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Testing the Technology Utilization, Satisfaction and Performance (TUSPEM) Model in a Mandatory Usage Environment

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ABSTRACT

The increasing re-occurrence of information systems (IS) under-utilization and subsequent abandonment despite heavy investments poses great challenges to its sustainability. Unfortunately, existing theories and models in information systems have rather predicted pre-usage, usage and post-usage variables independently. This study focused on understanding the underlying factors determining information system utilization and performance at individual level of analysis in a mandatory usage environment using the technology utilization, satisfaction and performance model (TUSPEM). From the survey instrument administered using stratified sampling technique, the views of 104 lecturers using an information system (e-examination software for students' semester assessment) from an educational institution were analyzed using structural equation modeling. The findings showed a statistically significant relationship between task technology fit, system utilization, user satisfaction and performance. The study would be crucial to understanding and improvements in future information systems analysis, designs and performance impacts as well as the sustainability of information systems in developing countries.

Keywords: Task technology fit, technology utilization-satisfaction-performance model (TUSPEM), Examination.

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INTRODUCTION

In today's world, institutions/organizations are becoming more dependent on information systems for increased level of efficiency, services and productivity. The widespread adoption and utilization of information systems in workplaces across the world is not unconnected to the catalytic and pivotal role information systems play in the 21st century workplaces. Organizations and institutions are today investing heavily in information systems with a view to experiencing massive turnaround and improvements in their businesses. Regrettably, as the number of information systems increases, there are increasing concerns at the rate at which several information systems are being used and abandoned partly due to the complex human factors.

According to Dede (2003), the barriers to using information systems are not so much technical or economic as "psychological, organizational, political and cultural" (p.9). In information system research, the underlying factors resulting from the human – computer interaction has been the subject of investigation among researchers globally.

A critical view on the past literature reveals information systems research models and theories being tailored along the following variables as dependent variables:

- Intention to use information system (Fishbein and Ajzen, 1975, 1980; Davis, Bagozzi and Warshaw, 1989).
- User satisfaction (DeLone and McLean, 2002; Igbaria, Guimaraes and Davis, 1995; McGill, Klobas and Renzi, 2008).
- Task performance (Goodhue and Thompson, 1995; Jarupathirum and Zahedi, 2007).

However, previous studies in the field of information systems have revealed the following weaknesses of the intention to use based models, satisfaction based models as well as users performance based models.

a. **The Intention-Use Based Models**
   - Precursors of use-based researches centre on behavioural intention rather than actual usage (Taylor and Todd, 1995).
   - Technology acceptance model (TAM – a widely used model in this group) is a good predictor of technology when choice of use is not mandatory (Reinders, 2008).
   - Intention based models are not applicable in determining the extent to which technology meets task-related requirements (Tai-Kuiei and Tai-Yi Yu, 2010).
   - It explains as low as 14% of the variance on usage (Wu, 2009; Wu and Du, 2010).

b. Satisfaction-Based Models
   - These models are centred on system, information and service quality with little attention to human impacts on utilization such as users habit, social norms, etc (Goodhue and Thompson, 1995; Staples and Seddon, 2004).
   - System utilization may not be influenced by system quality and information quality (Landrum, 2008).
   - Low model explanatory power. In Perez-Mira dissertation on validating the DeLone-McLean Model of Information System Success (DMIS) at organizational level of analysis, the variability of satisfaction, technology use and net benefits were found to be 1%, 18% and 60% respectively.

c. **Performance-Based Models**
   - The none inclusion of satisfaction in the TPC model especially in the e-learning domain has been identified as a major deficiency (Assefa and Prybutok, 2006; McGill et al., 2011).
   - Low predictive power of model. In the original TPC model, 16% of performance impact was explained by task technology fit (TTF) and utilization Goodhue and Thompson (1995). 31% of learning management system (LMS) performance was explained by TTF and utilization in McGill et al. (2011). 58% of performance impact was explained in Staples and Seddon's (2004).
   - The absence of constructs such as computer self-efficacy, usefulness and ease of use has also been identified by Dishaw and Strong (1999, 2002) as key deficiencies to performance based models.

In addition to the above, available literature in information systems have either investigated users intention to use information systems, utilization of information systems, systems performance, users satisfaction or a combination of two of these variables as dependent variables. There is an absence of research that investigates these key variables using a single model. Available research also shows the limited literature in information systems are primarily focused on developed countries, with little attention being given to developing countries like Nigeria.The work attempted answering the main questions: what factors affect information systems utilization and performance in developing countries and how are these factors related? Understanding and predicting information system usage and performance would in no small measure assist investors and organizations to measure and evaluate their return on investment in information systems in terms of utilization, user satisfaction and performance. This paper therefore tested the technology utilization, satisfaction and performance (TUSPEM) model in a mandatory usage environment context.

2. THE TECHNOLOGY UTILIZATION, SATISFACTION AND PERFORMANCE MODEL

The technology utilization, satisfaction and performance model (TUSPEM) emanated from three predictors of individual performance namely: the belief dimension which focuses on the precursors of utilization; the task technology fit angle that focuses on the suitability of the specific tasks for users and the technology as well as the post usage satisfaction dimension. Constructs like ease of information system usage and perceived usefulness originated from technology acceptance model TAM (1989), satisfaction from DeLone and McLean (2003), computer self-efficacy from Compeau and Higgins (1995). Furthermore, constructs such as task technology fit, usage, user habit, social norms and performance impact originated from the technology-to-performance model TPC (1985). Research on users' belief and behaviour and its impact on utilization of information systems are basically categorized into theories of users' attitude and behaviour. Prominent theories classified under the utilization based models include the work of Ajzen and Fishbein, 1980; Trice and Treacy, (1988); Davis, 1985, 1989; Averweg, 2008; Shrier, 2009. Using the TUSPEM model approach, factors such as users attitude, computer self-efficacy, attitude towards using an information system, users' perception on the usefulness of an information system, ease of using an information system facilitated by technical support and social norms (expectations) predicts technology utilization.

The task technology fit on the other hand can be determined by the combination of certain characteristics associated with the suitability of specific information systems for the accomplishment of given tasks by individuals or groups Goodhue and Thompson (1995). TUSPEM therefore postulates that for maximum performance to be achieved, the task, technology and individual characteristics must be suitable. The TUSPEM model also considered that performance using technology can be achieved when users of information systems are satisfied with the fit of an information system. Consequently, task technology fit and actual usage of information systems results to greater performance impacts when the users are satisfied using a specific information system. The basic argument of the TUSPEM model is that for maximum individual performance to be achieved the information systems must not only fit the task requirement and be used, it must satisfy the users.

From the original TPC model, task characteristics and individual characteristics have been found to influence task technology fit. Staples and Seddon (2004) and McGill et al., (2011) confirmed that it is sufficient to determine the task, technology and individual characteristics by determining task technology fit. The indirect relationship between all the precursors of utilization as contained in the TPC model were assumed to exist by Goodhue and Thompson (1995) and tested by Staples and Siddon (2004). Several information researchers have applied the TPC and TAM models in different context and applications as it relates to the determination of technology utilization and performance outcomes. The TUSPEM model is designed therefore to assist users of information systems in understanding the impact of human interactions with systems and its impacts on users' satisfaction, usage and performance. In a related study, Osang (2016) investigated the relationship between the precursors of system utilization in the open and distance learning environment as contained in the TUSPEM model and how these precursors of utilization influenced email utilization. None of the known research has tested the complete TUSPEM model in figure 1 below in a single study.

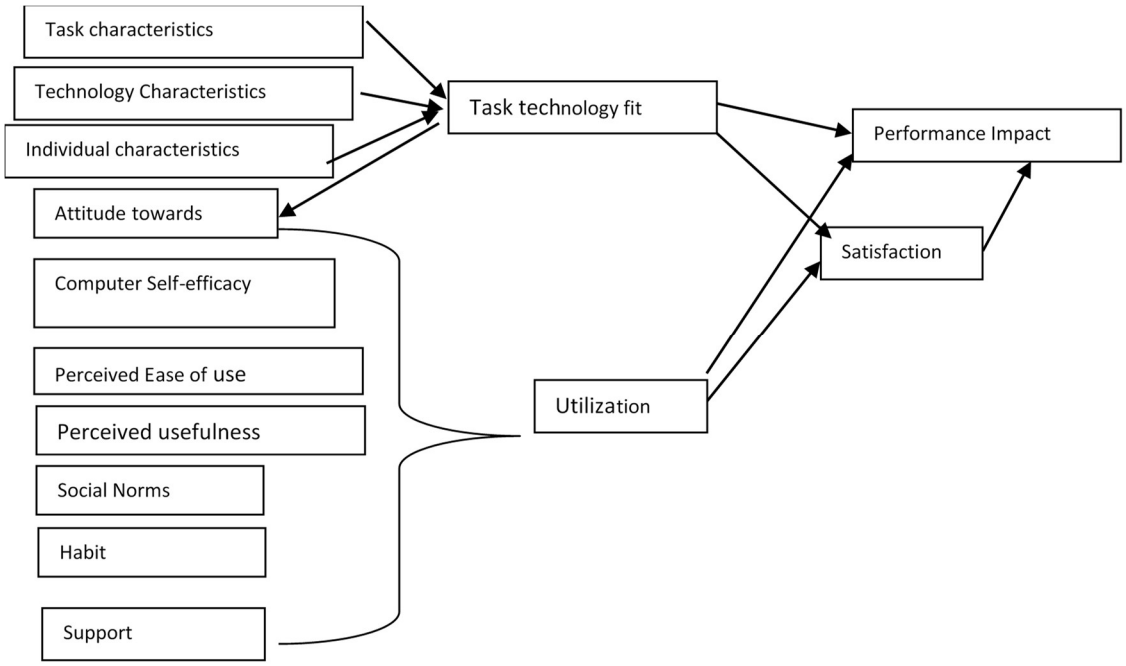

Figure 1: The Technology Utilization, Satisfaction and Performance Model (TUSPEM)

3. RESEARCH MODEL AND HYPOTHESES

TTF and Performance

The task technology fit concept in information systems research was first introduced by Goodhue and Thompson in 1995. TTF has been identified as a key determinant in investigating information system's utilization and performance. The impact of TTF on performance has been attributed to the variance in the degree to which the various information systems are suited for performing the various tasks portfolios. The evaluation of how well a specific technology is suited for the performance of a given task has motivational effects on the users Eden et al (2010).

The direct link between TTF and performance has been investigated with mixed findings. For example, Goodhue and Thompson (1995) supported the relationship in their study of 25 different technologies in two organizations. While calling for further conceptual and empirical investigations into whether there is a link or not, and under what condition the relationship is strong or weak, Goodhue (1998) maintained that such investigations would further give credence to the full understanding of the interactions surrounding performance using information systems (p.128). In a related study, Staples and Seddon (2004) found a strong support for the impacts of TTF on performance while testing the use of spreadsheet in a mandatory usage environment. Other related work that confirmed this relationship includes (D'Ambra and Wilson, 2004; McGill et al., 2011). In a related work, Luarn (2009) found moderate support for the linkage between TTF and employer performance. Hence, it is hypothesized as follows:

H_1: TTF will positively influence information systems (e-assessment) performance impacts for Lecturers.

TTF and User Satisfaction

The relationship between task technology fit and user satisfaction has been studied with mixed outcomes. This relationship presupposes that If the TTF of an information system is high, users would be satisfied using an IS and would continue to use such an information system. According to Goodhue (1988), user satisfaction is a fit between personal needs and the benefits of using a system and would be measured by an assessment of how a user feels about a system. Unfortunately, the technology-performance model never investigated this link. Contrarily, Baas (2010) found employee satisfaction as not being consistently related with task-technology fit.

H_2: TTF would be positively correlated with user satisfaction

TTF and Attitude towards Use

The suitability of a specific information system for a given task has great influence on users' attitude towards usage of such system. This relationship exist due to the fact that the better the fit, the more the tendency for users to develop a positive attitude towards the system. The work of Goodhue and Thompson (1995) only assumed the existence of the relationship but failed to investigate the link. Instead, the direct link between TTF and utilization was tested and confirmed to have a significant relationship. On the other hand, several other findings have investigated TTF and system usage through the precursors of utilization. For example, (Staples and Seddon, 2004; Luarn, 2009) found a positive relationship between the task technology fit of an IS and users attitude towards usage. Hence, the hypothesis:

H_3: TTF will positively influence users affect towards use of an information system.

Attitude towards usage and Utilization

The link between users' attitude towards usage of an information system has been identified as one of the major precursors of information system utilization. This link has been studied with mixed findings. For example, the work of Venkatesh et al., (2003) while investigating four organizations associated with entertainment, telecommunications, banking and public administration concluded that attitude towards using an information system does not influence usage in a mandatory environment.

Similarly, while investigating the precursors of learning management system utilization in Nigeria Osang and Galadima (2015) did not find a significant relationship between lecturers' attitude towards IS usage and actual usage. In another survey conducted to investigate if there would be any increase in students' attitude towards using supplementary technological devices to support face-to-face instructions, Teo (2008) concluded that attitude of students were improved following their exposure to technological devices. Thus, the hypothesis is framed as follows:

H_4: Lecturers attitude towards usage of an information system positively influences utilization

Computer Self-efficacy and System Utilization

The concept of computer self-efficacy has found its relevance in IS research. According to Markey and Parkinson (2010), personal experience, continuous learning, goal setting and hands-on the task improves self-efficacy and enhances usage of technology. Osang (2015) investigated the connection between teachers' self-efficacy and their commitment towards usage of IS for their instructions. Results showed that the more the teachers value an information system, the greater the amount of time and energy they would invest in the use of such an information system. The result also showed that teachers who devoted most time and effort to using an information system had more positive beliefs in their ability to use it than those who spend less time and energy using the IS.

In a related study, Marcinkiewicz (1994) examined the influence of personal factors on teachers using computers for instructional purposes. The findings showed that self-competence was a significant predictor of teachers' avoidance or pursuit of using computer. When the user feels competent, they were more likely to use the computer. This study therefore focuses on whether Lecturers believe that they have the necessary knowledge, skills, or ability to use information system (IS) in the context of e-assessment. Hence the hypothesis:

H_5: Lecturers computer self-efficacy influences system utilization

Social Norms and System Utilization

Social norms deal with users' belief on people's expectations regarding their capacity to perform certain behavior or task. In every organization, several tasks are assigned to specific people believed to have the capacity to accomplish the task. Management at the different levels expects tasks to be accomplished by their subordinates. In a mandatory usage environment, where one expects social norms to be critical in determining usage, Dishaw and Strong (1999) did not find any relationship between the social norms of users and their intention to use technology.

On the other hand, there was a significant relationship between social norms and technology utilization as reported by (Staple and Seddon, 2004; Venkatesh and Davis, 2000). Hence the hypothesis is presented as follows:

H_6: Social norms influences lecturers utilization of an information system

Lecturers Habit and System Utilization

Users' habit plays a crucial role in the utilization and continued usage of information systems (IS). Information system researchers have been investigating how users adopt information systems. As argued by Limayem et al., (2003), information systems that fail to meets the user's needs are discontinued even after being adopted. The relationship between users habit and utilization of information systems was also assumed to exist but was not tested by both Goodhue and Thompson (1995) and Staples and Seddon (2004) while testing the TPC model. However, Osang and Galadima (2015) tested the relationship while examining lecturers' usage of learning management system in an open and distance learning institution in Nigeria. The result of that study did not find any significant relationship between users' habit and utilization of information systems in a mandatory usage environment. (Bhattacherjee, 2001; Venkatesh, 2002 and Limayem et al., 2003) have all studied habit in continued used environment.

H_7: Lecturers individual habit positively influences system utilization

Perceived Usefulness and Utilization

As conceptualized by Davis et al., (1989), perceived usefulness is the level to which a person feels that the use of a particular information system would enhance his or her performance. The construct was considered critical in information system research as it has a significant effect on intention to use and eventual usage Davis et al., (1989). The findings from several studies have revealed contradictory results regarding this link. For example, while Chang et al., (2009) found perceived usefulness to positively influence system utilization, Osang and Galadima (2015) did not find a significant relationship between users perceived usefulness of information systems in a mandatory usage environment. Hence, the hypothesis was framed as follows:

H_8: Lecturers perceived usefulness of an information system has a positive influence on its utilization

Perceived Ease of Use and System Utilization

Perceived ease of use and usefulness are two important external variables in the technology acceptance model proposed by Davis et al., (1989). The relationship between perceived ease of use and actual system use has received much attention. Perceived ease of use is the level to which a person feels that the use of a particular technology is free of effort. A user of an information system is more likely to utilize a technology that is easy to use with little complains. While investigating academic staff views on the comparison between maple software e-test application and exam pro platforms, the educators confirmed that they prefer the latter to the former platform based on the level of ease of use of the latter platform Osang (2012). Legris et al. (2003) showed that perceived ease of use has a high proportion of positive correlation with users attitude in 10 studies including that of (Taylor and Todd, 1995; Hu et al., 1999) etc. On the other hand, (Bhattacherjee 2001; Karahanna et al., 1999) found that when users gain experience with the system, ease of use is replaced by perceived usefulness. Hence the hypothesis was stated below:

H_9: Perceived ease of use of an information system has a positive influence on utilization

Utilization and Satisfaction

Research on the relationship between system utilization and end-user satisfaction has been viewed from different perspectives and with mixed findings. Goodhue 1998 referred to satisfaction as affect towards using a technology that should serve as a precursor of usage. On the other hand, Baroudi et al. (1986) opined that end-user satisfaction leads to usage rather than usage influencing satisfaction. Igbaria and Tan (1997) investigated the impact of end-user satisfaction on utilization. It was found that end-user satisfaction has a positive and significant impact on the utilization. The work of Lee, Kim and Lee (1995) also found that system utilization is positively related to end-user IS satisfaction. On the contrary, technology utilization had a non-significant relationship with user satisfaction Osang (2015). Hence, the hypothesis was framed as follows:

H_{10}: Actual utilization of an information systems influences users' satisfaction with the system.

System Utilization and Performance Outcomes

Utilization of information systems plays a significant and positive effect on individual performance Igbaria and Tan (1997). An investigation of the link between system utilization and individual performance was confirmed by the work of (Goodhue and Thompson, 1995; DeLone and McLean, 2003; Staples and Seddon, 2004; Luarn, 2009). In the educational sector, McGill (2006) noted that there has been very little research on lecturers' use of technologies and their resultant outcomes. Most studies in the educational sector have concentrated on the students (Hiltz and Turoff, 2005) without much attention to the utilization of information systems by the lecturers who actually drive the technologies. Hence, a hypothesis was framed thus:

H_{11}: Utilization will positively influence information systems performance impacts for lecturers.

Satisfaction and Performance Outcome

In DeLone and McLean (2003) work, six out of the sixteen studies that tested and confirmed the positive and significant relationship between end-user satisfaction and individual performance were identified. In the TPC model, Goodhue and Thompson (1995) did not find the satisfaction construct as key in determining users' performance. Other researchers like McGill et al., (2011) have continued to emphasize the need for research into the relationship between users' satisfaction and performance. While investigating the link, Osang (2015) found that users' satisfaction has a positive and significant relationship with individual performance. Hence, the hypothesis is included as follows:

H_{12}: Satisfaction will positively influence e-assessment performance impacts for lecturers.

4. METHODOLOGY

Empirical Context of the Study

Before proceeding further, it is important to take a critical look at the empirical case study. At the National Open University of Nigeria (NOUN), the use and abandonment of over four e-assessment systems (A-tutor, maple ta, integrated learning management system (iLMS), MOODLE and exam pro) within the five years of the e-assessment journey was of concern to the researcher. Basically, the exam pro plus system (which was being used as at the time of this research) comprised of four different logically integrated modules namely: the global administrative module, study centre (branch) admin module, lecturer's module and student's module.

Lecturers' module was concerned with course assignments, creation and upload of questions and instructions in specified format, development of question banks, assessment of grade books, reporting etc. While the adoption of the e-assessment system was regarded as a step in the right direction, the challenges associated with the sustainability of such information systems appear enormous. For example, the public outcry that ensued from the 2015 post Unified Tertiary Matriculation Examination (UTME) exercise left so much to be desired. Are the current information systems sufficient in handling the modern task in workplaces? Or is it the human factors that are militating against positive outcomes resulting to subsequent abandonment of information systems? What factors affect utilization and performance even when the technologies have been provided by management?

To achieve this purpose, the relationships between the following constructs were investigated:

a. Task technology fit, attitude towards use, utilization, satisfaction and performance
b. Attitude towards use, social norms, computer self-efficacy, users' habit, perceived usefulness, ease of use and support as they influence lecturers utilization of information systems in a mandatory usage environment

The study was based on the data collected by a survey of lecturers from the National Open University of Nigeria. Surveys are known to provide a high level of general capability in representing a large population. The choice of the National Open University of Nigeria (NOUN) was based on the fact that NOUN is known to be the first university in Nigeria to adopt electronic examination system for her semester examinations and assessment in such a wide scale.

Method

The basic methodological process was the selection of a number of persons (respondents) from across the faculties in the institution through a stratified random sampling technique to express their opinions on the issues related to e-assessment as it affects fit, utilization, satisfaction and performance using e-assessment tools. The choice of stratified random sampling technique was to ensure fair representation of lecturers across the faculties in the institution. The data gathered in a survey possess a better description of the relative characteristics of the general population involved in the study.

Compared to other methods of data gathering, surveys are able to extract data that are near to the exact attributes of the larger population. Other considerations are listed below:

- The language of the questionnaire was simple enough to avoid complex and technical terms that could be easily answered by the target respondents.
- The questions were previously discussed with some lecturers which to a large extent assisted in understanding how the respondents interpreted the questions. In addition, the pilot test afforded the opportunity to effect changes in the final test items used in the study.
- The instrument was served in hard copies to the respondents. A total of 180 questionnaires were distributed.

Measurement

The second part of the instrument made use of items developed by previous related researchers and the researcher. All the items were modeled with reflective indicators and measured on a 7 point Likert scale with the end points being "strongly disagree" to "strongly agree". Discrepant cases in the spreadsheet were assigned -1 for computation.
Table 1 below shows the coding and the number of test items used in the measurement of each of the constructs used in the study.

Table 1: Constructs and their Codes

S/N	Construct	Code	No of Items
1	Perceived Usefulness	PUSE	PUSE1....PUSE6
2	Perceived ease of use	EASE	EASE1...EASE6
3	Task technology fit	TTF	TTF1...TTF8
4	Computer Self-efficacy	CSE	CSE1...CSE6
5	Attitude towards use	ATT	ATT1...ATT6
6	Performance Outcome	PERF	PERF1...PERF7
7	Lecturers Habit	HAB	HAB1...HAB6
8	Social Norms	SNM	SNM1...SNM5
9	Utilization	USE	USE1...USE5
10	Satisfaction	SAT	SAT1...SAT5

Validity and Reliability

The outer and inner models were considered for analysis in this work. The measurement model represented the relationship between the indicators and the latent variables (LVs). The outer model on the other hand assessed the model in terms of: uni-dimensionality, internal consistency reliability, indicator reliability, convergent validity and discriminant validity as discussed under measures above in table 1 since our model is a reflective model.
The measurement model focused on the statistical significance of the estimated model coefficients as well as the path coefficients of the latent variables used in the model.

Instrumentation

The first part of the questionnaire obtained information regarding the respondents' demographic information such as age, gender, level of education and computer literacy level.

Measurement of Demographic Variables

Variable Measurement
Gender: Male, female (nominal data)
Age: Indicated in years by selecting the appropriate range (ordinal data)
Education: Indicated by indicating education level (ordinal data)
Computer literacy: Indicated by indicating computer literacy level (ordinal data)
Years using Technology: Measure by number of semesters using the e-assessment technology.

5. FINDINGS

Data Collection

Out of the 180 questionnaires distributed across the Faculties of Education, Law, Management sciences, Arts, Social Sciences and Science as well as Access and General Studies, all located at the headquarters of the National Open University of Nigeria, a total of 104 lecturers completed and returned their questionnaires. A period of one month was used for the distribution and collection of the questionnaires specifically in the month of June. The data collected were recorded in Microsoft excel (csv format) and stored in a laptop with back up on external hard drives and flash drives.

Table 2: Showing Demographic Information

Gender	Male 65 (62.5%)			Female 39 (37%)			
Age	25-40 44 (42.3%)	41-50 38 (36.5%)	51-60 19 (18.3%)	61 and above (0%)		No Response 3 (2.9%)	
Designation	Assistant Lecturer 4 (3.8%)	Lecturer II 45 (43.2%)	Lecturer I 24 (23.1%)	Senior Lecturer 20 (19.2%)	Associate Professor 5 (4.8%)	Professor 2 (1.9%)	6 (5.8%)
Computer Lit Level	Beginners level 5 (4.8%)		Intermediate level 62 (59.6%)		Professional Level 37 (35.6%)		-
Semesters using software	1 Semester -	2 Semesters 40 (38.5%)	3 Semesters 13 (12.5%)	4 Semesters 17 (16.3%)	6 Semesters 37 (16.3%)	5 (4.8%)	

Measurement Model Evaluation

The model was assessed in terms of the following criteria: uni-dimensionality, internal consistency reliability, indicator reliability, convergent validity and discriminant validity.

Uni-dimensionality: Based on the item loadings of the constructs, one item each from affects towards use and social norms did not load sufficiently high on their corresponding constructs and were excluded from the analysis since they did not correlate well with the construct. Hence, these items failed to provide sufficient evidence of uni-dimensionality on affect towards use and social norms.

All other items loaded significantly on their latent variables. Hence there was high evidence of uni-dimensionality with the ten constructs indicator loadings used in the model as all items loaded above the upper threshold of 0.6 Gefen and Straub (2005).

Internal Consistency Reliability **(CR)**: Using the composite criteria, all constructs in the model exceeded the minimum threshold of 0.6 (Nunally and Berstein, 1994) and 0.70 (Hair et al., 2006). Hence, there was sufficient evidence of internal consistency reliability among the items of the variables in the model as shown in table 3 and below.

Table 3: Measurement model information

Construct	CR	No of items	AVE	1	2	3	4	5	6	7	8	9	10
Affect towards use	0.85	6	0.53	0.73									
Computer self-efficacy	0.85	6	0.50	0.62	0.71								
Ease of use	0.89	6	0.57	0.42	0.36	0.76							
Usefulness	0.86	6	0.50	0.26	0.22	0.47	0.71						
Performance	0.89	7	0.54	0.60	0.36	0.58	0.46	0.73					
Satisfaction	0.86	5	0.56	0.65	0.42	0.24	0.34	0.64	0.75				
Social Norms	0.86	5	0.55	0.54	0.30	0.28	0.32	0.53	0.44	0.74			
TTF	0.88	8	0.47	0.42	0.29	0.64	0.49	0.54	0.41	0.36	0.69		
User Habit	0.87	6	0.54	0.64	0.62	0.37	0.20	0.37	0.50	0.42	0.24	0.73	
Utilization	0.81	5	0.47	0.58	0.52	0.43	0.40	0.65	0.58	0.42	0.39	0.53	0.68

Indicator Reliability: Measures how much of the indicator variance is explained by the corresponding latent variables (LV). Values should be significant at a 0.5 level and higher than 0.70 Chin (1998). From the PLS diagram in figure 2 below, the following items had values lower than 0.70: perf (1,4), sat (4,5), use (2,3), TTF (8), att (4), cse (5), puse (4), snn (5), hab (3). All other 48 items used in the questionnaire had values higher than 0.7. To test the significance, from the t-statistics of the inner model, latent variables of the following constructs had values lower than 2: satisfaction to performance, habit to usage, ease of use to usage, social norms to usage, perceived usefulness to usage, computer self-efficacy to usage and affect towards use to usage. All other constructs had t-values greater than 2. Hence there was sufficient evidence of indicator reliability.

Convergent Validity: From the average variance extracted (AVE) values extracted from table 3 above, two constructs namely task technology fit and satisfaction had 0.47 each as AVE values. All other constructs showed values greater than the 0.50 threshold. This implies that the latent variables showed enough evidence of convergent validity Fornell and Larker (1981).

Discriminant Validity: From the squared AVE values shown in table 3 above, there was evidence of discriminant validity. Each of the constructs shared more variance with its assigned indicators than with any other variables within the column under it. As a test for discriminant validity, the items should load highest on their targeted construct and have relatively low loadings on all other constructs. In order words, for strong discriminant validity, the diagonal elements must be higher than any other corresponding row or column entry Barclay et al., (1995). Consequently, all items loaded highest on their targeted constructs as showed in table 3.

The Structural Model

The evaluation of the structural model involves the use of two criteria: the ability of the model to explain the variance in the dependent variables and the statistical significance of the estimated model coefficients.

The Predictive Power of the Model

The predictive power of the model for the dataset is represented by the R^2 value on the endogenous variables as shown in figure 2 below.

From the figure 2 below, the model predicts 60% of performance impacts, 37% of lecturers' satisfaction, 47% of utilization and 18% of users affect towards use constructs. It also implies that 60% of the dependent variable (performance) is explained by TTF, utilization and satisfaction. It equally implies that 40% of the performance impact was explained by other variables not included in the model.

Similarly, 37% of the satisfaction construct was explained by utilization and TTF. 63% of satisfaction was explained by other variables not included in this model. Equally, 37% of affect towards use was explained by TTF construct alone.

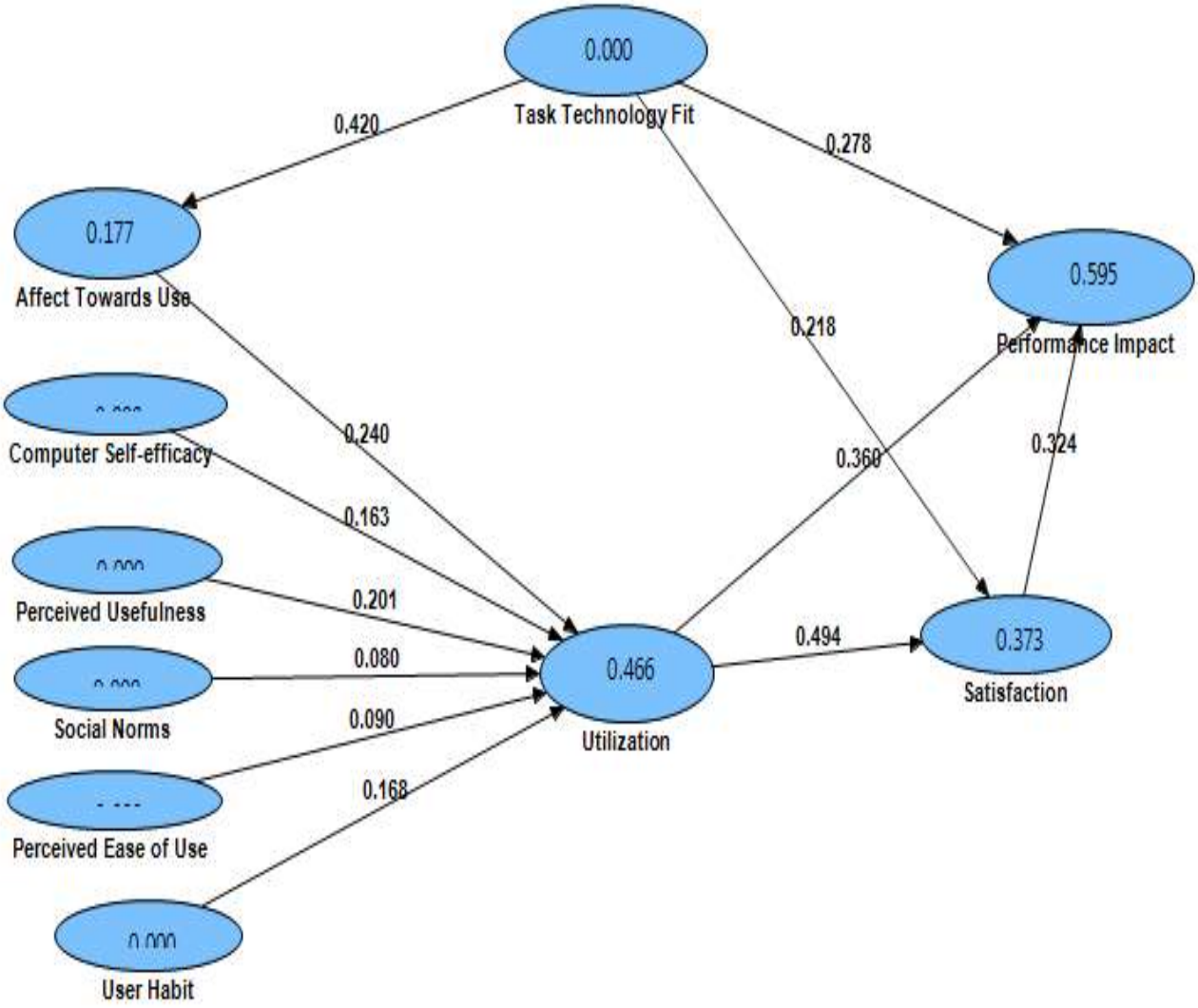

Figure 2: Showing the Structural Equation Modeling Results

The Statistical Significance of the Estimated Model Coefficients: The second aspect of the inner model examined the path coefficients of the latent variables used in the model.

Table 4: Decision Table and Significance Level

Hypothesis	Paths	Path Coefficients	t-value	Significance at p-value	Support for H1 ?
H1	TTF to performance	0.28	2.24	p< 0.009	Yes
H2	TTF to Satisfaction	0.22	1.70	p< 0.065	No
H3	TTF to Affect towards use	0.42	3.72	p< 0.000	Yes
H4	Affect towards use to Usage	0.24	1.61	p< 0.005	No
H5	Computer self-efficacy to Usage	0.16	1.5	p< 0.003	No
H6	Social norms to Usage	0.20	1.81	p< 0.022	No
H7	User Habit to Usage	0.08	0.72	p< 0.003	No
H8	Perceived usefulness to usage	0.18	1.53	p< 0.009	No
H9	Perceived ease of use to usage	0.90	0.89	p< 0.006	No
H10	Usage to Performance	0.36	3.18	p< 0.065	Yes
H11	Usage to Satisfaction	0.49	3.79	p< 0.003	Yes
H12	User satisfaction to Performance	0.32	2.06	p< 0.000	Yes

6. DISCUSSIONS ON FINDINGS

From the research model adopted in this study, the technology-to-performance model (TPC) was combined with two external constructs from technology acceptance model (TAM)'s constructs such as perceived ease of use and usefulness. Satisfaction from DeLone and McLean model with computer self-efficacy were also added to understand the predictive power of the model in terms of Nigerian lecturers use of electronic assessment technology and their corresponding satisfaction and performance outcomes. The results showed that 47% of utilization, 37% of satisfaction and 60% of performance impact was explained by the TUSPEM model.Using the TPC model, 16% of performance impact was explained by TTF and utilization Goodhue and Thompson (1995). 31% of learning management system performance was explained by TTF and utilization in McGill et al., (2011) studies. Similarly, 58% of performance impact was explained in Staples and Seddon's (2004) studies. Also, from the utilization angle, 36% of utilization was explained by Technology Acceptance Model (TAM). In staples and Seddon (2004) study, 24% of utilization was explained by the precursors of utilization such as expected consequence of utilization, affect towards use, social norms and facilitating conditions. Despite the key role technology usage play in information systems, it has relatively been insufficiently explained Lee et al., (2003). In the application of models to usage of emails, word perfect, Lotus 1-2-3, and Harvard graphics, Adam et al., (1992) framework was able to explain 15%, 4%, 35% and 30% respectively.

While investigating personal computing acceptance factors in small firms, 25% of the variance in usage was explained in Igbaria et al., (1997) framework. In using a large number of precursors of usage in their framework, Burton-Jones and Straub (2006) was able to explain 30% of usage. While suggesting the need for new models, King and He (2009) considered actual usage instead of the traditional perception-intention-usage framework. In his work, Wu (2009) showed that on the average, the traditional framework may only explain as low as 14% of the variance on usage".
In the current study, however, affect towards use, computer self-efficacy, perceived usefulness and ease of use, user habit and social norms contributed to 47% explanatory power on utilization using the indirect relationship between utilization precursors and TTF as contained in the TPC model.

Equally, there are similarities between this research model, Goodhue and Thompson's research model, Davis et al.,'s research, DeLone and McLean model and Compeau and Higgins model. Both models are used in work related environment and where usage is central. Based on these similarities, the comparison of R-square among these models becomes possible. The result of this study is different from those obtained from the TPC model by (Goodhue and Thompson, 1995; Staples and Seddon, 2004; McGill et al., 2008, 2011). While their results found more explanatory power from the task technology fit than from the utilization angle, this research found 36% explanatory power from utilization compared to the 27% obtained from the TTF construct in their studies. This is in line with Luarn (2009) findings which indicated that utilization has a greater effect on performance than TTF in a mandatory usage environment.

Apart from the efforts made by lecturers to get use to the available system in order to complete their e-assessment tasks requirement by Management, the support from the ICT support staff assist lecturers in the performance of their ICT related tasks. The analysis of H_{11} showed that utilization directly affected performance impacts of the lecturers. This finding is inconsistent with several studies from literature. For example, in testing the TPC model, Staples and Seddon (2004) did not find any relationship between level of utilization and performance. Equally, as contained in McGill et al. (2011), several researchers using the DeLone and McLean (1992) model of IS success as a framework have pointed out that utilization may not be influenced by system quality and information quality (Landrum et al., 2008). Also, that level of utilization may not influence performance (Wu and Wang, 2006; McGill, 2011). In fact, according to Seddon (1997), the causal relationship between utilization and individual performance proposed by DeLone and McLean may not exist.

In their updated model, DeLone and McLean (2002) explained that the level of utilization and performance may be domain specific. They argued that some users may need to use a system with poor TTF more frequently in order to meet their needs. Alternatively, they may decide to use a system with good fit more frequently because it meets their needs well. Although utilization had more explanatory power in predicting performance, the 27% contribution of the TTF construct to the performance outcome showed a statistically significant relationship between TTF and performance. Goodhue and Thompson (1995) supported the relationship in their studies that analyzed 25 different technologies in two of the organizations. Other findings that supported this relationship include (Staples and Seddon, 2004; Luarn, 2008 and Eden et al., 2010). According to Yuch and Hsu (2008), improvements in TTF of e-assessment usage should lead to a significant improvement in what lecturers are able to achieve in their e-assessment tasks.

The relationship between end-user satisfaction and lecturer's performance impacts showed a positive and significant connection H_{12}. This result is in agreement with the findings of DeLone and McLean IS success model (1992). It was also confirmed that six out of the sixteen studies that empirically tested the DeLone and McLean model, showed a positive and significant association between user satisfaction and performance impact (DeLone and McLean, 2003 p.14). The inclusion of satisfaction in determining performance impact especially in the e-learning domain has been re-echoed by several authors (Assefa and Prybutok, 2006; McGill et al., 2011). Usage was found to positively and significantly predict satisfaction in this study. It implies that after using the e-assessment system, the lecturers showed satisfaction with the system. This association is supported by the findings of Lee, Kim and Lee (1995). Several studies investigating this relationship supported the path from user satisfaction to system usage suggesting that satisfaction lead to usage rather than usage resulting to satisfaction. The hypothesized association of TTF and user satisfaction (H_2) in this study was found to be non-significant. However, the path coefficient was close to being significant (i.e, t = 1.7 for a path of 0.49) and would be if the p-value was relaxed to 0.10. This position would to some extend support Assefa and Prybutok (2006) findings that TTF positively and significantly influences user satisfaction. Although satisfaction was not included in the Goodhue and Thompson (1995), Goodhue (1995) opined that user satisfaction is a fit between personal needs and benefits of using a system and would be most appropriately measured using how a user feels about a particular system.

The hypothesized associations of the precursors of utilization such as affect towards use, social norms, users habit, computer self-efficacy, perceived usefulness and ease of use (H_4, H_5, H_6, H_7, H_8 and H_9) were found to be non-significant with the IS usage constructs.

Although Goodhue and Thompson (1995) did not test these links, they assumed the existence of the relationship and rather tested the direct path between TTF and utilization instead of TTF through its precursors. While testing the TPC model, Staple and Seddon (2004) found only affect towards use as not significantly predicting IS usage. Similarly, the relationship between social norms and usage has had mixed results. The findings of this research did not find any significant relationship between social norms and utilization. In their separate studies, (Venkatesh and Davis, 2000; Van Raaij and Schepers, 2008; and McGill et al., 2011) also did not find social norms influencing usage. Although social norm has been associated with usage from the post hoc hierarchical regression analysis in McGill (2008) study, majority of the respondents have become experienced enough using the e-assessment technology. From table 2 on demographic information above, over 95% of the respondents now have enough experience in the areas of computer literacy level and number of semesters using the e-assessment software.

The hypothesized relationship between perceived usefulness and perceived ease of use (H_6, H_9) and usage were found to be non-significant. Being regarded as the most important factors in the TAM model, both factors where used in this study. From the PLS diagram (figure 2) above, the path coefficient of perceived usefulness was very close to being significant with t-value of 1.81 for a path of .20. Like the TTF and satisfaction path, it is the view of the researcher that if the p-value was relaxed to .10, the path between perceived usefulness and utilization would be significant. This view is in line with the original TAM model that postulated that perceived usefulness and perceived ease of use are strong predictors of technology acceptance. Also that perceived usefulness is relatively stronger in influencing usage than perceived ease of use. In their work that combined some constructs from TTF and TAM, Dongsheng et al., (2011), also found positive relationship between perceived usefulness and perceived ease of use while attempting to explain mobile knowledge work adoption.

7. CONCLUSION

The need for the evaluation of the impacts of the numerous information systems being adopted by the various institutions/organizations cannot be over emphasized. While the impact of information systems deployments are enormous, the increasing failure rate emanating from such deployments need not to be ignored. An information systems model that explains 47% of IS utilization, 60% of user performance, and 37% of user satisfaction in a single model having satisfied all the measurement validity and reliability criteria shows a better predicting power in the measurement of IS usage, satisfaction and performance impact. From the findings, performance impact is a function of TTF, utilization and satisfaction instead of utilization and TTF alone as proposed by Goodhue and Thompson (1995).

These findings also suggest that in order to have maximum performance from users of information systems, the IS must not only fit the task alone, users satisfaction while using such system is equally critical. This implies that organizations should aimed at providing adequate training of staff to enable them fully utilize and appreciate the functionalities and capabilities of the various information systems in their work places. From the practical standpoint, this work attempted to raise Institutions Management awareness not to invest in the latest or more technologies, but to invest in user´s digital workspace which best fits and satisfy their usage needs while discharging their task portfolio.

8. RECOMMENDATIONS FOR FUTURE STUDIES

The hypothesized association of TTF and user satisfaction (H_2) in this study was found to be non-significant. However, the path coefficient was close to being significant (i.e, t = 1.7 for a path of 0.49) and would be if the p-value was relaxed to 0.10. The hypothesized associations of the precursors of utilization such as affect towards use, social norms, users habit, computer self-efficacy, perceived usefulness and ease of use (H_4, H_5, H_6, H_7, H_8 and H_9) were found to be non-significant with the IS usage constructs. Future research should also explore more on such relationships as contained in the TUSPEM model in a voluntary usage environment.

REFERENCES

1. Ajzen, I. (1991). The theory of planned behavior, *Organizational Behavior and Human Decision Processes*, 50(2), 179-211.
2. Assefa, S. and Prybutok, V. (2006). Towards a comprehensive model to predict perceived performance impact of wireless/mobile computing in a mandatory environment, *AMCIS 2006 Proceedings*, Paper 324 retrieved from http://aisel.aisnet.
3. Averweg, R. U. (2008). Information technology acceptance in South African; An investigation of perceived usefulness, perceived ease of use and actual system use construct, *African Journal of Information Systems*, 1(1), 44-66.
4. Barclay, D. W., Higgins, C. A., and Thompson, R. (1995). The partial least squares approach to causal modeling: personal computer adoption and use as illustration, *Technology Studies*, 2(2), 285–309.
5. Bagozzi, R. P. (2007). The legacy of the technology acceptance model and a proposal for a paradigm shift, *Journal of the Association for Information Systems,* 8(4), 244-254.
6. Bhattacherjee, A. and Premkumar, G. (2004). Understanding changes in belief and attitude toward information technology usage: a theoretical model and longitudinal test, *MIS Quarterly* 28(2), 229-254.
7. Burton-Jones, A., and Straub, D. W. (2006). Reconceptualizing system usage: An Approach and Empirical Test, *Information Systems Research*, 17(3), 228-246.
8. Cheng, M. M. H., Chan, K.-W., Tang, S. Y. F., and Cheng, A. Y. N. (2009). Pre-service teacher education students' epistemological beliefs and their conceptions of teaching, *Teaching and Teacher Education*, 25(2), 319–327.
9. Chin, W.W. (1998). The Partial Least Squares Approach to Structural Equation Modeling, in G.A. (Ed.), *Modern Methods for Business Research*, 295(1), 295-336.
10. Compeau, D. R., and Higgins, C. A. (1995). Application of social cognitive theory to training for computer skills, *Information Systems Research*, 6(2), 118-143.
11. Davis, F.D., Bagozzi, R.P., and Warshaw, P.R. (1989). User acceptance of computer technology: a comparison of two theoretical models, *Management Science*, 35(8), 982-1003.
12. D'Ambra, J., and Wilson, C.S. (2004). Use of the World Wide Web for International Travel: Integrating the Construct of Uncertainty in Information Seeking and the Task-Technology Fit (TTF) Model, *Journal of the American Society for Information Science and Technology,* 55(8), 731-742.
13. Dede, C. (2003). No cliché left behind: why education policy is not like the movies, *Educational Technology,* 43(2), 5-10.
14. Dishaw, M.T. and Strong, D. M. (1999). Extending the technology acceptance model with task-technology constructs, *Information and Management* 36, 9-21.
15. DeLone, W., and McLean, E. (2002). Information systems success: The quest for the dependent variable, *Information Systems Research*, 1, 60-95.
16. Dishaw, M., Strong, D., and Bandy, D. B., (2004). The Impact of Task-Technology Fit in Technology Acceptance and Utilization Models, *AMCIS 2004 Proceedings*, Paper 416.

17. Dongsheng,L., Hao,T., Bei,W. and Shimin, H. (2011). Integrating TTF and TAM perspectives to explain mobile knowledge work adoption. *Journal of Convergence Information Technology* 6(4), 50-63.
18. Fishbein, M., and Ajzen, I. (1975). Belief, attitude, intention, and behaviour : An introduction to theory and research, *Reading Mass*, Don Mills, Ontario: Addison-Wesley Pub. Co.
19. Fornell, C., Larcker, D.F., (1981). Evaluating structural equation models with unobservable variables and measurement error, *Journal of Marketing Research* 18(1), 39-50.
20. Gefen, D., and Straub, D. W. (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.
21. Goodhue, D. (1995). Understanding user evaluations of information systems, *Management Science*, 41(2), 1827-1844.
22. Goodhue, D., and Thompson, R. (1995). Task technology fit and individual performance, *MIS Quarterly*, 19(2), 213-236.
23. Hair, J., Black, W., Anderson, R., and Tatham, R. (2006). Multivariate data analysis 6th ed.), Englewood Cliffs, NJ: Prentice-Hall.
24. Hermans, R.; Tondeur, J.; Braak, J. and Valcke, M. G. (2008). The impact of primary school teachers' educational beliefs on the classroom use of computers, *Computers and Education* 51(2), 1499–1509. http://aisel.aisnet.org/mcis2011/4.
25. Hew, K. F., and Brush, T. (2007). Integrating technology into K-12 teaching and learning: current knowledge gaps and recommendations for future research, *Educational Technology Research and Development*, 55(1), 223-252.
26. Igbaria, M. and Livari J. (1995). The Effects of Self-efficacy on Computer Usage, *Omega, Int., Mgmt Sci*. 23(6), 587-605.
27. Igbaria, M., Guimaraes, T., and Davis, G. (1995). Testing the determinant of microcomputer usage via a structural equation Model, *Journal of Management Information System*, 11(4), 87-114.
28. Jarupathirum, S., and Zahedi, F. (2007). Exploring the Influence of Perceptual Factors in the Success of Web-Based Spatial DSS, Decision Support Systems, 43(2), 933-951.
29. King, W. R., and He, J. (2006). A Meta-Analysis of the Technology Acceptance Model, Information & Management 43(6), 740-755.
30. Klopping, I., and McKinney, E. (2004). Extending the technology acceptance model and the task technology fit model to consumer e-commerce, *Information Technology, Learning and Performance Journal,* 22(1), 35-48.
31. Landrum, H.T., Prybutok, V.R., Strutton, D., and Zhang, X. (2008). Examining the Merits of Usefulness Versus Use in an Information Service Quality and Information System Success Web-Based Model, *Information Resources Management Journal* 21(2), 1-17.
32. Lee, Y., Kozar K. A., and Larsen, K. R. T. (2003). The Technology Acceptance Model: Past, Present, and Future, *Communications of the Association for Information Systems* 12(1), 752-780.
33. Limayem, M., Hirt, S. G., and Cheung, C. M. K. (2007). How habit limits the predictive power of intention: the case of information systems continuance, *MIS Quarterly*, 31(4), 705– 737.
34. Lin, H., and Dwyer, F. (2006). The fingertip effects of computer-based assessment in education. *TechTrends,* 50(6), 27-31.
35. Luarn, P and Huang, K. (2009). Factors Influencing Government Employee Performance via Information Systems Use: an Empirical Study, *Electronic Journal of e-Government* 7(3), 227 – 240. Available online at www.ejeg.com
36. Marcinkiewicz, H. R. (1994). Computers and teachers: Factors influencing computer use in the classroom, *Journal of Research on Computing in Education*, 26(2), 220-237.
37. McCann, A. L., (2010). Factors affecting the adoption of an e-assessment system, *Assessment and Evaluation in Higher Education* 35(7), 799–818.

38. McGill, T. and Klobas, J. (2008). End-user perceptions of the benefits and risks of end-user web development, *Journal of Organizational and End User Computing*, 18(4), 22 – 42.
39. McGill, T., Klobas, J., and Renzi, S. (2011). The Relationship between LMS Use and Teacher Performance: The Role of Task-Technology Fit, *ACIS 2008 Proceedings*, 82. http://aisel.aisnet.org/acis2008/82.
40. Nunnally, J.C., and Bernstein, I. H. (1994). Psychometric Theory, (3rd ed.) McGraw-Hill, New York.
41. Osang, F. B. (2012). Electronic Examination in Nigeria, Academic Staff Perspective—Case Study: National Open University of Nigeria (NOUN), *International Journal of Information and Education Tech* 2(4), 304-307.
42. Osang, F. B. (2015). Task Technology Fit and Lecturers Performance Impacts: The Technology Utilization, Satisfaction and Performance (TUSPEM) Dimension, *Int J. Comp Sc. Issues* 12(3), 'IJCSI-2015-12-3-10405'.
43. Osang, F.B. (2016). Assessing the dimensionalities of email utilization among open and distance learning practitioners: a structural modelling equation approach, *West African Journal of Open and Distance learning (WAJOFEL)*, 4(1), 11 - 35
44. Osang, F. B; Abinwi, N. and Tsuma, C. (2015). Reviewing Information Systems Usage and Performance Models, *International Journal of Computer Science and Information Technologies*, 6(1), 476-484.
45. Osang, F. B. and Galadima M. B. (2015). Determining Technology Utilization: the Technology Utilization, Satisfaction and Performance Model (TUSPEM) Perspective, *International Conference on Computer Science, Engineering and Innovations* (ICCSEI, 2015), London.
46. Park, C. N., and Son, J.-B. (2009). Implementing computer-assisted language learning in the EFL classroom: teachers' perceptions and perspectives, *International Journal of Pedagogies and Learning*, 5(2), 80–101.
47. Pim, B. (2010). Task Technology Fit in the workplaces – affecting employee satisfaction and productivity, Masters Thesis Rotterdam School of Management, Erasmus University.
48. Reinders, M., Dabholkar, P., and Frambach, R. (2008). Consequences of forcing consumers to use technology based self Service, *Journal of Service Research,* 11(2), 107-123.
49. Staples, D.S., and Seddon, P. (2004). Testing the Technology-to-Performance Chain Model, *Journal of Organizational and End User Computing,* 16(4), 17-36.
50. Straub, D. W., Burton-Jones, A. and Veni, V. V. (2007). Breaking the TAM Logjam, *Journal of the Association of Information Systems* 8(4), 223-229.
51. Tai-Kuei, Y. and Tai-Yi, Y.F (2010). Modeling the factors that affect individuals' utilization of online learning systems: An empirical study combining the task technology fit model with the theory of planned behaviour, *British Journal of Educational Technology* 41(6), 1003-1017.
52. Taylor, S., and Todd, P. A. (1995). Understanding information technology usage: A test of competing models, *Information Systems Research*, 6(2), 144-176.
53. Teo, T. (2008). Pre-service teachers' attitudes towards computer use: A Singapore survey, *Australasian Journal of Educational Technology* 24(4), 413-424.
54. Trice, A.W and Treacy, M.E. (1988). Utilization as a dependent variable in MIS research, *DBase,* 19(3/4).
55. Van Raaij, Schepers J. (2008). The acceptance and use of a virtual learning environment in China, *Computers & Education* 50 (3), 838-852.
56. Venkatesh, V., and Davis, F.D. (2000). A Theoretical Extension of the Technology Acceptance Model: Four Longitudinal Field Studies, *Management Science* 46(2), 186-204.
57. Venkatesh, V., Morris, M. G., Davis, G. B., & Davis, F. D. (2003). User acceptance of information technology: Toward a unified view, *MIS Quarterly*, 27(3), 425-478.
58. Warburton, B. (2008). Quick win or slow burn? modelling UK HE CAA uptake, *Assessment and Evaluation in Higher Education*. http://www.informaworld.com/smpp/content~ content=a793501863~db=all
59. Wu, J. (2009). Intention or Behavior, on Which Should Researchers Concentrate? *In Proceedings for the Diffusion Interest Group in Information Technology* (DIGIT) Conference.
60. Wu, J., and Du, H, (2010). A New Theory of Technology Usage, *Proceedings of JAIS Theory Development Workshop, Sprouts:* Working Papers on Information System, 310-313.