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Evaluation feedback on the functionality of a mobile education tool for innovative teaching and learning in a higher education institution in Tanzania

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ABSTRACT

This paper presents the findings of the evaluation feedback on the functionalities of a mobile education tool (MET) prototype at the College of Business Education (CBE) known as the CBEMET Prototype, in Tanzania. The paper also describes the extent to which the CBEMET Prototype adheres to the traits and ideas of Design Science Research (DSR). To evaluate the pedagogical impact of the CBEMET Prototype in a real-life learning environment setting, a sample of 40 teachers was purposefully selected and 160 undergraduate students randomly selected for an experiment from the Dar es Salaam campus of the CBE. The data were collected through in-depth interviews and questionnaires administered to both teachers and students. The results of the students' management information system course pre-test and post-test were also collected and analyzed. Thematic analysis was done in regard to the qualitative data and descriptive analysis for the quantitative data using the Statistical Package for Social Sciences (SPSS) IBM version 23. The findings reveal that the CBEMET Prototype has significantly improved the sharing of education-related resources among teachers and students and reduced the cost of producing hard copies of education resources. The prototype has sparked innovativeness among teachers and students in the teaching and learning process.

Keywords*:* *DSR evaluation; CBEMET prototype; innovative teaching and learning; higher education institutions; mobile technologies; Tanzania*

INTRODUCTION

Mobile learning is any type of learning that takes place in learning environment spaces that takes into account the mobility of technology, mobility of learners, and mobility of learning (El-Hussein *et al.*, 2017). Also, it can generally be thought that the mobility of technology, learners, and learning are to a great extent enabled by mobile wireless technologies. Mobile wireless technologies and the associated infrastructure have significantly imparted innovation in the education sector, among many other sectors to date. Mobile education tools and mobile applications (*mobile apps*) have emerged as important tools for innovative teaching and learning in educational institutions. According to (Cook, 2010), the context for learning in the 21st century is being augmented and accelerated by new digital tools and media, particularly by mobile devices and networks and structures, to which they connect people.

Mobile education tools are good examples of digital tools aimed at enhancing the way teaching and learning is done, especially in higher education institutions where teachers and students are mostly using mobile devices (Mfaume, 2019). Khaddage, Lattermman (2013) note that mobile education apps, if well integrated, provide an efficient and innovative way of delivering learning content to students. Traxler (2005) noted the importance of using mobile technologies given its global context and that education should reflect that context. Mobile devices through supporting

technologies have capabilities to store, process, retrieve, and disseminate information just like any computer or laptop can do.

The advantage of mobile devices against the desktop computers is the fact that they are portable, easy to carry and enables communication and exchange of information anytime, anywhere, that is, in a bus, train, and basically in any location regardless the time of the day and location. Furthermore, they can store video, multimedia, and textual file formats facilitating new ways for where information is stored, created and presented. Similarly, mobile applications, popularly known as *mobile apps,* installed on mobile devices enable and simplify access to and sharing of information, products, and services online (Pimmer and Pachler, 2014). Through *mobile app*s, users can share information in terms of texts, videos, and audio files, which greatly impact on the quality of online education in the higher education sector, especially in the developing countries where there are many educational challenges (Sinha and Bagarukayo, 2019). Lwoga and Komba (2015) reiterates that mobile technology use in higher education institutions simplify access to educational-related content and therefore enhances innovative teaching and learning. Mobile education, therefore, through *mobile apps* on mobile devices is an innovative way where teaching and learning are done in different new ways, in an online environment.

Mobile education enables flexibility in the teaching and learning environment in higher education institutions (Sandhu and Sankey, 2019). It enables the exchange of education-related resources like teaching notes, assignments, group work, and provides access to online resources anytime convenient for both the teachers and students (Mtega *et al.*, 2012; Mtebe and Kondoro, 2016). Mobile learning promotes innovation in the teaching and learning context by extending and improving the traditional face-to-face teaching and learning environment. Kukulska-Hulme et al., (2009) in their study report that mobile education through different projects had stimulated innovations in learning by challenging the boundaries imposed by traditional classroom learning. According to Lindsay (2016), teachers and students in higher education institutions can use shared materials to enrich the education system. Mobile devices and mobile education tools and applications enable teachers and students to interact anytime and exchange a variety of educational related content even beyond classroom hours (Mtega *et al.*, 2012).

In the context of higher education in Tanzania, the Tanzania Commission for Universities (TCU) and the National Council for Technical Education (NACTE), the two bodies that oversee the functions of higher education institutions, are the pioneers of the application of mobile technology in higher education in Tanzania. The two education bodies have given directions that all students' applications for admissions in higher education institutions in Tanzania should be done online. One criterion, therefore, for accreditation of higher education institutions among others in Tanzania is to have online systems for processing applications and submitting the list of students and their details to NACTE and TCU respectively. The government of Tanzania also, through its ICT policy, has indicated that mobile phones should be used as a strategy to enhance the quality of education in Tanzania (Mfaume, 2019). The different online application systems accessed through mobile phones in higher education institutions in Tanzania are becoming popular for both the teachers and students. Through these central systems, students can apply for courses offered by any higher education institutions and they can check the status of their applications at any time through their mobile devices. Also, the TCU and NACTE bodies through the central systems, can assess the status of academic activities of the higher education institutions online at any time and this is why the online systems are mandatory in Tanzania. One good example of the assessment is the online check on the timing to review the curriculum of these institutions through the central system. It is a condition that every higher education institution should review its curriculum every three years up to a maximum of five years, and if there is failure to do that, the institution is banned (National Council for Technical Education, 2018).

In a bid to abide with the directives from NACTE, the College of Business Education, adopted the Students Academic Register Information System (SARIS) in 2012. This is a learning management system for students and teachers, and indeed was one of the first attempts of the College of Business Education to embrace innovative teaching and learning. It was a move designed to try and attempt to minimize mistakes and errors in the processing of largely manual examinations. The main functions of SARIS include processing and registering students, processing students' payment, uploading and downloading examination related data (course work, final results) and processing the examination grades. It enables teachers to upload course work and final grades to SARIS, which students can access online or download to their computers, tablets, or mobile phones. This use of SARIS phased out the manual processing of examinations and personal data which was bug-ridden with so many problems before this technology.

The decision of the management of the College of Business Education to adopt SARIS came as a result of it being developed to cater for the need to use technologies in teaching and learning in the context of higher education institutions in Tanzania. Other mobile learning systems like Moodle were considered but the management preferred to start with SARIS first.

One of the limitations in the use of SARIS was that it did not allow online interactions among teachers and between teachers and students, such as sharing teaching materials, issuance of assignments, and working on projects collaboratively. Also, during the period of developing and adopting SARIS, teachers as users, were not involved to provide their inputs and therefore SARIS overlooked some crucial requirements of the teachers and the students (Mwandosya, Montero and Mbise, 2019). Teachers at CBE complained that SARIS, for example, could not allow them to share different educational resources online and provide mobile learning training for innovative teaching and learning at CBE. This limitation necessitated the design of an alternative mobile application tool that supports an innovative way of teaching and learning at the College of Business Education. The use of mobile technology appeared plausible because of the increased expansion of mobile technology infrastructure at the College of Business Education in recent years, and the ownership and usage of mobile devices by teachers and students provides an opportunity for mobile learning. Mobile technology would, therefore, perpetuate the good culture of sharing education-related content, mostly printed documents, among teachers of the College of Business Education. Some of the documents that the newly developed online system facilitates are the sharing for example, of curricula, timetables, and teaching notes, just to mention a few. Consequently, the CBEMET Prototype was co-designed and developed in collaboration among the application developer, researchers, and teachers in line with the Design Science Research (DSR) framework, to enable College of Business Education teachers to share educational-related documents.

Statement of the Problem

Mobile phones are considered vital tools for both the teaching and learning processes that can best serve as alternative devices for overcoming the shortage of technological tools, for example, in higher education institutions as described above. Kafyulilo (2014), noted that the use of mobile phones by teachers and students as tools for enhancing teaching and learning have resulted in positive outcomes. As a result, many educators and application development technologists are keenly interested in examining how the available mobile education tools, through wireless and mobile technologies in the wireless-enabled mobile devices, can enhance the way people learn and interact with each other (Sung *et al.*, 2005). In Tanzania, several scholars (Sife, Lwoga and Sanga, 2007; Mtebe, Dachi and Raphael, 2011; Mtebe and Kondoro, 2016) have explored how mobile devices installed with mobile education tools or systems are used in improving education in higher education institutions in Tanzania. These studies take credit for identifying the need and the importance of using mobile technologies in the teaching and learning environment in the context of Tanzania. However, most of these earlier studies exempted the exploration of the

process of how those mobile education tools or *mobile apps* were evaluated by either teachers or students, let alone to explain whether there was any involvement of teachers in co-designing those mobile applications, that is, involvement of the final users of the applications. Finding the requirements definition, developing and implementing a technological solution for enhancing innovative teaching and learning, should be based on explored requirements from the users themselves (teachers and students) in higher education institutions. The concentration of several studies was on finding the perceptions, or how either students or teachers accept the technologies (mobile education application tools). Examples of some of these studies include Mtebe and Raisamo (2014); Lwoga and Komba (2015). There is, therefore, lack of concrete information on the evaluation of these mobile learning systems through feedback from the users. Also, there is a lack of evaluation models or frameworks in the Tanzanian context that tells systematically how the mobile education application tools are evaluated or should be evaluated. In addition, there is a lack of extensive explanations about the feedback on the functionalities of mobile applications from users of these systems after they have used the systems.

Based on the above discussions, the study addresses the following research objectives.

Research Objectives

This paper presents an evaluation of the CBEMET Prototype from the previous work of co-designing and development of the prototype through seeking teachers and students' feedback after using the prototype, and specifically presents the views on the impact of the CBEMET prototype on innovative teaching and learning at CBE. The objectives of the study were, therefore:

- To explore the achievements of the CBEMET Prototype in facilitating the sharing of educational-related resources among teachers and students at the College of Business Education in Tanzania.
- To assess the impact of the CBEMET Prototype on innovative teaching and learning at the College of Business Education.
- To explore the pedagogical experiences of both teachers and students at the College of Business Education on the usage of the CBEMET Prototype for teaching and learning.

The following research questions were pursued by this study:

1. What are the achievements of the CBEMET Prototype in facilitating the sharing of educational-related resources among teachers and students at the College of Business Education in Tanzania?
2. What is the impact of the CBEMET Prototype on innovative teaching and learning at the College of Business Education?
3. What are the pedagogical experiences of both teachers and students at the College of Business Education on the usage of the CBEMET Prototype for teaching and learning?

In bridging the gap, this study is believed to be the first of its kind in Tanzania to present the experiences of the process of involving both teachers and students in evaluating an artifact, in this case, the CBEMET Prototype, as an artifact using DSR evaluation framework. The CBEMET Prototype being the artifact in question that was developed to facilitate the sharing of education-related resources with the ultimate goal of innovative teaching and learning experiences through the DSR stages. In DSR, an artifact is any tool (concept, information system, algorithm, procedure, etc.) that is used to solve practical problems (Johannesson and Perjons, 2014).

This paper contributes to the literature on mobile learning and mobile education tools evaluation in Tanzanian higher education by using the DSR evaluation framework. The evaluation of the CBEMET Prototype done by teachers and students for innovative teaching and learning sets the ground for the improvement of the quality of education in higher education institutions in developing countries. The rest of the paper is presented as follows: the literature review discusses mobile education and tools, the DRS framework where the evaluation of an artifact is one of the stages. The methodology, research design, data analysis, presentation and discussion of the findings. Finally, limitations of the study and future work.

LITERATURE REVIEW

Mobile education in the African context

In the 21st century, the world has witnessed tremendous technological advancement spreading across all sectors, whereby in the education sector the use of technologies in teaching and learning started to mushroom (Onyema and Pokidko, 2017; Mfaume, 2019). Science, technology, and innovation (STI) in the 21st century has created an opportunity to produce innovative products (Marburger, 2011). Organizations such as universities, research institutes, investment banks, schools, and government ministries, have applied these technologies for improved innovative performance. In the education sector, in particular, these technologies are used for innovations in teaching and learning. In Africa, mobile education (ME), through emerging mobile technologies, has been increasingly used in higher education institutions in recent years (Bozalek, 2013). It is said that several factors have contributed to the massive spread of mobile education in the African context. These include the abundance, affordability, and availability of mobile devices, mobile and wireless technologies. These devices contain remarkable computing power, a variety of interesting tools installed, wireless communication capability, and portability (Oyelere, Suhonen and Sutinen, 2016) which have together paved the way to viable mobile education. The opportunity to install different *mobile apps* such as mobile education tools in these devices makes them ideal and a reasonable option to transform the education sector in developing countries like Tanzania, by overcoming the educational challenges like shortage of classrooms, textbooks, and other teaching aids. For example, iPhones, iPads, and other similar smart devices are equipped with many functionalities and unique features that can be used for delivering learning content (Khaddage, Lattermman, 2013). This is quickly seen as a deliberate move aimed at overcoming many education challenges such as crowding of students in classes, delivery of quality education, innovative teaching and learning due to spoon-feeding of our students in the widely used traditional face-to-face teaching and learning in HEIs in most of the countries in Africa (Grimus, Ebner and Holzinger, 2012). There is a need for deliberate actions by the authorities in the education sector to utilize technologies for innovative teaching and learning.

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Innovative Teaching and Learning

Innovative teaching and learning involves the use of technologies to create an environment whereby teachers and students are engaged together to produce innovations as an outcome. Innovation and creativity are increasingly becoming important for the development of the 21st-century knowledge society (Anusca Ferrari, 2009; Ferrari and Schoolnet, 2009). Education, is therefore seen as central in fostering creative and innovative skills. Mobile education offers technological innovations and contextualized learning opportunities to make teaching and learning attractive and exciting to both teachers and students (Oyelere *et al.*, 2016). Mobile devices provide an opportunity for the delivery of education in higher education to be innovative through different authoring tools that specialize in Intelligent Tutoring Systems (ITS). These are aimed at providing an environment for cost-effective development of tutoring systems that can be intelligent and adaptive to students (Virvou and Alepis, 2005). A study by Fauzia et al., (2012)

report the effects of innovative teaching strategies on students' performance. The authors divided students into two groups of 25 each, and one group was taught using conventional methods and the other using innovative techniques for one month. A post-test established that the group taught using innovative techniques outperformed the one taught using conventional methods. A study by Lee (2011), using Structural Equation Modeling (SEM) to verify their research model, focused on the effect of teaching innovation on learning effectiveness in a technical-vocational college in Taiwan. Lee eventually established that the use of the technology solved a challenge of teaching distance students through correspondence courses. In an effort to realize an innovative format of the distance education system in the modern conditions of information of higher education, Bobkova *et al.*, (2015), developed a model of innovative teaching of bachelor and masters' students by correspondence. The authors report that the application transformed the existing experience into the psycho-pedagogical and technological condition of learning. Overall, the need for innovative teaching and learning in higher education institutions should go hand-in-hand with the available infrastructure to support it. Mwandosya, Suero Montero and Mbise (2019) recommended that mobile technology as an infrastructure to support innovative teaching and learning in higher learning institutions should be thoroughly analyzed. Similarly, Shear, Gallagher and Patel (2011) supported the view that ICT infrastructure integration is an important enabler to the innovative teaching mission in higher education institutions.

Mobile Education Tools

Development of mobile applications or *mobile apps*, for use in the education sector has been on the increase. Social media applications on mobile devices are viewed as some of the tools that aid teaching and learning (Gikas and Grant, 2013). Mason and Rennie (2008) note that the popularity and use of a wide range of social software among young people provides an opportunity for educators to develop this practice and enthusiasm for educational use. Several notable *mobile apps* have been developed to specifically help improve a certain aspect of pedagogical instruction. For example, Ford and Leinonen (2006) developed mobile tools and services platform for formal and informal learning (MobilED) which was very successful. The application aimed at designing teaching and learning environments that are meaningfully enhanced with mobile technologies and services. Likewise, in an attempt to utilize mobile education applications as a tool in enriching the way education is delivered in classrooms, Sung et al., (2005) in their study combined hardware and software architecture system to enable a variety of individual and group-based context-aware applications. The system allowed for the rapid implementation of complex, distributed applications that are context-aware of students and teachers' collaboration in a real-time setting. The collaborative learning which mobile applications allow is one of the most emphasized types of learning in higher education (Zhu, Valcke and Schellens, 2010). This is because it enables joint learning and sharing of the educational experience among teachers and students and by doing so improves teaching and learning. On the strength of mobile applications in facilitating interactive learning, Järvelä *et al.*, (2007) developed a mobile lecture interaction tool (M.L.I.). According to the authors, use of the M.L.I. tool in their application activates students' participation in lectures, and the mobile mind map tool stimulates collaborative knowledge construction in a group, whereas mobile "Edufeeds" creates shared understanding among virtual learning communities. They report that students felt that the tool is quite effective in regulating and supporting their thinking and their involvement in lectures. Furthermore, Virvou and Alepis (2005) developed a mobile application known as *Mobile Author* to enable instructors and students to communicate, exchange tests and home work, and more importantly, to enable teachers to monitor their students' progress. The evaluation of the *Mobile Author* app by the instructors and students proved it useful in their teaching and learning. Table 1 below shows some of the mobile application tools' descriptions and their outcomes.

Table 1: *Related mobile education tools in the education context.*

Mobile education tool type	Short description	Outcomes
STRONG Balasubramanian et al., (2006)	Development of a prototype and necessary instructions for teaching science, technology, engineering, and mathematics (STEM) for middle school students	The study established students' reasons to learn by responding to authentic science-based challenges. The tool, STRONG empowered both students and teachers
MobileEdu Oyelere & Suhonen (2016)	Developed a mobile app to enhance the learning of computing science courses on mobile devices in Nigeria.	The mobile learning app supported learners to meaningfully engage and interact in the Nigerian higher education context.
MOLT Cavus & Ibrahim (2009)	A windows-based programme for teaching new technical English Language words to 1st- year undergraduate students to support their normal English Language lectures.	The student responses were positive in favor of MOLT as a mobile phone-based teaching system.
MOLE (Ferrer, Hodges and Bonnardel, 2013)	A project aimed at providing learning resources and tools for personnel in a disaster or emergency.	The results show that mobile devices could be practical and effective in providing training when coupled with videos, texts, sounds, etc.
MIT.EDU Sung, et al., (2005)	A system using distributed mobile device architecture for rapid prototyping of wireless mobile multi-user applications for use in classroom settings.	MIT.EDU has proved to allow for the rapid implementation of complex, distributed applications that are context-aware and can enable students and teachers to interact in real-time.
M.L.I. (Järvelä *et al.*, 2007)	A mobile lecture interaction tool designed for regulating and supporting students' thinking and participation in lectures	The students agreed that M.L.I. had succeeded in transforming them such that their thinking became different. Also, use of the M.L.I. tool supported the engagement of students during lectures.
Mobile Author Virvou & Alepis, (2005)	Intended to provide an intelligent tutoring system (ITS) to enable instructors and students to access and exchange homework, tests, and progress.	Evaluation of Mobile Author proved very useful in facilitating access and exchange of materials among teachers and /or students. The results showed the mobile features of Mobile Author to be very useful
HandleR (Sharples, Corlett and Westmancott, 2002)	The project was intended to develop a portable interactive personal system to be accessed as a book.	The software was evaluated through interviews and questionnaire and found appropriate for learning in the fields.
MOBILearn (www.mobilearn.org)	This was a project aimed at developing, implementing and evaluating architecture for mobile learning in a mobile environment	The project was successful in providing tools for mobile interactions and awareness.

The above mentioned different mobile education tools from previous studies. Although they explain the usefulness of the tools they lack concrete explanations of how the tools were thoroughly evaluated. In this regard, the present study contributes to the literature by extending the DSR evaluation framework and involving teachers and students in the evaluation of an artifact CBEMET Prototype, which had been specifically designed to address and facilitate the exchange of education-related content at the College of Business Education in Tanzania, for innovative teaching and learning. It is unique in the Tanzanian context in that it is the first to extend the two stages of the DSR framework (Johannesson and Perjons, 2014) by demonstrating the artifact and subsequent evaluation. This artifact, a prototype known as CBEMET Prototype shows the Teachers Menu in Figure 1 below. As previously indicated it is tailored to enable the sharing of educational resources among teachers and students to enable innovative teaching and learning at the College of Business Education (CBE). The CBEMET Prototype also facilitates teachers and students to exchange classroom work (assignments, quizzes, notes, timetable) through mobile devices. Moreover, the CBEMET Prototype eases the access to and exchange of learning resources anywhere and anytime. To facilitate the sharing, the CBEMET Prototype consists of a mobile server broadcasting sub-system to share data and resources among all mobile devices connected to the server, as well as a classroom management and administration sub-system where all activities for unified learning, teamwork, social networking, and learning assessment is carried out. This paper, therefore, describes the evaluation of the CBEMET Prototype in terms of its functionalities in facilitating the sharing of education resources and innovative teaching and learning among teachers and students CBE

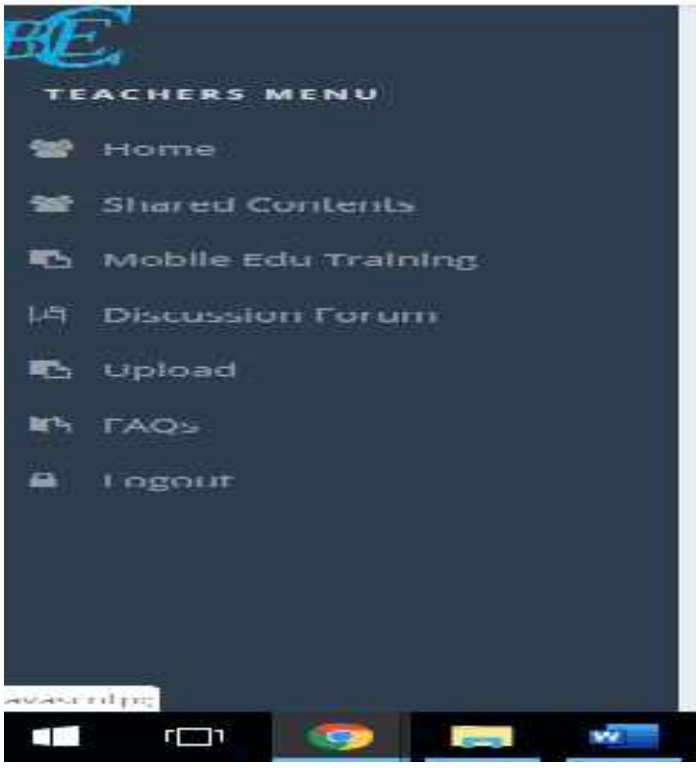

Figure 1: The CBEMET Prototype Teachers' menu

DESIGN SCIENCE RESEARCH FRAMEWORK

Progress in improving teaching and learning through technology may be accomplished using design research as an alternative model of inquiry. The proper use of a research method and its adequacy for the problem being studied are significant factors in attaining the necessary research rigor. According to Saunders, Lewis and Thornhill, (2012), international periodicals tend to value articles that display the rigorous use of research methods especially when such methods are recognized in the traditional sciences. In this study, the research method used in the design and development of the CBEMET Prototype was the Design Science Research (DSR) whereby evaluation of the artifact (CBEMET Prototype in our case) is one of the stages. DSR is known for its rigor in solving problems through use of artifacts (Hevner *et al.*, 2004). The problems that DSR solve are normally practical problems. The practical problems represent an undesirable state of affairs or more precisely a gap between the current state and desirable state, as perceived by participants in the practice. A practice is a set of human activities performed regularly and seen as meaningfully related to each other by the people participating in them. According to DSR artifacts are normally developed to solve practical problems. An artifact is defined as an object made by humans to address a practical problem. An artifact can take any form including a hammer, car, an architectural drawing, or a design of a database. Artifacts in the Information Technology and Information Systems range from algorithms, logic programs, formal systems, information models, design guidelines, production systems for the development of prototypes (Dresch and Valle, 2015). In the case of the College of Business Education, the practical problem was the lack of an application that could enable the contextual sharing of educational related content and experiences for innovative teaching and learning experienced by teachers and students (Mwandosya and Montero, 2017). This means that a prototype was needed to accommodate the sharing of education-related content (that is, teaching notes, teaching experience, time tables, assignments, recorded training videos) among the stakeholders at the College of Business Education. As a result, the CBEMET Prototype was designed using the DSR method to fulfill the objective and this is the reason and basis for the evaluation.

DSR is a relatively new type of research method in Tanzania. Many scholars have tried to explain, elaborate and define DSR. For example, Dresch and Valle (2015) define it as a method that establishes and operationalizes research when the desired goal is an artifact or a recommendation. Hevner *et al.*, (2004) define it as a purposeful method for information technology artifact creation to address an important organizational goal. Wieringa (2014) asserts that the DSR methodology is a process of designing and investigation of artifacts designed to interact with a problem context to improve something in that context. Johannesson and Perjons (2014) define DSR as a scientific study and creation of artifacts as they are developed and used by people to solve practical problems of general interest.

The notable outputs during the DSR process include model, software application, instantiation, designing the object, recommendation, good practices as well as new theories (Hevner *et al.*, 2004). There are different frameworks relating to DSR explaining the concepts and process that are part of the DSR (Dresch and Valle, 2015). However, according to Johannesson & Perjons (2014), DSR has 5 iterative stages which start at investigating the contextual practical problem at hand for a plausible solution. In the development of the CBEMET prototype, this framework by Johannesson & Perjons (2014) was modified to identify two stages (see Figure 2 below).

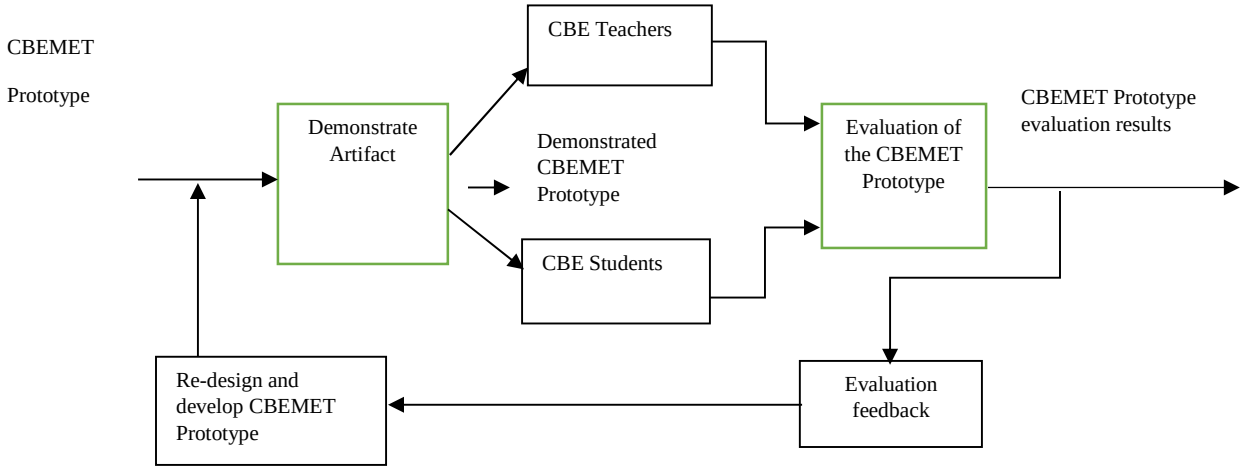

Figure 2*:* Research model adapted and extended from the DSR evaluation framework by Johannesson and Perjons (2014).

METHODOLOGY

The identification of a practical problem is very crucial as far as the DSR method is concerned. One crucial point is that when the practical problem is well known, the activities of finding a plausible solution becomes simplified and the processes are likely to bear outcomes that are desired. According to Johannesson & Perjons's (2014) framework, the first activity is the explication *of the problem* which means that a thorough investigation and analysis of a problem is done. That is, the problem at hand should be precisely formulated to simplify the process of finding the solution. Likewise, it should be of general interest to identify both local and global practices. The stages that follow are the *definition of the requirements, design and develop artifact, demonstrate artifact and evaluate artifact*. This study focuses on explaining the demonstration and evaluation of the artifact (CBEMET Prototype) providing suggestions on the improvement. The following section explores the methods used.

Research Context and Participants

The training on how to access and use the CBEMET Prototype was conducted with 40 teaching staff purposefully selected out of 103 and 80 randomly selected bachelor degree students out of about 500 from the College of Business Education Dar es Salaam campus. The training took place at the main hall that could accommodate all participants. The College of Business Education has four campuses in four different strategic regions of Tanzania, namely, Dar es Salaam, Dodoma, Mwanza, and Mbeya. Dar es Salaam is a city on the coast of the Indian Ocean. It is the major commercial city and the former capital city of Tanzania. Dodoma is a city in the central of Tanzania. It is the current capital city of Tanzania and thus the seat of ministries and key institutions in Tanzania. Mwanza is a city to the northern part of Tanzania with borders with Kenya and Uganda through Lake Victoria. It is a key commercial city in the lake zone. Moreover, Mbeya is a city which borders Malawi, Zambia, and the Democratic Republic of Congo. It is the only city to the southern part of Tanzania.

After the training, 20 teachers and 80 students (experimental group) started to use the prototype while the other group of 80 students did not use the prototype (control group), rather, they learned the MIS subject through the normal face-to-face methods. The teachers mainly used the prototype to exchange and share education-related content and students used the prototype for sharing educational resources and for learning purposes. The subject chosen was management information systems (MIS) as it was a cross-cutting subject. The usage of the prototype started during the 2018/2019 academic year.

CBEMET Prototype Demonstration to Teachers and Students

The demonstration of the CBEMET Prototype was intended to let the teachers and students be familiar with the access and usage in terms of sharing education resources while the evaluation stage was intended to expose areas of the application that needed improvement regarding the functionalities and the structure of the application. As shown in Figure 1 above, the teachers' menu included: *Home; Shared Contents, Mobile Education Training; Upload and Discussion Forum tabs* and the demonstration phase started with an orientation to users on how to access the CBEMET Prototype. This was followed by the actual usage of the prototype for a period of three months starting from October 2018 to December 2018 and from January to May 2019. The CBEMET Prototype as an android-based mobile application consists of clients (Android-supported mobile device), system administrator, storage, and the server. For one to access the prototype, he or she had to be a user – in this case, a teacher, researcher, and developer. Each user had different roles to play. For example, teachers were the main target of the prototype. Consequently, they were supposed to assess the system from the moment they accessed it to the moment they logged off after use. They had to also give feedback on what they observed in the system. On the other hand, researchers were supposed to teach the community to explore how best the prototype enhanced the teaching and learning at the College of Business Education. They would also take all remarks from users on how to improve the software. The demonstration of the CBEMET Prototype was quickly followed by its evaluation.

Figure 3: Demonstration of the CBEMET Prototype to teachers and students

Sharing Activity

First, all participants in this activity (teachers and the students) were introduced to a concept of innovative teaching and learning and how the CBEMET Prototype could realize them. The idea was to coach the same understanding of the working of the prototype. Secondly, they were introduced to the modified look of the prototype. Thereafter, the teachers were instructed to prepare different education resources they would like to share among themselves and with

students for innovative teaching and learning. Then, the students were asked to register in the system to access the prototype. The teachers were then instructed to upload materials they had prepared into the system. The sharing activity was divided into two parts: first, teachers sharing of their different education-related resources for improving their innovative teaching and learning and secondly, the sharing of education resources (assignments, books, project details, time table, and examination information) with the students. The participants then next tried to use the prototype under guidance until they mastered it. What followed was an assessment of the achievement of the prototype in facilitating innovative teaching and learning among CBE stakeholders. The intended evaluation involved experience in sharing education-related content by teachers and learning experiences by students in the third year of the bachelor degree.

Learning Activity and Experimental Design

The subject that was agreed and chosen for the learning activity through the CBEMET Prototype was the Management Information System (MIS) because it is a subject taken by bachelor students from different departments. Table 2 presents the chronological order of activities and their contents in this phase of experiment design.

Table 2: *Students' MIS learning activities*

Week	**Description of activities**
1.	Introduction to the CBEMET Prototype, user guides tutorials & introduction to innovative teaching and learning
2.	Sharing of innovative teaching and learning materials and schedules – teachers to teachers and teachers to students
3.	Lesson 1 – Introduction to MIS course subject
4.	Lesson 2 – Chapters 1 - 3 MIS
5.	Lesson 3 – Chapters 4 - 6 MIS pre-test examination and quizzes
6.	Lesson 4 – Chapters 7 - 9 MIS
7.	Lesson 5 – Chapters 10 -12 MIS and group assignments
8.	MIS individual assignments
9.	Lesson 6 – MIS discussions, sharing experiences
10.	Lessons 7 – Sharing MIS resources discussion forum
11.	Lessons 8 – Sharing MIS resources and group discussions
12.	Lessons 9 – Chapters 13, 14 and 15 of the course contents and discussions
13.	Summary and feedback sessions
14 and 15.	Post-test examination preparations

All 160 students received the basic management information system course and therefore, they were all on the same scale in terms the level of learning. To confirm the engagement, after lesson 3, a 30-minute pre-test was administered to all 160 students. The pre-test was aimed at evaluating the students' understanding of the fundamental knowledge of the management information system course.

After the pre-test, the remainder of the course were taught for twelve weeks. Students in the experimental group used the CBEMET Prototype application to learn and connect with their teachers and fellow students online, ubiquitously. The experimental group students had the opportunity to learn, share ideas, educational materials even after normal class hours. In using the CBEMET Prototype application they had an opportunity to share ideas even with their teachers and also post questions to their teachers to seek clarifications and help about unclear topics or sub-topics. The students in the control group depended only on the face-to-face instructions in the classroom hours interacting with their colleagues. After the 15th week of instructions and examination preparations, the students undertook a 120-minute post-test examination. The experiment procedure is shown in Figure 4 below.

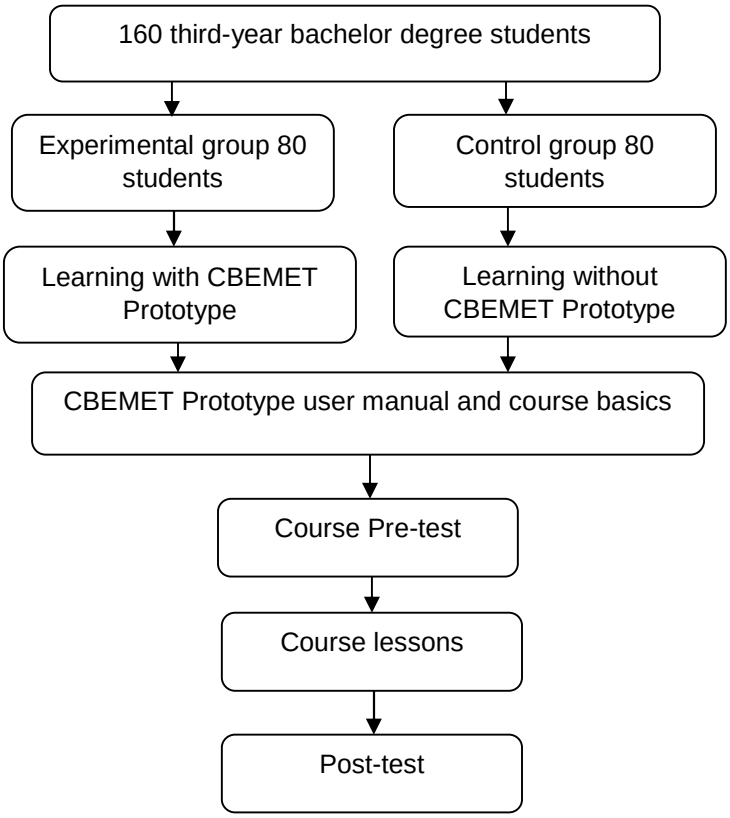

Figure 4: Experiment procedure

Research Instrument

The research data for this study was drawn from the bachelor degree students of the Dar es Salaam campus of the College of Business Education. To obtain feedback on the functionality of the CBEMET Prototype from the students' quizzes, assignments, and teachers' sharing of their

education-related resources for innovative teaching, the data were drawn from pre-test, post-test, semi-structured interviews, and a questionnaire. The pre-test and post-test were developed to evaluate students' feedback on the impact of the CBEMET Prototype in innovative learning. The pre-test intended to confirm that both experimental and control group students had an equal fundamental knowledge of the management information system course. The pre-test contained 25 multiple-choice items. The post-test contained 10 fill-in-the-blank items, 15 multiple-choice items, and 25 true-or-false items. The post-test covered all topics of the management information system course. To ascertain the validity of the questions in the test, they were verified and evaluated by two expert teachers in the same field from a nearby institute, the Dar es Salaam Institute of Technology. Moreover, the teachers and the students were interviewed to obtain insights on how the CBEMET Prototype had in fact helped to enhance innovative teaching and learning. Furthermore, a questionnaire was administered to all 160 bachelor students from different departments to gather their perceptions, attitudes, and pedagogical experiences about learning in the management information system course through the CBEMET Prototype. Another questionnaire was administered to 40 Dar es Salaam campus teachers. The questionnaire contained 10 seven-point Likert-scale items, where "1 represented *strongly disagree"* to "7 which represented *strongly agree"*. To ensure the validity of the questionnaire, three more research experts were engaged to review the content to finalize experts' opinion.

DATA ANALYSIS

The combination of quantitative and qualitative approaches was used in the data analysis. According to Creswell (2014), mixed method involves combining or integrating qualitative and quantitative research data in a research study. Qualitative data tends to be open-ended without predetermined responses while quantitative data usually includes closed-ended responses such as those derived from questionnaires or psychological instruments. The idea behind mixed-methods lies in the fact that each method separately has bias and weaknesses, and the collection of both quantitative and qualitative data neutralizes each form of bias in the data (Creswell, 2014). The quantitative data were analyzed using the Statistical Package for Social Sciences (SPSS) 23 software (IBM Corp.). During the data analysis, the mean, standard deviation, and percentages were determined, and T-tests were performed. A confidence interval of 95% (0.05 significance level) was used for the interpretation of data.

FINDINGS

The objectives of the study were evaluation the prototype known as CBEMET, whereby teachers and students shared their views on the impact of the prototype on innovative teaching and learning at the College of Business Education (CBE) in Tanzania. Specifically, the results are presented holistically in the sections below.

Demographic Information

Teachers as sampled respondent were drawn from each of the 5 departments at the College of Business Education. 8 teachers (20%) who participated in the study came from each of the following departments: ICT and Mathematics Department, Business Administration Department, Accounting Department, Marketing Department, and Procurement and Supplies Department. 15 teachers (37.5%) were females and 25 teachers (62.5%) were males.

For students: 51 students (31.9%) were from ICT and Mathematics Department, 50 students (31.3%) from the Business Administration Department, 27 students (16.9%) from the Accounting Department, 17 students (10.6%) from the Marketing Department, and 15 students (9.3%) from

the Procurement and Supplies Department. Also, for all 160 student respondents, 89 (55.6%) were males and 71 (44.4%) were females.

Question 1 of this study asked: What are the achievements of the CBEMET Prototype in facilitating the sharing of education-related resources among teachers and students at the College of Business Education?

Achievement of the CBEMET in facilitating the sharing of educational-related resources among teachers and students

Achievement statements: The questionnaire prepared for the study contained questions which were purposefully looking for the perceptions of teachers regarding the achievement of the tool CBEMET Prototype in sharing educational-related resources (See Table 3).

Table 3: *Questionnaire items*

Teachers questionnaire items	**Students questionnaire items (SQI)**
TQI1: I have been able to share and receive educational-related resources from my fellow teachers.	SQI1: I have been able to receive training and educational-related resources from teachers through the prototype.
TQI2: I find the CBEMET Prototype useful to learn from other teachers' innovative teaching they normally do.	SQI2: I find the CBEMET Prototype useful to learn from other students in a collaborative way to achieve innovative learning.
TQI3: I. easily achieve my daily goals in teaching through the CBEMET Prototype	SQI3: I easily achieve my daily goals of learning through the CBEMET Prototype I have installed on my phone.
TQI4: There is no difference in my teaching before and after using the CBEMET Prototype as a tool for innovative teaching.	SQI4: There is no difference in my learning before and after using the CBEMET Prototype as a tool for innovative learning.
TQI5: It is difficult to use CBEMET Prototype for online sharing of education-related resources helpfully.	SQI5: It is difficult to use CBEMET Prototype for online learning and sharing of education-related resources helpfully with my fellow students.
TQI6: The easiness of sharing of education-related resources is hampered by the slowness of accessing the CBEMET Prototype.	SQI6: The easiness of sharing of education-related resources is hampered by slowness of accessing the CBEMET Prototype online
TQI7: It is difficult to upload assignments through the CBEMET Prototype.	SQI7: It is difficult to download assignments through the CBEMET Prototype
TQI8: I can share materials with teachers from other campuses as well.	SQI8: I can share materials with students from other campuses as well
TQI9: The results of the tests and assignments are not always easy to upload.	SQI9: The results of the test and assignments are not always easy to download

In responding to question one, we looked at different reports that showed the number of successfully uploaded and downloaded files by both the teachers and students. This report was obtained from the system administrator who had a facility for showing different reports including

the number of successful uploads and downloads. Also, we analyzed data concerning sharing of different educational-related materials in the questionnaires for both the teachers and students by using descriptive analysis, the results of which are shown in Table 4 below.

Table 4: *Descriptive analysis results for teachers and students' questionnaire items*

Teachers questionnaire items (TQIs)	Mean (N=40)	Standard Deviation	Students questionnaire items (SQIs)	Mean (N=160)	Standard Deviation
TQI1	4.8250	1.69293	**SQI1**	4.6812	1.63057
TQI2	4.5500	1.41331	**SQI2**	4.8437	1.61575
TQI3	4.4750	1.24009	**SQI3**	4.1125	1.75545
TQI4	2.5250	1.60108	**SQI4**	3.2187	1.97364
TQI5	3.0500	1.78239	**SQI5**	2.9000	2.17822
TQI6	5.1000	.98189	**SQI6**	4.2313	1.78823
TQI7	4.9500	1.7370	**SQI7**	4.1500	1.94645
TQI8	4.9500	1.53506	**SQI8**	4.3063	1.28854
TQI9	4.1750	1.4217	**SQI9**	4.5375	2.06159

The main issue for the teachers and students at the College of Business Education prompting the use of technology was about easy sharing of education resources. The CBEMET Prototype as the technology to enable them to fulfill their needs was in use and both teachers and students had before the evaluation used it for the whole semester. The questionnaires were similar in content in almost all the items differing only specifying for teachers or students. The items belonging to the sharing of different education-resources were:

1. TQI1 and SQI1 – sharing and receiving of learning materials – positive responses by both teachers and students.
2. TQI5 and SQI5 – difficulty in using CBEMET Prototype for sharing and learning – negative responses
3. TQI6 and SQI6 – ease of sharing educational-related resources through CBEMET Prototype – positive responses especially teachers
4. TQI7 and SQI7 – difficulty in uploading and downloading of education content – indicates there is a problem in uploading and downloading education content
5. TQI8 and SQI8 – sharing with other campuses – positive responses, especially for teachers.
6. TQI9 and SQI9 – test results upload and download – positive responses for both teachers and students.

From the results, we noted that the majority of sharing-related items for both the teachers and students have a score of above 4 (see **Table** 4) meaning that to a great extent the issue of sharing of education materials through CBEMET Prototype had been a success.

The crucial checking point for the functionality of the CBEMET Prototype was the sharing of education-related resources. For example, through a live chat, a teacher may ask a fellow teacher for some notes to share so that it can be downloaded **(see Figure 5 for an illustration).**

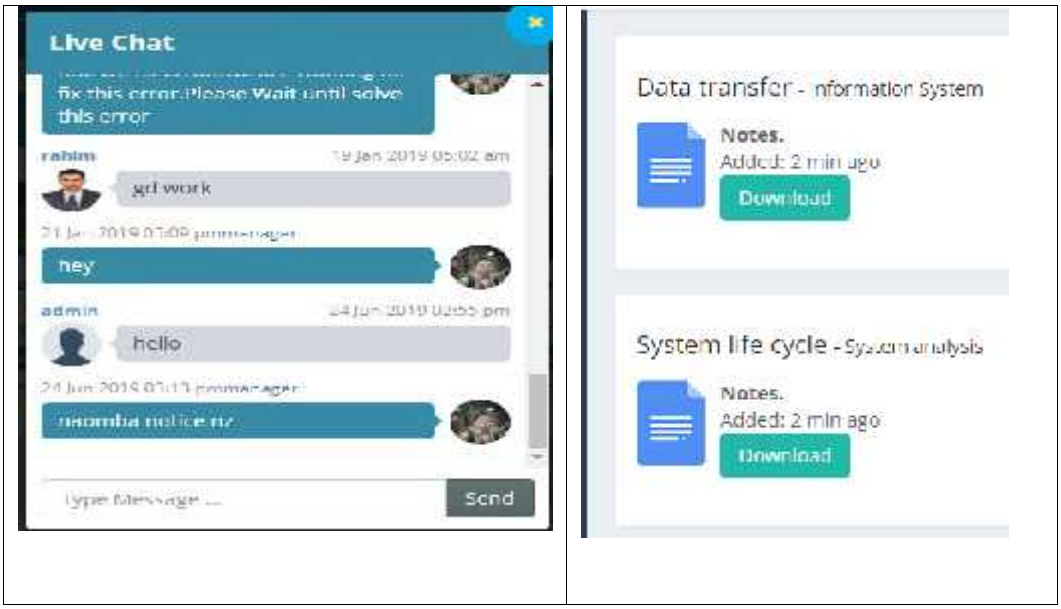

Figure 5: *The achievement of CBEMET Prototype in accessing, sending SMS, upload and download different education*

Impact of CBEMET Prototype on innovative teaching and learning

Research question two (2) asked – what is the impact of the CBEMET Prototype on innovative teaching and learning at CBE? We hence conducted an MIS course to 160 bachelor degree students for a total of 15 weeks (one semester) while other subjects were conducted using normal face-to-face teaching and learning. We restricted 80 students in the experimental group to use of the CBEMET Prototype only to access the MIS subject while 80 other students - the control group - used the normal face-to-face teaching and learning method. In other words, the teachers teaching MIS course to the experimental group did not use the normal face-to-face lecture method, rather, all the resources including videos, notes, and PowerPoint slides were posted on the server for the students to access. The evaluation of the prototype was based on the access to the MIS resources, ability to download the notes, power point slides, assignments, and to upload the responses and the results of the pre-test and post-test examinations. The server administrator was given the task of keeping the logs of access, downloads, and rectifications of any problems leading to either failure to access the resources or failure to upload. Furthermore, the evaluation of the CBEMET Prototype was on its impact on innovative teaching and learning – what teachers saw as innovative teaching, and for what aspects in using the prototype, students saw as innovative learning. Performance in the MIS course was used to test the impact of the application to education. The MIS course was used as the subject of this research considering that bachelor students normally have a MIS course as one of their subjects in the first semester of the third year. We compared the performances of the two groups of

students (those who used the CBEMET Prototype and those who did not use the CBEMET Prototype) using an independent t-test at the end of semester.

The students in the control group were subjected to the traditional face-to-face learning mode, while the experimental group had the application installed on their gadgets to facilitate learning in the subject area. The students in the experimental group were told that they should be learning while regulating and controlling their studies without much interference and a physical face-to-face meeting with the teachers.

Likewise, teachers from the three campuses; Dar es Salaam, Dodoma, and Mwanza were instructed to make sure that classes had students from both the control and experimental groups. The results from the other three campuses were delayed as training on the usage of the CBEMET Prototype was ongoing. At the end of the semester, an examination was set and keenly supervised to make sure that there was no cheating.

Pre-test and post-test examinations: An independent t-test was used to analyze the pre-test data, confirming that students in the two groups had equal learning abilities after obtaining the basic knowledge of the course; the results of the descriptive statistics are presented in Table 5 below.

Table 5: *Descriptive statistics results of pre-test learning achievement*

	Group of students	N	Mean	SD
Pre-test	Control	80	19.5875	2.53928
	Experimental	80	19.4750	2.31109

The results of the t-test showed that there was no significant difference (t=0.293, two-tailed p = 0.770) between the control and experimental groups. That is, the two groups of students considered in the experiment have statistically equivalent abilities at the beginning of the course. Analysis of the covariance (ANCOVA) was performed on post-test, and the results are presented in Table 6 below. During the ANCOVA, pre-test scores were used as a covariate. From the post-test learning performance score, we deduced that the experimental groups' average learning performance and achievement was significantly better than students in the control group, ($F = 7.49$, $p < 0.001$). Furthermore, we computed the effect size, d, which is a measure of the magnitude of a treatment effect between the two groups, (Cohen 1988). According to Cohen's benchmark, the effect size is defined as small, d = 0.2, medium, d = 0.5, and large, d = 0.8. In our study, Cohen's d value of 0.34 indicates above small effect size and close to medium effect size. This shows that use of the CBEMET Prototype somewhat helped to improve students' learning achievement at the College of Business Education.

Table 6: *Analysis of the covariance (ANCOVA) results*

	Group of students	N	Mean	SD	Adjusted mean	Std. error	F value	d
Post-test	Control	80	61.5875	7.95190	61.59	.843	7.49*	0.34
	Experimental	80	64.1625	7.56649	64.16	.843		

*p<0.001

Pedagogical experience of teachers and students in the implementation of the Prototype

In determining the pedagogical experiences of teachers and students on the implementation of the CBEMET Prototype at the College of Business Education, research question three (RQ_3) asked: "What are the pedagogical experiences of both teachers and students at the College of Business Education on the usage of the CBEMET Prototype for innovative teaching and learning?" The CBEMET Prototype was introduced as a mobile education tool prototype application intended for innovative teaching and learning in the higher education context in Tanzania at the College of Business Education.

The use of mobile devices in accessing different educational-resources online has been an innovative pedagogical way of teaching and learning at the College of Business Education. Teachers and students had come across and experienced an online mode where the exchange of educational-resources is possible. Teachers prepare lessons or a variety of educational content that they would like the class, according to the syllabus, to learn and post on the server, and the students access using their mobile devices, laptops, and desktops at any time. A message was then sent to all students who were connected and were members of the groups (different classes formed groups – for example, the bachelor III class was one group). The in-depth interviews were done with 6 teachers and 8 students, which revealed several interesting themes on the experiences gained. During and after the interviews, data analysis started with reading of the transcripts, labeling relevant pieces, deciding which codes were the most important, and creating categories by bringing several codes together. Vital information about teachers and students' experiences using the CBEMET Prototype for innovative teaching and learning were identified. The identified themes are summarized in Table 7 below.

Table 7: *Pedagogical experiences of teachers and students on using the CBEMET Prototype*

Theme	**Aspect**	**Example quotation (teachers and students)**
Improved teaching and learning	Access to education resources	"*Using CBEMET Prototype has made it possible to easily access education-resources, simplifies, and improves my learning*" (**student**).
	Anytime anywhere learning	"*I used to only get help in the classroom, but now I can get help and learn from my fellow students anytime*" (**student**).
	Communication	"*I can easily communicate challenges that I face in class to my fellow teachers and share with them my views*" (**teacher**)
Sharing education resources	An appreciation of sharing ability	"*I am confident that through CBEMET Prototype, the sharing of education resources has improved our knowledge*" (**teacher**). "*It has increased our engagement with learning resources and contents. It is great*" (**student**)
	Increased quality of teaching and learning	"*It is easy now for all CBE campuses to teach and learn similar skills*" (**teachers and students**). "*Knowledge cuts across all campuses*" (**teacher**)
Innovative teaching and learning	Interactivity through the CBEMET Prototype	"*Face-to-face teaching and learning are boosted by the instant sharing and collaboration online which the prototype allows*" (**teachers and students**).
Personalized	Flexibility in learning	"*I can learn on my own through the prototype, it gives*

learning experience		*me the freedom to learn at my own pace*" (**student**). "*I set my own goals of learning anytime*" (**student**).
Usability issues and technical challenges	Problem with Internet connectivity, poor network set up, poor reception of network and stability	"*I find it difficult to upload assignments*" (**teacher**). "*It is difficult to download examination results*" (**student**). "*It is sometimes difficult to access the prototype*" (**teachers and students**). "*Slow Internet connectivity makes it hard to access CBEMET Prototype*" (**teachers and students**). "*Despite Internet challenges, I am satisfied with the way we share education resources*" (**teacher**).
Features of CBEMET Prototype	Shared education resources, discussion forum, teachers' groups, students' groups, and Live chat received positive feedback	"*Shared education resources work well; it enables smooth sharing of resources*" (**teachers**). "*Live chat tab has been successful in prompt delivering MIS lessons to students*" (**teacher**).
Improvement	Internet availability, stable connections, increased bandwidth, and educational games should be emphasized	"*The Internet connections at the campuses should be improved to realize mobile education goals*" (**teachers and students**).

DISCUSSION

The purpose of this study was to evaluate and explore the experiences in sharing education-related resources among teachers and students at the College of Business Education after using the CBEMET Prototype application. The CBEMET Prototype was demonstrated to teachers and students who under the directives of the researchers started using it. The evaluation was done on the functionality of the CBEMET Prototype to enable the sharing tasks, promotion of innovative teaching and learning, and the pedagogical impact of the prototype.

We discovered that the students who were taught the MIS subject using the CBEMET Prototype through their mobile devices, improved their knowledge in different educational areas in contrast to those who were taught using the traditional face-to-face method. Similarly, the students who learned through the CBEMET Prototype found access to learning resources easier, faster and realized up-to-date materials. Further, they noted that the sharing of assignments was instant, which helped them a lot in their learning. The experiment results also showed that those who used the CBEMET Prototype performed slightly better than those who did not use the CBEMET Prototype and that they were happy with the self-regulated or personalized learning. The CBEMET Prototype was found to have achieved the initial goals of sharing education resources, The mean score for students on the issue of ease in sharing educational-related resources was above 4 (neutral), with Mean = 4.2 which meant that they agreed. For the teachers (the Mean of 5.1 indicated that CBEMET Prototype helped them as well in regard to sharing among teaching staff and with the students. These results are similar to other studies that have shown the application of different educational tools for sharing learning resources, preparation of instructions for learning, and exchange of home work, tests, and progress (Virvou and Alepis, 2005;

Balasubramanian, Wilson and J. Cios, 2006; Ferrari and Schoolnet, 2009). Some of the mobile-related applications in similar studies that were developed primarily for helping learning in higher education contexts, for example, MobileEdu (Oyelere *et al.*, 2018) had observed similar results specifically in the performance of students who used the mobile tool from those who did not use a tool. However, MobileEdu differs from the CBEMET Prototype in that MobileEdu was primarily designed for helping students to learn science subjects only, whereas the CBEMET Prototype was developed to accommodate any subject in any field and the sharing of education resources. Furthermore, MobileEdu was developed for students and the CBEMET Prototype was co-designed and developed in association with the researchers, developers, teachers, and students. Additionally, CBEMET is different in focus from other previous tools (Cavus and Ibrahim, 2009), Unlike the CBEMET Prototype, the MOLT application is a windows-based program developed primarily for helping first-year undergraduate students to learn new technical English words. The CBEMET Prototype is also different from the MIT.EDU education tool intended to enable rapid prototyping of wireless mobile multi-user applications for use in classroom settings. This is in line with ensuring maximum understanding of the subject matter in a classroom using an education tool. In comparing Sung, et al's., (2005) MIT.EDU study with the CBEMET Prototype, we noted that MIT.EDU is the application intended for soliciting feedback from students whether what is being taught is positively or negatively being absorbed by indicating "Bored", "Applause", or "Lost". The teachers get the feedback through a Wi-fi equipped Zaurus equipment display in real-time.

Both teachers and students using the CBEMET Prototype were of the view that use of the CBEMET Prototype had increased enthusiasm in the teaching and learning environment at CBE. The ability to share and discuss issues online through the discussion forums was also seen as one of the achievements of the application. One of the respondents noted,

> "*Using CBEMET Prototype has made it possible to easily access education-resources simplifying and improving my learning* ".

Consequently, we concluded that the CBEMET Prototype had a significant and positive impact on the performance of the students and exchange between teachers and students.

CONCLUSION

The use of technology in teaching and learning in higher education institutions is an inevitable undertaking, especially when undertaken with the aim of improving teaching and learning. This study has shown interesting results and evaluation views from teachers and students at CBE on how the CBEMET Prototype facilitated the sharing of educational-related materials and providing new ways of communicating academically. The CBEMET Prototype facilitated the sharing of educational-related resources, through the shared-resources tab where teachers and students could upload videos, audio files, animations, and texts of learning items. The students' "Notes tab" in the CBEMET Prototype was found to improve the availability of notes anywhere, anytime and minimized the volumes of printed materials at CBE which involved considerable costs. Similarly, students who in one way or another missed some notes in class could get such notes through the sharing tab. The use of mobile education tools in the education sector, especially in higher education institutions has been proven to enhance innovative teaching and learning (Balasubramanian, Wilson and J. Cios, 2006; Kukulska-Hulme *et al.*, 2009; Kivunja, 2015). The students in the experimental group that used the CBEMET Prototype for learning in the MIS subject showed that the prototype instilled in them a sense of innovation since they discovered new ways of learning through peer group discussions and sharing. Since most teachers and students in the institution possess one or more mobile devices like smartphones, tablets, and PDAs, it was easy to integrate the mobile application on their devices. In doing so, teachers and

students at CBE were able to share educational resources to enhance teaching and learning anywhere, anytime.

LIMITATIONS AND FUTURE WORK

One of the limitations of this study is that it was conducted at the College of Business Education as one of more than 50 higher education institutions available in Tanzania which use learning management systems and mobile learning systems. The findings from this study especially on the views of using a mobile education tool for innovative teaching and learning might be different in other contexts in higher education in Tanzania. The design of the CBEMET Prototype followed the need for an application to enable the sharing of educational-related resources at the College of Business Education only. Teachers at the College of Business Education have been printing volumes and volumes of notes, assignments and project details for students either to buy or copy them at a cost (it is estimated that the College of Business Education spends about 10 thousand USD for printing activities per semester). There have also been cases, where there is a mismatch in education materials given to students across CBE branches due to each teacher arranging notes according to his/her preference. Online sharing of the education materials provides the opportunity for all relevant materials to be found in one place, therefore, becoming easy to access and use across all the four campuses. The authors are of the view that other institutions may experience different challenges such that the method of evaluation could be different. Though, on the other hand, the evaluation method can be copied and modified accordingly. Similarly, teachers had no online "academic space" where they could easily share their experiences, teaching notes, and improve their innovative teaching and learning.

Furthermore, other limitations of this study are that, although teachers and students were involved in the evaluation of the prototype, it was done only for teachers and third-year bachelor students of the Dar es Salaam campus. To obtain a thorough evaluation, it might be a good idea for the evaluation to be done by teachers and students from all four campuses of the college after they used the prototype for a while at least.

The evaluation reported on in this paper was based on the needs and requirements of teachers and students at the College of Business Education, therefore, we believe that the findings of this study, will be useful for further scrutiny in the context of other higher education institutions in Tanzania and other emerging economies. Future work should also concentrate on conducting successful research that reports on the need and importance of involving users of the systems or applications in the design and development of different education tools in the context of different subjects. In most of the higher education institutions in Tanzania, for example, the College of Business Education, and others have subjects that can have specific guidelines using tools, for example, accounting (accounting procedures), marketing (marketing principles), procurement and supplies (logistics and value chain), computer programming (programming tools) and business administration (management principles, managing tools, and reports, among others). Similarly, further research may be conducted to address the kind of innovative teaching and learning apart from mobile education applications which we introduced in this paper. Self-regulated learning can further be introduced fully to enable students to be involved in accessing, arranging, and storing educational-related content and materials without depending on their teachers. To instill the concept and need for innovative teaching and learning, we also suggest that future work in teaching and learning could focus on self-regulated learning and smart learning. This will provide students with opportunities to learn on their own given the relevant materials and where they can be involved in searching learning resources and be truly innovative (Fauzia, Ansari and Khurshid, 2012).

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