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Leveraging Informal Learning Practices for Broadening Participation in University Education: A Kenyan Case Study

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Abstract

Kenyan public universities primarily provide classroom-based courses. However, socio-economic realities prevent many rural learners from attending classes regularly. Interestingly, because of the willingness of Kenyans to further their education, informal education is picking up fast. Individuals are forming informal learning circles and have proactively found ways to use smartphones to access online educational resources. This paper explores ways to leverage the strengths of these informal learning practices to enhance participation in formal higher education for Kenyans. One way this can be achieved is through blended learning. With blended learning, students experience the convenience of online learning without losing the on-campus social interactions they are accustomed to. Currently, the use of blended learning in Kenyan public universities is not at the desired level. Economic constraints mean that a lack of conventional computing resources, such as laptops and desktop personal computers, (PCs) is a contributing factor. Given their widespread adoption, we suggest smartphones could be a viable platform for blended learning in Kenya. To explore this idea, a survey was conducted with 114 students in Tom Mboya University College (TMUC), a rurally based public university in Kenya. The survey examined students' attitudes to using smartphones in education. Results indicate smartphones are already an integral part of students' informal education and they have a strong desire to integrate smartphones in their formal education. We envisage that our research will contribute knowledge towards the adoption of blended learning in resource-constrained university environments.

Keywords: learning technologies; smartphone-based learning; blended learning in developing countries; mLearning Africa; higher education Kenya

Introduction

Public universities[1] in Kenya face significant budget cuts due to economic pressure. These cuts have led to a general lack of resources in the universities, notably for the information technology (IT) infrastructure. The paucity of technological resources such as desktop personal computers (PCs) and laptops limits the extent to which these universities can explore other teaching strategies such as blended learning or e-learning (Tarus et al., 2015). As a result, these institutions primarily provide classroom-based courses (Kashorda & Waema, 2014). However, compared with the ever-increasing enrolment rates, these universities have few classrooms,

[1] Our focus is on public universities because they are the most affordable gateway to formal university education.

leading to overcrowded lecture halls (Gudo et al., 2011). As a consequence, many students miss some lectures involuntarily, while others, in a bid to avoid scuffling for seats, voluntarily opt out of attending some lectures. For rural-based learners, the classroom-based mode of learning limits their ability to participate fully in formal higher education, but this is more as a consequence of socio-economic barriers than overcrowded lecture halls. The collectivist culture and subsistence lifestyle of the rural population in Kenya means students have a filial duty to contribute to the family's income (GSMA, 2014a), and so are unable to attend lectures regularly.

Fortunately, because Kenyans are willing to further their education (Gudo et al., 2011), informal education is picking up quickly. Firstly, individuals are forming informal learning circles. For example, Peer-2-Peer University (P2PU), an international organisation that leverages the potential of learning communities to increase access to higher learning, has partnered with Kenya National Library Services to provide free in-person courses and MOOCs across the country (P2PU, 2019). Secondly, despite the general lack of conventional technological resources (laptops and desktop PCs) in the country, Kenyans have proactively found ways to use their smartphones to access free online education. This is apparent when it comes to agricultural education. Eighty percent of the population rely on agriculture for their livelihood (FAO, 2018), and several mobile apps have been designed to provide agricultural students with on-the-go learning content. For instance, the Kenyan government implemented E-extension, a smartphone-supported programme, which provides informal agricultural education to more than seven million farmers (Gichamba et al., 2017).

This paper explores ways to use self-motivation, and the tools used in Kenya's informal learning sector, to broaden student participation in the resource-constrained formal university education sector. Many aspects need to be investigated, but in this paper we focus on two: 1) the potential for furthering blended learning in the universities; and 2) using smartphones as the technological basis for furthering blended learning. As stated earlier, adoption of blended learning in Kenyan public universities is not at the desired level (Kashorda & Waema, 2014; Tarus et al., 2015). Although many other factors—such as institutional policies (Graham et al., 2013) and pedagogical challenges—stunt a transition to blended learning, we stress that the lack of conventional computing resources (laptops and desktop PCs) is salient. Blended learning has the potential to enrich university education in Kenya. Learners will experience the convenience of online learning without losing the on-campus social interaction they are used to. University management will find that blended learning helps to mitigate overcrowding in classrooms because students will not always attend on-campus lectures. The idea of exploring the smartphone as the primary tool for blended learning has a sound basis. Eighty percent of the population in sub-Saharan Africa (including Kenya) has access to a smartphone (compared with 19% desktop PC or laptop ownership) (Deloitte, 2016). It seems that, in spite of noticeable poverty levels in these underdeveloped regions, individuals can still find practical ways to afford low-cost smartphones (Karlsson et al., 2017). Perhaps, unlike in the developed world where smartphones are mostly used in the social context, in sub-Saharan Africa smartphones are necessary to access basic amenities such as finance, health, and agriculture (GSMA, 2017b). More specifically, in Kenya, mobile money (through *M-Akiba* and *M-Pesa* applications) has become a lifeline for most of the population, and has provided access to financial services for the unbanked population (GSMA, 2017c). Hence, smartphones play an integral part in improving the living standards of the Kenyan population.

To advance blended learning in Kenya, we deem it imperative to explore the smartphone as the primary learning tool in formal university education. Smartphones' portability will provide more flexibility for learners who cannot always physically attend lectures—they are already being used (informally) by the Kenyan population to augment their learning outside the classroom, and this could further ease the transition into blended learning. To build an evidence base that this approach (smartphone-supported blended learning) could work in formal university education,

we conducted a survey with 114 students in Tom Mboya University College (TMUC), a rurally based Kenyan public university. The survey examined TMUC students' attitudes to using smartphones in their formal university education. The findings are presented here.

Literature review

The nascent nature of blended learning in developing countries

While acknowledging that there are several definitions of blended learning (Osguthorpe & Graham, 2003), for this article we define it as "the combination of classroom-based and out-of-class technology-mediated instruction" (Graham et al., 2013). Blended learning uses technology's potential for extending learning beyond the classroom but also recognises the importance of the need for physical student–student and student–lecturer interactions. Certainly, blended learning is not a novel concept in the developed world. Many universities in developed countries have progressively reduced in-classroom instruction by using learning management systems (LMSs) such as Moodle and Blackboard, which allow the students to access most of their coursework online. A study by Gaebel et al. (2014) concluded that of the 249 European institutions surveyed, 82% stated that they offer online courses. Obviously, this transformation of how learning occurs is influenced by widespread ownership of personal computers (Baller et al. 2016). Although most of the institutions principally offer blended learning (a mix of online and in-classroom instruction), there is great potential for fully online courses in the near future. To date, institutions like OERu.org and The Open University have made great strides towards offering fully online university certifications.

When we shift the lens to developing countries (particularly those in sub-Saharan Africa), we see that blended learning is still in its infancy. Taking Kenya as an example of a developing country in sub-Saharan Africa, Tarus et al. (2015) aver that public universities in Kenya have only started to incorporate technology in their curriculum. Furthermore, in Ghana, Tagoe (2012) points out that the University of Ghana has done very little in terms of incorporating technology in teaching and learning; and Mbengo (2014) asserts that technology integration is nascent in Zimbabwean state universities.

To more critically demonstrate the validity of our argument and show how far technology-enhanced education (such as blended learning) lags in developing countries, perhaps we should compare its adoption in those countries with adoption in developed regions.

Figure 1 illustrates global PC ownership in the last 15 years, and Figure 2 shows the current state of blended learning in both regions, based on Figure 1 data. Figure 3 shows smartphone adoption from 2010 to 2025.

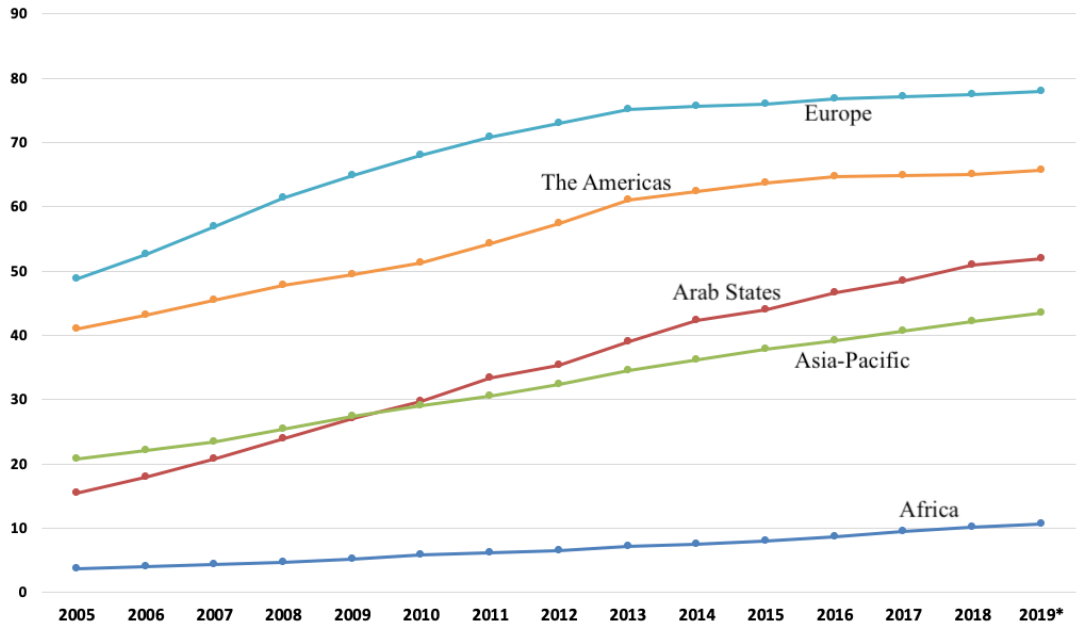

Figure 1 Percentage of PC ownership in the last 15 years (ITU, 2019)

Using Figure 1 as reference, it is interesting to see that PC ownership in Africa today is still nowhere near where it was in the developed world 15 years ago. Accordingly, given that a significant portion of blended courses rely on technology-mediated instruction, it would be wise to assume that the adoption of blended learning in Africa is following the same trajectory.

Educational technology has a long history. Technology-enhanced learning (TEL) gained attention with the advent of personal computers in the latter part of the 20th century. Since then, the discipline of educational technology has experienced several paradigm shifts (Spector et al., 2014). Anderson and Dron (2012) categorise these shifts as first, second, and third generations of learning technology. The first-generation technologies used mass media (television and radio) to broadcast learning content; the second-generation technologies (Web 1.0) put TEL on the map. Web 1.0 provided instant worldwide access to a plethora of educational resources in the form of web pages. However, this content was static, so learners could not interact with other users' web pages on the website. Third-generation TEL incorporated Web 2.0, which was highly interactive (Anderson & Dron, 2012). Web 2.0 allowed learners to comment, contribute, and receive feedback from existing online resources and other users, thereby creating a network of knowledge. Although the three generations still exist, developed and developing countries are now predominantly in third-generation TEL. However, based on Figure 1 data, it can be argued that in developing countries TEL is still in the early stages of the third-generation. Figure 2 illustrates where this article places most of the developing nations in regard to the adoption of TEL. It can be observed that there is a significant gap between developing regions and the developed world. The dates have been retrieved from Casey (2008).

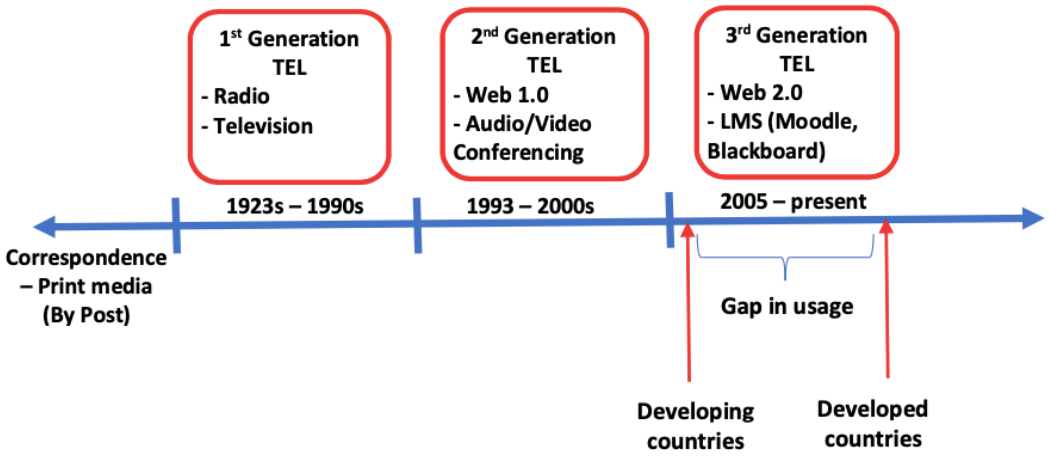

Figure 2 Progression of technology-enhanced learning (TEL) in developing and developed countries

Current effect of smartphones in technology-enhanced learning

Given the globally pervasive presence of smartphones (see Figure 3) and their impressive computing capabilities, higher learning institutions are indeed acknowledging the potential for the pocketable smartphone to provide convenient flexible learning environments, especially when compared with cumbersome laptops. The smartphone has found its niche as a supportive learning tool. Noteworthy examples (in both the developing and developed regions), which highlight where the smartphone lies in principle with regard to educational technology are presented next. Table 1 presents a summary of the studies inspected.

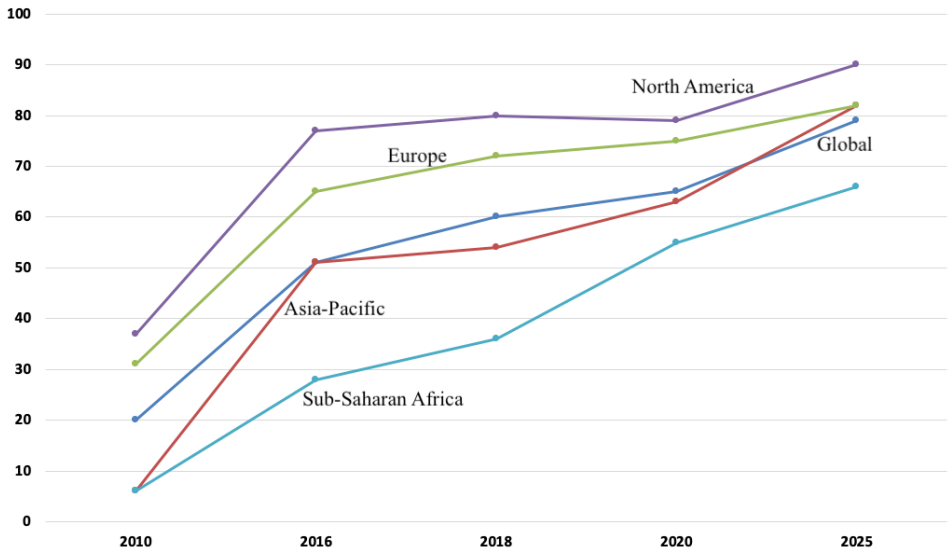

Figure 3 Percentage of smartphone penetration 2010-2025 (GSMA, 2014b, 2015, 2017a, 2019)

i) The developed world

Stanford University's *SMILE* (Stanford Graduate School of Education, 2016), a mobile-based question application, requires students to use their smartphones to generate and share multiple-choice questions to be answered by their peers during class. Each student is expected to take the quiz that is generated from all the students' questions. The quiz results are then displayed

immediately on the student's mobile screen. The game-like collaborative environment increases interaction and engagement.

A Twitter-based smartphone response system that was used at a South Korean university by Kim et al. (2015) required students to use their smartphones to answer quiz questions. Results from the pilot study indicated that students preferred the smartphone-based quiz (on Twitter) to the conventional method of quizzing (paper or verbal). According to the authors, incorporating the smartphone, to which the learners were already personally attached, improved learning efficiency and contributed to increased student engagement.

iPAC, which is used by Open University of Catalonia (Ferran-Ferrer et al., 2014), allows teachers to mark and correct PDF student submissions directly from their iPhone. By allowing annotations via a smartphone, *iPAC* obviates the need for instructors to use PCs, laptops, or paper to provide feedback to students. Once corrected, instructors simply upload the PDF on the iPhone for students to review.

Georgetown University School of Medicine requires its students to own a smartphone (SOM, 2017) for use in clinical rotations. The students use the phones for clinical decision-making and to answer clinical questions at point of care. Their technical skills in applying handheld devices during medical care are also tested with the smartphone. This demonstrates how smartphones are used outside classrooms to support work integrated learning (Scott et al., 2017).

GeoSciTech (Price et al., 2014) enabled pre-service teachers who were studying for a science postgraduate certificate in education to use smartphones to design and test teaching sessions for a fieldwork-based learning activity on botany. *GeoSciTech* facilitated in situ learning by using the smartphone's camera and sensors to allow the pre-service teachers to take pictures and videos, measure temperature and humidity of their environment, and provide spatial patterns of plant distribution and their adaptation in the globe. This demonstrates the smartphone's ability to support learning through augmented reality.

ii) The developing world

The *Dunia Moja Project* (Ryou, 2007; Steinbeck, 2009) is a large-scale ongoing mobile learning project across two continents, connecting faculty and students from Stanford University (USA), University of Western Cape (South Africa), Mweka College of African Wildlife Management (Tanzania), and Makerere University (Uganda). The project was started by Stanford University to pilot an international environmental course that aimed to design global solutions for environmental issues. This is achieved by using smartphones that allow students from these institutions to exchange, contribute, and discuss field-related course content. Students are expected to post multimedia content from their smartphones on *moblog*, the platform's online interactive mobile blog. Here they can show other learners their fieldwork experiments in their local contexts. This exchange allows them to better design global collaborative activities and solutions.

In Kenya, tertiary agricultural education enrolments constitute only 7.4% of overall tertiary enrolments (Kanwar et al., 2015), but about 80% of the population rely on agriculture for their livelihood (FAO, 2018). To improve agricultural education and foster food security, the Kenyan government started an *E-extension* programme that uses the smartphone. The platform can reach more than 7,000,000 farmers in the field to provide informal agricultural education. This is achieved with a combined approach of using mobile apps, social media, short message services (SMS), and agricultural websites that provide tailor-made multimedia content for farmers' specific needs (Gichamba et al., 2017; Tata & McNamara, 2017).

In India, Ray and Deb (2016) leveraged the portability and affordability of smartphones to introduce virtual reality (VR) into an undergraduate course on micro-controllers and Arduino boards. To participate in the session, the students had to connect their smartphones to Google's Cardboard headsets—then they were presented with 3D content with embedded notes and panoramic views. According to Ray and Deb (2016), the smartphone-based VR system was a success and led to a significant increase in student performance.

According to GSMA (2014a), more than 6,000,000 youths in the Philippines are excluded from education due to socio-economic barriers. However, through the *Abot Alam* programme, the government partnered with leading mobile-service providers to expand access to education. The mobile operators provide mobile-based educational materials via mobile phones. For instance, through their Alternative Learning System app, Smart Communications (a leading mobile operator), they partnered with the Open University of Philippines to deliver a MOOC on smartphones.

The University of Botswana School of Medicine (Chang et al., 2012; GSMA, 2011) noted that their trainee physicians in rural hospitals found it difficult to access medical information and assistance from their remote mentors. Hence, the trainees were equipped with 3G-enabled *Google myTouch* smartphones that were preloaded with applications that had content on point-of-care and drug information. They also had a telemedicine app that allowed trainees to submit and discuss case information with their mentors. In this context, the smartphones enabled the trainees to circumvent the lack of connectivity, and facilitated self-directed learning.

In Lesotho, *Sterio.me* (Reid & Pruijsen, 2015), an SMS- and voice-based mobile education project, allows student assignments to be created, shared, and marked on a mobile phone. Initially launched in Nigeria, *Sterio.me* also allows teachers to record lectures and quizzes which can then be accessed for free by the students with a specific SMS code. Once the quizzes are completed, teachers are prompted to provide feedback on performance instantly, or to provide student tutoring.

Table 1 Summary of case studies showing current effect of smartphones in education

Project	**Smartphone's potential**
• SMILE • iPAC • Sterio.me	• Mobile-based assessments
• Twitter-based smartphone response system (South Korea) • Dunia Moja Project	• Global establishment of ad hoc peer-to-peer learning communities.
• Abot Alam • GeoSciTech • Google Cardboard course (India)	• mEducation: delivery of educational resources via mobile learning content management systems (m-LCMS) and in immersive environments (virtual reality and augmented reality).
• Georgetown University SOM • University of Botswana SOM • E-extension (Kenya)	• Supports work-integrated learning.

Reflecting on the aforementioned studies, and on the data presented in Figure 3, we propound smartphones could indeed be a viable platform on which to progress blended learning in Kenya, and to broaden participation in university education. Nonetheless, it is essential we examine this

hypothesis in a real context. The following sections describe where rural Kenya presently lies in principle with our hypothesis.

Study design/approach

The case study

This survey is the first of a series of studies that are part of a larger case-study research: "From Gimmick to Game Changer: A Study on the Use of Smartphones to Expand Access to Higher Education in Developing Countries". Given the proliferation of smartphones in these regions, the mission of the research is to examine how a student who owns a smartphone and does not have access to a laptop or desktop PC can successfully participate in a university course. The practical work mainly targets Kenyan rural learners because they face more socio-economic barriers that limit them from fully participating in university education (WBG, 2018); Kenya is an example of a developing country. The overarching goal of our research is to develop a framework that provides guidelines on how to successfully deliver blended university courses solely to a smartphone. Recent studies of smartphone use in educational settings explore ways to adapt laptop and desktop PC content for viewing on smartphones, but they have not reached the depth of research possible (Livingston, 2009; Pimmer & Pachler, 2014). Little innovative work has been done to customise the content to fit the functional capabilities of a smartphone (Farley et al., 2015; Parsons, 2014). Therefore, developing a framework to facilitate blended learning with smartphones could provide a foundation on which educators in developing countries with a similar context to Kenya (or who have learners who study under the same restrictions) can adopt the approach with little fine tuning.

Survey design

i) Permission

Consent to collect data was obtained from NACOSTI, the government body responsible for authorising all research carried out in Kenyan Universities (NACOSTI, n.d.); the management at Tom Mboya University College (TMUC); and the survey respondents. Before filling out the survey, respondents were made aware (in writing and verbally) that participation was voluntary, and that they could withdraw at any time. Confidentiality was preserved by making the survey anonymous.

ii) Participants

A non-probabilistic convenience sampling technique was used to access TMUC students. Although literature (Creswell, 2012) shows that probabilistic sampling techniques in quantitative research are more rigorous, and are ideal for researchers who want to make generalisations, TMUC had closed for the holidays and we could approach only those individuals who were available (living near or on campus) to participate in the survey. Due to unforeseen time constraints, it was not possible to conduct the survey when school resumed.

Creswell (2012) argues that, although researchers cannot ascertain the respondents are representative of the population in convenience sampling, the sample can still provide useful data for answering hypotheses. So, based on the researcher's knowledge, past experience, and support from TMUC faculty, the survey was extended to all potential participants in the six schools at TMUC. Due to the sampling technique used, there was no specified sample size for the survey. A total of 114 responses were collected.

iii) Data collection and analysis

The survey was a month-long activity. A structured questionnaire, administered as an anonymous online survey, was used to collect the data. The questionnaire was adapted from an existing instrument by Ahmed (2016) and consisted of 42 questions divided into three parts. Part A

gathered nominal data about the participants' characteristics (age, gender, enrolment level; smartphone ownership, and expertise; and students' awareness of free online learning resources). Part B and Part C gathered ordinal data with five-point likert scales, ranging from "strongly-agree" to "strongly disagree". Part B explored the participants' perceptions of using smartphones for various academic activities. Part C assessed the participants' current use of smartphones for education. The questionnaire items were distributed as: Part A = 9; Part B = 13; Part C = 20. A response was required for each question. Descriptive statistics were calculated with Microsoft Excel 2019. Cronbach's alpha coefficient was used to evaluate internal consistency (the extent to which a set of items are interrelated).

Findings

For internal consistency, a Cronbach's alpha (α) of 0.8643 was recorded for Part B and 0.9572 for Part C. The participants' responses were skewed towards "strongly agree" and "agree", implying a high degree of interrelatedness among the items. This indicates satisfactory reliability of the survey (Cortina, 1993; Gliem & Gliem, 2003; Tavakol & Dennick, 2011). In the calculation, Part A was excluded because it largely comprised demographic data. Although the high alpha (> 0.9) in Part C could suggest duplicated items, after a thorough review of the questions we conclude this is not the case. However, because this section (Part C) addressed one construct, "Current Smartphone Use", there was some similarity between some items.

Questionnaire Part A results

Seventy-nine percent of the sample were male; 21% were female. This was expected because the current TMUC enrolment rates stand at 1050 males and 630 females (source: TMUC's Academic Registrar). As illustrated in Table 2, all participants own smartphones and 95% selected the smartphone as their preferred device for education. This is noteworthy—it validates the device ownership trend we presented in the literature review. No participants selected "desktop PC" as an ideal device for education. This could be because, generally, Kenyan public universities have few computer labs (Kashorda & Waema, 2014). As anticipated, more than half of the respondents know of at least one free online learning resource. This could indicate that TMUC students supplement their formal coursework with informal learning resources.

Table 2 Smartphone ownership, expertise, and awareness of free online educational resources (114 responses)

Respondents' Profile	**%**
I own a mobile phone:	
Smartphone	100
Feature phone	0
Basic phone	0
My smartphone operating system is:	
Android	99
Apple iOS	1
Windows	0
Other	0
My skill in using a smartphone is:	
Expert user	77
Good User	22
Limited user	1
My choice device for education is a:	
Smartphone	94
Laptop	5
Desktop PC	0
Tablet	1
I am aware of the following free online learning resources:	
Open Education Resources	18
MIT Open Educational Resources	25
Massive Open Online Courses (MOOCs)	13
Coursera	9
edX	0
None	35

Questionnaire Part B results

Q6 in Table 3 shows that almost all participants like the idea of recorded lectures. This justifies our assumption that integrating online learning in the current classroom-based lessons could enrich the educational experience of many TMUC students. Q1 implies that, if TMUC does implement online learning, the students would like the LMS to have the mobile function enabled. Unlike web-based LMSs, mobile-based LMSs allow offline access to content. This is ideal, given the variety of environments in which students use their smartphones.

Table 3 Do you like the idea of using your smartphone in university education for the following activities? (114 responses)

Key: Strongly Agree – SA; Agree – A; Neutral – N; Disagree – D; Strongly Disagree – SD						
Q	*Activity*	**%**				
		SA	**A**	**N**	**D**	**SD**
1.	Using mobile apps (applications) for learning	48	51	0	1	0
2.	Taking notes during lectures	33	62	1	3	1
3.	Reading e-books	37	61	0	2	0
4.	Using online resources	32	65	0	1	2
5.	Searching for educational resources	36	64	0	0	0
6.	Viewing Video or Audio recorded lectures	38	59	0	2	1
7.	Taking assessments, quiz, surveys and polling	29	68	0	1	2
8.	Submitting assignments	34	64	0	1	1
9.	Asking the lecturer questions	27	72	0	1	0
10.	Communicating with friends for educational help	34	66	0	0	0
11.	Using Social Networking sites for learning	31	66	1	2	0
12.	Collaborating online for learning	32	67	0	1	0
13.	Collaborating with faculty for educational help	30	68	1	1	0

Questionnaire Part C results

The data in Table 4 indicates a high inclination to use smartphones for university education. For example, Q9 demonstrates that 94% of the participants get pleasure from using their smartphone for learning. This could be attributed to feeling that the smartphone increases their productivity as illustrated in Q6. Consequently, it is not surprising that in Q5 and Q8, 97% agreed the cost of their smartphone is worth it; and 96% reported that they regularly use their smartphone to access educational resources. Although Q3 shows 12% of the respondents disagree that using their smartphone for education is effortless, Q1 proves that all the participants are confident they can easily learn this essential skill. This is essential, given that most existing university pedagogies do not comfortably support smartphone use.

Q12 in Table 4 supports our argument that Kenyans are generally social learners. This is further backed up by the data in Q11–Q13 in Table 3, which indicates almost all students are in favour of collaborating online with their peers and lecturers. We are aware that smartphone use (especially on social-networking sites) could be a distraction from study, but one way to mitigate this issue is for instructors to start creating activities and resources that support the way students already use their devices (Farley et al., 2015; Tossell et al., 2015). This could cause students to increasingly perceive smartphones as learning tools. As it is, items Q17–Q20 in Table 4 suggest that TMUC students have a strong desire to continue using their smartphones for study.

Table 4 Please respond to the following statements about your current smartphone usage (114 responses)

Key: Strongly Agree – SA; Agree – A; Neutral – N; Disagree – D; Strongly Disagree – SD						
Q	*Item*	**%**				
		SA	**A**	**N**	**D**	**SD**
1.	Learning how to use my Smartphone for my education is easy for me.	51	49	0	0	0
2.	I have the knowledge necessary to use my Smartphone for my education.	37	63	0	0	0
3.	Using my Smartphone for my education is effortless.	29	57	2	11	1
4.	I have the resources necessary to use my Smartphone for my education.	26	67	1	5	1
5.	Considering its benefits, my Smartphone cost is acceptable for my university education.	32	65	1	2	0
6.	Using my Smartphone for my university education increases my productivity.	39	56	2	3	0
7.	My Smartphone assists me in my university assignments.	39	58	1	2	0
8.	I regularly use my Smartphone to access helpful learning content from the Internet to aid my university education.	33	63	1	3	0
9.	I get pleasure using my Smartphone for my education.	32	62	2	3	1
10.	My Smartphone lets me learn anywhere and anytime.	35	62	1	2	0
11.	I use my Smartphone to communicate with my university classmates for educational help.	32	63	2	3	0
12.	I collaborate with my university classmates using my Smartphone for my education needs.	35	62	1	2	0
13.	My Smartphone is the first device I use to contact my classmates for educational help.	34	62	1	2	1
14.	My family is supportive of the use of my Smartphone for my education.	30	66	1	2	1
15.	My university lecturers and supervisors encourage me to use my Smartphone for my education.	27	66	0	6	1
16.	My Smartphone gives me flexibility in learning when I access online content for my university education.	39	58	0	3	0
17.	My Smartphone is central to my daily life.	25	70	0	5	0
18.	As a student, leaving my Smartphone at home would force me to go back home and pick it up.	32	63	1	4	0
19.	The use of my Smartphone has become a habit in my education.	30	66	1	3	0
20.	I plan to continue using my Smartphone for my education.	39	58	0	3	0

Discussion

The survey results demonstrate that TMUC students are happy to use their smartphones for formal education. The next step in our case study is to look at the lecturers' attitudes to smartphone use in formal education. For this, we have an unpublished paper that indicates TMUC lecturers are flexible and willing to integrate smartphones in their teaching. We plan to redesign an existing classroom-based TMUC course into a smartphone-supported blended course to determine the requirements and decision points that emerge when blended learning is adopted at TMUC. For example, what institutional policies and learning and teaching strategies need to change to accommodate a blended course? Note that, although the context of this article is rural Kenya, the research can be generalised. Most of the attributes of Kenyan rural learners and Kenyan rural-based universities are evident in other developing countries (particularly in sub-Saharan Africa). Table 5 presents some of the general characteristics of rural areas, learners, and universities in most developing countries.

Table 5 Characteristics of rural areas, rural learners and rural-based universities in Kenya and most developing countries

Characteristics (rural areas)	**Description**
Remote	• Usually far from basic amenities/infrastructure (e.g., roads, technology, tertiary institutions) (GSMA, 2016; WBG, 2018).
Subsistence lifestyle	• Inhabitants typically live on minimum wages, just enough for survival (WBG, 2018).
Characteristics (rural learners)	**Description**
Experience digital exclusion	• Limited access to technological resources (e.g., laptops, desktop PCs, fixed broadband networks and/or wifi), but most have smartphones (Deloitte, 2016; Spector et al., 2014).
Educational constraints	• Remote locations means they have limited access to tertiary institutions/education (GSMA, 2014a). • Typically cannot afford current university education fees (due to subsistence lifestyle) unless funded by the government (GSMA, 2014a; Spector et al., 2014; UNESCO, 2010).
Part-time students	• Have to work to support and contribute to the family income (GSMA, 2014a).
Social learners	• Prefer to work in communities or as groups (Poushter, 2016).
Characteristics (rural-based universities)	**Description**
Overcrowded	• Very few public universities, so strains the institution's resources (e.g., lecture-hall space, learning technologies, and hostel accommodation) (Gudo et al., 2011; Kearney et al., 2012).
Non-comprehensive teaching approaches	• Predominantly support instructor-led approaches in which students have to attend classes on campus (Tarus et al., 2015). • Underdeveloped technology-enhanced courses due to lack of technical resources (Spector et al., 2014).

Conclusion

In many low-income countries, access to personal computers (laptops and desktop PCs) is unusual, which is contrary to what is observed in developed nations. Consequently, technology-enhanced university education strategies such as blended learning (and their affordances) are impoverished, leaving most learners with no choice but to attend classroom-based lectures. Yet, for many of these students, particularly the rural-based learners, socio-economic barriers seriously limit regular lecture attendance. Even so, although there is a general lack of resources in Kenyan public universities to sufficiently cater to the specific needs of these rural-based learners, the self-motivation of the population to further their education outside the formal

classroom has led them to find ways to continue learning in resource-constrained environments. Kenyans are forming informal learning circles and using their smartphones to access informal online education. We propound that, by leveraging the strengths of the informal learning practices of this community, it is possible to enhance participation in formal higher education—thereby removing one more barrier to full participation in university education for Kenyan learners. We envisage our research will contribute knowledge towards the adoption of blended learning in resource-constrained university environments.

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