MobileEdu, meanwhile in the design of CBEMET prototype teachers as users were involved directly. In using MobileEdu though, the students showed improved learning capabilities. A study by Ford & Leinonen, (2016) who developed a mobile tools and services platform for formal and informal learning (MobilED) showed similar process of a way of testing the functionalities of the tool as the way it was done with CBEMET prototype whereby the ideas of the learners from the first and second pilots were used to improve the MobilED an exercise that was successfully done and attained the objectives set.

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Generally, it was established that CBEMET prototype has changed the perception of lecturers on the use of mobile devices for teaching and learning. Lecturers are seen shifting from frequent social media access to using the CBEMET prototype for teaching, learning and coordinating activities. For example, one notable change is that CBEMET prototype has made it possible to implement a project entitled "Introduction of Mobile Learning in Higher Education Institutions in Tanzania". This project is expected to unite members of management teams, teachers, and students from selected higher education institutions in teaching using mobile learning tools. The sharing of projects' activities will be done through the discussion forum of the CBEMET prototype. Furthermore, CBEMET prototype has realized the innovative teaching and learning through the use of educational audio and video tools, access of different shared educational resources, preparation of multimedia learning contents, and presentation skills.

CONCLUSION

The objectives of the study were (1) to identify the mobile education tool's design features and functionalities for innovative teaching and learning at CBE, (2) to co-design design and co-develop a mobile education tool prototype incorporating CBE teachers' requirements, and (3) to demonstrate and use the CBE mobile education tool to the CBE teachers after its development In fulfillment of these objectives, we have demonstrated how mobile application can be co-designed and co-developed by developers and users in the contextual environment. Different features and functionalities of the CBEMET prototype were observed, discussed, and agreed upon for future improvement of the application. Through the workshops, lecturers were able to participate fully to design different items of the CBEMET prototype. With all the challenges that have been recorded as a result of co-designing of the prototype, the study's objectives have been met. That is, a mobile education tool which emphasize interactivity, adaptivity, and instilling a sense of ownership of the application has been developed. The demonstration results were very encouraging and showed the appreciation of the contribution of mobile software features to education. The challenges encountered will be used to improve the CBEMET prototype until it is fully developed into a real integrated system for the entire community of CBE.

The biggest contribution of this paper is therefore using a DSR participatory approach combining lecturers, researchers, and software developers to design and develop a suitable mobile education tool to enhance teaching and learning in a contextualized environment (Muller, 2002). This study has shown how using DSR user participatory approach in designing a mobile education tool application can be done collaboratively and how the end product of such collaborations suits the requirements of users and inform subsequent designs, development of similar products. It underscores that collaborations and sharing of innovative experiences of individual teachers is vital for quality education in higher education institutions. Further, it proves that collaborations can be easily achieved through mobile technologies and the development of mobile education application tools. Moreover, the study stimulates the need to changes from the traditional way of teaching and learning mostly face-to-face to innovative teaching in higher learning institutions to serve the needs of the society in the best way and sustainably.

As a result, the CBEMET prototype has enabled CBE lecturers to share educational resources online, to uploading and downloading educational resources, and to access departmental related documents. It provides uniformity of learning materials across all campuses, and in so doing, increases the quality of education. The CBE lecturers have been positively impacted by the CBEMET prototype and more suggestion has been received as using the MET prototype gaining momentum.

LIMITATIONS OF THE STUDY AND FUTURE WORK

The requirements and the development of the MET prototype only considered CBE environment, which means that some features may not apply in different set of environments. Furthermore, the lack of bandwidth appeared a limitation to the use of the application; by users who cannot afford buying large internet bundles from the internet operators. In addition, the system did not focus on the needs of students who are also the stakeholders of higher education in Tanzania. Therefore, future development of CBEMET should look into integrating students' needs of access notes, recording lectures and other related educational materials to ensure innovative teaching and learning campaign.

The CBEMET prototype also lacks interactive forums that would make it more productive in terms of teaching and learning – compared to similar systems in developed countries such as Finland, Norway, Sweden, United Kingdom, and Turkey just to mention a few. These countries have shown tremendous development in using innovative teaching and learning in HEIs. Other related activities of importance to be considered in future include assessing students' work electronically as suggested by (Alsadoon, 2017) and the importance of online instructional environment where instructors and students share for the innovative teaching and learning (Sarsar & Harmon, 2017).

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CONFLICT OF INTEREST

There is no conflict of interest in this study.

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