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Improving the accessibility of digital content via mobile technology. A case study of Mount Kenya University

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Abstract
Globally, Higher Education Institutions (HEI) have embraced the use of mobile technology in the delivery of instructional resources, which has promised multiple benefits in digital or blended learning; HEIs are facing the challenge of high internet tariffs. The current study sought to improve the accessibility of digital content via mobile technology within limited Internet connectivity contexts. The study used a quantitative research approach within which a descriptive survey research design was adopted. The case study was Mount Kenya University in Kenya. The study was guided by the Technology Acceptance Model (TAM). The target population was 15123 individuals comprising 15,000 students, and 123 were educators/ ICT staff who accessed digital content in the academic year 2018/2019. The mobile-based model used a WIFI router device which is not internet-supported as an alternative to a wired internet connection where students and educators access digital content from the mobile sub-server, which was not connected to the internet through their mobile technology. The findings showed a statistically significant relationship between internet connectivity, type of mobile technology, user literacy, data caching, and eLearning policy significantly affected the accessibility of digital content. The variables were statistically significant. The adjusted R squared was 0.862, indicating that 86.2 % of the total variation of accessibility of digital content can be explained by Internet connectivity, e-learning policy, type of mobile technology, data caching, and user literacy. The study then went ahead to develop a mobile-based e-learning model. The findings showed that the use of mobile-based e-learning (m-learning) in universities would significantly improve access to digital content and hence e-learning. The study recommends using m-learning to provide alternative means of optimizing Internet connectivity.

Keywords: Mobile technology, Digital content, Learner/ student, E-learning/ M-learning, mobile-based model.

Introduction
Due to the COVID-19 pandemic, which was a health crisis, many schools in different countries were closed to reduce the contraction of the disease and save lives. The classroom learning process was distributed so that teaching was done online and assessments were done online. Mount Kenya University, one of the facilitators of e-learning, had faced a challenge in accessing digital content via mobile technology due to low internet connectivity. Many factors have been sighted as influencing access to digital content online. Key among these include the adoption of mobile technology, connectivity, and the use of technology to access digital content. This paper discusses each of these factors.

According to Watson (2015), digital content will be necessary for creating a system that contributes to digital content learning through technology. Mobile technology can also help educators concentrate on developing a better learning atmosphere that assists students in reading/learning more. Public schools use 1 computer per 5 students (1:5), and also those schools spend almost $3 billion per year on digital learning materials. Most teachers have been slow in transforming the way they teach despite the arrival of new technology (Herold, 2016). With the use of LMS, many doors are opened for digital learning experiences that promote more engagement through mobile technology.

Mobile technology and devices with cellular connectivity increase learning style by engaging both students and teachers (West, 2015). West (2015) mentioned that students are pretty flexible whenever they use technology for their learning. With this, it makes students aware of new learning methods such as online courses, virtual reality, and video games for instructional purposes.

According to Komen (2017), in universities such as Makerere University in Uganda and Open University in Nigeria, learners have shown that mobile devices are better placed to give learners a well-controlled learning process and access to digital material. The same research indicated perceived worries among educators about the effects of using their mobile devices for teaching purposes.

Connectivity, social interactivity, availability, Portability, context-sensitivity, and individuality have made mobile technology appealing for educational use. Access to digital learning content through mobile technology is more convenient for learners and educators (Mukherjee, 2016).

Wanja (2014) indicate that lecturers possess mobile phones, as in the case of Mount Kenya University; they do not use them for Digital content access due to the negative attitudes they hold toward mobile devices. The use of mobile technology at Mount Kenya University was improving at a very high rate because the university introduced e-learning to DIBEL students. Educators use mobile devices to access digital content and assignments and discuss with students. University uses Sakai as LMS to access digital content while students use mobile technology to access digital content. The HEIs were

forced to turn away from classroom learning globally due to the COVID-19 pandemic. It forced the HEIs to deliver digital content/learning online but also it was a big challenge to most of the HEIs to deliver digital content to the students online due to a lack of knowledge of internet connectivity quality at that moment (Cullinan, Flannery, Harold, Lyons and Palcic, 2021). The lack of fast internet connectivity was one of the significant challenges that e-learning mode faced. The study empirically studied the accessibility issues and challenges as the basis of the improvement performed. The following objectives guided this study; to establish the factors that influence mobile technology in accessing digital content at Mount Kenya University. To identify the challenge and extent to which it affects the learners who access digital content at Mount Kenya University via mobile technology. To develop a mobile-based model to mitigate the challenges facing students and educators in accessing digital content via mobile technology.

Literature Review

The Technology Acceptance Model (TAM) consisted of two main constructs: Perceived Usefulness and perceived Ease of Use, as shown in Figure 1. These constructs are theorized to be basic determinants of system usage, and they are formulated through their hypothesized influence on system use (Davis, 1989).

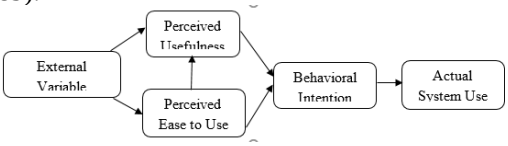

Figure 1: Technology acceptance model (Davis, 1989)

First, construct, perceived usefulness intends to show how users intend to use or not to use new technology on the point they believe the technology can assist them in achieving expected goals. In comparison, the second construct, Perceived Ease to Use, intends to analyze the usability of the technology to improve its performance and its benefits of technology. I.e., despite users believing that new technology can assist in achieving expected goals, the new technology can again be too tough to use, and the expected goals are overshadowed by the effort of technology (Davis, 1989). Davis (1989) also indicated that the use of the TAM model, both perceived usefulness and perceived ease of use, had to affect the behavioural intention of the users in using the information system. TAM was initialized from the Theory of Reasoned Action (TRA) (Fishbein, Ajzen, 1975). Ngo and Gwangyong (2014) also extended TAM by adding service quality, perceived social interaction, system commitment, and mobility value into the behavioural intention to use for educational purposes via mobile technology. According to Ngo and Gwangyong (2014), mobile learning was supported mainly through different values that affect perceived usefulness and ease of use. Mobility value, quality of services, perceived social interaction value, and student readiness affected perceived usefulness, while students' readiness and system commitment affected perceived ease of use. According to Ngo and Gwangyong (2014), training learners and educators during post and pre-implementation on how to use mobile technology in m-learning properly and effectively was important because it influenced learners' and educators' beliefs about a system and usage behaviour (system commitment).

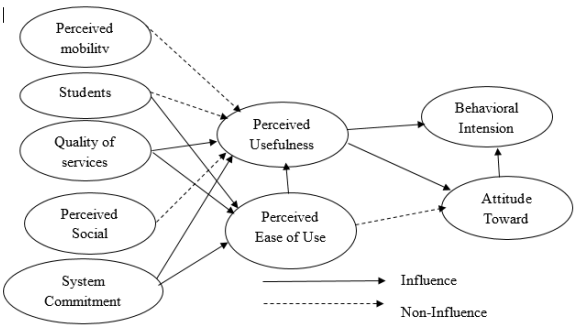

Figure 2: Technology Acceptance Model (Ngo and Gwangyong, 2014)

TAM was extended in this study by adding several constraints that involved perceived usefulness and ease of use. Under the TAM construct (Perceive usefulness), the type of mobile technology was predicted and explained to be the most important in accessing digital content in m-learning. Perceive usefulness indicates that users believe that new technology will improve their performance or efficiency. According to (Afzaal, Noah, Abd, Rudy, and Armanadurni, 2015), mobile device usage has been proven to be a useful interactive tool in e-learning because it increases the communication between learners and educators or learners and learners. In this case, the usability and mobility of mobile technology and proper accessibility of digital content depend on the type of mobile technology used by learners and educators. Other variables that can be approved using perceived usefulness include; internet connectivity, VLMs, and user literacy. Under the TAM construct (perceived ease of use), users' literacy level, integration, and e-learning policy also play and explain their role in the accessibility of digital content. The level of education, knowledge on the usability of the type of mobile technology, and the rate of digital content accessed by learners explain the perceived ease of use. The perceived ease of use indicates how much the user is comfortable with using mobile technology. Perceived usefulness and perceived ease of use lead to behavioural intention, which indicates the intention of learners and educators in accessing digital content using the chosen type of mobile technology, as shown in Figure 3.

Conceptual Framework

In this study, Davis's (1989) model TAM demonstrated how internet connectivity, type of mobile devices, user literacy, data caching, and e-learning policy improve accessibility to digital content. This section explains the determinants/constructs used in this study.

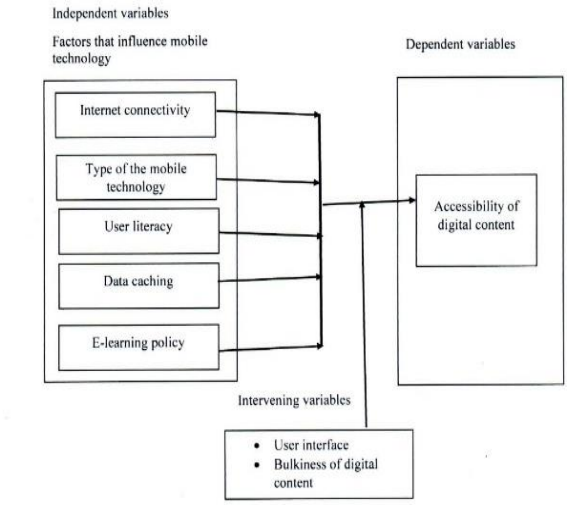

Figure 3: Conceptual Framework of the Study

1. ***Internet connectivity*** was defined as how students and educators were linked to the internet through a dial-up connection (mobile lines), broadband connections, wireless devices, or satellites. Lu, June did the research; Yu, Chung-Sheng; Liu, Chang; and Yao, James (2003) indicated that acceptance of internet connectivity (technology) was positively related to perceived usefulness because students who have the flow of internet connectivity had a good chance of accessing digital, improve education quality and also had helped students' satisfaction. In this study, internet connectivity is hypothesized to directly affect the accessibility of digital content through perceived usefulness in the TAM.

2. ***Type of mobile technology:*** In this study, the type of mobile technology was added in the TAM as an external construct that depends on perceived usefulness. Mobile technology can be referred to as any device that includes; laptops, tablets, smartphones, and iPods. In the 21st century, the mobile revolution has been changing education, mostly on accessing digital content. According to Belén (2015), tablets and smartphones are changing the way of accessing digital content when most students use tablets and smartphones rather than desktops to access digital content. The efficiency of digital content accessibility, e-learning system usage, and real-time feedback depends on the type of mobile technology used. In this study type of mobile technology is hypothesized to directly affect the accessibility of digital content through perceived usefulness in the TAM.

3. ***User literacy:*** User literacy measured users' ability to use mobile technology, use the internet to access content, and access digital content. Students and educators can communicate through literacy and access digital content comfortably without any blocks using mobile technology. Educators need to be literate to provide education to their students via mobile technology (Callum, 2014). Callum (2014) concluded that educators and students need to have a high literacy level to interact with confidants via mobile technology in the classroom and through m-learning. The user literacy hypothesis directly affected perceived usefulness and ease of use.

4. ***Data caching:*** The data caching concept stores data at proxies or the device browser temporarily. Efficient digital content access in the M-learning system was a problem in the 21st century because students use mobile phones that use limited storage space, which prevents students from accessing a large cache of data (Elmorshidy, 2012). A suggestion was made to store the cache data at proxies nearby for mobile devices such as phones to access digital content from those proxies instead of the main server to reduce latency time for ease of use (Elmorshidy, 2012). It showed that the data caching hypothesis directly affected perceived ease of use.

5. ***E-learning policy:*** In this study, the e-learning policy was added to the TAM as an external construct that depends on perceived ease of use. E-learning policy and its awareness were needed to promote the accessibility of digital content to the students and educators and give out quality education via mobile technology. The M-learning policy should promote gender equality and accessibility for learners with disabilities, which would meet the higher education goals of providing quality education to all students through the use of the ICT strategy of using mobile technology as the vehicle for accessing digital content (Mohamed, Ibtisam, and Nabeela, 2016). People fear using their mobile devices to access digital content, but if the university creates e-learning policy awareness, there will be no fear among educators and some students about their information being disclosed through a network (Mohamed, Ibtisam, and Nabeela, 2016). It indicates that the e-learning policy hypothesis directly affected perceived ease of use.

Research Methodology

This research study used a quantitative research approach to collect data on the improvement of the use of mobile technology in accessing digital content. The study adopted a descriptive survey research design to collect. The locale of the study was Mount Kenya University, which is located in Thika town along General Kago Road in Kiambu County. The study's target population was 15123 individuals comprising 15,000 students, and 123 were educators/ ICT staff who accessed digital content in the academic year 2018-2019. The sample size was determined using Sloven's formula (1960). The sample size was 390, comprising 333 students and 57 facilitators/ICT staff, as shown in Table 1. A questionnaire was the main instrument of data collection. The internal consistency of the research instrument reliability was measured using Cronbach's alpha coefficient. A value of 0.89 was obtained,

showing a high internal consistency. Data were analyzed using descriptive statistics such as mean, percentages, and Pearson product correlation coefficient and inferentially using a regression model.

Table 1: Target population

Schools	***Target population***	***Sample size***
Institute of Security Studies, Justice and Ethics	300	20
School of Business and Economics	2300	60
School of Education	10000	120
School of Engineering, Energy and the Built Environment	200	8
School of Health Sciences	600	30
School of Nursing	300	20
School of Pure and Applied Science	300	20
School of Social Sciences	500	25
School of Computing and Informatics	250	15
School of Public Health	250	15
Total	**15000**	**333**
Lecturer/ICT staff	123	57
Total	**15123**	**390**

Table 2: Testing of normality

	Kolmogorov-Smirnov			Shapiro-Wilk		
	Statistic	df	Sig.	Statistic	df	Sig.
AODC	0.184	0.371	0	0.902	0.371	0
EP	0.167	0.371	0	0.936	0.371	0
UL	0.147	0.371	0	0.946	0.371	0
TOM	0.188	0.371	0	0.93	0.371	0
IC	0.146	0.371	0	0.961	0.371	0
DC	0.19	0.371	0	0.9	0.371	0
a. Lilliefors Significance Correction AODC=Accessibility of Digital Content						

Findings

Before analysis, the data were tested for normality using the Shapiro-Wilk test. The findings are presented in Table 1. Table 2 shows that the data were normally distributed, Shapiro-Wilk = 0.902, $\rho < 0.001$ at $\alpha = 0.05$. The data were also subjected to multicollinearity. The findings are presented in Table 3. Table 3 shows the low VIF runs for all the variables for multicollinearity levels. In this case, no collinearity among predictor variables also shows that the tolerance of all variables in the regression was not equal to 0, indicating that the regression equation was viable. A regression analysis was carried out and yielded the model in Figure 3.

Table 3: Multicollinearity Test

Model	UC		SC	t	Sig.	CS	
	B	SE	Beta			Tle	VIF
Ctd	0.254	0.094		2.699	0.007		
IC	0.090	0.15	0.114	5.814	0.0	0.965	1.036
TOMT	0.24	0.008	0.57	2.948	0.003	0.984	1.016
UL	0.266	0.25	0.299	10.707	0.0	0.476	2.100
DC	0.605	0.25	0.664	24.068	0.0	0.490	2.042
EP	0.033	0.009	0.075	3.523	0.0	0.829	1.206
UC=Unstandardized Coefficient, SC= Standardized Coefficient, Tle= Tolerance							
IC= Internet Connectivity, UL=User 1literacy CS=Collinearity Statistics, SE= Standard Errors							
DC= Data Caching, EP=eLearning Policy, TOMT=Type of mobile technology, Ctd= Constant							

Table 4: Model Summary

Model	R	RS	ARS	Std.
1	0.93	0.864	0.862	0.157
RS= R Square, ARS= Adjusted R Square				
Std= Standard error in the Estimate				
Predictors:- (Constant), Internet Connectivity, eLearning Policy, Type of Mobile Technology, Data Caching, User Literacy				
Dependent Variable:- Accessibility of Digital Content				

Table 5 shows that the model was statistically significant, $F(5, 370) = 464.377$, $\rho < .001$ at $\alpha = 0.05$. Table 4 shows that an adjusted $R^2 = 0.862$ indicates that 86.2% of the total variation of accessibility of digital content can be explained by internet connectivity, e-learning policy, mobile technology, data caching, and user literacy. From Table 6, the following model was derived.

Table 5: ANOVA

Model	SOS	df	MS	F	Sig.
Regression	57.23	5	11.45	464.38	0
Residual	8.997	365	0.025	0	0
Total	66.23	370	0	0	0
SOS=Sum of Square, MS=Mean Square					

Table 6: Coefficient

Model	UC		SC	t	Sig.
	B	SE	Beta		
Ctd	0.254	0.094		2.699	0.007
IC	0.09	0.015	0.114	5.814	0
TOMT	0.024	0.008	0.057	2.948	0.003
UL	0.266	0.025	0.299	10.707	0
DC	0.605	0.025	0.664	24.068	0
EP	0.033	0.009	0.075	3.523	0

$$Y = 0.254 + 0.09\ X_1 + 0.024X_2 + 0.266\ X_3 + 0.605\ X_4 + 0.033\ X_5 + 0.157 \quad (1)$$

Where Y= Access to digital Literacy, X_1= internet connectivity, X_2 = type of mobile technology, X_3 = user literacy, X_4 = data caching and X_5 = eLearning policy.

Table 6 shows the significance level p-value of the predictors shows that internet connectivity ($\rho < 0.001$, e-learning policy ($p = 0.003$), type of mobile technology ($\rho < 0.001$), data caching ($\rho < 0.001$) and user literacy ($\rho < 0.001$) were statistically significant to the model.

The study shows that majority were males (65%) while females were 35%. To resolve the challenge of internet connectivity, the researcher introduced data caching which was confirmed by finding that it was another challenge. The data caching factor was used to cache digital content in the user interface. The respondents agreed that there was a need to introduce data caching in mobile technology to improve accessibility to digital content (mean = 4.33), and also it would reduce the time taken through a network connection to the main servers.

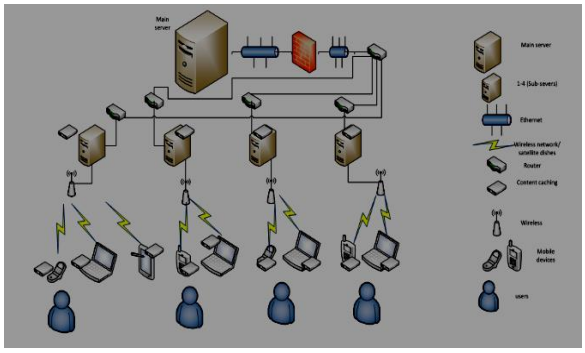

Figure 4: Mobile-based model

Development and Validation of a Model for Accessing Digital Content Via Mobile Technology

One of the findings from this study was that internet connectivity was a major challenge that affected both educators and learners during their daily learning process via mobile technology in the university. To ease the process of both students and educators to access digital content directly from the university's main server and also reduce the challenge of internet connection, using the model developed, digital content was cached in sub-servers and mobile technology where sub-servers were located in different towns such as Nakuru, Lodwar, Kisumu, Nairobi, Mombasa, Garissa, and Eldoret. By caching the content from sub-servers, learners and educators could access digital content freely without being connected to the main server. It also helped students and educators access digital content even when these sub-servers were not connected to the internet because what students needed was the sub-server network to access digital content through WIFI.

This sub-server connects to the main server for uploading/ updating details submitted by either students or lecturers. Any digital content requested by the educator or learner was cached in their mobile technology for a given duration. The digital content was also held in the sub-server using mobile technology. It helped them reduce the challenge of internet connectivity, which came in because they connected to the main server every time they needed to access the content. The assignments, tests and quizzes, and any other content were tackled offline and later submitted to the server once the mobile technology or sub-server gets connected to the internet. The model was validated using expert questionnaires given to the digital learning user, ICT expert, and educator. The model was also validated by implementing the model in the university, which worked successfully.

Recommendations

The study recommends developing a mobile-based caching system e-learning model the Mount Kenya University's management for users to access digital content.

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References

[1] Afzaal H. Seyal, Noah, Abd Rahman, Rudy Ramlie, and Armanadurni Abdul Rahman. (2015). A Preliminary Study of Students' Attitude on m-Learning: An Application of Technology Acceptance Model. International Journal of Information and Education Technology, Volume 5(8), pp. 610.

[2] Belén Cruz Zapata. (2015). Empirical Studies on Usability of mHealth Apps: A Systematic Literature Review: Journal of Medical Systems, Volume 39(2), pp. 182.

[3] Callum, K. M. (2014). Factors Impacting Teachers' Adoption of Mobile Learning. Journal of Information Technology Education; Research, Volume 13(1), pp. 143.

[4] Davis, F. D. (1989). Perceived Usefulness, Perceived Ease of Use, and User Acceptance of Information Technology. IT Usefulness and Ease of Use, Volume 13(3), pp. 320.

[5] Elmorshidy, A. (2012). Mobile Learning – A New Success Model. The Journal of Global Business Management, Volume 8(2), pp. 18-27.

[6] Herold, B. (2016). Technology in Education. Retrieved 22nd January 2018 from https://www.edweek.org/ew/issues/technology-in-education/index.html

[7] Komen, J. L. (2017). M-Learning: Appropriating social media for pedagogy in Africa (PhD, Daystar University Kenya). Retrieved 12th January 2018 from

https://www.researchgate.net/publication/318569679_M_Learning_Appropriating_social_media_for_pedagogy_in_Africa

[8] Lu, June; Yu, Chung-Sheng; Liu, Chang; and Yao, James. (2003). Acceptance of Wireless Internet via Mobile Technology in China. Retrieved 12th August 2018 from https://pdfs.semanticscholar.org/e5dd/6cee0a8d7a43d914f0dde66f98d7171db445.pdf

[9] M. A. Fishbein, Icek Ajzen. (1975). Belief, attitude, intention, and behaviour: An introduction to theory and research. California: Reading, MA: Addison-Wesley.

[10] Mohamed Sarrab, Ibtisam Al Shibli, and Nabeela Badursha. (2016). An Empirical Study of Factors Driving the Adoption of Mobile Learning in Omani Higher Education. International Review of Research in Open and Distributed Learning Volume 17(4), pp. 342.

[11] Mukherjee. (2016). Using technology to bridge the learning gap across Africa.

[12] Ngo Tan Vu Khanh and Gwangyong Gim. (2014). Factors influencing mobile-learning adoption intention; an empirical investigation in high education. Journal of Social Sciences, Volume 10 (2), pp. 51-62.

[13] Wanja, S. N. (2014). Utilization of mobile phones in enhancing learner support services for distance education programs: a case of Mount Kenya University, (master thesis, University of Nairobi, Kenya). Retrieved 10th March 2018 from http://erepository.uonbi.ac.ke/handle/11295/77063

[14] Watson, J. (2015). Blending Learning: The Evolution of Online and Face-to-Face Education from 2008–2015. Retrieved 26th November 2019 from https://www.inacol.org/wp-content/uploads/2015/07/inacol_Blended-Learning-The-Evolution-of-Online-And-Face-to-Face-Education-from-2008-2015.pdf

[15] West, M. (2015a). Digital divide: Improving Internet access in the developing world through affordable services and diverse content. Retrieved 25th March 2018 from https://www.brookings.edu/wp-content/uploads/2016/06/West_Internet-Access.pdf

[16] West, M. D. (2015b). Connected learning: How mobile technology can improve education—retrieved 18th November 2018 from https://www.brookings.edu/wp-content/uploads/2016/07/west_connected-learning_v11.pdf.

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