

Applying Diffusion of Innovation (DOI) Theory to Mobile Learning For Quality Education

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Abstract

Embracing of new learning services using mobile devices can enhance students' engagement, enthusiasm, reduce cost of textbook and enhance quality of education. Studies on use of mobile devices for learning are on the increase. However, several mobile learning researches have been on adoption of mobile learning with respect to usage. In order to take advantage of potentials of mobile learning, research that addresses the adoption with respect to quality of education is essential. Diffusion of innovation is one of theories used to ascertain the level of adoption and quality of service from mobile learning. This study used the diffusion of innovation (DOI) theory to study the level of adoption and quality derived from using mobile learning in Nigeria. Statistical Package for Social Science (SPSS) was used for data analysis. The results of the findings will provide insights into m-learning usage in Nigeria and other developing countries.

Keywords: *Adoption, Diffusion of Innovation, m-learning, Perceived Relative Advantage and Perceived Usefulness*

1. Introduction

With the revolution of Information and Communication Technology (ICT) over the years, the different forms of learning have transcended through the following pedagogical phases: face-to-face/classroom, TV-based learning, desktop-based learning, telephone-based learning, web-based learning and mobile learning (m-learning). In Nigeria, the revolution in the telecoms sector has given birth to several operators of GSM companies. This factor has brought about a reduction in cost of subscription as a result of competitive edge. It is an undeniable fact that students and youths are among the most carriers of mobile phones in the developing countries.

Most students of today are connected with a mobile device for communication, and now it's time to connect them to the classroom. Embracing of new learning programs using mobile devices such as iPads, iPod, PDA, *etc.* can enhance students' engagement, enthusiasm, reduce cost of textbook and enhance quality of education. The weakening quality of education and its harrowing effects on the nation is a predicament that calls for great concern.

Diffusion of Innovation (DOI) has been used to determine the level of adoption of information systems in the last two decades. Mobile learning (mlearning) is the use of mobile device to support learning. Mlearning gives a high sense of freedom, consistence and flexibility to the learners, choosing the time to learn, location and the choice of content to learn. The choice of privacy or interaction is also given to the learner [1-2]. The quality of education is enhanced by mlearning and interactions without fear and pressure on both sides is achieved. It is the kind of a learning that has broken all barriers. Age, sex, religion, ethnicity and affluence are no factors to its availability and usage.

Today, a higher percentage of rural dwellers and those in urban centers in Nigeria have access to mobile phones. Nigeria now has a total number of telephone subscribers as 146,561,744 and teledensity as 104.69 [3]. The revolution brought about by mobile technologies has resulted to the emergence of mobile learning, which is a type of e-learning [4]. Mobile learning is any type of learning that is conducted with the help of a mobile device. The embracement of mobile learning by students and educators is vital for the successful implementation of mobile learning systems therefore it is important to understand the factors affecting students' intentions to use mobile learning [5]. Despite the several studies on mlearning adoption, little attention is paid to determine the level of quality derived from using a mobile device for learning. In addition to carrying out investigation of factors that influence the usage and adoption of mobile learning, research on the factors that influence the impact of quality on student learning is required. DOI is one of the factors that has shown to influence both the adoption and usage of IS and their level of quality. This paper considers the role of mobile learning success, and addresses the question of how DOI influences the level of quality derived by students using m-learning. The remaining part of this paper is organized as follows. Section two contains review of literature with emphasis on quality of education in Nigeria and successes on mlearning research. Section three describes research design, model, questions and hypotheses. The research methodology, data analysis/presentation and hypotheses testing/discussion of results are presented in section four. Section five concludes the paper.

2. Literature Review

2.1. Enhancing Quality of Education in Nigeria

In a review of literature, [6] explores the factors that influence educational quality in developing countries and concluded that poor research funding and poor allocation from the government to the education sector have badly influenced the quality of education which show poor infrastructure, non availability of teaching and learning materials in some rural areas, large class sizes, multiple-shift school days and inadequate instructional materials. The most terrible is the fact that some children learn under trees in rural areas but no effective teaching or learning could have taken place under such condition.

Education is a right to all and not a privilege. However, in Nigeria it remains a privilege as many do not have access to education. The quality of education received by those that have access fall short of standard; just as in many developing countries of the world. The face-to- face learning demands the presence of the teacher and the learner where shortage of teachers and time constraint kicked many out of school. These shortcomings led to the revolution in Information and Communication Technology (ICT) and the Open and Distance Learning (ODL) being deployed into the Nigeria's educational system [7].

2.2. Successes of M-Learning Research

Several success stories of mlearning research exist in literature, but not without some hindrances. The current challenges and factors affecting the adoption of m-learning were explained by [8]. The major focus on mlearning research has been on predicting the level of adoption using information system (IS) framework such as TAM for online adult education [9] and Chinese universities [10]. Unified theory of technology and use of technology (UTUAT) was used to study m-learning in [4-5,11]. These IS theories have also been used to study the adoption of new technology in different fields and countries including Saudi Arabia [12]. UTUAT was also used to predict mlearning adoption in developing countries such as Guyana [13], East Africa [14] and Nigeria [15]. The Extended UTAUT was applied to the adoption of m-learning [16]. The self-efficacy

theory, self-directed learning theory, and the UTUAT were used to examine the potential use of mobile device in agricultural education courses [17]. Structural equation modeling using South Korea as a case study was presented by [18].

In the context of diffusion of innovation (DOI) theory, some researches discuss the qualities that determine the successful implementation of an innovation [19]. Diffusion of innovation was applied to several domains in predicting the level of adoption, amongst are Banking [20-21] and Telecenters [22], and Mobile telecommunication sector [23].

Most of the factors investigated in the aforementioned researchers under the IS theory predict the intention to adopt mlearning in schools. The data suggested that students are accepting the use of mobile technology in academic settings to improve learning. The results from the studies show that the acceptance level of students on m-Learning is on the increase. However, the results cannot be generalized in all countries since some of the findings suggest that to promote the adoption of mlearning the country must be considered. Moreso, the mobile learning researches highlighted above dwell more on adoption of mobile learning with respect to usage. In order to take advantage of potentials of mobile learning, research that addresses the adoption with respect to quality of education is desirable.

3. Research Design

3.1. Research Model

The Diffusion of Innovation theory is a tested and trusted model in the investigation of factors affecting adoption of information systems platforms. This research adopts the Diffusion of Innovation theory as theoretical framework and the external variables are: Reliability, responsiveness, availability, product portfolio, competence, complexity, compatibility, and relative advantage. Figure 1 represents the proposed research model. It contains some external variables defined as follows: Perceived ease of use is the “degree to which a person believes that using a particular technology would be free of effort” [24].

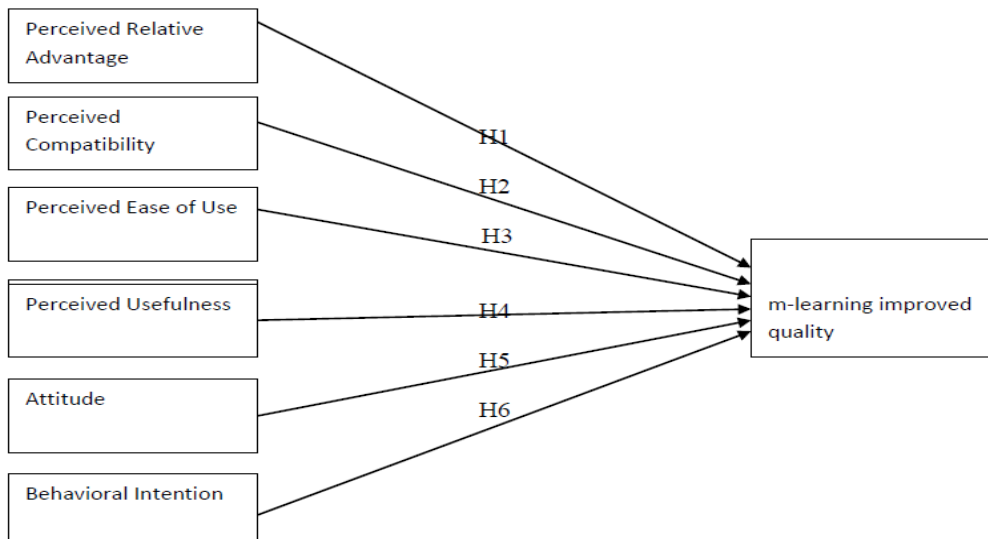


Figure 1. The Research Model

Perceived usefulness refers to the users’ perceptions of the expected benefits derived from using a particular technology or Information Systems [24]. Attitude is the users’ desirability to use a system or technology [24-25]. Previous researches have stated that attitude is the driver of consumer utility. The work in [26] confirmed that customers’ attitude has a dominant positive effect on customers’ intention to use new technologies or

information system. Behavioral intention is “the degree to which a person has formulated conscious plans to perform or not perform some specified future behavior” [24]. Perceived relative advantage is the degree to which an innovation is considered to be better than its predecessors [27]. The advantages should not be as stated by the innovators but by the users. It can be measured in economic, social prestige, satisfaction, and convenience terms. Perceived compatibility is the degree to which an innovation is confirmed to be at par with the values, past experiences, and requirements of potential adopters. An idea that is incompatible with their values, norms or practices will not be adopted as rapidly as an innovation that is compatible.

3.2. Research Question and Hypotheses

This study considers the application of Diffusion of Innovation in mlearning, and mlearning effect on quality of education. The main research question investigated in this study was “How does diffusion of innovation relates to the quality of mlearning for students?”. From the proposed research model, the following research hypotheses are formulated:

- H1: Perceived relative advantage is positively related to m-learning improved quality
- H2: Perceived compatibility is positively related to m-learning improved quality
- H3: Perceived ease of use is positively related to m-learning improved quality
- H4: Perceived usefulness is positively related to m-learning improved quality
- H5: Attitude is positively related to m-learning improved quality
- H6: Behavioral intention is positively related to m-learning improved quality

4. Research Methodology

4.1. Research Instrument

The survey method was adopted for this work. The study employs a questionnaire method to collect data. The questionnaire has two sections; the first section captures respondents’ demographic profile, capability and type of mobile device possessed, and respondent’s mobile learning readiness (nine cogent questions). The second section explores the variables to be studied for acceptance of mobile learning to improve quality, namely: Perceived compatibility (iii), perceived relative advantage (iv), complexity/ease of use (iv), Perceived competence (iii), security risk (iii), attitude (iv), perceived integrity (iii). Others in the section seek to identify respondents’ attitude to m-learning to improve quality of education examining reliability, responsiveness, availability, competence, m-learning usage, content portfolio, ergonomics, social influence and others (three questions each). There are 51 questions altogether.

All model constructs requested participants to indicate their perceptions on five-point Likert-style responses ranging from 1(strongly disagree), through 3(undecided) to 5 (strongly agree). The questionnaires were randomly distributed within the research population: Lagos and Ogun states of Nigeria, the former being densely populated with numerous active people and the latter hosting many higher institutions than any other state in Nigeria. 400 questionnaires were randomly distributed, 362 were received and 33 incomplete. The remaining 329 valid questionnaires were used for the quantitative analysis, representing 82.2% response rate. The data collected was analyzed using the SPSS 16.0.

4.2. Data Analysis and Presentation

A total of 329 questionnaires were analyzed. 62.0% of respondents are male and 38% female. Majority of respondents are from Ogun state with 67.1% and 32.8% from Lagos state. Undergraduate students were involved more than other educational levels with 80.2% undergraduates, 11.6% graduates and 8.2% postgraduate respondents. Considering

employment status, 84.5% are students (learners), 14.3% of the respondents are employed while 1.2% are unemployed. The monthly income of respondents is as shown in Table 1.

Table 1. Demographic Profile

Variable	Frequency	Percentage
Gender		
Male	204	62
Female	125	38
Total	329	100
Location		
Ogun	221	67.2
Lagos	108	32.8
Total	329	100
Education		
Undergraduate	264	80.2
Graduate	38	11.6
Postgraduate	27	8.2
Total	329	100
Employment		
Employed	47	14.3
Student	278	84.5
Unemployed	4	1.2
Total	329	100
Monthly Income		
< 50,000	248	75.3
50000-100000	21	6.4
100000-150000	42	12.8
> 150,000	18	5.5
Total	329	100

The descriptive statistics and correlation analysis is contained in Table 2. The model summary is shown in Table 3. The ANOVA and coefficients values are presented in Table 4 and Table 5 respectively.

Table 2. Descriptive Statistics and Correlation Analysis

		PRA	PC	PEOU	PU	ATT	BI	Mean	Std. Dev.
PRA	Pearson Correlation	1	.475**	.456**	.561**	.551**	.641**	3.7538	1.13235
	Sig. (2-tailed)		.000	.000	.000	.000	.000		
PC	Pearson Correlation	.475**	1	.636**	.558**	.472**	.520**	3.8308	1.05430
	Sig. (2-tailed)	.000		.000	.000	.000	.000		
PEOU	Pearson Correlation	.456**	.636**	1	.512**	.524**	.554**	4.0462	0.99107
	Sig. (2-tailed)	.000	.000		.000	.000	.000		
PU	Pearson Correlation	.561**	.558**	.512**	1	.537**	.676**	3.8000	1.00312
	Sig. (2-tailed)	.000	.000	.000		.000	.000		
ATT	Pearson Correlation	.551**	.472**	.524**	.537**	1	.672**	3.8308	1.00886
	Sig. (2-tailed)	.000	.000	.000	.000		.000		
BI	Pearson Correlation	.641**	.520**	.554**	.676**	.672**	1	4.0000	.96825
	Sig. (2-tailed)	.000	.000	.000	.000	.000			

** . Correlation is significant at the 0.01 level (2-tailed), N = 329

5. Reliability Analysis/Regression

Table 3. Model Summary

Model	R	R Square	Adjusted R Square	Std. Error of the Estimate
1	.683 ^a	.467	.431	.75648

a. Predictors: (Constant), Attitude, Perceived Compatibility, Perceived Relative Advantage, Perceived Ease of Use

Table 4. ANOVA

Model		Sum of Squares	df	Mean Square	F	Sig.
1	Regression	30.064	4	7.516	13.134	.000 ^a
	Residual	34.336	60	.572		
	Total	64.400	64			

a. Predictors: (Constant), Attitude, Perceived Compatibility, Perceived Relative Advantage, Perceived Ease of Use

b. Dependent Variable: Perceived Usefulness

Table 5. Coefficients

Model	Unstandardized Coefficients		Standardized Coefficients	t	Sig.
	B	Std. Error	Beta		
(Constant)	.696	.452		1.538	.129
Perceived Relative Advantage	.242	.105	.273	2.299	.025
Perceived Compatibility	.246	.121	.258	2.022	.048
Perceived Ease of Use	.119	.132	.117	.902	.371
Attitude	.202	.122	.204	1.666	.101

a. Dependent Variable: Perceived Usefulness

6. Hypothesis Testing and Discussion of Results

The result of multiple regression analysis indicates that perceived relative advantage and perceived compatibility have a significant association with the perceived usefulness of quality mobile learning. The results show that perceived relative advantage is positively related to perceived usefulness ($t = 2.299$, $Beta = 0.273$, $p\text{-value} = 0.000$). The result is in tandem with previous studies reported by [28] and [29]. The overall model fit shows that a combination of the entire model constructs ($R^2 = 0.467$, Adjusted $R^2 = 0.431$, $df = 5$, $\alpha = 0.05$, $F = 13.134$, $Pvalue = 0.000$) has significant effect on adoption of mobile learning and its improvement on quality of education. Therefore, the five hypotheses are supported.

7. Conclusion

This research discussed how diffusion of innovation (DOI) can be used to explain mobile learning adoption towards improving quality of education in Nigeria. Using the DOI, the study has confirmed the argument of previous researches that perceived ease of use and perceived compatibility determine the adoption of new technologies or information system. The statistical analysis result reveals that the six external variables used influence the quality and adoption of mobile learning, and perceived usefulness is the anchor factor for mobile learning acceptance.

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