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A Modified Unified Theory of Acceptance And Use of Technology (Utaut) Model For E-Health Services

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ABSTRACT

E-health is a technological tool with the capability of mitigating the myriads of challenges facing the healthcare sector in Nigeria if properly accepted, adopted and deployed. The evaluation of technological tools is usually carried out using a Technology Acceptance Model to improve the usage of these tools. One of such, is the Unified Theory of Acceptance and Use of Technology (UTAUT) model. However, the different economic, social and political environments underscore the need to modify these models to account for the peculiarities of the environment of study. In this study, a modified UTAUT model is developed for evaluating the use and acceptance of E-health services in Lagos, Nigeria. The study develops a modified UTAUT model from factors identified in a focus group discussion and existing literature. The developed model was validated using data describing E-health services usage that was collected using a questionnaire from ten healthcare facilities in Lagos State. 210 responses were received from users of E-health services in the ten healthcare facilities. The questionnaire measured ten identified factors influencing E-health services usage and acceptance. The results of regression analysis revealed that the Social Influence variable had an R-squared value of 0.729. The corresponding values for facilitating condition, Anxiety, Policy, Effort Expectancy, Awareness, Attitude, Self-Efficacy, ICT Infrastructure and Performance Expectancy are 0.550, 0.544, 0.534, 0.494, 0.489, 0.486, 0.449, 0.359 and 0.343 respectively. The result suggests that the strongest impact factor in E-health technology adoption in Nigeria is social influence which meant that most users would use the system if encouraged by their colleagues or superiors.

Keywords: E-Health, Modified UTAUT model, E-health Adoption, Technology acceptance factors

INTRODUCTION

E-health is a modern technology developed to make healthcare delivery more efficient, while allowing patients and professionals to do the previously impossible (Oh, Rizo, Enkin and Jadad, 2005). E-health services, when implemented, offers several benefits to adopters. Some of which include, an informed decision-making process resulting in a better quality of care, remote consultations, cost-effective delivery of care, accurate diagnoses, faster access to a patient's medical history. Due to the advantages of E-health, and the ever increasing cost of delivering qualitative healthcare services, especially in low and middle-income countries, stakeholders in the healthcare sector are searching for innovative approaches to eliminate the geographic and financial barriers to healthcare service delivery. This has resulted in mounting interest in the potential of e-health and m-health in low- and middle-income countries (Adeloye et al. 2017). However, a factor that could impact the growth of E-healthcare in any society is E-healthcare readiness which is defined as the extent to which a community is ready to participate and succeed in E-Healthcare adoption (Coleman and Coleman, 2013). Understanding readiness is a critical first step towards the successful adoption of E-healthcare. In a study by Emuoyibofarhe, (2012), the author evaluated the e-Health readiness status of health practitioners, public, patients and the healthcare mangers from the western part of Nigeria. Result from the study showed that health managers are not structurally ready for E-healthcare while public and patients were willing to embrace the technology if implemented.

Apart from readiness assessment, another tool for improving the adoption of technological solutions is the periodic evaluation of its use and acceptance. The evaluation helps determine the level of acceptability of technological innovation and further reveals factors that influence a wider adoption of the technology. The Unified Theory of Acceptance and Use of

Technology (UTAUT) is a technology acceptance model (TAM) formulated in . The UTAUT explains user intentions to use an information system and subsequent usage behavior. However, due to the growing consensus that the conventional technology acceptance model should be modified and expanded as a result of the different political, economic, social and cultural environments and to provide a better understanding of the behaviour related to internet services, researchers have been modifying the UTAUT model in various research efforts.

In a study , a modified UTAUT model was used to examine the factors influencing information system(IS) acceptance among five healthcare professionals in Canada. The research work developed a research model and tested it with data collected in a survey of 227 healthcare professionals'. Results showed that effort expectancy, social influence, compatibility, and organizational facilitating conditions significantly influenced IS adoption in the country. Another related study utilized the UTAUT model and recent literature on user trust in technology to develop and test a model of the factors influencing South African physicians' acceptance of e-prescribing. To test the developed model, data was collected from a sample of 72 physicians with results indicating a general acceptance of e-prescribing amongst physicians. Results from the study, further revealed that physicians' performance expectancies and perceptions of facilitating conditions had significant direct effects on acceptance whilst trust and effort expectancy had important indirect effects. AlMashgba and Nassar, (2014) also modified the UTAUT Model to Study the Factors Affecting the Adoption of Mobile Banking in Jordan. The modifications on the UTAUT model were in two directions, the first direction was by adding new moderator factor called the influence of education. The second direction was by adding the Reliability, Design Issues, and Security as a three-technology related factor to the UTAUT model. The results showed that Security factor plays the most significant factor on the intention to adopt m-bank services, and the Facilitating Conditions (FC) has a powerful effect in the actual use of m-bank services. A study by Lee, Ma and Wu (2017) integrated perceived enjoyment and cyberloafing with the UTAUT and used the modified model to investigate the behavioral intention and user behavior of access internet device users. The results show that perceived enjoyment can be used as the antecedence variable of performance expectancy (PE) and effort expectancy (EE). In another related study, developed a theoretical model based on the UTAUT model and empirically tested it for determining the key factors influencing elderly users' intention to adopt and use the mHealth services. Result from the study revealed that performance expectancy, effort expectancy, social influence, technology anxiety, and resistance to change had a significant impact on the users' behavioral intention to adopt mHealth services. In Jewer (2018), UTAUT was modified to the context of patient acceptance and use of an Emergency Department (ED) wait-times website. An empirical validation of the modified model revealed that performance expectancy and facilitating conditions had the most significant effect on behavioral intention to use the website, while the effort expectancy impact was not significant.

The survey of literature revealed a scarcity of study on a modified UTAUT model for E-health services in the Nigerian environment, hence the need for this research effort. This current study aims to develop a modified UTAUT model for E-health services in Nigeria.

MATERIAL AND METHODS

The Modified UTAUT Model

To develop a modified version of the UTAUT model for E-health services in Nigeria, a focus group discussion was used to identify and explore perceived factors that influences the adoption and use of E-health services in the country. The focus group discussion comprises of the Head of ICT units in charge of E-health infrastructure in ten health institutions in Lagos state.The analysis of data gathered from the focus group session was then used to develop a modified version of the UTUAT model. The model was modified by adding six new constructs. The added constructs include (i) E-health awareness (ii) ICT Infrastructure (iii) E-health Policy (iv) Self-Efficacy (v) Attitude and (vi) Computer Anxiety. The UTAUT model and

the modified version are shown in Fig. 1 and 2 respectively.

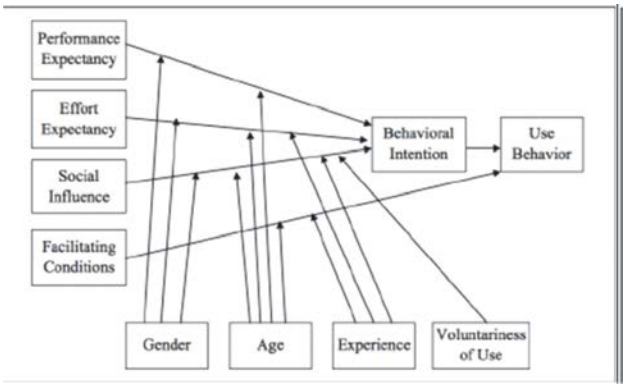

Fig. 1: The UTAUT model

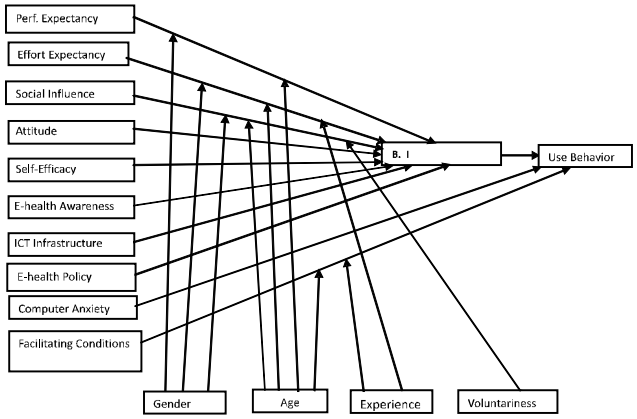

Fig. 2:The modified UTAUT model

Table 1: Factors and their definitions

Model Construct	Definitions
Performance Expectation	how far a user believes that using the system can help him or her to achieve a skill in his or her work performance
Effort Expectation	level of ease which is related to the use of the system
Social influence	describes how far a user believes that a person who is more important than him or her thinks that he or she should use the technology
Facilitating conditions	how far the technology eases the organization and how a user believes that the organization and technical infrastructure that exist can support the use of the technology
Attitude	the beliefs and feelings about computers rather than one's emotional reaction towards using computers
Computer Anxiety	as a fear of computers when using one or fearing the possibility of using a computer
Self-Efficacy	a belief of one's capability to use the computer
ICT Infrastructure	the availability of facilities that E-health depends on
E-health Policy	the availability of a policy or framework that guides the use of E-health technology
E-health Awareness	the knowledge of the benefits provided the E-health technology

Table 2: Constructs and their cronbach alpha values

Construct / Variables	Cronbach's Alpha	Number of Items
Performance Expectancy	0.67	4
Effort Expectancy	0.77	4
Attitude	0.76	4
Social Influence	0.74	3
Facilitating Conditions	0.77	4
Self-Efficacy	0.63	5
Anxiety	0.76	4
Awareness	0.77	2
ICT Infrastructure	0.80	2
E-health Policy	0.76	2
Behavioral Intention	0.53	3
Use of Technology	0.85	2

To establish a relationship between the dependent and independent variables in the model,a regression analysis was carried out. A model of the relationship is hypothesized and estimates of the parameter values are used to develop an estimated regression equation. Various tests are then employed to determine if the model is satisfactory. If the model is deemed satisfactory, the estimated regression equation can be used to predict the value of the dependent variable given values for the independent variables. The model used to describe the relationship between a single dependent variable y and a single independent variable x is

$$Y = 1 \quad \alpha_0 + \alpha 1\chi + \beta = \qquad (1)$$

α_0 and α_1 are referred to as the model parameters, and β is a probabilistic error term that accounts for the variability in y that cannot be explained by the linear relationship with x. If the error term were not present, the model would be deterministic; in that case, knowledge of the value of x would be sufficient to determine the value of Y. β is calculated as

$$\beta = \frac{\sqrt{\left[\frac{\Sigma(yi - yi)^2}{n - 2}\right]}}{\sqrt{\Sigma\,(xi - xi)^2]}} \qquad = \qquad (2)$$

where y_i is the value of the dependent variable for observation i, y_i is estimated value of the dependent variable for observation i, xi is the observed value of the independent variable for observation i, x is the mean of the independent variable, and n is the number of observations.

In correlation analysis, we estimate a sample correlation coefficient, more specifically the Pearson Product Moment correlation coefficient. The sample correlation coefficient, denoted r, ranges between -1 and +1 and quantifies the direction and strength of the linear association between the two variables. Correlation between two variables can be calculated using equation 3 to 6

$$r = \frac{cov(x, y)}{\sqrt{S_{\bar{x}}^2 * S_{\bar{y}}^2}} \qquad = \qquad (3)$$

where *Cov (x, y)* is the covariance of x and y and is defined as

$$Cov\,(x,y) = \Sigma\,\frac{(x - \hat{x})\,(y - \hat{y})}{n - 1} \qquad = \qquad (4)$$

Also, $S^2_{\bar{x}}$ and $S^2_{\bar{y}}$ are the sample variances of x and y and can be defined as

$$S^2_{\bar{x}} = \Sigma \frac{x - \hat{x}}{n - 1} = (5)$$

$$\text{And } S^2_{\bar{y}} = \Sigma \frac{y - \hat{y}}{n - 1} = (6)$$

Based on the research model, this study has postulated to test the following hypotheses:

H1: The influence of performance expectancy on behavioral intention to adopt will be moderated by gender and age.

H2: The influence of effort expectancy on behavioral intention to adopt will be moderated by gender, age, and experience

H3: The influence of social influence on behavioral intention will be moderated by gender, age, voluntariness, and experience

H4a: Facilitating conditions will not have a significant influence on behavioral intention.

H4b: The influence of facilitating conditions on usage will be moderated by age and experience.

H5a: Computer self-efficacy will not have a significant influence on behavioral intention.

H5b: Computer anxiety will not have a significant influence on behavioral intention.

H5c: Attitude toward using technology will have a significant influence on behavioral intention.

H6a: E-health awareness would have a positive effect on the behavioral intention to use E-health technology.

H6b: Availability of ICT Infrastructure would have a positive effect on the use of the technology.

H6c: Availability of an E-health policy would have a positive effect on the use of the technology.

H7: Behavioral intention will have a significant positive influence on usage.

RESULTS AND DISCUSSION

To test Hypothesis 1 (H1), a regression analysis was performed, with Performance Expectancy as an independent variable and Behavioral Intention as the dependent variable. The analysis revealed a $p<0.001$ and $r=0.343$ which supports the hypothesis.

$$BI = 9.099 + 0.343 * \text{Performance Expectancy } x + \beta \text{ with } p<0.001 = (7)$$

For hypothesis 2 (H2), using Effort Expectancy as an independent variable and Behavioral Intention as the dependent variable, result revealed a $p<0.001$ and $r = 0.494$ which supports the hypothesis.

$$BI = 5.933 + 0.494 * \text{Effort Expectancy} + \beta \text{ with } p<0.001 = (8)$$

To test for hypothesis 3 (H3), Social Influence was used as an independent variable and Behavioral Intention as the dependent variable. Result revealed a $p<0.001$ and $r=0.729$ which also supports the hypothesis.

$$BI = 4.915 + 0.729 * \text{Social influence} + \beta \text{ with } p<0.001 = (9)$$

When hypothesis 4a (H4a) was tested with Facilitating Conditions as an independent variable and Behavioral Intention as the dependent variable, result revealed a $p<0.001$ and $r=0.550$ which supports the hypothesis.

$$BI = 4.658 + 0.550 * \text{Facilitating Condition} + \beta \text{ with } p<0.001 = (10)$$

For Hypothesis 4b (H4b), using Facilitating Conditions as an independent variable and Actual Use as the dependent variable. Result revealed a $p<0.001$ and $r=0.389$ which supports the hypothesis.

$$\text{Actual Usage} = 2.655 + 0.389 * \text{Facilitating Condition} + \beta \text{ with } p<0.001 = (11)$$

To test for Hypothesis 5a (H5a), self-efficacy was used as an independent variable and Behavioral Intention as the dependent variable. Result revealed a $p<0.001$ and $r=0.449$ which supports the hypothesis.

BI = 5.102 + 0.449 *
Self Efficacy + β with p<0.001 = (12)

When hypothesis 5b (H5b) was tested using Computer Anxiety as an independent variable and Behavioral Intention as the dependent variable. Result revealed a p<0.001 and r=0.544 which supports the hypothesis.

BI = 4.805 + 0.544 *
Anxiety + β with p<0.001 = (13)

For Hypothesis 5c (H5c), using Attitude as the independent variable and Behavioral Intention as the dependent variable, result revealed a p<0.001 and r=0.486 which supports the hypothesis.

BI = 4.304 + 0.486 *
Attitude + β with p<0.001 = (14)

The test for Hypothesis 6a (H6a), revealed a p<0.001 and r=0.489 which supports the hypothesis while the test for hypothesis 6b revealed a p<0.001 and r=0.359 which also supports the hypothesis. The test for hypothesis 6c also revealed a p<0.001 and r=0.534 which supports the hypothesis.

BI = 6.202 + 0.489 *
Awareness + β with p<0.001 = (15)

Actual Use = 2.905 + 0.359 *
Infrastructure + β with p<0.001 = (16)

Actual Use = BI = 6.205 + (0.534 * Policy) +
β with p<0.001 = (17)

To test for Hypothesis 7 (H7), Behavioral intention was used as the independent variable and Usage as the dependent variable. Result revealed a p<0.001 and r=0.428 which supports the hypothesis.

Actual Use = 4.582 + (0.428 * BI)
+ β with p<0.001 = (18)

Each of the indicators used in the evaluation model showed significant relationship with adoption and use of the E-health system revealing they are all important factors in determining E-health adoption. The data shows that p-value of performance expectancy is (0.002) effort expectancy (0.005), self-efficacy (0.009), anxiety (0.042), awareness (0.001), infrastructure (0.001), policy (0.001), attitude toward using technology (0.004), social influence (0.001) and facilitating conditions (0.000). This meant all these factors impacted the adoption of the system.

On the other hand, the results of correlation and regression analysis revealed that the Social Influence variable had a R-squared value of 0.729. The corresponding values for facilitating condition, Anxiety, Policy, Effort Expectancy, Awareness, Attitude, Self-Efficacy, ICT Infrastructure and Performance Expectancy are 0.550, 0.544, 0.534, 0.494, 0.489, 0.486, 0.449, 0.359 and 0.343 respectively. This suggests that the strongest impact factor in E-health adoption in Nigeria is social influence which meant that most users would use the system if encouraged by their colleagues or superiors. The other factors that influenced the adoption in the impacting order are facilitating conditions, anxiety, self-efficacy, effort expectancy and attitude toward using technology and performance expectancy.

CONCLUSION

This study developed a modified UTAUT model for E-health services. To validate the developed model, E-health services usage data was obtained from 210 respondents in ten hospitals in Lagos, Nigeria. Using regression analysis to establish the relationship between variables in the model, results from the analysis revealed that the model was valid, and that social influence had the strongest influence on a user's behavioral intention to use E-health services. The implication of the developed model is that stakeholders in the healthcare industry can utilize the factors identified to influence a wider use and acceptance of E-health services. It could also be used by researchers when evaluating the level of adoption of E-health services.

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