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Mobile Cloud Computing Based Technologies for Enhancing E-learning Content Delivery and Sharing in Higher Learning Institutions in Tanzania using Learner-Centered Approach

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Abstract
Electronic learning (E-learning) in Higher Learning Institutions (HLIs) offers a cost-effective teaching and learning that support social interactivity, flexibility, context sensitivity, and active participation of learners in learning activities. The objective of this study was to investigate the challenges facing the traditional E-learning tools and leverage the advanced capacity of Mobile Cloud Computing (MCC) to enhance E-learning service delivery and sharing of learning resources focusing in learner-centered approach. Also, the evolvement of mobile computing devices such as smartphones, Personal Digital Assistance (PDA), and laptops owned by learners bring prospects in overcoming the inherent challenges facing HLIs in developing countries such as shortage of computer laboratories and network resources.Consequently, this study proposes MCC-based E-learning content delivery and sharing to augment higher learning institutions with limited resource setting in developing countries. The main benefits of MCC-based E-learning include, first, augment traditional LMS by provisioning abundant processing capacity and storage in the cloud that guarantee unlimited learning materials available for learners and instructors; Second, improves performance in local Learning Management System (LMS) servers by outsourcing execution and storage into the cloud especially when resource-intensive E-learning contents such as games, Virtual Reality (VR), and video streaming are used for learning; third, supports multi-platforms to execute the workload of various E-learning applications in the cloud which is potential for E-learning resource sharing; and fourth, guarantee cost-effective E-learning content delivery and sharing.
Keywords: Mobile cloud computing, E-learning, content delivery, Learner-centered learning
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1. Introduction

The rapid growth of Information and Communication Technology (ICT) is considered important in augmenting traditional learning practice through supporting learner-centered paradigm. Traditional teaching method which is also known as teacher-centered learning approach mostly apply instructional methods such as lectures, guided discussions, demonstrations and "cookbook" labs that promote a focus on the teacher (Liguori & Winkler, 2020). Similarly, the physical design of the classroom often promotes a focus on the teacher and limits student activity that disrupts that focus which is important for imparting the skills of communication among their students (Scherer et al, 2020). The methods used in classrooms determine the interest level and motivation of the students towards the learning and acquisition of knowledge. The improvement in learning paradigm include transition from the teacher-centered learning to student-centered learning paradigm. In a former paradigm the main emphasis was placed on acquisition and transfer of knowledge where learning process is more aligned on the teacher.

The new educational paradigm which is known as Competence Based Curriculum (CBC) implement its principles by setting forward the process of increasing the time for independent and practical work of students which allows to be active at seminars and laboratories works, to participate in discussions, and seize design techniques(Nyoni, 2018, Scherer et al., 2021). Also, practical use of knowledge allows the development of models as solution to existing problems in various domain and carry out experimental assessment to analyze and choose the correct decision. Student-centered learning approach shifts the role of learning to student while teachers remain as instructors. This learning method has been applied mostly in Higher Education Institutions (HEI). However, some studies conducted in Tanzania reported challenges related to the implementation of CBC such as teachers fear of change to shift to the new paradigm of teaching, shortage of in-service capacity building programs on the CBC, Lack of awareness and skills to implement CBC among the teachers, and shortage of resources to support CBC such as internet connectivity, storage facilities, funds, and learning resources (Nyoni, 2018).

To address some of the aforementioned challenges, experiential learning method such as simulation experiments have been useful in equipping students with real-world experience to practice the theoretical knowledge acquired in class (Kennedy, 2018). Similarly, simulations facilitate enhanced self-knowledge and self-assessment because they allow the students to make mistakes on their own or as part of a group and then to

understand and learn from these mistakes (Levant et al, 2016). Experiential learning method differs from the traditional learning methods where the former allows students to learn through applications and actions which prepares students to be better in addressing challenges while the later focuses on lecture-based teaching and learning. As HEIs in developing countries increasingly move towards fully online and blended teaching modes, it is crucial to critically assess the limiting factors, opportunities, and scrutinize the contributions to the pedagogy (Salmon, 2019). In this era of technological advancement, online learning has become viable, highly attractive, flexible and effective tools to support learning anywhere and anytime (sadiku et al.,, 2018; Singh & Thurman , 2019). For instance during COVID-19 pandemic, online teaching and learning played key role mostly in developed countries and developing countries (Sadiku et al. , 2018; Dhawan, 2020))

In developing countries, online learning reveals many challenges and opportunities for teachers and students as well as educational sector. Despite the good plans of building capacity and creating awareness to instructors to provide equitable and beneficial learning experiences to students, majority of instructors feel anxious and not suitably equipped to fully depend on online teaching and learning because some consider themselves still need more understanding on how to apply the online platforms (Rucker & Downey, 2016). Also, despite the fact that online learning environment is promising solution to improve learning content delivery , the assessment activities are often limited in the variety and modes in which they are allocated in the online environment. Moreover, fully online learning can isolate a learner which act as a barriers to participate in collaborative learning tasks through group work, group presentations and group assessments.

This paper leverages the advance capacity of Mobile Cloud Computing (MCC) to enhance E-learning service delivery and sharing of learning resources in an online learning. The MCC encompasses various technological infrastructures such as cloud computing, wireless communication, portable computing tools, location-based facilities and mobility services that support users to access unlimited learning resources in the cloud. In MCC architecture, both storage of learning resources and data processing happens in the cloud, the mobile devices such as smartphones, laptops and other portable devices are used for accessibility through the internet. The main benefits of MCC includes, first, augments mobile devices by provisioning abundant processing capacity and storage of learning materials in the cloud. Second, improves performance of mobile applications by outsourcing execution of resource-intensive tasks used for learning such as video games and Virtual Reality (VR) into the cloud, and third, support multi-platforms to execute workload of various applications in the cloud.

The remaining parts of this paper are organized as follows: section 2 presents the literature review, section 3 presents the research methodology, and section 4 discusses the survey results. Moreover, the components of the proposed MCC-based E-learning content delivery and sharing framework using learner-centered approach are presented in section 5 and finally section 6 presents the conclusion and proposes future works.

2. Literature review

The student-centeredness is different from the traditional classroom teaching model centered on "textbooks, teachers, and classrooms". The purpose of learner-centered learning is to learn, students being the main body of teaching activities. Tanzania is among the country that provides fully online learning especially in university level like the open university of Tanzania. Development of educational technologies to support online learning played great role especially during the COVID-19 crisis to address learning challenges through online learning.

Alanezi and Alazwami, (2020) reported good impression from the student in utilizing mobile learning in higher education, the study further recommended adoption of online-learning in HLIs. However, the study reported underutilization of mobile-based technologies for learning (Alanezi & AlAzwani, , 2020).

Rajab et al (2020) explored online learning challenges in medical education during the COVID-19 outbreak. The study engaged 208 participants which included both learners and faculty members. The challenges reported in the literature include communication infrastructures, shortage of skills in conducting online learning, inefficient technological tools for learning, anxiety on technology, and costs of accessing online tools. Mahyoob et al (2020) explored possible solutions and suggestions for future virtual learning. The study was conducted at the undergraduate level for English language learners and it was performed after completing online teaching classes.

Another study explored the importance of online learning and investigated the analysis of weaknesses, strengths, challenges, and opportunities of online education in the time of the pandemic (Shivangi, 2020). The study provided some guidelines for dealing with online learning challenges at natural disasters and epidemics. Also, the study conducted by Wolfinger (2016) assessed the key factors contributing to fully online virtual schooling through middle school. The research focused to academic, social support, learners' characteristics, and educational support. The study revealed the importance of teachers' role in virtual learning, and parents' involvement could promote their academic achievements.

Ali et al. (2017) focused on Blackboard utilization as a motivator in English language learning and teaching. The study found out that some learners were motivated to work harder in learning English using the Blackboard platform. Also, Alturise (2020) conducted a study about learners' and teachers' satisfaction in the online learning model using the Blackboard platform. The study reported that e-learning mode is advancement in education, but

significant works are needed to improve online learning applications. Some researchers investigate challenges and obstacles in e-learning during COVID-19 according to their educational environment setup, also they identified the possible solutions that can improve the learners' performance and overcome these problems in future (Mahyoob, 2020). Recently, challenges to access online learning are becoming less because both learners and teachers have some experience in interacting with E-learning tools such as mobile-based learning, computer-based learning, and web-based learning (Byun, Sooyeon, & Slavin, , 2020).

3. Research Methodology

This study used survey methodology to assess the state-of-the-art adoption of E-learning and learner-centered in HLIs in Tanzania. The selected study area own necessary ICT infrastructure to support E-learning such as Local Area Network (LAN), Learning Management System (LMS), computer laboratories, well equipped video conferences, and other basic facilities. The population comprises of mainly learners, instructors, and system administrators from HLIs. Random sampling procedure was applied to formulate the sample to be included in the study. The study collected both quantitative and qualitative data using various methods mainly structured questionnaire and interview. Collected data were classified into themes relative to variables relevant to the investigated problem. The quantifiable data were analyzed and visualized using Statistical Package for Social Sciences (SPSS), where descriptive statistics such as frequencies and percentages were used. Also, the content analysis were used to analyze qualitative data that were considered important to provide additional information and generalizing the findings of this study. Then, we adopted a well-known Mobile Cloud Computing (MCC) framework to propose an E-learning content delivery and sharing in higher learning institutions in Tanzania using learner-centered approach.

4. Results and Discussion

4.1 Demographic characteristics of respondent

This section presents the demographic information of the respondents who participated in this study especially during the process of data collection. The characteristics of the respondents have important suggestion on the assessment of data collected about Assessment of the challenges and opportunity for fully online learning by using learner centered approach. The demographic information of respondent such as gender and age are considered to justify the relevance of the study population. This study involved 120 respondents with 74 (61.7%) male and 46 (38.3%) female. To ensure the meaningful representation of women and men, this research adheres with targets of the 5nd Sustainable Development Goal (SDG) dealing with gender equality by ensuring 38.3% women involvement in the data collection. Also, because this study involved mostly university students, the results provided in Figure 1 shows that majority of respondents (above 90%) were above the age of 20 years old. This indicates that respondents were mature enough (by age) to respond to the corresponding questionnaires in the process of data collection.

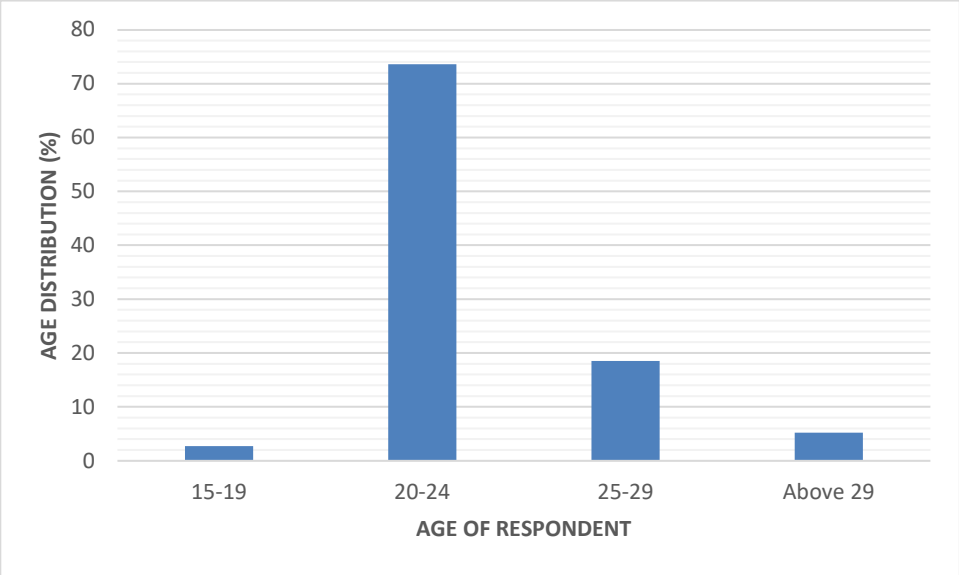

Figure 1. Demographic characteristics of respondent

4.2 ICT resources ownership and familiarization of learner's to the online learning

Figure 2 portrays the analysis of results investigating to what extent respondents use online learning. The results show that majority of students (57%) occasionally use online learning, 20 % of students frequently use online

learning, and 23% of students are not using online learning due to various reasons. The results indicate that majority of the respondents obtained from random selection are using online learning, in average 77% of respondents are familiar with and are already using online learning while the rest 23% are not familiar. Also, Mahenge & Sanga (2016) reported an increasing ownership of mobile computing devices by students in HLIs reaching an average 85% (laptops), 65% (smartphones), and 78 % (other portable devices). Consequently, the results demonstrate that it is possible to utilize ICT equipment owned by learners to enhance E-learning service delivery in Higher Learning Institutions (HLIs) in Tanzania using Learner-Centered. Moreover, this is facilitated by the rapid development of Internet technology, the advanced capacity of MCC infrastructure, fast dispersion of smart mobile computing devices, high mobile subscriptions rate, and affordable Internet costs in developing countries, particularly Tanzania (ITU, 2014; TCRA, 2020).

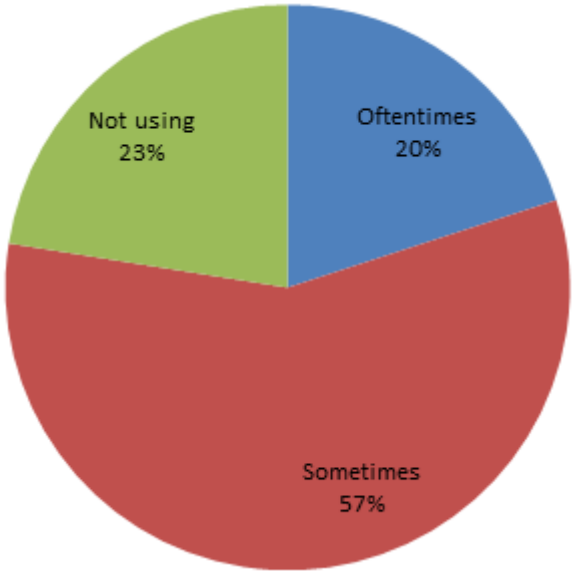

Figure 2. Learner's utilization and familiarization of the online learning applications

4.3 Tools used to conduct online teaching and learning activities

Figure 3 demonstrate the tools to reinforce E-learning process through the advanced Information and Communication Technologies (ICTs). The Learning Management System (LMS) is necessary in conducting E-learning, the results shows that the commonly used E-learning tools in HLIs in developing countries include Moodle (28.5%), YouTube (31.5%), and Zoom (24%) respectively. It was further observed that YouTube is mostly used to access uploaded videos which help learners to follow and understands the concepts easily after class. Other tools used for E-learning include Google Drive (11.5%), Google meet app (3%), and ezTalks (1.5%). To make learner-centered learning approach more impactful, Scherer et al (2021) recommended that HLI instructors should be empowered with professional development and sufficient time to improve their digital literacy for online teaching and learning services to strengthen their competence and self-confident in online facilitation. Moon and Demei (2013) put more emphasis on the self-regulation to be considered as an essential factor in influencing students' success in and online learning environment.

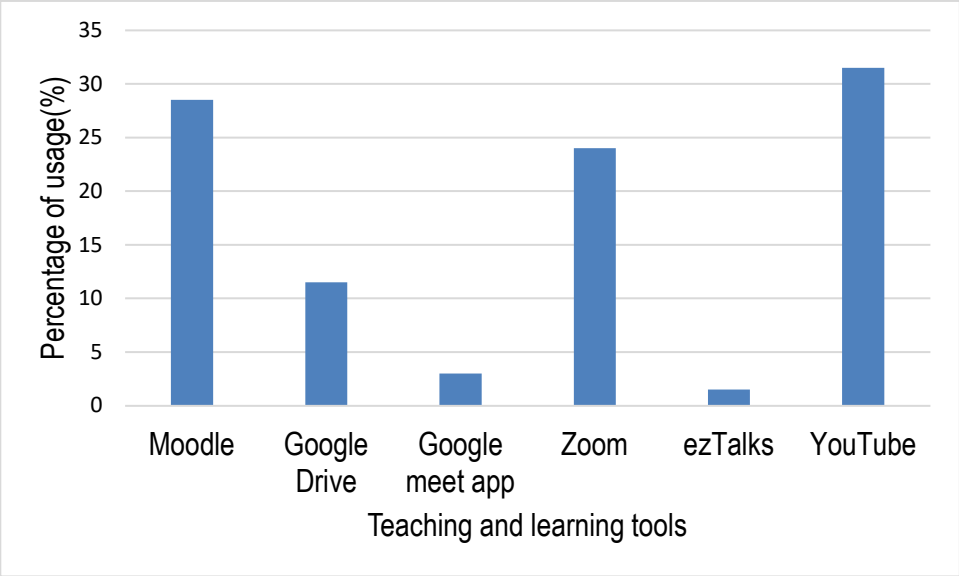

Figure 3. Tools to facilitate online teaching and learning in developing countries

4.4 Learners' perception on fully online learning

Figure 4 presents the perception of learners on fully online learning assessed using various metrics. Majority of respondents agreed that online learning provide accessibility to learning materials anywhere and anytime (61%) which they found it to be more flexible learning approach which is not limited by distance and time. This was evidenced during COVID-19 pandemic where it was not possible to meet physically in most countries such as China, Rwanda, Kenya, and many other countries where students in various countries including Tanzania were attending classes online. Also, 19% of respondents perceived online learning as costly in terms of Internet connectivity. Consequently, some learners experienced some difficulties to access learning resources when they are outside the university campus. Similarly, Fishbane and Tomer (2020) argued that students who could not meet the expense of hi-speed Internet are most susceptible to lag behind and face challenges to attend online conversation or group meeting. Furthermore, 5% of respondents perceived the online learning as it gives students and instructor new teaching and learning experience, 7% responded that the online learning tools are easy to use, and 8% perceived the online learning as it needs ICT skills.

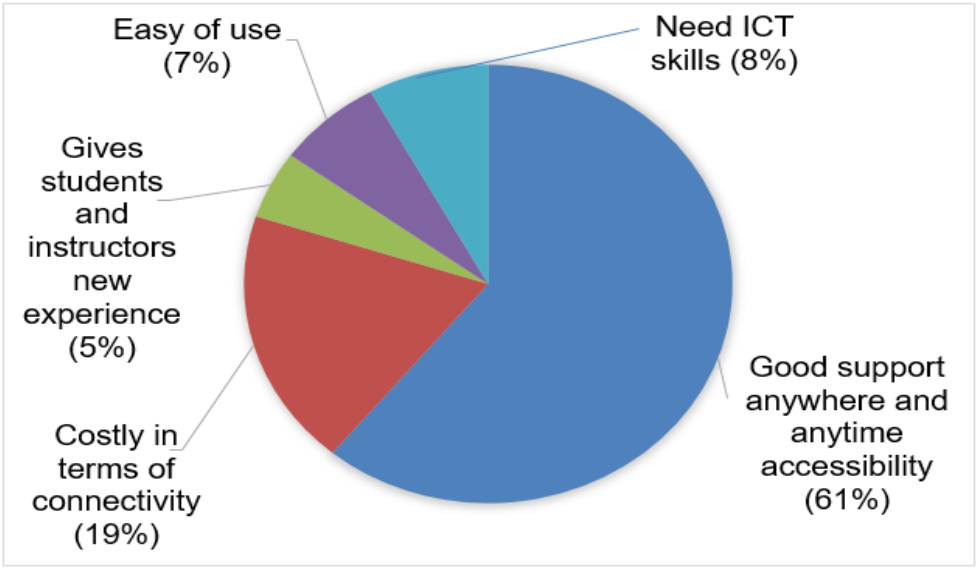

Figure 4. Learners' perception on fully online learning using learner-centered approach

4.5 Challenges facing online learning based on learner-centered approach

Table 1 presents the challenges associated with the existing online learning based on student-centered learning environment. In the range of 1-5 where 1= strongly agree, 2= Agree, 3=for some extent, 4=Disagree, and 5=strongly disagree, 43.3% strongly agreed, 36% agreed, and 20% agreed for some extent that it is difficult to handle practical works in virtual learning environment. The results reaffirm the investigation by Adedoyin and

Soykan (2020) which found that in engineering, and science related fields where hands-on practical skills are vital lack of compatibility with online learning, particularly teaching laboratories. In case of delayed feedback from the instructor found to be not a big challenge facing online learning, the responses showed that 38.3 % indicated that the delay happen for some extent, 28.3% disagreed and 15.0% strongly disagreed that online learning causes delay in feedback from the instructor. Internet connectivity challenges was a big concern for majority of respondents, 37.5% strongly agreed, 33.3% agreed, and 13.5% indicated that Internet connectivity is the major obstacle for effective online learning using learner-centered approach. This result confirms the results by Mahenge (2017), and Mtebe and Raphael (2018) that found that the cost of Internet services intensify the challenges of E-learning services delivery in HLIs in Tanzania. In terms of missing some course information and guidance, and inadequate academic support from the instructor majority indicated that it happen for some extents quantified by 44.2% and 35% respectively. However, the difficulties in learning during power outage was found to be the issue of concern for many learners using learner-centered approach, 30% strongly agreed, 40 agreed, and 20% specified that the challenges of power outage happen for some extents. Online learning become much challenging on HLIs that have no reliable power backups to support learning during power outage, 17.5% strongly agreed, 29.2% agreed, and 45% indicated that it happens for some extent. In terms of difficulty in attending face-to-face and insufficient learning materials for the course were lightly considered as challenges facing online learning when using learner-centered approach. The results indicated that 44.2% disagreed, and 25.8% strongly disagreed that using online learning make it difficult in attending face-to-face learning. Likewise, 35% indicated that for some extent online learning has insufficient learning materials for the course. This challenges caused by a number of factors which include instructor failed to upload learning materials to the learning management system or insufficient storage space on the learning management servers especially when large volume of data such as videos, images, simulated data, or games are used for learning. Finally, high cost of Internet to access learning platforms when learners are off-campus is considered to be an obstacle for effective learning. The results show that 16.7% strongly agreed, 40% agreed, and 33.3% indicated that to some extent high cost of Internet is a major challenge facing virtual learning environment especially in developing countries. This result agree with the results by Mahenge (2017), and Mtebe and Raphael (2018) that found that the cost of Internet services intensify the challenges of E-learning services delivery in HLIs in Tanzania. Moreover, the results confirm the results by Fishbane and Tomer (2020) that argued that expensive connectivity of hi-speed Internet causes some students with financial constrains to be left behind and become inactive in an online conversation or group meeting.

Table 2. Challenges associated with online learning environment (N=120)

Challenges, issues, and problems associated with virtual learning environment	1 Frequence (%)	2 Frequence (%)	3 Frequence (%)	4 Frequence (%)	5 Frequence (%)
Difficulty in handling practical works	52 (43.3%)	36 (30%)	20 (16.7%)	10 (8.3%)	2 (1.7%)
Delayed feedback from the Instructors	8 (6.7%)	14 (11.7%)	46 (38.3%)	34 (28.3%)	18 (15.0%)
Internet connectivity is the major issue	45 (37.5%)	40 (33.3%)	22 (13.5%)	9 (7.5%)	4 (3.3%)
Missing some course information and guidance	6 (5%)	24 (20%)	53 (44.2%)	24 (20%)	13 (10.2%)
Inadequate academic support from the instructor	9 (7.5%)	15 (12.5%)	42 (35%)	24 (20%)	30 (25%)
Difficulties in learning during power outage	36 (30%)	54 (40%)	20 (16.7%)	8 (6.7%)	2 (1.7%)
There are no power backups to support learning during power outage	21 (17.5%)	35 (29.2%)	54 (45%)	3 (2.5%)	7 (5.8%)
Difficulty in attending face-to-face	12 (10%)	14 (11.7%)	10 (8.3%)	53 (44.2%)	31 (25.8%)
Insufficient learning materials for the course	26 (21.7%)	33 (27.5%)	42 (35%)	8 (6.7%)	11 (9.2%)
High cost of internet to access online learning platforms off-campus	20 (16.7%)	54 (40%)	40 (33.3%)	4 (3.3%)	2 (1.7%)

Scale: 1= strongly agree **2**= Agree **3**=for some extent **4**=Disagree **5**=strongly disagree

5. Components of the proposed MCC-based E-learning content delivery and sharing framework using learner-centered approach

The MCC paradigm is considered to be important technological advancement to augment the traditional LMS in terms of E-learning content delivery and sharing costs, storage, and computation especially when resource-intensive and data-driven applications such as games, Virtual Reality (VR), image processing, and video streaming are used for E-learning. Figure 5 demonstrate the Components of the proposed MCC-based E-learning content delivery and sharing framework. The MCC-based E-learning encompasses components such as LMS servers and databases in cloud for processing, storage, and analysis of data for decision making; wireless communication facilities between end-users and the cloud; portable mobile computing devices used by end-users such as learner and instructors to access or share E-learning contents; location-based facilities to track location of learners; and mobility services that support users to access unlimited E-learning resources in the cloud. In the MCC-based E-learning content delivery and sharing framework, both E-learning contents storage and processing happen in the cloud and the mobile devices are used for accessibility through the internet. The main benefits of MCC-based E-learning include, first, augment traditional LMS by provisioning abundant processing capacity and storage in the cloud that guarantee unlimited learning materials available for learners and instructors; Second, improves performance in local LMS server by outsourcing execution and storage into the cloud especially when resource-intensive E-learning contents such as games, VR, and video streaming are used for learning; third, supports multi-platforms to execute the workload of various E-learning applications in the cloud which is potential for E-learning resource sharing; and fourth, it is cost-effective approach for E-learning content delivery and sharing because the management of infrastructures such as servers and networks will be the responsibility of the cloud service provider and provided as a service to the HLIs which cut down the cost of owning high performance computing servers and management overhead to the HLIs.

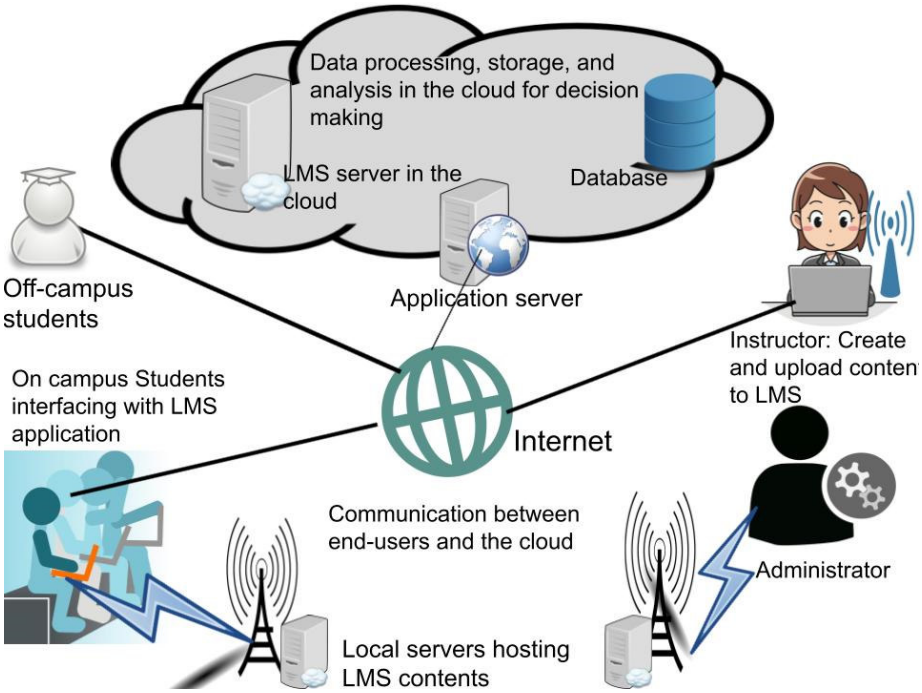

Figure 5. Components of the proposed MCC-based E-learning content delivery and sharing framework

6. Conclusion and future works

This paper investigate the state-of-the-art E-learning content delivery and sharing for learner-centered approach in HLIs in Tanzania. The survey results indicate that majority of the respondents obtained from random selection are using online learning, in average 77% of respondents are familiar with and are already using online learning while the rest 23% are not familiar. In terms of mobile computing devices ownership by students in HLIs reached 85% (laptops), 65% (smartphones), and 78 % (other portable devices). The results show that it is possible to utilize ICT equipment owned by learners to enhance access to E-learning contents in HLIs. Also, in terms of users' perceptions, majority of respondents (61%) agreed that E-learning supports anywhere and anytime access to learning materials which they found it to be more flexible learning approach which is not limited by distance and time. Moreover, the challenges facing E- learning tools based on learner-centered approach in developing countries mostly emanates from the high cost of Internet to access E-learning platforms especially for off-campus students, power outage, insufficient LMS servers for processing and storage of E-learning contents, and network connectivity problems. Therefore, this paper proposes cost-effective MCC-based E-learning framework to augment the

traditional LMS in terms of E-learning content delivery and sharing costs, storage, and computation capacity especially when resource-intensive and data-driven applications such as games, Virtual Reality (VR), image processing, and video streaming are used for E-learning.

In the future, the researcher implement the proposed approach in real-working environment to evaluate the improvement of the proposed framework. Also, the future works will consider capacity building for both learner and instructors to ensure E-learning are used efficiently to benefit the learners and contribute to the HLIs as well as the nation. Finally, the study will conduct the rigorous assessment of the impact of the proposed MCC-based E-learning framework.

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