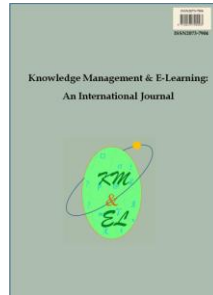


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ICT for e-learning in three higher education institutions in Tanzania

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Abstract: The advancement in Information and Communication Technology (ICT) has brought new opportunities for learning. Tanzania is adopting the new technologies in Higher Education Institutions (HEIs) through e-learning and m-learning. However, delivery of learning contents is becoming a challenge for HEIs due to the constraints in resources and network bandwidth. This study discussed learners' perceptions on using e-learning applications and mobile devices for learning in three HEIs in Tanzania. Findings show that majority of the students own more than one mobile devices which can be used as a tool for facilitating the learning process. It is suggested that in order to improve e-learning content delivery and accessibility under limited resource settings, HEIs in developing countries should make an effective use of emerging mobile computing technologies which are relevant to their respective environments.

Keywords: e-Learning; ICT; Higher education institution; Mobile learning

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Furthermore, he has co-authored two books as well as co-authored book chapters in the following books: “Information and Communication Technology: Changing Education” published by ICFAI University Press (India) and “Technology-Mediated Open and Distance Education for Agricultural Education and Improved Livelihood in Sub-Saharan Africa” published by Commonwealth of Learning (Canada). In addition, he has co-authored book chapter in the book titled “Technology Development and Platform Enhancements for Successful Global E-Government Design” by IGI-Global (USA).

1. Background

Information and Communication Technology (ICT) has brought many opportunities in all sectors including education. The advance in e-learning and mobile technology has brought prospects for personalized and smart learning. While personalized learning is a blended approach for delivery of education both within and beyond the traditional classroom environment (Cachia, Ferrari, Ala-Mutka, & Punie, 2010). Smart learning in this context refers to knowledge delivery and accessibility through the use of ICT tools at anytime and anywhere (i.e. dynamic and mobility in content delivery). Sife, Lwoga, and Sanga (2007) argue that mobile technology is evolving in a rapid pace offering new capabilities for sustaining data transmission, storage, and sharing different multimedia formats that can be advantageous for the education sector. On the other side, ICTs enhance interactions among students, instructors, and information systems in ways that have never been possible before. Applying ICT to the education sector is one of the national strategies to eradicate poverty in Tanzania (Lujara, 2008). The Government of Tanzania through the Ministry of Education and Vocational Training (MoEVT) recognizes the potential of ICT acting as a means of improving education delivery, outcomes and impact, as evidenced in the national plans, policies and strategies (TNIP, 2003; Mshangi, 2013). In 2008, there were two HEIs in Tanzania using digital learning applications: the University of Dar es Salaam (UDSM) and the Open University of Tanzania (OUT) (Swarts & Wachira, 2010). In 2012, Sokoine University of Agriculture (SUA) adopted Moodle as the free and open source software for learning management system, but only for ICT courses. Although students in Tanzania appreciate the use of ICT for support of their learning at anytime and anywhere, they are facing a number of challenges including the cost of Internet services, poor interaction between students, their peers and instructors, inadequate computer skills, and lack of access to ICT facilities Mahai (2012). This study aimed to investigate the learners’ perceptions of using e-learning applications and mobile devices for learning in three HEIs in Tanzania: SUA, OUT, and Nelson Mandela African Institution of Science and Technology (NM-AIST).

The rate of mobile phones adoption and access to Internet in Tanzania is generally growing at a rapid rate. As evidenced by Deloitte and GSMA (2012), smart phone adoption in Tanzania has increased from 3% in 2010 to 9% in 2014 and even more in the coming years (Fig. 1). Implementing m-learning in HEIs is possible because the students have already been using their mobile phones for other activities like mobile banking, mobile money (e.g. M-PESA, TIGO-PESA and AIRTEL MONEY), and social networking (Mtega, Benard, & Dettu, 2014; Ngugi, 2011).

However, Bakari, Mbwette, and Salaam (2010) commented that the learning and teaching processes in HEIs in Tanzanian are still performed mainly through the face-to-face mode. Adoption of modern ICTs such as computers, the Internet, mobile phones,

IPAD, e-readers and personal digital assistants (PDAs) in education can significantly help to improve education service delivery together with use of other ICTs such as radio and television. According to Tanzania Communications Regulatory Authority (TCRA) (2015) there were a total of 31 million mobile phone subscribers by June 2015. The rise in the use of these mobile computing devices, in particular mobile phones by students from HEIs, needs to be studied to understand how the mobile devices can provide a cost effective solution for teaching and learning. In particular, the solution needs to integrate face-to-face learning; e-learning and mobile learning (i.e. blended learning) (Brown, 2010). The integrated solution provides opportunities to facilitate flexible learning through supporting online and mobile learning (Fig. 2).

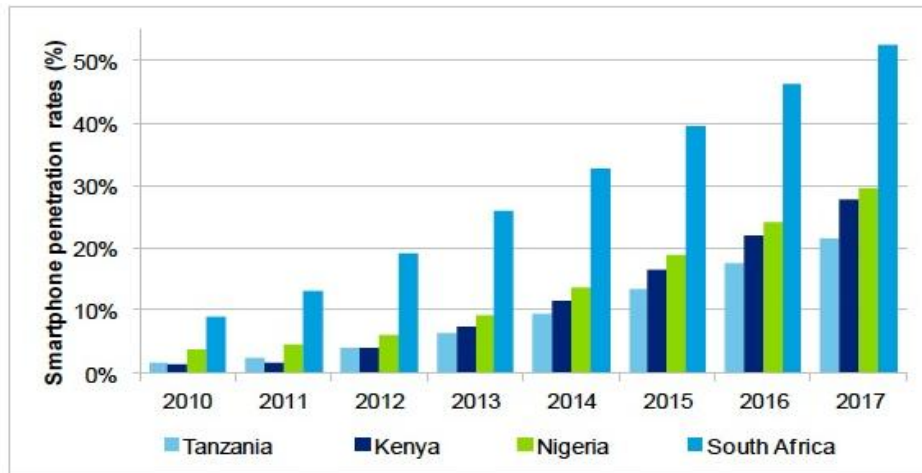


Fig. 1. Smartphone adoption

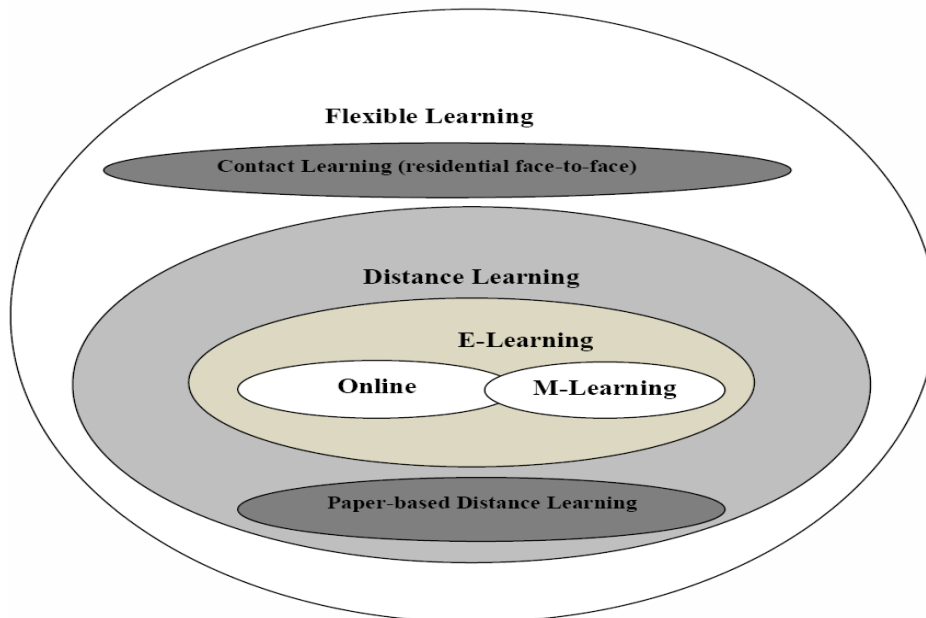


Fig. 2. Integrated learning solution. Adapted from Brown (2010)

2. Methods

This study was carried out in three HEIs in Tanzania namely: SUA, OUT and NM-AIST. All of these higher education institutions own basic ICT infrastructure such as Local Area Network (LAN), Internet, computers, and mobile technology that form the basis for the establishment of e-learning. Therefore, the selected HEIs provided a good setting for study. The population for this study was made up of students, instructors, researchers and administrators from the HEIs. In addition, key informants such as students, researchers and IT personnel available in the institutions were effectively involved in this study in order to give their views on the researched problem.

2.1. Study design and sampling

Survey methodology was used to identify and assess ICT for e-learning. During the survey different methods including interview, structured questionnaire and review of empirical literatures were used. Respondents involved in the survey process included students, instructors, administrators and IT personnel responsible for ICT services in HEIs. Random sampling technique was used to determine the sample to represent the population under the study.

2.2. Data collection

The field work for the study was conducted from December 2013 to January 2014. Data was collected using structured questionnaire. The structured questionnaire comprised of dichotomous items and closed ended questions whereby the respondents had to select the response they thought was most correct. The interview was conducted to ICT technical staff for each institution to generate a holistic view of the problem under study. Also, the interview was done in order to have opinions of the interviewee on how to improve learning contents delivery and accessibility in HEIs.

2.3. Data analysis

Collected data were categorized into themes in relation to variables pertaining to the researched problem. To this end, whereby quantitative data were analyzed using Statistical Package for Social Sciences (SPSS). In addition, descriptive statistics involved frequencies and percentages. Other qualitative data were analyzed through content analysis in order to have more information which was important in the comparison of the data and making generalization of the findings. Seemingly, ANOVA was used to compare the analyzed continuous data to determine if there was a significant statistical difference between the results obtained from the three case studies. In addition, Chi-square test was used to determine statistic significant relationship between two categorical values within individual institution.

3. Results and discussions

3.1. Demographic characteristics of respondents

Demographic characteristics such as gender, level of education and designation were assessed. The characteristics provided an overview on the background information of the

respondents, which in turn provided an overview about the appropriateness of the study population. Generally, the survey involved 202 respondents, among these, 145 (73.2%) were male and the remaining 57 (26.8%) were female. For individual institution, gender of the respondents involved in the survey is as shown in Fig. 3.

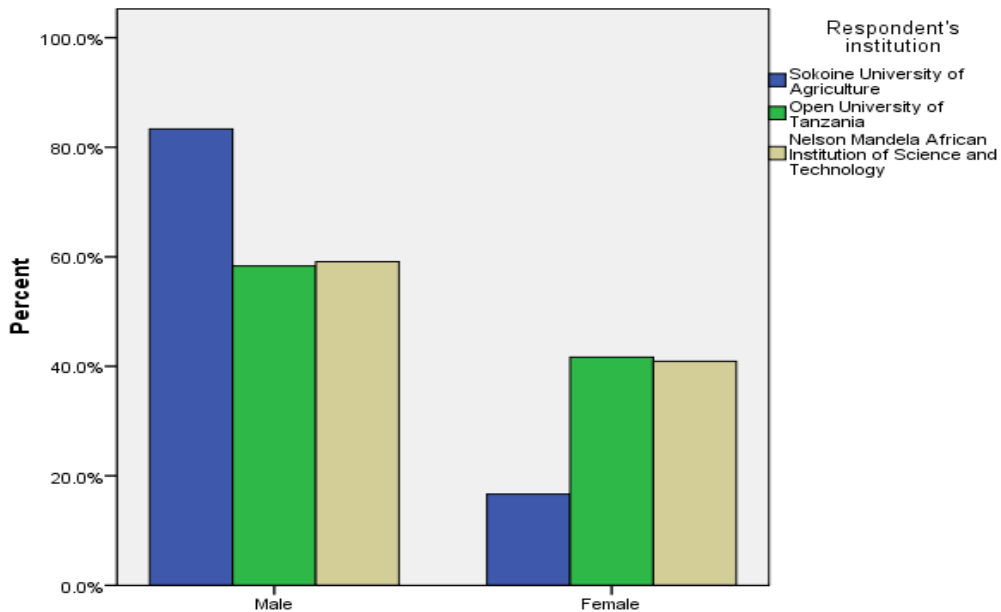


Fig. 3. Gender of the respondents

Out of 202 respondents 164 (81.2%) were students, 35 (17.5%) were instructors and 3 (1.2%) were administrators. In same vein, amongst 164 students, 47 (28.7%) were female and 117 (71.3%) were male. This implies that relatively few female students are enrolled to pursue science subjects in HEIs than male. Similar results were also observed by Sanga, Magesa, Chingonikaya, and Kayunze (2013). Furthermore, out of 164 students, 6 (3.7%) were diploma students, 110 (67.1%) were first degree students, 22 (26.8%) were master's students and 4 (2.4%) were PhD students. In light of academic qualifications of the respondents, it was learnt that the higher of the qualification the higher acceptance of using ICT devices in teaching and learning process in the study institutions.

3.2. Applications supporting delivery and accessibility of learning materials

In order to realize the applications that are used to support delivery and accessing to learning materials in HEIs, a number of applications were assessed through multiple-response questions. Findings in Table 1 provide empirical evidence that, the HEIs employ Web 2.0 technologies such as social networking artifacts (e.g. YouTube, Facebook and twitter), wikis, blogs and discussion forum in delivering and accessing learning contents. Moreover, the use of e-learning indicated by the respondents from SUA (65.9%), OUT (63.6%) and NM-AIST (42.1%) showed that they use e-learning platform for accessing learning contents. Also, it was revealed that students access Youtube, Twitter, facebook and other social media tools on their mobile devices to do some learning activities in certain courses. However, findings indicated low rate of using mobile phones for mobile learning evidenced by 12.2% (SUA), 25.0% (OUT) and 23.7% (NM-AIST). These results

reaffirm to the findings reported by Mtega, Benard, and Dettu (2014) that the level of usage of Web 2.0 tools for non-academic activities was higher than for academic purposes. Additionally, these findings concur with the study by Lwoga (2012) who established that the adoption of e-learning and Web 2.0 technologies is still in its infancy in Tanzania's public universities. However, there were much enthusiasm amongst respondents for developing the potential of e-learning and Web 2.0 tools (i.e. e-learning 2.0 or education 2.0) in their universities. Therefore, this study remark issues in the current applications for learning contents delivery and accessibility. The recent integration of social media (web 2.0) to e-learning has created a new term called e-learning 2.0 or education 2.0 (Silius et al., 2010; Lwoga, 2012). On the other hand, the advantage of embedding social network artifacts to e-learning is to promote new forms of learning. This includes: inquiry-based and exploratory learning; new forms of communication and collaboration; new forms of creativity, co-creation and production; and richer contextualization of learning. The learning and teaching approaches adopted when social network artifacts are fused into e-learning result into problem-based, reflective, constructivist, collaborative, experiential and participatory (Tlhapane & Simelane, 2010).

Table 1
Applications used for learning materials delivery and accessibility

S/ N	Applications	SUA n = 102		OUT n = 54		NM-AIST n = 46	
		Freq	%	Freq	%	Freq	%
1	YouTube	69	68.3	35	65.9	37	81.6
2	Facebook	24	24.4	22	40.9	24	52.6
3	Twitter	64	63.4	29	54.5	27	60.5
4	Wikis	57	56.1	25	47.7	20	44.7
5	Skype	24	24.4	19	36.4	35	76.3
6	Discussion forum	73	72.0	28	52.3	38	84.2
7	E-learning platform	67	65.9	34	63.6	19	42.1
8	Mobile learning platform	12	12.2	13	25.0	10	23.7

Findings presented in Table 1 also agree with the previous study conducted by Reuben (2008) which found that social media offers enhancement professionals that gives a great opportunity for keeping in touch with alumni after they graduate. Also, social media gives institutional management and staff the opportunity to harmonize stories of students and alumni of their institutions, which can create trustworthiness and bring in future business and eventually add value to discussion forum. Moreover, this study agree with the study conducted by Mtega, Bernard, Msungu, and Sanare (2012) which remarked that most of the mobile Web 2.0 applications can in one way or another be adopted in teaching and learning process. Furthermore, Web 2.0 supports constructivist approaches to learning with great potential to socialize online learning by providing technologies that foster interactive, collaborative, and participative roles of instructors and learners.

3.3. Learners' perceptions of e-learning content delivery and accessibility

This section presents learners' perceptions of e-learning contents delivery and accessibility using existing e-learning systems/applications. Learners' perception were evaluated in terms of cost of bandwidth connection and usage, access to learning contents during offline period, satisfaction of learners, performance, portability, dependency on internet connection, ability to share data and manage learning contents. Fig. 4 presents learners' perceptions of e-learning contents delivery and accessibility rated in percentages (%) based on the responses from respondents. Learners' perceptions were analyzed to test a significant relationship between limiting factors and the quality of delivered learning contents. Findings show that there is statistical significant relationship between the quality of the media used for learning process and the satisfaction of the learner in learning process ($p \leq 0.05$). However, it was noted that there is no statistical significant relationship between dependence on the Internet of the devices used to access learning contents and the quality of learning content delivered ($p=0.294$). Likewise, there is no statistical significant relationship between accessibility of learning contents during offline period and the quality of the contents accessed ($p=0.372$). Furthermore, there is no significant relationship between reliability and portability of the media used to access learning contents and the quality of learning contents delivered ($p=0.619$).

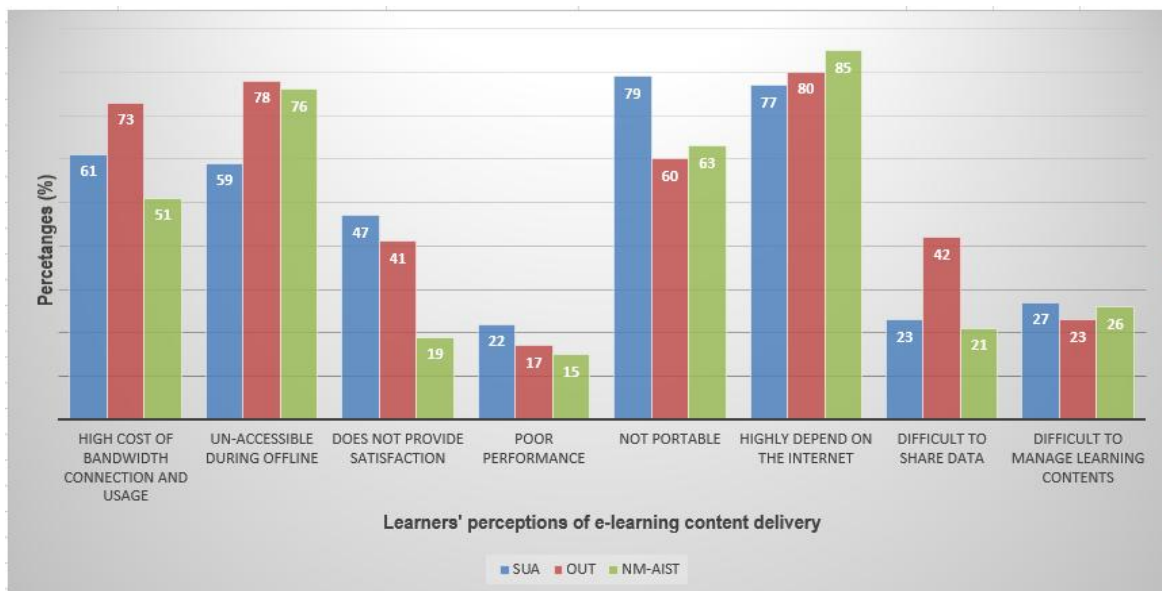


Fig. 4. Learners' perceptions of e-learning content delivery and accessibility

Findings presented in Fig. 4 agrees with the previous studies (Milovanović, 2010; Trifonova, 2006; Sanga, Kilima, & Busagala, 2010; Swarts & Wachira, 2010; Suhail & Lubega, 2011) which pinpointed that delivery and accessibility of learning contents in HEIs for web based learning systems is affected by issues such as: cost of bandwidth connection and usage, need for continuous internet connection for web-based system, limited mobility and portability features, un-accessibility of e-learning contents during offline period and shortage of ICT facilities (hardware and software).

However, during interview and desk review of existing e-learning system, it was revealed that majority of the challenges are caused by highly dependency on the Internet connection, increased number of users that lead to decreased system performance for

automated/semi-automated learning systems, resources and network bandwidth constrained environment and high cost due heavily dependent on the Internet.

Furthermore, majority of respondents in focus group advocated the use of free and open source software (FOSS) to support content authoring, content development, content dissemination, discussion forum and other functionalities in their mobile. This is similar to other studies which advocated the adoption of FOSS in e-learning to lower cost because there is no associated cost from procuring software and paying license (Sanga, Lwoga, & Venter, 2006). However, the operational and maintenance cost of FOSS in e-learning might be high due to fact that it highly depends on the internet connection. The adoption of FOSS in e-learning has cost implication in terms of funds for acquiring and maintenance of hardware and Internet connectivity. While owning and maintaining ICT infrastructure for the university community has many challenges, the growth of mobile phones brings new opportunities for universities for educational purposes.

3.4. Mobile computing/communication devices ownership

The exponential growth worldwide of consumers in electronic devices such as personal computers, cell phones, Smartphones and other electronic devices, has increased the opportunity for mobile computing devices ownership (Lalita, 2011). Mobile computing/communication devices ownership was analyzed to determine whether there was statistical significant difference in ownership among the three institutions. Results presented in Fig. 5 provides empirical evidence that there is a statistical significant difference of smartphone ownership among the three institutions ($p \leq 0.05$). However, there is no statistical significant difference of cell phone ownership among the three institutions ($p = 0.917$). Similarly, there is no statistical significant difference of laptop ownership among the three institutions ($p = 0.097$).

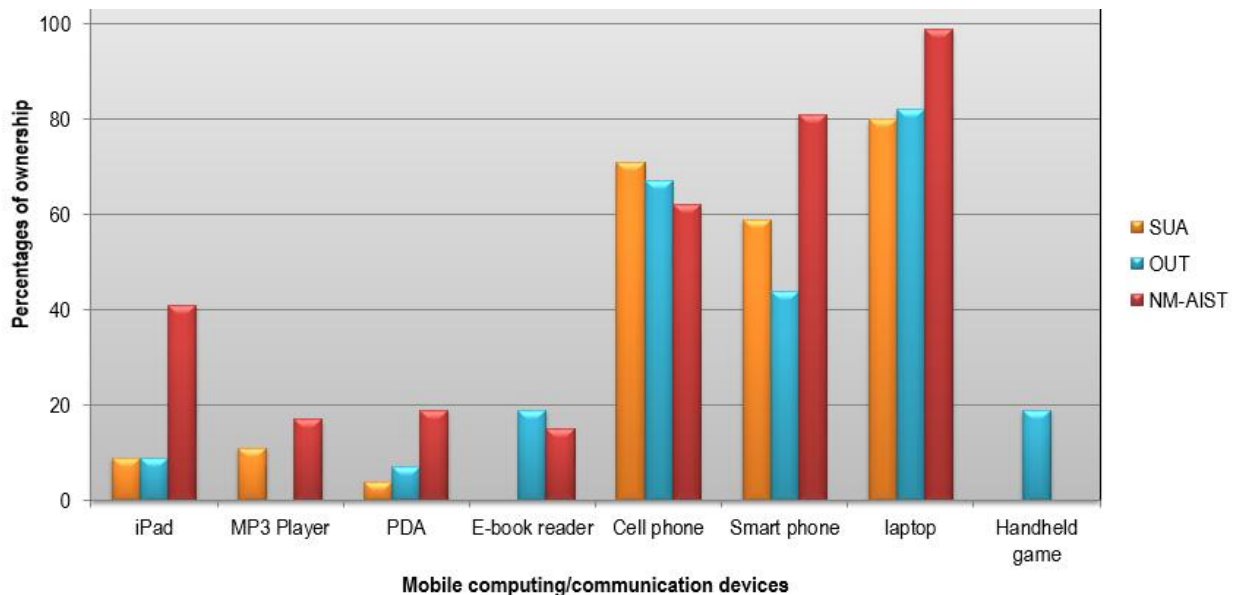


Fig. 5. Mobile computing devices ownership

The findings from this study are promising indicators for universities to adopt mobile technologies for enhancement of learning contents delivery and accessibility in a

cost-effective way rather than concentrating on the web based learning which is costly (Fig. 5). The trends of mobile computing device ownership gives a favourable and enabling environment for HEIs to deploy blended m-learning for enhancing learning contents delivery and accessibility (Muyinda, Lubega, Lynch, & van der Weide, 2011). The results presented in Fig. 5 involved only students who assessed the extent to which students own mobile computing devices and that can be used for educational purpose.

3.5. Towards improving access to education in HEIs of Tanzania using mobile technologies

In order to evaluate the extent to which mobile technologies had improved access to education in HEIs of Tanzania, the respondents were presented with mobile computing/communication activities related to education in which they always engage in. These mobile computing/communication activities were evaluated for each respondent selected in this study from the institutions. The results presented in Table 2 involved only students assessing the extent to which they use mobile computing devices for learning activities.

Table 2
Learning activities supported by mobile devices

S/N	Activities	SUA n=82		OUT n=44		NM-AIST n=38	
		Freq	%	Freq	%	Freq	%
1	Download and listen to audio academic materials	52	63.4	28	63.6	28	73.7
2	Download and view movies/video clips	58	70.7	20	45.5	24	63.2
3	Send and receive text messages	76	92.7	36	81.8	30	78.9
4	Download and read e-books	72	87.8	32	72.7	30	78.9
5	Downloading and reading scholarly materials	78	95.1	40	90.9	36	94.6
6	Transfer files from one place to another	74	90.2	36	81.8	22	52.7
7	Play interactive games via Internet on handled game console	22	26.8	12	27.3	16	42.1
8	Transfer photos or other data via smart phones	58	70.7	28	63.6	32	84.2
9	Send and receive email	30	36.6	20	45.5	31	81.6
10	Collecting data	78	95.1	36	81.8	34	89.4

Findings provide evidence that 52.4% of mobile computing device users do use the devices for downloading online resources and listening to academic audio, 54.9% acknowledged that they use the devices for downloading and viewing movies through YouTube, 76.8% use the devices to send and receive text messages, 70.7% for downloading and reading e-books, 82.9% for sending and receiving emails, 56.1% for transferring files from one place to another, 93.9% for downloading and reading scholarly materials, 24.4% for playing interactive games, 88.6% for data collection purpose and

59.8% used mobile computing devices for transferring photos and sharing data via application installed in Smartphone like whatsapp, Google drive and many others. The results provided indicative possibility of implementing m-learning in HEIs in Tanzania since students are already using mobile computing devices for learning activities as presented in Table 2.

These findings support the study by Cortez (2012) who argues that mobile technology is constantly evolving and offering new capabilities for supporting higher data transmission, storage, and multimedia formats that can be beneficial for education (Yueh, Lin, Huang, & Sheen, 2012). In addition, findings confirm the previous study by Tarouco and Barcelos (2010) which observed that the use of mobile devices improved the availability and accessibility to the learning content, which enhances the motivation and learning opportunity for students. Furthermore, these findings agree with the study conducted by Lai (2011) and Zhao and Jiao (2012) which suggested that the use of digital technologies such as podcast could improve the quality of the learning experiences if they are used as a participatory communicative tool to support collaboration and construction of knowledge.

4. Conclusion

Even though, the study found that the development in ICTs offers great prospect for universities in third world countries to improve delivery and accessibility of learning contents as it was established that 85% of students owns laptops, 65% owns smartphones and 78% of students owns mobile phones. In same vein, majority of universities in Tanzania own basic ICT infrastructure such as Local Area Network (LAN), Internet, computers, and mobile technology that form the basis for the establishment of e-learning. However, findings provide evidence that the rate of adoption of m-learning in HEIs of Tanzania is very low. Seemingly, it has been observed that majority of HEIs in Tanzania do not utilize fully the opportunity brought by ICT for e-learning due to resource and network bandwidth constrained environments. In this regard, it has been argued by Bon (2007) that efficient access to learning contents depends on the quality of the connectivity and the media used for delivery and accessibility. On the other hand, it had been mentioned that the cost of bandwidth (connection and usage charges), limited mobility and portability features in e-learning systems, shortage of ICT facilities (hardware and software) and un-accessibility of e-learning contents during offline period are major barriers for effective and efficient use of e-learning in Tanzania. Furthermore, it had been reported that, the offline period which occurs for different reasons including power outage, shortage of infrastructure and Internet disconnection. Sometimes, the available Internet connections are too expensive for the user as a result it affects efficient access to educational opportunities. This is true for institutions which are using very small aperture terminal (VSAT) technologies for Internet connectivity.

It was also noted that even if majority of respondents acknowledged that they own and use mobile computing/communication devices for doing some learning activities like downloading online resources and listening to academic audios, downloading and viewing movies through YouTube, sending and receiving text messages, downloading and reading e-books, sending and receiving emails, transferring files from one place to another, downloading and reading scholarly materials, data collection and for transferring photos and sharing data. But there are other HEIs that have adopted e-learning which is not fully operational due to resources, network bandwidth constrains and financial constraints. In Tanzania, learning and teaching process in HEIs is still mainly done

through talk and chalk mode. However, the mentioned mobile computing/communication activities demonstrate great opportunity brought by mobile technology for offering new capabilities in supporting higher data transmission, storage, and multimedia formats in HEIs.

5. Recommendations

An integrated approach that combines face to face learning, e-learning and m-learning in a blended manner is recommended by this study. Currently, there is no an ICT policy at level of a nation as well as HEIs on how mobile computing devices/ technologies can be used for learning and teaching. There is a need to formulate a national ICT policy to guide the adoption of ICTs in educational sector. This study suggests that in order to improve the e-learning content delivery and accessibility under limited resource settings, universities in developing countries, Tanzania in particular should make an effective use of emerging mobile computing technologies which are relevant to their respective environments. A critical successful implementation of a blended m-learning requires a strategic approach which should be owned by the university community and other stakeholders. The approach should take into account significant issues including pedagogy, mobile infrastructure, appropriate mobile content authoring technologies, human resources, m-learning policy, and capacity building to staff and students, and integration of e-learning, m-learning and digital literacy into HEI's curricula.

In determining the effectiveness of the integrated approach there is a need of a model for evaluation. Thus, the evaluation model may consider Adedokun-Shittu and Shittu model, which is an extension of Context, Input, Process and Product (CIPP) and the Kirkpatrick models (Adedokun-Shittu & Shittu, 2013). Another area for future study will be on how e-learners adopt mobile learning. The adoption models described by Van Biljon and Kotzé (2007) including Technology Adoption Model (TAM), Rogers' Diffusion Model, Unified Theory of Acceptance and Use of Technology Model (UTAUT), Models Applied to Mobile Technology, and Mobile Phone Technology Adoption Model (MOPTAM) will be considered.

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