Factors Influencing Mobile Learning in Selected Universities in Nigeria and the United States

Ajibike Itegboje, Yaba College of Technology, Nigeria.
Solomon Negash, Kennesaw State University, United States.
Titilola Adewale, Texas A & M University, United States

The IAFOR Conference on Educational Research & Innovation 2019
Official Conference Proceedings

Abstract
The prevalence of mobile devices in today's society has made mobile learning a fast spreading alternative to face to face education for underserved learners. Even though it operates on low information communication technology infrastructure (ICTI), a favorable feature for successful implementation of mobile learning especially in rural areas with less internet infrastructure such as rural United States (U.S.), there still exists a gap in its implementation at many higher educational institutions in the U.S. and Nigeria. As a measure of the factors influencing mobile learning in selected universities in these two countries, a modification of the Technology Acceptance Model (TAM) was used to conduct the study. The study investigated the impact of ICTI, institutional support and faculty teaching tasks, on mobile learning in both countries. The study encompassed an online and paper survey of 233 participants drawn from eight selected universities in the two countries as well as a virtually conducted semi structured interview of five respondents. Out of the 233 respondents only 119 data were found useful as the remaining 114 data were found to be incomplete. Data analysis was conducted using Descriptive Statistics and Structured Equation Modelling. The results and findings revealed that ICTI was critical to the implementation of mobile learning in Nigeria while in the United States perceived ease of use was the most critical factor. The implications of mobile learning for higher education in both countries were discussed.

Keywords: Mobile technology, mobile devices, Technology Acceptance Model, mobile learning, Nigeria, United States

iafor
The International Academic Forum
www.iafor.org

Introduction

The role of education in the social uplifting of an individual and the economic development of a nation has been voiced by several leaders. Nelson Mandela described education as the most powerful weapon to use in bringing about change in the world (Mandela, 2003). Teferra and Altbach (2004) posit that higher education is key to modernization and development. Unfortunately, around the world access to higher education has not matched demand, and current enrolment is dwindling due to many factors including:

1. Rising higher education costs and budget cuts for educational institutions in developed countries like the United States (The Economist, 2012), In 2003 58% of parents in the rural U.S. expect their children's educational attainment to be at least a Bachelor's degree, however, as at 2010 it is doubtful if there was any significant improvement in their expectations (Provasnik, KewalRamani, Coleman, Gilbertson, Herring, and Xie, 2007).

2. An inadequate number of academic institutions, limited infrastructure, and shortage of requisite faculty in developing countries, like Nigeria, where less than 20% of qualified candidates get admitted annually into the few available universities and colleges (Moti, 2010; Ajadi, 2010).

To address this decline, and changes in learners' demand, stakeholders will need to embark on other paths to provide education with less infrastructure and at a cheaper cost. The introduction of mobile technology, according to Tai and Ting, 2011 has brought about mobile devices such as smartphones with potentials beyond the basic functions of voice calling and a host of other things. These mobile devices have become global commodities for people irrespective of their literacy or age. In the U. S. and other parts of the world, college students possess some sort of Internet enabled mobile device, such as a 3G cell phone, personal digital assistants (PDAs), and smartphones (El-Sofany, Al-Turki, El-Howimelm, Al-Sadoon, and El-Seoud, 2013), and the prices of these devices continue to fall (Maccallum Jeffery, 2009). These devices have the capacity to run educational applications that will supplement faculty's teaching activities inexpensively.

Traxler (2009) recounts that between 2002 and 2009; the mobile learning community has demonstrated that learning can be provided to underserved citizens. This assertion is based on the fact that mobile devices operate on batteries that can be powered and backed up for use when there is no availability of electrical power supply. This infrastructure is in short supply both in the developed and developing worlds. Despite policies to bridge the gap between telecommunication infrastructure in the city and rural areas in the U.S. (Mills and Whitacre, 2003), some states still lack adequate availability of quality broadband networks, for example, Louisiana State ranks 47th of 50 states of the United States in broadband networks (TechNet, 2012). Considered against these backdrops, the researchers investigated the role of ICTI, Institutional Support (INSSUP) and Faculty tasks (TASKS) on the implementation of mobile learning.

Theoretical Background

Mardis, Hoffman, and Marshall (2008) suggested that since educational research often focuses on practitioner's evaluation, and organizational studies to place schools in a social and technological context. it can be enhanced by borrowing from the theoretical frameworks which guide information systems. Chuttur (2009) reported that the technology acceptance model (TAM) has been the only theory to capture the most attention from the information systems community in investigating user technology behavior. This study was an investigation into faculty user acceptance of mobile learning as an alternative to face-to-face education. Based on this premise the study was conducted using the Technology Acceptance Model (TAM).

Technology Acceptance Model

The Technology Acceptance Model is a theory that specifies the causal relationship between perceived usefulness, perceived ease of use, user attitude, intention and actual usage (Davis, Bagozzi, &Warshaw, 1989). Acceptance has been defined as an act of adoption, meaning, the initial decision to use or not to use a technology. Perceived usefulness (PU) was defined as the degree to which a person believes that using a particular system would enhance his or her job performance, and perceived ease of use (PEOU) is the degree to which a person believes that using a system would be free of effort (Davis, 1989; Davis, Bagozzi, and Warshaw, 1989). The proposed model, therefore, incorporated the constructs ICTI, INSSUP and TASKS into TAM as external variables as well as PU and PEOU as mediating variables between external variable and actual usage (the proposed conceptual model is as depicted in figure 1).

Research Model and Hypotheses

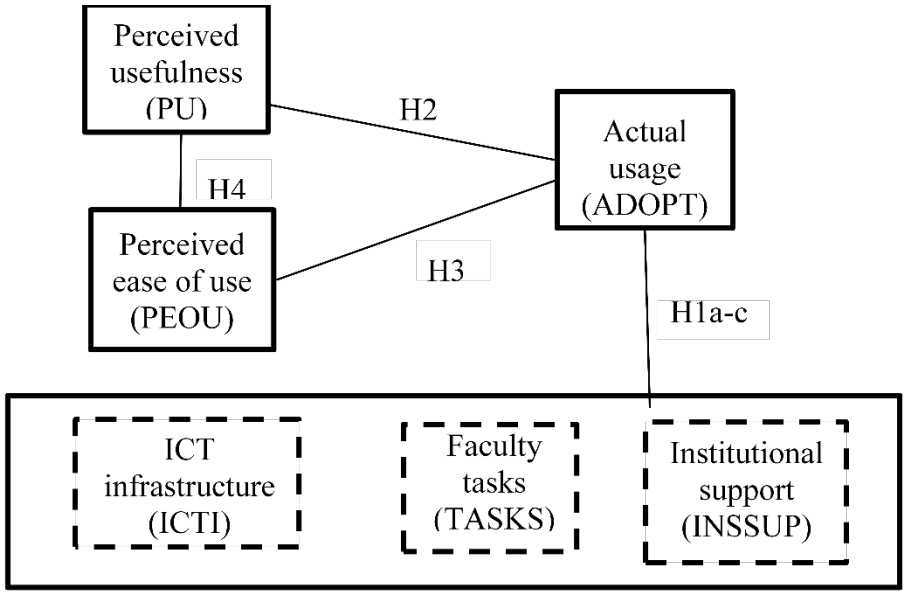

Figure 1: Conceptual Framework Based on TAM Constructs

(dashed boxes introduced by researcher)

ICT Infrastructure and Adoption.

According to Chuttur, (2009), perceived behavioral control (PBC) is influenced by the effects of two beliefs: control belief and perceived facilitation control belief, which are the individual's assessment of available resources to the achievement of a given set of outcomes. Availability of infrastructure is crucial to the usage of any digital device, though mobile technology has been found to be low in infrastructural needs, yet network access and bandwidth size are crucial to its operations. The researchers hypothesized:
H1a: ICT infrastructures have direct effects on actual usage of mobile devices in teaching activities.

Faculty Teaching Tasks and Adoption.

Rapid advances in information and communication technologies have resulted in users' ability to choose from a range of systems, while using the same systems for tasks that are different from what the system was initially designed for, thus leading to user's preference for a system (Sun, 2012). Shih and Chen (2013) reported that TAM usage is attitude related, so a user may use a technology perceived not as useful or easy to use if the technology improves their job performance. Though mobile devices were initially not designed for teaching and learning activities, through innovation and the capabilities possessed by mobile devices, users have extended these tools to teaching activities such as posting information, assignments, lecture delivery, and test taking. To empirically test the direct effect of tasks on adoption, the hypothesis that follows is proposed:
H1b: Faculty tasks have direct effect on actual mobile devices usage in teaching activities.

Institutional Support and Adoption.

Institutional support is the degree to which a technology user believes there exists within the institution both technical resources and management support that will facilitate use of the technology (Al-alak & Alnawas, 2011). Samarawickrema and Stacey (2007), in their study of web-based approach to teaching in six Australian universities revealed that the use of the technology with ongoing training had more impact on usage than ease of use of the technology. To validate the influence of institutional support on usage the hypothesis is proposed:
H1c: Institutional support has direct effect on actual mobile devices usage in teaching activities.

Perceived Usefulness as Moderators of Adoption.

A technology will be used when its perceived benefits outweigh the cost of using it (Lambooij & Hummel, 2013) - benefits such as usefulness of the technology, capabilities of the technology to improve job performance and the ease with which user's goals are achieved with the technology. Two cognitive beliefs which are characterized as perceived benefits and influence adoptive behavior, as posited by TAM, are perceived usefulness and perceived ease of use (Davis, 1989). A user may tolerate a difficult system if it is for accessing the functionality of the system, so long

as it will improve performance of his or her job. To validate the effect of perceived usefulness on actual usage the hypothesis is proposed:
H2: Perceived usefulness has a direct effect on actual usage of mobile devices in teaching activities.

Perceived Ease of Use as Moderators of Adoption.

Gefen and Straub (2000) in their study investigating the importance of perceived ease of use on adoption behavior found that the importance of PEOU on adoption is dependent on the inbuilt value a user attaches to the system characteristics such as the systems usefulness or ability to perform what it specifies to perform, thus effect of PU on adoption far outweighs the effect of PEOU. Wu and Wang (2004) conducted a study on usage of a consumer technology, and their investigation revealed perceived ease of use was not significantly related to usage intention of the technology. To validate the effect of perceived ease of use on adoption, the hypothesis was proposed:
H3: Perceived ease of use has a direct effect on actual usage of mobile devices in teaching activities.

Van Raaij and Schepers (2006), in their quantitative study of 45 MBA students on acceptance and use of a virtual learning system, found that PU had a direct positive impact on system usage but not PEOU, which was found to have an indirect effect on adoption through PU. The effects of perceived usefulness and perceived ease of use on systems usage have been in a mediating role between external variables and actual usage. Consequently, Burton-Jones and Hubona (2006), in their qualitative study of usage behavior of 125 employees of a company, with regards to two different applications found that external variables do have a direct effect on usage behavior, and that the direct effect of external variables on usage is greater than the effects of external variables through the mediating role of perceived ease of use and perceived usefulness. They argued that a technology becomes easy to use and perceived to be useful after routine use, thus making the effect of PU and PEOU become a non-issue to usage. Based on the foregoing, the hypothesis that follows was proposed to validate earlier findings:
H4: Perceived ease of use has a direct effect on perceived usefulness of mobile devices in teaching activities.

Materials and Methods

Thirty-eight items of which twenty-nine were previously validated research items as well as those developed by the researchers were modified to suit mobile technology adoption for teaching activities. The twenty-nine items were used to measure the constructs for the research framework, while the remaining nine items measured the demographic characteristics of participants and the usage level of mobile devices. Three items adapted from Davis (1989) were used to measure PEOU, and six items adapted from (Davis, 1989; Davis et al., 1989; Moore & Benbasat, 1991) were used to measure PU. Three items adapted from Ajzen (1985) and Rogers (2003) were used to measure INSSUP. Four items adapted from Moore & Benbasat, 1991; Butler & Sellbom, 2002; Burton-Jones & Hubona, 2006; Tai & Ting, 2011 were used to measure ADOPT. Eight items on TASKS variables and five items on ICTI related variables were constructed by the researchers (See Appendix A, Table 1).

All items relating to the latent variables were measured on a five-point Likert-type scale, where respondents had to indicate the extent to which they agreed with a given statement.

1. = "Strongly Disagree"
2. = "Disagree"
3. = "Neither Disagree nor Agree"
4. = "Agree"
5. = "Strongly Agree"

Data Collection Procedure

The survey was posted online for academic staff of eight universities, four each from the southwest of Nigeria and the southern part of the United States. The universities run some form of or total distance education and have on-ground infrastructure for electronic learning and wireless Internet facilities.
At the end of five months, responses were received from 233 faculty members across the two countries but only 77 from Nigeria and 42 from the U.S were found usable due to incomplete data. These responses were both from online and paper surveys as most faculty in Nigeria preferred the paper survey. Five participants were interviewed using in-depth, semi-structured interviews for the qualitative phase of the study. The participants sampled included men and women drawn from various disciplines and rank.

Data Analysis and Results

The quantitative data were analyzed using Statistical Package for Social Sciences (SPSS 12.0) for initial item and descriptive analyses. Testing of the measurement model such as construct validity, instrument reliability, structural model, and the statistical significance of the relationships in the model were done using SmartPLS 2.0 M3 software (Ringle, Wende, &Will, 2005), while the Lincoln and Guba (1985) comparative analysis was used for analyzing the qualitative data.

Testing the Measurement Model

In evaluating the measurement model, the reliability, convergent and discriminant validity were tested through a path analysis of the 29 items—ADOPT1-4, ICT1-5, INSSUP1-3, PEOU1-3, PU1-6, TASK1-8. ADOPT1, INSSUP3, PEOU1, PU1, PU2, and PU3 were dropped because they had factor loadings less than 0.6 (Appendix B, Table 2). Hair, Anderson, Tatham, and Black (1992) recommend that any item with factor loadings of less than 0.6 is indicative of poor item reliability (Appendix B, Table 3) is a full summary of the results of the path analysis. According to Hair (2010), the Cronbach Alpha should be above 0.7 for good internal consistency, but ADOPT (ACTUAL_USAGE) and PEOU had values less than this cut off. However, he also recommends a composite reliability value of 0.6 and above as appropriate value for good internal consistency. Since the composite reliability was ACTUAL_USAGE = 0.7859, ICTI = 0.8666, INSSUP = 0.9228, PU = 0.9210, FACULTY_TASKS = 0.9177, and PEOU= 0.7965, these items therefore had a high level of internal consistency. The value of the average variance extracted (AVE) of constructs according to Nunnally (1967) should be greater than 0.5 for good

discriminant and convergent validity to be achieved. The AVE for (ACTUAL_USAGE = 0.5525, ICTI = 0.5685, INSSUP = 0.8567, PU = 0.7975, FACULTY_TASKS = 0.5827, PEOU= 0.6642), which showed good discriminant and convergent validity among constructs. The Fornell and Larcker (1981) criterion for good discriminant validity among constructs is that the square root of the AVE of each construct must be greater than the correlation value between the constructs. Appendix B, Table 4 reveal the square roots of the AVE which are on the diagonal, while the correlations between constructs are in the lower triangle below the square root of the AVE. For example, the square root of AVE for ACTUAL_USAGE = 0.7433 which is greater than the correlation between ACTUAL_USAGE and FACULTY_TASKS = 0.5197, ACTUAL_USAGE and ICTI = -0.2608, ACTUAL_USAGE and INSSUP= 0.0234, ACTUAL_USAGE and PEOU= 0.1383, ACTUAL_USAGE and PU = -0.0411. Thus, based on the Fornell and Larcker (1981) criteria for good discriminant and convergent validity among constructs, the results stated above have further revealed good discriminant and convergent validity among the constructs.

Appendix D, Tables 5 and 6, are demographic statistics of participants in the quantitative and qualitative phases respectively.

Quantitative Results

Results revealed a 57% usage in Nigeria and 51.9% usage in the U.S. (Appendix D, Table 7). Measuring the usage level across the two countries at $\alpha = .05$, $p = .459$ ($p > .05$) (Appendix D, Table 8). This result showed that there were no statistically significant differences between the level of usage in the two countries, though the percentage of users in Nigeria is greater than the percentage of users in the U.S. The results suggest that the selected universities in Nigeria have a greater usage level than the U. S.

The t values for each hypothesized model revealed the following: The Effect of ICT infrastructure on usage in Nigeria was (T statistics = 2.9849, p > 05), tasks for which faculty used mobile devices (T statistics = 5.1647, p > 05), perceived usefulness on usage (T statistics = 4.2365, p > 05)),). Thus, the effects were statistically significant. However, the following were statistically insignificant: perceived ease of use on usage (T statistics = 0.9496, p > .05), institutional support on usage (T statistics = 0.5162, p > 05) and perceived ease of use on perceived usefulness (T statistics = 0.4844, p > .05).

The Effect of ICT infrastructure on usage in the U.S was (T statistics = 1.809, p > .05), Institutional support to usage (T statistics = 1.5006, p > .05), perceived usefulness on usage (T statistics = 1.4297, p > .05). Thus, the effects were not statistically significant. However, the following were statistically significant: perceived ease of use on usage (T statistics = 4.3232, p > .05), tasks for which faculty use mobile devices (T statistics = 5.4925, p > .05), and perceived ease of use on perceived usefulness (T statistics = 2.1501, p > .05). These results revealed a difference in influencing factors for mobile device usage for teaching activities in both countries.

Qualitative Findings

Interviews (Appendix C) with five respondents yielded the following themes: usage level, motivation for usage, factors impeding usage, and improved usage. The researcher asked an interviewee "In your institution, is usage of mobile devices in teaching activities still low despite the need for mobile device usage and good infrastructure, as well as the pervasiveness of the devices in the society at large? "What do you think is responsible for this low usage?". Justified, a U. S. faculty member responded "Faculty do not know they can use mobile devices in teaching activities, even the receptors are laggers - that is, they lag behind in usage, but don't feel a compelling need to use it in all areas of their teaching activities, so they continue to lag behind… Institutional infrastructure is poor, signal strength is bad. In some buildings, you want to access the web and you cannot." The researcher commenting then asked "I have never experienced that in the United States. You mean there are areas where you find Internet access problematic?" Justified reiterated "hmm! Service carriers, you can't get anything, in this area no connectivity and within a few steps away from the area you are connected. Hmm! Down south within a few areas you get nothing."

Another interviewee - Rejoice recounted "usage of mobile devices in teaching activities though mandatory in our institution has been greatly hampered by epileptic power supply and poor Internet access -- for example, bandwidth size and connectivity which are mostly unreliable during the day-time. Many subscribers are on it during the day. My institution does not even give any incentives to using mobile devices." To the question "Can you please detail the reasons for your usage of mobile devices in your teaching activities?", Reliable gave her student-based motivation thus "I come with my own devices, my institution does not even provide. I cannot compromise standards, I do what I do, not to impress any supervisor, but in the interest of my students. I want my students to be able to compete with other students who have been exposed to technology." To the question "Please, can you share with me any additional comments that have not been covered in this interview but are of concern to your use of mobile devices in teaching activities?" Onyx, a Nigerian faculty member was of the view that "we are in the world driven by ICT compulsorily, meaning, the world is a global village and anyone, organizations, institutions, societies, or countries cannot be relevant if they do not embrace the use of ICT in this contemporary world. So consciously or unconsciously, they will all embrace the use of mobile devices at the end of the day."

Discussions

A lower usage level was found in the United States compared to Nigeria. This result corroborates Ellis (2013), who reported that Africa has the highest rate in the world for the use of mobile e-devices for teaching and learning and that mobile devices are perceived as the primary computing device. Moreover, in the United States distance learning stakeholders have used other type of ICT devices such as teleconferencing, and avatars to reach students such that mobile technology may not be a must-use technology for educational engagements.

H1a: ICT infrastructures have direct effects on actual usage of mobile devices in teaching activities.

The results showed that ICT infrastructure was critical to faculty members in Nigeria and the factor played a vital role in mobile devices usage in teaching activities. This finding supported past research findings including Wang (2008); and Nyirigo (2009). These researchers found the availability of appropriate ICT infrastructure to be a contributory factor to the usage of a technology. On the contrary, ICT infrastructure in the U.S. did not have any direct effect on the usage of the devices in teaching activities. This observation may be attributed to the availability of free Internet services in some areas round the clock in the U.S. Contrary in Nigeria, internet facilities are subscribed; therefore, where institutional facility does not support Internet services, access will be limited. Faculty members in the U.S may have reported ICT infrastructure was a non-issue, although a U.S. faculty member interviewed in this study reported erratic Internet access in some areas of the United States could negatively impact usage.

H1b: Faculty tasks have a direct effect on actual usage of mobile devices in teaching activities.

The results showed that "faculty tasks" played a vital role in the use of mobile devices in teaching activities in both countries, supporting the findings of Burton-Jones and Hubona (2006) that external variables directly impact usage. It also supports Shih and Chen (2013) that tasks directly impact technology usage provided the technology improves the user's job performance.

H1c: Institutional support has a direct effect on actual usage of mobile devices in teaching activities.

Institutional support was found to be minimal and with no significant effect on usage of mobile devices in teaching activities in both countries. This result however, differed from findings of Wood, Mueller, Willoughby, Specht and Deyoun (2005), Samarawickrema and Stacey (2007), and Al-alak and Alnawas (2011) that institutional support impacts adoption. The classification of the mobile devices, the sophistication and individual preferences play larger roles in influencing usage than the different institutional supports. This may have accounted for the divergent results from previous research findings. The interviewees from both countries indicated that their motivation to use mobile devices in their teaching activities was mostly fueled by their personal desires to assist their students rather than the support they received from their individual institutions.

H2: Perceived usefulness has a direct effect on actual usage of mobile devices in teaching activities.

Perceived usefulness was found to have a direct effect on actual usage of mobile devices in teaching activities in Nigerian institutions. This supported previous studies by Venkatesh and Brown (2001), Van Raaij and Schepers (2006), Smith (2008), and Pollara (2011) that perceived usefulness of a technology has a direct influence on the usage of the technology. The findings in the United States were contrary i.e. perceived usefulness did not have a direct effect on actual usage. Burton-Jones and

Hubona (2006) argued that the users to whom a particular technology had become routine will no longer be influenced by perceived usefulness. This could explain why perceived usefulness influencing usage is refuted in Nigeria, because the Nigerian faculty usage level is greater than the usage level of U.S. faculty members. Similarly, Shih and Chen (2013) reported that a technological device may be perceived as not very useful, but it will still be used if the user perceived it as improving his /her job performance. The Nigerian interviewee affirmed that mobile technology has been found to be the best device for reaching learners at a distance.

H3: Perceived ease of use has a direct effect on actual usage of mobile devices in teaching activities.

Perceived ease of use was not found to have a significant direct effect on actual usage of mobile devices in teaching activities in Nigeria. This is in agreement with Davis (1989) who found that perceived ease of use predicts perceived usefulness rather than actual usage of a technology. Other researchers, Wu and Wang (2004), Burton Jones and Hubona (2006), reported their research findings that perceived ease of use was not directly related to actual usage of a technology. Paradoxically, the findings of this research in U.S. universities is that perceived ease of use had a direct effect on the usage of the mobile devices in teaching activities (Wood et al., 2005). Furthermore, the usage of mobile devices for many tasks greatly aided proficiency level of the Nigerian faculty; hence, ease of use of the technology has become a non-issue, whereas the tasks usage level was still low in the U.S. The more a technology is used, the less difficult usage becomes (Burton-Jones & Hubona, 2006). Some of the participants in the selected universities in Nigeria were mandated to use mobile devices by their university, while all participants in the U.S. were voluntary users. This may have contributed to the ease of use of the technology in Nigeria. Similarly, as reported by Gefen and Straub (2000), perceived ease of use is dependent more on the usefulness a user attaches to it than on the difficulty experienced in its use. Shih and Chen (2013) said a technology may not be easy to use yet the users will use it if they perceive it as improving their job performance. This may be responsible for the non-significant effect of perceived ease of use on usage as found amongst the Nigerian faculty.

H4: Perceived ease of use has a direct effect on perceived usefulness of mobile devices in teaching activities.

The perceived ease of use was not regarded as a factor that would have any effect on the perceived usefulness of the mobile devices in Nigeria. This finding is in contradiction with Davis (1989), who reported that perceived ease of use has a direct effect on perceived usefulness. The Nigerian faculty members are proficient at using the mobile devices in teaching activities. The devices were no longer difficult for them to use; they have also recognized the usefulness of the devices, as the findings from the interview revealed. This may explain why perceived ease of use had no effect on their perceived usefulness. *Perceived ease of use was found to have a direct effect on perceived usefulness of mobile devices in teaching activities in the case of the U.S.* This is in line with the findings of Davis (1989) and Smith (2008).

Conclusions and Recommandations

There is a need to improve the educational status of citizens in both developed and developing economies to increase their human capital. The findings of this study revealed faculty members in both countries found mobile devices to be a good tool for teaching activities. Adoption of mobile technology in teaching will enable governments and institutions reach and educate more, especially in the rural areas, thereby producing more and better graduates.

For Policy and Decision Makers

The current usage level of mobile devices among faculties has to improve, more so when faculty members in Nigeria reported that they use mobile devices despite the poor ICT infrastructure. To achieve this goal, more incentive must be given to faculties to encourage the use of mobile devices for better communication and stronger interactions with students. In addition policy and decision makers should

a. Make the use of mobile devices mandatory for teaching activities, most especially when courses are to be taught at a distance. In making the use of these devices mandatory, enabling factors should be incorporated - for example, paying for internet subscription for faculty members since they must be connected at all times not just when they are on campus. This will promote distance learning and give better opportunities to financially disadvantaged students allowing them to study at their convenience and at an affordable rate. It will also expose students to technologies, making them relevant in the 21st century and beyond.

b. Provide mandatory training to all faculty members in the use of mobile devices for teaching activities.

c. Further promote the use of mobile devices for teaching at a distance by granting frequency of usage some points in the faculty appraisal score sheet. Similarly, financial support towards the acquisition of mobile devices and easy access via Wi-Fi should be made for all faculty members. The desire on the part of faculty members to have institutional support, especially in the United States where usage level is low, was found to be very strong in this study, and one of the major reasons for this was the low morale of the faculty members.

For Researchers

The use of convenience and purposeful sampling has been recommended in situations where time and cost are the main considerations in a study. However, the weakness of this approach, is that the results and findings of the investigation cannot be generalized (Schonlau, Fricker, & Elliott, 2002). The findings of this study are therefore limited to the selected universities.

The sample sizes in the two countries were not the same though they had similar characteristics. It is possible this dissimilarity in sample size may have affected the findings.

The study was self-reporting i.e., the participants reported their usage behavior, which may be subjective or otherwise biased in many ways. Self-reported usage could have been responsible for the disparity in the factors influencing usage across the two countries. Observing users may have given a different result.

Another limitation was that the sample consisted of voluntary users and mandatory users, a situation that may have affected the responses obtained for the level of usage and ease of use in each country. The design of future research should consider either mandatory use or voluntary use but not the mixture of both.

This research should be replicated with more faculty members within each country; this could make findings generalizable unlike this study where findings were limited to selected universities.

The teaching experiences as well as the effect of academic rankings of the participants were not considered in this study - the observations in this study showed that older faculty members have very poor appreciation of mobile electronic devices and this, if not properly addressed, will have a negative effect on the technological development of the students. It is therefore recommended that future research should have these two variables incorporated into the study.

Appendix A

Table 1. Operationalized of item variables

Constructs	Variable Definition	Item for Variable in institution and personal usage
ICT Infrastructure	The information communication technology infrastructure that permits the usage of mobile technology.	ICTI1-- The wireless Internet in my institution is reliable to support the use of mobile technology for teaching activities. ICTI2-- The quality of infrastructure such as bandwidth support the use of mobile technology. ICTI3--The wireless Internet in my residence is reliable to support the use of mobile technology ICTI4--The quality of infrastructure such as bandwidth in my residence is adequate to support the use of mobile technology. ICTI5— Is bandwidth a critical factor to the success of mobile technology adoption for teaching activities?
Faculty Tasks	Different teaching tasks for which faculty may use their mobile devices.	TASK 1-8 – I know how to use mobile device for… Lectures, posting assignments, retrieval of students' submissions, announcements, Test taking, posting results/grades, posting corrections, Posting a course outline.
Institutional Support	Objective factors in the environment that observers agree make an act easy to do, including the provision of computer.	INSSUP1 -- There are technical supports in my institution for faculty using mobile technology for teaching activities. INSSUP2--There are training sessions for faculty in my institution on how to use mobile technology for teaching activities. INSSUP3--There are incentives in my institution for those using

		mobile technology for teaching activities.
Perceived Usefulness	The degree to which a person believes that using a particular system would enhance his or her job performance.	PU1-- I find mobile devices useful in my teaching activities PU2—Using mobile devices in teaching activities enables me to accomplish more tasks quickly. PU3— I accomplish more teaching activities with the use of mobile devices. PU4-- Mobile technology affords me more interaction time with my students. PU5--Mobile technology allows me to respond promptly to my students' enquiries. PU6--Mobile technology affords me real time broadcast for unforeseen events.
Perceived Ease of Use	The degree to which a person believes that using a system would be free of effort.	PEOU1-- Using mobile devices in teaching activities will make it easier for me to do my job. PEOU2-- I find it difficult to prepare my teaching activities using mobile devices. PEOU3-- I don't have a problem uploading my teaching activities using mobile technology.
Actual Usage	A composite measure of both variety and frequency of usage	ADOPT1- I use my laptop for teaching activities ADOPT2 - I use my tablet PCs for teaching activities. ADOPT3- I use my smartphone for teaching activities. ADOPT4--How often do you use mobile devices in teaching activities?

Appendix B

Table 2. Standardized Factor Loadings after dropping items and recoding PEOU3 Across Countries

	ACTUAL_USAGE	FACULTY_TASKS	ICTI	INSSUP	PEOU	PU
ADOPT2	0.6751					
ADOPT3	0.8310					
ADOPT4	0.7152					
ICT1			0.7946			
ICT2			0.8171			
ICT3			0.7833			
ICT4			0.6728			
ICT5			0.6606			
INSSUP1				0.9455		
INSSUP2				0.9068		
PEOU2					0.8829	
PEOU3					0.7444	
PU4						0.7644
PU5						0.7868
PU6						0.7840
TASK1		0.7527				
TASK2		0.7715				
TASK3		0.7581				
TASK4		0.6927				
TASK5		0.7770				
TASK6		0.7758				
TASK7		0.8279				
TASK8		0.7481				

Table 3. Summary after Deleting items to Test for Reliability and Validity

	Cut off Criteria	AVE	Composite Reliability	Cronbach's Alpha
ACTUAL_USAGE	≥0.60	0.5525	0.7859	0.6164
FACULTY_TASKS	≥0.60	0.5827	0.9177	0.8986
ICTI	≥0.60	0.5685	0.8666	0.8067
INSSUP	≥0.60	0.8567	0.9228	0.8372
PEOU	≥0.60	0.6642	0.7965	0.5114
PU	≥0.60	0.7975	0.921	0.8657

Table 4. Correlation among Study Variables and AVE

	ACTUAL_USAGE	FACULTY_TASKS	ICTI	INSSUP	PEOU	PU
ACTUAL_USAGE	**0.7433**					
FACULTY_TASKS	0.5197	**0.7633**				
ICTI	-0.2608	-0.0558	**0.7540**			
INSSUP	0.0234	0.0482	0.2760	**0.9256**		
PEOU	0.1383	0.1969	-0.0996	0.2286	**0.8150**	
PU	-0.0411	0.1868	0.3349	0.2872	0.1738	**0.8930**

Appendix C

Qualitative Phase- Interview Questions

1. What is your highest level of education?
2. How long have you been in faculty?
3. Please permit me to ask if you are a junior or senior faculty or otherwise
4. What is the level of your expertise in the use of mobile devices in teaching activities?
5. What type of teaching activities do you use mobile devices?
6. What will be the extent of your mobile device usage if you become a senior faculty member?
7. Can you please detail the reasons for your usage of mobile devices for your teaching activities?
8. What is your motivation for using mobile devices for your teaching activities considering the fact that the IT infrastructure at your institution is poorer than your residence and there are no institutional incentives for using the devices for your teaching activates?
9. What problems have you encountered in your usage of mobile devices in teaching activities?
10. In your institution usage of mobile devices in teaching activities is still low in spite of the need for mobile device usage and good infrastructure in your country, as well as the pervasiveness of the devices in the society at large, what do you think are responsible for this low usage (U.S.)
11. Is usage of mobile devices for reaching your distance learners mandatory or voluntary in your institution?
12. In your institution, usage is high, infrastructure is good, but this does not hold in other institutions, what may be responsible for this, what type of incentives are you offered by your institutions for using mobile devices (NIGERIA).
13. Please can you share with me any additional comments that have not been covered in this interview but are of concerns to your use of mobile devices in teaching activities?

Appendix D

Table 5. Demographic Statistics of Participants for Quantitative Phase

	Nigeria			United States		
	Count	% Count	Cumulative	Count	% Count	Cumulative
Gender						
Female	32	41.55	41.55	14	33.33	33.33
Male	45	58.44	100	28	66.66	100
Qualification						
Ph.D.	24	31.2	31.2	33	78.6	78.6
M.Sc.	30	39.0	70.1	8	19.0	97.6
First Degree	19	24.7	94.8	0	0	97.6
Others	4	5.2	100.0	1	2.4	100.0
Rank						
Professor	11	14.3	14.3	13	31.0	31.0
Assoc. Prof/Snr. Lect.	9	11.7	26.0	5	11.9	42.9
Asst. Prof/Lect. I	27	35.1	61.0	14	33.3	76.2
Instr./Lect. II- III	2	2.6	63.6	2	4.8	81.0
Adjunct/Part Time	21	27.3	90.9	5	11.9	92.9
	7	9.1	100.0	3	7.1	100.0
Department						
Science	24	31.2	31.2	4	9.5	9.5
Soc. Science	5	6.5	37.7	8	19.0	28.6
Medical	4	5.2	42.9	0	0	28.6
Engineering	1	1.3	44.2	0	0	28.6
Law	4	5.2	49.4	0	0	28.6
Education	12	15.6	64.9	17	40.5	69.0
Agriculture	1	1.3	66.2	0	0	69.0
Business	0	0	66.2	8	19.0	88.1
Others	26	33.8	100.0	5	11.9	100.0
Mobile Devices						
Used	67	87	Overlap in	31	73.81	
Laptop	43	55.84	devices	10	23.81	
Tablet PCs	51	66.23	used	6	14.28	
Smartphone						

	Nigeria			United States		
	Count	% Count	Cumulative	Count	% Count	Cumulative
Frequency of Use						
Never	3	3.9	3.9	9	21.4	21.4
Sometimes	18	23.4	27.3	9	21.4	42.9
Don't Take Count	13	16.9	44.2	8	19.0	61.9
Often	24	31.2	75.3	11	26.2	88.1
Always	19	24.7	100.0	5	11.9	100.0

Table 6. The Demographic Statistics of Interviewees

Participant's pseudo name	Country	Gender	Qualification	Teaching experience	Rank	Expertise	Category of use
Affluent	Nigeria	Female	MSc.	3 years	Junior	Proficient	Mandatory
Justified	United States	Male	PhD	5 years	Junior	Expert in some areas.	Voluntary
Reliable	United States	Female	PhD	2 years	Adjunct	Proficient	Voluntary
Rejoice	Nigeria	Female	PhD	7 years	Senior	Proficient	Voluntary
Onyx	Nigeria	Male	MSc.	5 years	Junior	Proficient	Mandatory

Table 7. Level of Usage for Teaching Activities Across Countries

			Usage		Total
			No	Yes	
Country	US	Count	39	42	81
		% within Country	48.1%	51.9%	100.0%
	Nigeria	Count	58	77	135
		% within Country	43.0%	**57.0%**	100.0%
Total		Count	97	119	216
		% within Country	44.9%	**55.1%**	100.0%

Table 8. Significance Testing of Usage Across Countries

	Usage
Mann-Whitney U	5184.000
Wilcoxon W	8505.000
Z	-.740
Asymp. Sig. (2-tailed)	.459

References

Ajadi, T.O. (2010). Private universities in Nigeria – the challenges ahead. *American Journal of Scientific Research* 7, 15-24. Euro Journals Publishing, Inc. 2010, retrieved from: http:// www.eurojournals.com/ajsr_7_02.pdf.

Ajzen I. (1985). From intentions to actions: A theory of planned behavior. In J. Kuhl and J. Beckmann (Eds), *Action-control: From cognition to behavior*, Heidelberg, Germany: Springer, 11-39.

Al-alak, B.A. & Alnawas, I. A. M. (2011). Measuring the acceptance and adoption of e-learning by academic staff. *Knowledge Management & E-Learning: An International Journal, 3(2), 201 -221.*

Burton-Jones, A., & Hubona, G.S. (2006). The mediation of external variables in the technology acceptance model. *Information & Management 43* (2006) 706–717 doi:10.1016/j.im.2006.03.007.

Butler, D.L & Sellbom, M. (2002) Barriers to adoption of technology for teaching and learning. *EDUCASE Quarterly, 2,* 22-28 retrieved from http://cmapspublic3.ihmc.us/rid=1KC10V38V-C21PMV-GG/Barriers%20To%20Technology.pd.

Chuttur, M.Y. (2009). "Overview of the technology acceptance model: Origins, developments and future directions," Indiana University, USA. *Sprouts: Working Papers on Information Systems*, 9(37). http://sprouts.aisnet.org/9-37.

Davis, F.D. (1989). Perceived usefulness, perceived ease of use, and user acceptance of information technology. *Management Information Systems Quarterly*, *13*(3), 319–340.

Davis, F.D., Bagozzi, R.P., & Warshaw, P. R. (1989). User acceptance of technology: A comparison of two theoretical models. *Management Science*, *35*(8), 982-1003.

Ellis, R. K. (2013). Mobile learning booms in global markets. *T+D, 67*(12), 12.

El-Sofany, H. F., Al-Turki, T., El-Howimelm, H., Al-Sadoon, A & El-Seoud, S.A. (2013). Improving educational outcomes by providing educational services through mobile technology. *iJIM, 7*(1) retrieved from http://online-journals.org/i-jim/article/view/2287/2449.

Fornell, C. & Larcker, D. F. (1981). Structural equation models with unobserved variables and measurement errors. *J Marks Res 18*(1), 38-50.

Gefen, D., & Straub, D. (2000). The relative importance of perceived ease of use in IS Adoption: A Study of e-commerce adoption. *Journal of the Association for Information Systems*, *1*(8). 1-28.

Hair, J., Anderson, R., Tatham, R., & Black, W. (1992*). Multivariate data analysis*. 2nd Edition. Macmillan. New York.

Hair, J. F., Black, W. C., Babin, B.J., & Anderson, R.E. (2010*). Multivariate data analysis*. Englewood Cliffs, N. J: Prentice Hall.

Lambooij, M. S., & Hummel, M. J. (2013). Differentiating innovation priorities among stakeholder in hospital care. *BMC Medical Informatics & Decision Making, 13*(1), 1-11. doi:10.1186/1472-6947-13-91.

Lincoln, Y. S., & Guba, E. G. (1985). *Naturalistic inquiry*. Beverly Hills, CA.

Mandela, N. R. (2003, July) *"Lighting your way to a better future: Speech delivered at Launch of Mindset Network,* Johannesburg, South Africa Retrieved from http://db.nelsonmandela.org/speeches/pub_view.asp?pg=item&ItemID=NMS909&txtstr=education%20is%20the%20most%20powerful dated September, 3 2014.

MacCallum, K., & Jeffrey, L. (2009). Identifying discriminating variables that determine mobile learning adoption by educators: An initial study. *ascilite,* (pp. 602-608). Auckland. Retrieved from http://www.ascilite.org.au/conferences/auckland09/procs/maccallum.pdf.

Mardis, M., Hoffman, E., & Marshall, T. (2008). A new framework for understanding educational digital library use: re-examining digital divides in U.S. schools. *International Journal On Digital Libraries*, *9*(1), 19-27. doi:10.1007/s00799-008-0035-z.

Mills B. F.& Whitacre. B. E (2003). Understanding the non- metropolitan-metropolitan digital divide growth & change. Vol. 34 Nos. 2 pp 219-243.
Moti, U. G. (2010). The challenges of access to university education in Nigeria. *DSM Business Review,2*(2), 27-56 *ret*rieved from http://www.dsmbusinessreview.com/pdf/vol2no2/di_v2n2c.pdf.

Moore, G.C., & Benbazat, I. (1991). Development of an instrument to measure the perceptions of adoption an information technology innovation. *Information Systems Research*, *2*(3), 192- 222.

Nunnally, J. C. (1967). *Psychometric Theory*. New York: McGraw-Hill,

Nyirigo, N. K. (2009). Technology adoption and integration: A descriptive study of a higher education institution in a developing nation. (Doctoral dissertation, Virginia Polytechnic Institute and State University, Blacksburg, Virginia.)

Pollara, P. (2011). Mobile learning in higher education: A glimpse and a comparison of student and faculty readiness, attitudes and perceptions. (Doctoral dissertation. Louisiana State University and Agricultural and Mechanical College). Retrieved from http://www.google.com/url?sa=t&rct=j&q=&esrc=s&frm=1&source=web&cd=1&ved=0CDIQFjAA&url=http%3A%2F%2Fetd.lsu.edu%2Fdocs%2Favailable%2Fetd-11042011.

Provasnik, S., KewalRamani, A., Coleman, M.M., Gilbertson, L., Herring, W., and Xie, Q. (2007). *Status of Education in Rural America* (NCES 2007-040). National Center for Education Statistics, Institute of Education Sciences, U.S. Department of Education. Washington, DC.

Ringle, C.M., Wende, S., Will, A. (2005). *SmartPLS 2.0 (beta)*. Retrieved from http://www.smartpls.de

Rogers, E. M. (2003). *Diffusion of innovations* (5th ed.). New York. The Free Press

Samarawickrema, G., & Stacey, E. (2007). Adopting web-based learning and teaching: A case study in higher education. *Distance Education*, *28*(3), 313-333. doi:10.1080/01587910701611344.

Schonlau, M., Fricker, R. D., & Elliott, M. N. (2002). *Conducting research surveys via e-mail and the web*. Santa Monica, CA: Rand.
Shih, Y., & Chen, C. (2013). The study of behavioral intention for mobile commerce: via integrated model of TAM and TTF. *Quality & Quantity, 47*(2), 1009-1020. doi:10.1007/s11135-011-9579-x.

Smith, T. J. (2008). Senior citizens and e-commerce websites: The role of perceived usefulness, perceived ease of use, and web site usability. *Informing Science*, 1159-83.

Sun, J. (2012). Why different people prefer different systems for different tasks: An activity perspective on technology adoption in a dynamic user environment. *Journal Of The American Society For Information Science & Technology, 63*(1), 48-63 doi:10.1002/asi.21670.

Tai, Y & Y-L, Ting. (2011). Adoption of mobile technology for language learning: Teacher attitudes and challenges. *Jaltcalljournal*, *7*(1), 3-18.

TechNet, (2012). TECHNET'S 2012 State Broadband Index https://ocio.iowa.gov/sites/default/files/documents/2016/10/technet_2012_state_bb_index.pdf

Teferra, D., & Altbach, P.G. (2004). African higher education: Challenges for the 21st century. *Higher Education, 47*(1), 21-50. Retrieved from http://www.jstor.org/stable/4151555.

The Economist. (2012, December 1). Higher Education. Retrieved from http://www.economist.com/news/united-states/21567373-american-universities-represent-declining-value-money-their-students-not-what-it.

Traxler, J. (2009). Current State of mobile learning in mobile learning: Transforming the delivery of education and training, Ally, M. (Ed.) AU Press, Athabasca University, Edmonton, AB. 9-24.

Van Raaij, E. M., & Schepers, J.J. L (2006). The acceptance and use of a virtual learning environment in China. *Computers & Education, 50*, 838–852. doi:10.1016/j.compedu.2006.09.001.

Venkatesh, V. & Brown, S.A. (2001). A longitudinal investigation of personal computers in homes: Adoption determinants and emerging challenges. *MIS Quarterly, 25*(1), 71-102.

Wang, Y-M. (2008). Determinants affecting consumer adoption of contactless credit card: An Empirical Study. *Cyberpsychology & Behavior, 11*(6), 687- 689. DOI: 10.1089/cpb.2007.0244.

Wood, E., Mueller, J., Willoughby, T., Specht, J., & Deyoung, T. (2005). Teachers" Perceptions: barriers and supports to using technology in the classroom. *Education, Communication & Information*, *5*(2), 183-206. doi:10.1080/14636310500186214ss.

Wu, J-H., Wang, S-C. (2004). What drives mobile commerce? An empirical evaluation of the revised technology acceptance model. *Information & Management, 42,* 719–729. doi:10.1016/j.im.2004.07.001.

Contact email: jibike_itegboje@yahoo.co.uk