Open Educational Resources Development in Nigeria: Determining Task Technology Fit (TTF) Impact on Faculty Usage, Satisfaction and Performance

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Abstract—**The concept of Open educational resources (OER) is gaining grounds globally. However, different regions face different obstacles to OER adoption, policies and experiences. Unfortunately, Africa has continued to trail behind the rest of the world in the adoption of OERs. A number of factors have been adduced from literature ranging from lack of awareness; absence of policies, infrastructural deficits among others with total absence of literature on the fit of the existing technologies being used and, how these technologies fit and affects utilization, satisfaction and performance impacts. This work adopted the TUSPEM model as a theoretical framework to assess the causal relationship between five constructs namely Task Technology Fit, social norms, utilization, satisfaction and performance impacts. Through a quantitative research approach, snowballing sampling was adopted to identify 123 respondents from a Nigerian University. Smart PLS was used to analyze the dataset. The results showed strong support for relationships between TTF and satisfaction, with a stronger relationship from the "post usage satisfaction" dimension to performance than from TTF to performance. By implication, in a voluntary usage context, TTF and user satisfaction are critical predicting performance.**

Keywords—open educational resources; TUSPEM; Performance; satisfaction; utilization; social norms

Article history: Manuscript received 2 July 2019; received in revised form 3 September 2019; Accepted 4 September 2019.

I. INTRODUCTION

THE public outcry on the falling standard of education especially in Africa is alarming. While huge chunks of budget projections are directed towards improving the standard of education, little effort is made towards improving access to the quality content. As reported by [32], educational institutions rely on printed resources which are usually (a) expensive (b) old and outdated (c) non-interactive or lacks multimedia quality (d) almost impossible to share with wider group of readers etc.

The ever-rising cost of these materials remains a major source of concern to different countries of the world. In a study conducted by Council of Alberta University Students, it was reported that the rate of textbook increased 2.8 times higher than inflation rate in Canada [26].

Realizing the implication of this global challenge, different countries of the world are today responding with different strategies, policies and initiatives. In the United State of America, the Affordable Textbook Act 2015 seeks to increase the amount of openly licensed materials for institutions at the states and federal levels [59]. Similarly, the school sector initiative policy of the UK government encourages the release of resources by institutions (educators) under the Creative Commons license [60, 59].

Today, the concept of open educational resources addresses most of these challenges. OER has been defined as teaching, learning, and research resources that reside in the public domain or have been released under an intellectual property license that permits their free use and repurposing by others [33]. The idea of Open Educational Resources

(OER) was muted in a forum on the impact of open courseware for higher education in developing countries in 2002 hosted by United Nations Educational, Scientific and Cultural Organization (UNESCO) in Paris, France [41].

Past research show that OER increases access to quality materials and heavy reduction in the cost of purchasing materials [22]. In a study that focused on tertiary education in the US, [1] analyzed the cost of OER by focusing on ten US college courses which were available in that subject area. The study concluded that on the average, 80% annual savings of the cost of material was achieved using OER.

With a total of 1.4 billion resources at the end of 2017, the growth of OERs tracked by the number of creative commons licenses was unprecedented. In 2015, Africa continent trailed behind the rest of the world with only 2% contribution [33]. Fortunately, efforts by the OER movement and other initiatives targeted at sensitizing African institutions is yielding fruits as Africa overtook the Arab world with 7% as against 6% [33].

In order to further entrenched OER, a number of searching techniques (web tools) and evaluation tools have been designed to find and to evaluate OERs namely CC Search, OER Commons, OER Africa, Google Power Searching among others [33]. Additionally, on successful identification of appropriate OERs, some tools exist (hosted at OER Commons, OER Quality Evaluation, UKOER Synthesis and Evaluation etc.) in the determination to fit for purpose and an evaluation system comprising rubrics aimed at addressing issues of quality of open learning resources.

OERs are being put to use through (a) developing an online platform that supports faculty to create, locate and customize curriculum in open content. (b) The creation of African Storybook Initiative where children stories are translated into different African languages as well as (c) the creation of free and adaptable textbooks [33].

In a survey by [23] for Common Wealth of Learning (COL) and UNESCO on OER across continents of the world, African countries except South Africa reported lack of awareness of OER, lack of skills for the development of OERs, lack of infrastructural facilities, lack of funds to undertake the production of OER, digital illiteracy, absence of OER policy etc. Similarly, research on learning designs is on the increase as teachers and practitioners need to make appropriate choices in the creation of effective pedagogy using technologies to enhance teaching and learning [58].

Consideration of the fit perspective remain critical as research has shown that not less than 80 percent of tools developed for organizational usage ought to fit the organizational operations while 20 percent of the application can be customized if the standard rule of thumb for customization is anything to go by [44]. However, there has been little or no known research that has focused on understanding the fit phenomenon in predicting faculty's performance impacts on OERs despites it theoretical and practical needs.

This work adopted the TUSPEM model as a theoretical framework to assess the causal relationship between five constructs namely Task Technology Fit, social norms, utilization, satisfaction and performance impacts as they relate to faculty usage of technologies for OERs in Nigeria.

II. THE TECHNOLOGY UTILIZATION, SATISFACTION AND PERFORMANCE MODEL (TUSPEM)

The widespread adoption of software applications has necessitated the urgency for a deeper understanding of fit, usage, performance and other dependent variables. Since the advent of information and communication technologies, there have been several theories aimed at formulating principles guiding its operations [67, 36, 7, and 2].

While several theories focus on pre-adoption studies [11], others concentrate on satisfaction-based studies [12] with the aim of exploring satisfaction derived from usage of ICTs. Several others concentrate on performance-based evaluations with a view to assessing/interpreting the impacts of ICTs on individual and organizational performance [21, 39]. Employee job performance has been

defined as the "behaviours that are relevant to organizational goals and that are under the control of individual employees" [65].

The TUSPEM model is a hybridization of the technology-to-performance model [21] and other information systems models [9,11]. It is hinged on a tripartite dimension predicting performance impacts of technologies and information systems namely the task technology fit dimension, the utilization pre-cursors dimension as well as the satisfaction dimension. The fit dimension presupposes that for a technology to perform any given task satisfactorily, it must first and foremost suit that given task. As noted by [17], an evaluation of how well a specific technology is suited for the performance of a given task has motivational effects on the users. It agrees that task characteristics, technology characteristics and individual characteristics are major determinants of task technology fit which in turns affect performance [21]. The satisfaction dimension views satisfaction from the post usage perspective [12]. It proposes that users' satisfaction of an information system/technology is a product of usage. The utilization dimension focuses on the pre-cursors or determinants of information system utilization which includes users' attitude to using, computer self-efficacy, perceived usefulness and ease of use, social norms, habit and IT support.

TUSPEM combined constructs such as ease of use and perceived usefulness from technology acceptance model (TAM), satisfaction from [12], usage, TTF, user habit, attitude and performance from [9, 17, 21, 48].

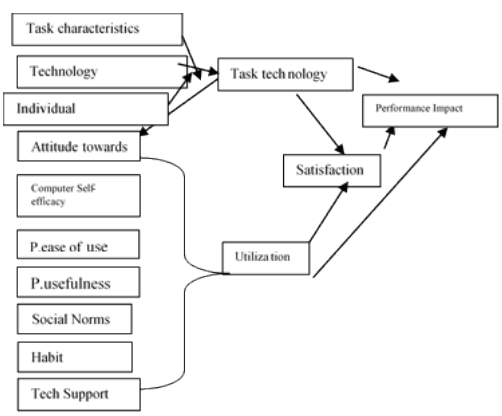

Fig. 1. The technolgy utilization, satisfaction and performance model [36]

A. The Research Model and Hypotheses

The Task-Technology Fit Construct

Prior to the advent of computers, several operations were driven through manual operations. Today, the advent of computer systems has resulted to the computerization of tasks required to drive processes both at individual and organizational levels. The capability for any specific technology to handle a given task requirement is what is regarded as task-technology fit. Fit changes with the technology [28]. TTF is seen to be higher when the functionality of a technology and the user's requirements are similar. Additionally, TTF is lower if the functionality of the technology is less adequate in meeting the needs of the users. Individuals have a greater tendency to utilize technology if the capabilities of the technology fit the needs of the individual.

In their study [49] found that Word/email and Google Docs were perceived to have a better Task-Technology Fit than Twiki or Office Live with no perceived difference in fit between Word/email and Google Docs or between Twiki and Office Live.

Aguirre-Urreta and Miguel investigated on collaborative writing and editing tools and the factors that impact on TTF and technology acceptances using 162 students from College of Business at a Midwestern US university. Students in three semesters were subjected to the same tool (MS Word/email, Google Docs, and Office Live/ Office 365) [49]. The study speculated that students are eager to interact with new tools than with older tools. They perceive that the old technology no longer fits the task as well. Thus, it performed lower on outcome measures. It was also observed that even though the Word/email technology did not change during the time of the study, its scores went down, possibly due to users' experience with newer technologies being more suited to the task.

Task characteristics, technology characteristics and individual characteristics have been identified to be determinants of TTF [14, 21]. However, findings have confirmed that users' evaluation of TTF on performance can be sufficiently determined on performance without necessarily assessing its determinants [30].

The casual relationship between TTF and performance has been investigated in IS literature with mixed findings. TTF has been confirmed to have a positive and motivational impact on job performances [17]. Reference [37] opined that reduced task effort improves task performance through flow cognitive elaboration as a moderating factor. In a study that examined the effect of chronotypes on the omnichannel process using 311 digital shoppers that uses online and mobile channels in China, [9] confirmed that while mobile channels shows greater task-technology fit to evening-type respondents, desktop channels showed better task-technology fit to morning-type respondents. On the contrary, [29] found moderate support for the linkage that TTF will positively affect the performance of employees to collaborate. Thus, the hypothesis is stated thus:

H1: TTF has a positive relationship on faculty's performance using OER tools
H2: TTF has a positive relationship with satisfaction
H3: TTF has a positive relationship with utilization

Social Norms

One key precursor of utilization according to the TPC model [21] is social norm. In organizational settings, it is incumbent on the employer to provide the tools needed by the employee to carry out assigned tasks. Depending on existing organizational policies/interest, users are expected to produce expected outcomes using available tools. Results from literature on this construct shows mixed findings.

In the corporate context, educational institutions for example, results from literature shows mixed findings on the relationship between social norms and LMS utilization. [46] found that in a mandatory usage environment, and when experience is at its early stages, social norms directly impacted on users' intention to use an application.

In the eLearning domain, [50] found that social norms affected usage only when the lecturers felt that students are expected to use LMS. Reference [51] on the other opined that, social norms relates with user's intention indirectly through perceived usefulness. Thus, the hypothesis is stated thus:

H4: Social norms have a positive relationship with lecturers' utilization of OER tools.

System Utilization

There has been a plethora of intentions-to-use based researches in the IS field without much recourse to investigating actual usage and how this construct result to user's satisfaction and eventual performance. While [11] and other TAM-based researchers identified perceived ease of use and perceived usefulness as external variables resulting to intention to use and actual usage predictions, the TUSPEM model considers precursors of utilization to include computer self-efficacy, social norms, affect towards use, users habit, perceived usefulness, perceived ease of use and ICT support. However, since this research is not interested in the entire precursors of utilization as modelled by both TPC and TUSPEM models, we model the precursors using a critical precursor social norm [39, 50] to ensure that utilization is sufficiently explained in a mandatory usage context to test the relationship between utilization and OER performance impacts.

Being a key component of several models, findings from researches in the field have been characterized by mixed findings depending on the tools, system and context. On lecturers' use of learning management system (LMS), [50] found a significant relationship between lecturers LMS utilization and performance impacts. On the contrarily, while testing the TPC model among university librarians, students and users of productivity software, [39] results failed to support the relationship between users' level of utilization and performance. Thus, the hypothesis:

H5: Utilization of OERS has a positive relationship with faculty job performance
H6: Utilization of OERS has a positive relationship with faculty job satisfaction

User Satisfaction

Satisfaction is a complex construct and can be influenced by many factors [64] in the information system domain.

This work viewed satisfaction as a post usage experience as it affects performance. It postulated that increase in satisfaction with an information system results to increase in individual and organizational performance.

In workplace environment, employee's emotional satisfaction is influenced by what is considered as one's important job values. When these values are not met, dissatisfaction sets in [61] and can results to a display of negative attitude, poor job quality and low job performance [13].

In investigating users experience and satisfaction with enterprise resource planning systems (ERP) using qualitative content analysis method, [27] found that aspects of task and the type of technology used affects job satisfaction. The causal relationship between task characteristics and job satisfaction was investigated by [47] with the job characteristics model JCM as the theoretical foundation. Questionnaires were used before and after the implementation. To further determine the validity of the influence, it was confirmed that all the five job characteristics had an influence on job satisfaction. Conversely, while [53] found employee satisfaction as not being consistently related with task-technology fit, [29] found moderate support between TTF and utilization directly. Hence, the hypotheses were stated thus:

H7: User satisfaction has a positive relationship with performance,

The research model for this work is presented in Fig 2.

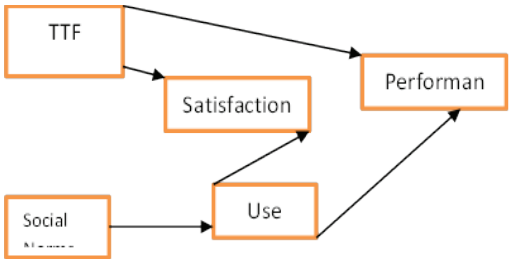

Fig. 2. The Research Model

III. METHODOLOGY

A. Design

The study adopted an offline survey with a view to empirically validate the theoretical model. Based on the theoretical framework, structured test items were adapted bearing in mind that the research model had two exogenous constructs (TTF and social norms) and three endogenous constructs (use, satisfaction and performance). The methodology used was the structural equation modelling. Structural equation modelling is a second-generation multivariate technique used to analyse or test theoretical relationships among the variables in a model [19].

B. Sampling

In order to ensure that the views collected through the survey is representative of the Lecturers familiar with OERs operations, snowballing method was used. This approach is suitable in identified respondents through referrals.

Of the 150 selected across the schools for the study, 123 respondents participated actively in the study by returning the questionnaires. In calculating the minimum sample size required using PLS, the endogenous construct with the most paths leading to it was considered.

In calculating the minimum sample size required using PLS, the endogenous construct with the most paths leading to it was considered (Performance with three precursors leading into it). According to [8], the minimum sample size must be 10 times the number of paths leading to the construct with the most endogenous variables. Hence, the sample size in this study is considered adequate for the PLS analysis.

C. Development of the Instrument

The first section of the instrumentation used four ordinal scales for the collection of basic demographic information namely age (between 30 -70), gender (male or female), education (Bachelors, Masters and Doctorate), and years of experience with OERs (1-10 years).

The second section of the instrument adopted the direct measurement of the variables under study. To guarantee content validity, the items used were adapted from existing validated scales from previous related studies. The twenty-nine test items were modified to suit the context. All the items were modelled with reflective indicators and measured on a 7 point Likert scale with the end points being "strongly disagree" and "strongly agree".

The diagram below shows the coding used and the number of test items used in the measurement of each of the constructs used in the study.

TABLE I. CONSTRUCT CODES

Social Norms	SN	SN1…..SN4
Performance Outcome	PERF	PERF1...PERF7
Satisfaction	SAT	SAT1….SAT5
Task Technology Fit	TTF	TTF1….TTF8
Utilization	USE	USE1….USE5

D. Validity and Reliability

The work considered both the outer model and inner models for analysis. The measurement model represents the relationship between the indicators and the LVs. The outer model assessed the model in terms of Uni-dimensionality, internal consistency reliability, indicator reliability, convergent validity and discriminant validity as discussed under measures above since our model is a reflective model.

E. Survey Protocol

The survey was conducted in a Nigerian University. Members of the faculty who participated in OER workshop on course material development using OER tools organized by OER Africa in collaboration with the National Open University of Nigeria (NOUN) took part in the survey at the end of the workshop. In addition, faculty members familiar with OER whose courses were selected for 'OERization' also participated in the survey. Completion of the questionnaire was voluntary and all responses anonymous. The questionnaire and completion process were pilot tested by some members of staff of the OER unit in NOUN and slight changes were made in order to further simplify some items.

F. Collection of Data

A one-week period was given to the faculty to enable them enough time to respond to the instrument. The data was collected by the researcher and recorded in excel (csv) format. Discrepant cases in the spreadsheet were assigned -1 for computation. Storage of the data was done in both internal and external disk drives to avoid any loss of data after collection.

IV. RESULTS AND DISCUSSION ON FINDINGS

A total of 123 Lecturers (Male (71), Female (52)) from the rank of Assistant Lecturer to Full Professor participated in the survey with ages ranging from 30 to 70 years. The participants had varying number of years of experience in OERs.

A. The Measurement Model

Assessment of the outer model comprised of uni-dimensionality, internal consistency reliability, convergent validity and discriminant validity.

Uni-dimensionality: Out of the 29 items used, twenty-two loaded significantly on the latent variables. Three items from social norms (SN1, SN3 and SN4) and four items from utilization (USE1, 3, 4 and 5) failed to meet the threshold as recommended by [20] and were consequently eliminated for purification purposes. Hence there was high evidence of uni-dimensionality with the other construct's indicator loadings used in the model as all items loaded above the upper threshold.

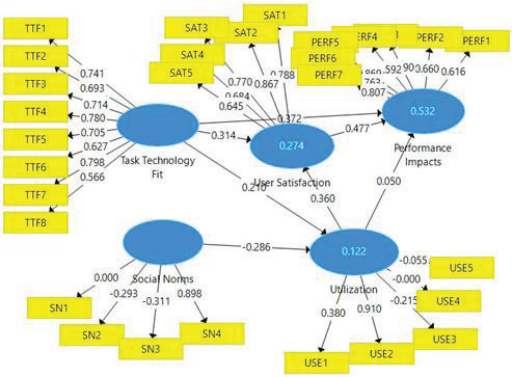

Fig. 3. Indicators validity and reliability measures

Composite reliability (CR): For determination of the extent to which measured items within the same construct were related to each other, composite reliability measurement criteria were used in this study to assess internal consistency reliability. All constructs in the model exceeded the minimum threshold of 0.6 [54] and 0.70 [22] except utilization that had 0.51 as shown in Table II below. Hence, there was also sufficient evidence of internal consistency reliability among the items of the variables in the model.

Convergent reliability was assessed using average variance extracted (AVE). All constructs met the threshold of AVE greater than 0.50 [22] social norms and utilization as shown in Table II below.

Discriminant Validity: From the squared AVE values shown in the table below, 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 diagonal elements must be higher than any other corresponding row or column entry [56]. Consequently, all items loaded highest on their targeted constructs as showed in Table II:

B. The Structural Model

Ability of the model to explain the variance in the dependent model and the statistical significance of the estimated model coefficient are the assessors of the inner model.

TABLE II. OUTER MODEL

Construct	R Square Value
Performance Impact	0.532
User Satisfaction	0.274
Task Technology Fit	-
Utilization	0.22

The Predictive Ability of the Model

The predictive power of the model for the dataset is represented by the R2 value on the endogenous variables as shown in figure 4 below which indicates that 53% of performance impact, 27% of user satisfaction and 12% of utilization were predicted by the factors contained in this model.

Fig. 4. The Structural Equation Modelling (SEM)

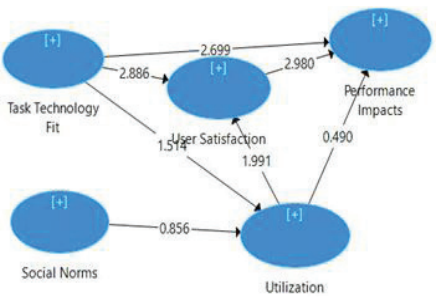

Fig. 5. Bootstrapped result

The detailed R square values derived from the SEM calculation are showed in Table III:

TABLE III. R SQUARE VALUES

Construct	CR	No of items	AVE	Rho-A	1	2	3	4	5
Perf	0.89	8	0.54	0.86	0.74				
Social Norm	0.03	4	0.23	0.23	-0.01	0.50			
TTF	0.89	7	0.50	0.88	0.57	0.01	0.71		
Satisfaction	0.86	5	0.57	0.86	0.64	0.15	0.39	0.76	
Utilization	0.21	5	0.20	0.21	0.33	0.23	0.20	0.42	0.45

The statistical significance of the estimated model coefficients/ Hypotheses Testing

The second aspect of the inner model examines the path coefficients of the latent variables used in the model. Table IV shows the path coefficient, t-values and r-values.

TABLE IV. PATH COEFFICIENTS

Hypothesis	Paths	Path Coefficients	t-value	R-values	Support for H_1 ?
H_1	TTF to performance	0.37	2.63	0.01	Yes
H_2	TTF to Satisfaction	0.31	2.78	0.00	Yes
H_3	TTF to Utilization	0.21	1.52	0.13	No
H_4	Social Norm to Utilization	0.29	0.85	0.40	No
H_5	Utilization to Performance	0.05	0.50	0.62	No
H_6	Utilization to Satisfaction	0.36	2.01	0.00	Yes
H_7	User Satisfaction to Performance	0.48	2.93	0.00	Yes

C. *Discussion on Findings*

With a 53% predictive power of the research model used, it is implied that the model is suitable for research especially in the eLearning domain. From the figure 3 above, 53% of performance impacts is explained by TTF, utilization and satisfaction, 27% of Lecturers satisfaction is explained by TTF and utilization, and 12% of utilization is explained by TTF and social norms constructs. It also implies that the model predicts 53% of the dependent variable (performance). By implication, 47%, 73% and 88% of performance, satisfaction and utilization respectively would be explained by other variables not included in this researched model.

While TTF contributed about 37% in determining performance impacts, the relationship in this study was found to be positive with a t-value of 2.63 at a 0.01 significance level and was supported. This finding is consistent with the work of [37] which opined that reduced task effort improves task performance through flow cognitive elaboration as a moderating factor. TTF has earlier been reported to having a positive and motivational impact on job performances [2, 3, 17, 66]. [39] also reported strong support for the influence of TTF on the performance impact using library management systems. By implication, members of the faculty's performance would be increased with an increase in the fit of OER tools available for discharging their functions.

The hypothesized relationship between TTF and user satisfaction (H2) was significant and was therefore supported with a t-value of 2.63 at 0.00 significance level. This finding agrees with [27] that found that aspects of task and the type of technology used affects job satisfaction. [27] also supported the causal relationship between task characteristics and job satisfaction using the JCM model as the theoretical foundation during an ERP system implementation.

The relationship between TTF and utilization (H3) as hypothesized was not supported at with a t-value of 1.52 at 0.13 level of significance. This finding is supported by earlier works of [3, 39] while testing the TPC model among university librarians and students' users of productivity software which did not support the relationship between users' level of utilization and performance.

The causal relationship between usage and performance was not supported. This finding agrees with [3, 39]. While testing the TPC model, they did not find any relationship between level of utilization and performance. Equally, as contained in the [50] that pointed out that utilization may not be influenced by system quality and information quality [57]. It was also concluded that level of utilization may not influence performance [42, 50 and 52]. In fact, according to [39], the causal relationship between utilization and individual performance proposed by [12] may not exist.

Equally, the hypothesized relationship between usage and satisfaction (H6) vis-a-vis user satisfaction and performance (H7) were supported with 2.01 and 2.93 t-values at 0.00 and 0.00 levels of significance respectively. This association was supported by the findings of [56]. This work therefore supports the suggestion that satisfaction is a product of usage. By implication, increased in performance/ production is achieved when users are satisfied using any system.

The causal relationship between social norms and utilization (H4) was not supported. Scholars in the information system field have been involved in testing effects of social

norms (presence) with different variables and context. [51] also supported that social norms relates with users intention indirectly through perceived usefulness. On the other hand, the relationship between social norms and performance expectancy has been tested in the e-commerce context [34] and microblogging context [43].

These findings also suggest that in order to have maximum performance from Lecturers, the technology must not only fit the e-assessment task, their satisfaction while using such system is equally crucial. It implies that educational institutions and organizations should aimed at providing adequate training of staff to enable them to fully utilize and appreciate the functionalities and capabilities of the various technologies in their work places.

V. CONCLUSION

The result of this study is different from those obtained from the TPC model by [21, 30 and 39]. While their results found more explanatory power from the task technology fit than from the utilization angle, this research found more explanatory power from satisfaction 48% compared to the 37% obtained from the TTF construct in this study. In the optional usage context, post usage satisfaction is the most critical factor in determining performance.

The results showed that TTF had a direct impact on faculty's performance impacts using OER tools. This implies that the better the fit of the technology to the task and the better the effect on their task performance. Contrarily, poor TTF results to dissatisfaction with the system, frustrations and eventual abandonment of information systems. It implies that for organizations to adopt OERs, adequate training and retraining of faculty members must be carried out on existing tools with the view to determining fit, satisfaction and usage perceptions to avoid waste of financial and material resources.

It is believed that this research has contributed towards the establishment of the linkage between technology utilization, satisfaction and performance impact in a mandatory IS usage environment. Most of the studies along this dimension have focused on predicting performance only from the TTF and utilization angles. This study however has expanded the scope to include satisfaction as well, as a predictor of performance impact.

It therefore means that for performance impacts of an IS to be determined especially in the e-learning domain, the technology must not only fit the task and be used, it should also satisfy the user for better performance.

Another important dimension is the post utilization study of the influence of IS usage on satisfaction. Usage influences satisfaction instead of the pre-usage approach of satisfaction stimulating usage in information systems studies.

A. Recommendation for Future Research

Considering the effect of social norms in mandatory and compulsory usage environment context, further research should explore it effect on usage using other test items as only one of the four test items used in this model was appropriate for the construct. Further work should formulate test items with higher unidimensional and internal consistency reliability criteria.

The relationship between the precursors of utilization such as affect towards use, social norms, users' habit, computer self-efficacy, perceived usefulness and ease of use and other related constructs should be explored to provide deeper understanding of utilization in different context using different technologies.

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