



IMPLEMENTATION OF MOBILE VIRTUAL LABORATORY: CONTRIBUTORY FACTORS IN A DEVELOPING COUNTRY

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ABSTRACT

The growing availability of mobile devices across developing countries and coupled with increase awareness of mobile learning as well as the use of mobile devices for laboratory practical warrant the exploration of its wider application in learning. This study explored the factors that contribute to the successful implementation of mobile virtual laboratory in a developing country. A Nigerian higher institution was selected because of its peculiar location in a rural area and was important in the evaluation of the Internet penetration in rural areas of Nigeria for m-Learning. A designed questionnaire for need analysis was distributed to 132 consented participants and the resulting data were analysed using SPSS-21. The study shows that the term mobile learning was not too new to majority of the learners as (44.7%) indicated that they had heard about it. However majority of the respondents (78.8%) had never heard about Mobile Virtual Laboratories. MTN data plan was mostly used for Internet because of its ₦1000 (5 US dollars) data plan. Again, majority of the respondents used Blackberry (57%) and Android phones (32%). Based on the findings in this study, the network, data plan, device type and learners awareness were important factors characterising the needs and choices of learners. Overall, uptake of mobile learning will be easy and enhanced if determinants of learners needs and choice as identified in this study are considered in the implementation of mobile virtual laboratory in a developing country.

Keywords

Contributor factors; Cross-platform; e-Learning; Learning objects; m-Learning; Mobile Virtual Laboratories; Virtual Laboratories

Academic Discipline And Sub-Disciplines

Computer Science

SUBJECT CLASSIFICATION

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INTRODUCTION

Ubiquitous technologies are making it possible for learners not to be bound in fixed classrooms for learning purposes. Such “anytime”, “anywhere” computing platforms have ignited a paradigm shift from e-learning models to m-learning models (Luis de Marcos *et al.*, 2006). Hence increasing research attention is unfolding in the area of m-learning from industrialists, researchers, educationist and policy makers (Ayala and Castillo 2008; Traxler, 2007). As a consequence, m-learning has been variously defined. While considering a mobile device as an enabler of learner mobility, Traxler (2007) defined m-learning as learning which takes place at anytime in anyplace using a mobile device. Similarly, Luis de Marcos *et al.* (2006) defined m-learning as a form of e-learning which employs wireless, tiny, handheld and portable devices to extend and deliver learning to learners. A view earlier expressed by Brown (2005) emphasized that m-learning is e-learning which uses mobile devices to deliver learning. It is evident from the various definitions that m-learning is a form of e-learning which takes place at anytime in any place using mobile devices.

The mobile telephone industry has seen unprecedented growth in developing countries over the last decade. According to International Telecommunication Union ITU (2007), Africa experienced a compound annual growth rate in mobile subscription of 49.4% as compared to Europe’s 17% between 2002 and 2007. By 2007 the ITU posited the World percentage of mobile phone to total number of telephone subscribers at 72.6%. Africa had 89.7% of its total telephone subscribers as being from mobile phone users.

Table 1 NCC - Monthly Subscriber data (May 2013-April 2014)



Monthly Subscriber Data (May 2013 – April 2014)

OPERATOR	Apr '14	Mar '14	Feb '14	Jan '14	Dec '13	Nov '13	Oct '13	Sep '13	Aug '13	Jul '13	Jun '13	May '13	
Connected Lines	Mobile (GSM)	172,913,989	168,595,831	167,371,945	162,719,517	159,758,538	155,938,379	156,129,961	158,239,230	150,891,051	153,665,438	164,642,742	150,888,100
	Mobile (CDMA)	4,076,933	4,083,672	7,620,525	7,667,314	7,684,028	11,241,343	11,341,578	11,307,307	11,344,675	11,462,206	14,250,514	14,217,718
	Fixed Wired/Wireless	328,388	327,524	2,238,458	2,238,894	2,233,981	2,459,530	2,458,077	2,414,988	2,362,487	2,370,287	2,452,697	2,450,260
	Total	177,319,310	173,007,027	177,230,928	172,625,725	169,676,545	169,639,252	169,929,616	171,961,525	164,598,213	167,497,931	181,345,953	167,556,078
Active Lines	Mobile (GSM)	126,958,904	124,884,842	126,246,648	125,173,177	124,841,315	121,000,000	119,101,719	118,470,236	109,846,288	111,866,933	117,412,363	117,765,609
	Mobile (CDMA)	2,256,612	2,039,391	2,398,581	2,421,970	2,404,777	2,377,790	2,423,746	2,438,590	2,440,934	2,519,602	2,567,177	2,593,253
	Fixed Wired/Wireless	172,876	172,963	357,612	365,433	360,537	362,434	362,549	362,392	375,217	373,871	382,678	389,892
	Total	129,391,392	127,097,196	129,002,841	127,960,580	127,606,629	123,740,224	121,888,014	121,271,218	112,271,439	114,760,406	120,362,218	120,748,754
Teledensity	92.42	90.78	92.14	91.40	91.15	88.39	87.06	86.62	80.47	81.97	85.97	86.25	

From the above data table from Nigerian Communication Commission (NCC), the ratio of mobile phone subscribers to fixed telephones in April, 2014 stood at about 747 to 1. By April 2014, the mobile tele-density in Nigeria was 92.42% (NCC, 2014). These statistics present a scenario of high mobile phone in the developing countries like Nigeria. This proliferation presents a fertile ground for M-Learning growth especially if appropriate mobile networking technologies are available to learners.

The justification of this study stems from the realization that in Africa, electronic learning is constrained by limited availability of Internet connectivity, lack of or intermittent power supply, low Internet bandwidth, lack of Information and Communication Technology (ICT) skills and limited financial resources (Farrell and Isaacs, 2007) among others. These constraints can be overcome by mobile learning (Brown, 2005). The following factors that impede the implementation of mLearning are: learner acceptance, Small screen size, lack of data imputing capability, low storage, low bandwidth, limited processor speed, short battery life, software issues and interoperability and finally lack of standardization (Manair and Bennett, 2007; Abu-Al-Alish and Love, 2013; Sarrab *et al.*, 2012) .

Several research works have been carried out in developing countries which have identified that the available mobile devices with different capabilities are positive pointers to the readiness of the educators and students to accept the new trend in education (Osang *et al.*, 2010; Oyerinde, 2014; Asabere, 2013). Factors that lead to the successful adoption and usage of one technology in one country do not necessarily apply to other countries. This is because of the different environmental factors. Osang *et al.*, (2010) posited that in Nigeria factors such as learning environment, perception of the educators, motivation of the educators, security challenges, cost of bandwidth to support mobile learning are parameters that should be considered greatly. The afore- mentioned issues provided the impetus for setting out this study to explore



the factors that are cardinal to the implementation of mobile virtual laboratory in a developing country.

METHODOLOGY

This is a cross-sectional, descriptive questionnaire based study on need assessment analysis. One hundred and fifty targeted learners were purposively selected and 132 consented participants completed the questionnaire. The evaluation was carried out using students from Ambrose Alli University, Ekpoma – Nigeria. This institution was selected because it is located in a rural area and this requirement was important in the evaluation of the Internet penetration in rural areas of Nigeria for m-Learning.

The information assessed included socio-demographic data of respondents, the available mobile network, the Internet data plan and the mobile device mostly used by the students, the learners' awareness of mobile learning was also evaluated.

At the beginning of the experiment, participants had a one-hour orientation session about how to download and use the mobile virtual laboratory components. In the orientation session, each student was informed of the study and briefed on the research instrument.

After returning the questionnaires, the data was processed in preparation for analysis. Data were checked to ensure that there were no inconsistencies and inaccuracies. However, care was taken during survey design, to ensure that clear instructions are given. Each questionnaire was given a unique identifier to avoid duplicate entries during analysis. Unstructured (open ended) responses were categorized into mutually exclusive groups and coded.

The Statistical Package for Social Sciences version 21 (SPSS-21) was used to conduct the statistical analysis. The researcher used the Friedman's test to determine test of significance.

RESULTS

Table 2: Demographic characteristics

FACTORS/VARIABLES	FREQUENCY(N=132)	PERCENT (%)
Year		
100 LEVEL	45	34.1
200 LEVEL	30	22.7
300 LEVEL	15	11.4
400 LEVEL	16	12.1
500 LEVEL	22	16.7
600 LEVEL	2	1.5
MSC/GRADUATE	2	1.5
SEX		
MALE	64	48.5
FEMALE	68	51.5
PROGRAMMES		
Faculty of Natural Sciences (FNS)	91	68.9
Faculty of Mgt Science (MGT SC)	37	28.0
ART	4	3.0

Source: Field survey (2014)

The above Table 2 reveals the demographic characteristics of the respondent of this study. Majority of the respondents (34.1%) are in Year 1 (i.e. 100 level). The female participants are sixty-eight with the proportion of 51% and the remaining proportion of 48.5% are male. This implies that females are slightly more than male respondents. For the programme of study (68.9%) of the participants were from the Faculty of Natural Sciences (FNS) and 28% from the Faculty of Management Science with the lowest number of respondents 4% from Faculty of Arts.



Table 3: Responses to need analysis

FACTORS/VARIABLES	FREQUENCY(N=132)	PERCENT (%)
DATA PLAN		
HOURLY	1	0.8
DAILY	11	8.3
WEEKLY	11	8.3
MONTHLY	104	78.8
OTHERS	5	3.8
COST		
<₦1000	15	11.4
₦1000-2000	100	75.8
>₦2000	17	12.9
TOUCH		
YES	97	73.5
NO	35	26.5
SITE VISIT		
YES	95	72.0
NO	37	28.0
HEARD OF MOBILE LEARNING		
YES	53	40.2
NO	79	59.8
HEARD OF MOBILE VIRTUAL LABORATORY		
YES	18	13.6
NO	114	86.4
INTENDED COURSE IN MVL		
SCIENCE	62	47.0
OTHERS	23	17.4
NONE	47	35.6
USEFULNESS OF LEARNING MATERIALS		
USEFUL	126	95.5



NOT USEFUL	4	3.0
NO RESPONSE	2	1.5
INTEREST IN FURTHER RESEARCH ON MVL		
YES	97	73.5
NO	24	18.2
NO RESPONSE	11	8.3
MOBILE NETWORKS		
GLO	33	25.0
MTN	73	55.3
ETISALAT	2	1.5
AIRTEL	6	4.5
MULTIPLE	18	13.6
PHONE MAKE		
HTC	2	1.5
GIONEE	2	1.5
SONY ERICSSON	5	3.8
SAMSUNG	10	7.6
NOKIA	14	10.6
TECHNO	23	17.4
BLACKBERRY	76	57.6

Source: Field survey (2014)

The Table 3. above indicates that the highest proportion of the participants of this study i.e. (78.8%) supports the monthly Data Plan and only seven of the respondents with a proportion of (0.8%) subscribed to the hourly plan and the remaining (11.4%) of the participants supports daily, weekly and other types of Data Plan. (40.2%) had previously heard of mobile learning while (59.8%) had not heard of mobile learning. This means that a large number of them had previous knowledge of mobile learning. For mobile virtual laboratories (13.6%) had heard of Mobile Virtual Laboratory (MVL) while (86.4%) had



not heard of MVL, which indicates that MVL was new to majority of the respondents. (18.2%) of the respondents indicated that they were not interested in further research on MVL while (73.5%) indicated that they will be interesting in further research on MVL. The Internet service provider mostly used by the respondents on their mobile device was MTN, by 55 % of the respondents followed by GLO (25%) then Airtel (4.5%) and Etisalat (1.5%).

Table 4. Crosstabs showing relationship between cost and phone make

COST * MAKE Crosstabulation									
Count									
		MAKE							Total
		HTC	GIONEE	SONY ERICSSON	SAMSUNG	NOKIA	TECHNO	BLACKBERRY	
COST	<= ₦1000	0	0	0	0	8	4	3	15
	₦1000-2000	0	1	3	8	6	16	66	100
	> ₦2000	2	1	2	2	0	3	7	17
Total		2	2	5	10	14	23	76	132

Chi-square value = 57.394, df =12, p-value = 0.000

From Table 4. above it indicates that there is a significant relationship between cost and Make of phone since the p-value is less than $\alpha(0.000)$ with the chi-square ratio of 57.394 with df=12. This showed that most of the students use a blackberry because of the ₦1000 monthly plan that was most affordable.

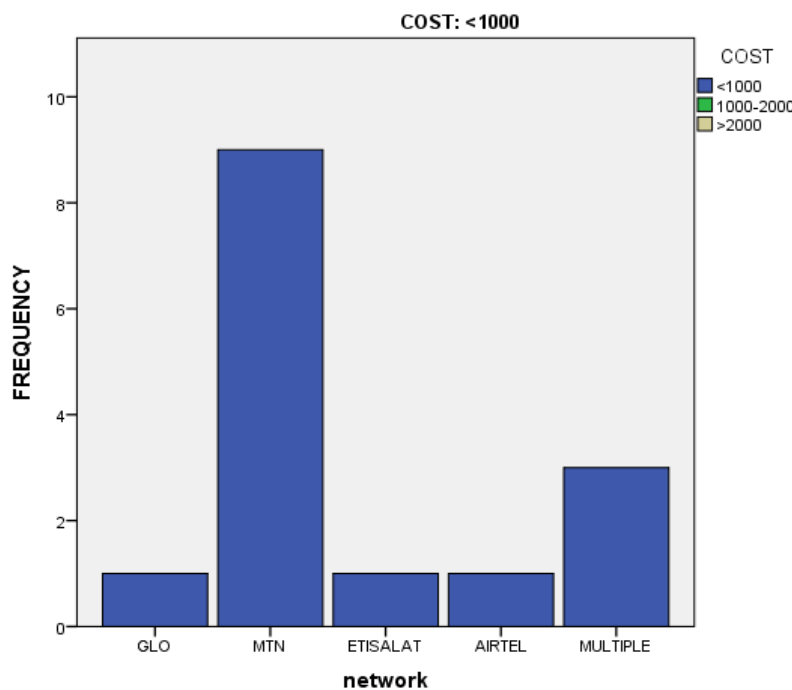


Figure 2: Bar chat showing the mobile networks against cost >₦1,000

The bar chart above shows that most students used MTN network service provider because of the affordable ₦1,000 data plan they provided.

DISCUSSION

The purpose of this study was to present the findings regarding the perceived benefits and barriers to implementing m-Learning using Mobile Virtual Laboratory (MVL). It considered the cost of existing infrastructure, mobile devices, preferred network, and learner factors like informed choice and willingness to use MVL for learning.

The study shows the different types of mobile devices owned by the students; for instance about two-thirds owned blackberry, and about one-third owned Android mobile devices. This indicates that students already have the necessary phone capabilities to support mobile learning, which is in line with the statistics made available by NCC (2014), which indicated that the mobile tele-density in Nigeria was 92.42%. The availability and use of mobile devices like Blackberry and Android will certainly enhanced the quality of the learners content.



Another important area covered by the research was assessing the learners' awareness of mobile learning and mobile virtual laboratory. From the responses, almost half of the respondents had previous knowledge of m-Learning and more half of them had not heard of mobile learning. These findings indicate that mobile learning was not entirely new to the students. A contrary finding was observed with respect to Mobile Virtual Laboratory as over three-quarter of the respondents had never heard of mobile virtual laboratory while less than one-quarter had heard of MVL. As it is Mobile Virtual Laboratory was new to most of the respondents. This finding supports the works of other researchers (Sarrab *et al.*, 2012; Abu-Al-Aish and Love, 2013) and underscores the need for students to be properly oriented in order to effectively participate in its use for learning as well as enhance learner acceptance.

Furthermore, it can be seen from this study that almost three quarters of respondents were interested in further research on MVL, while less than a quarter were not interested in further research. This observation shows that many of the respondents were interested in participating in MVL experiments. Thus, it is an indicator that the students were ready to key into the new mode of learning showing learner acceptance of this new mode of learning. This interest can be further enhanced through motivation, which is in line with recommendations from earlier research (Abu-Al-Aish and Love, 2013; Liu *et al.*, 2010).

Beyond the above, the study observed that over three quarters of the respondents subscribe to the monthly data plan because of its affordability. There is a significant relationship between the cost of the data plan and the make of the mobile device as over half of the students used blackberry for the N1,000 MTN data plan because it is the provider with the cheapest and most flexible data plan. This further supports the fact that the cost of data plan and type of mobile device are important factors for the effective implementation of MVL.

Overall, the study identified factors such as network service provider, data plan, device type and learners awareness that can guide stakeholders when considering implementation of MVL. Similarly, mobile learning was not an entirely new concept, nevertheless majority have never heard about MVL but they showed interest in further research in this area. Evidently, the importance of using MVL mode of learning especially in institutions where they don't have immediate access to expensive laboratory equipment cannot be over emphasized. However, this study identified a number of contributory factors (including network service provider, data plan, device type and learners awareness) as key to the successful implementation of mLearning in developing countries.

Limitations of the study

The survey instrument was only administered in one university. Responses from more universities could possibly enrich the result beyond what was obtained.

CONCLUSION

Mobile learning is the future of education in Nigeria and many developing countries particularly because of the improvement in Internet penetration and the availability of mobile devices.

This study identified the factors that can guide stakeholders considering the implementation of mLearning. Given that mLearning uptake will be easy and enhanced if planning is done with the consideration of learner factors like informed choices, convenience, mobile device, preferred network, cost existing infrastructure amongst others are considered. This paves way for other researchers to build or develop tools for other academic levels from secondary education level to the tertiary level. Mobile Virtual Laboratory implementation strategies require policy makers to ensure that various stakeholders take advantage and explore the opportunities in reaching out to rural communities. We also advocate creation of awareness on MVL.

Future works

Future work would be in the area of measurement of the possible impact that can be achieved with the proposed approach in terms of administering the survey instrument in two other institutions of higher learning and then carry out a comparative analysis of the result.

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