

Extended Technological Acceptance Model for Evaluating E-Learning: The African Context (ETAM-4EEA)

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Abstract— The Technological Acceptance Model (TAM) was developed in USA, which is culturally different from Africa. Due to the cultural differences and the Africa cultural diversity, applying the existing TAM to evaluate applications intended for use in Africa, might not produce good results. To accommodate cultural diversity, and in particular the African culture, relevant literature was reviewed and a mixed approach applied to collect and analyze data. The data were collected from 50 learners in five universities across five African regions (North, South, East, West and Central). The data were analyzed using Cronbach's α measure, Kaiser-Meyer-Olkin (KMO) measure, Bartlett's test of sphericity, confirmatory factor analysis (for each construct) and descriptive statistics (average mean and standard deviation). Based on results, an Extended Technological Acceptance Model was developed. The proposed model has four main constructs: Perceived Ease of Use (PEOU), Perceived Usefulness (PU), Perceived Performance (PP) and Benefits (B). Each of the constructs influence Behaviour Intention. Contrary to Davis, PEOU rated higher than PU: among the four constructs, PU rated the lowest. The study found that PEOU influence PU: this confirms Davis findings. Considering that this study only developed a model, it is recommended that the model is tested using a number of information systems in Africa.

Keywords— African Context, Culture, E-learning, Technological Acceptance Model,

I. INTRODUCTION

By definition, culture is the belief of people towards human behavior and their relationships with reality: the way people live in a country, express their truths and values [6]. Dimensions of culture include individualism and collectivism. Individualism accepts the value that each person takes care of himself/herself before others and Collectivism accepts the value that a group places itself first before individuals [27].

Africa has 3000 distinct ethnic groups with 2000 languages (Africanholocaust, 2017) in 55 countries (African Union, 2018) and is home to the most genetically diverse people on Earth: diverse that two Africans are more genetically different from

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Other (12). Technology Acceptance Model (TAM) has continuously been adapted and improved to be applied more widely, hence TAM3 is currently available [54], however, the uniqueness of the African cultures may pose a problem when TAM is applied in the African context . Applying TAM in Africa may not produce good results [42]. Transfer of TAM to different cultural context (except USA where it was originally developed) requires rigorous testing. [42] agree with this when they recommend that caution be taken when applying TAM in some countries and this may be because of cultural differences. Similarly, [57] and [35] point out that a deeper understanding of factors contributing to Ease of Use and Usefulness, two of the TAM constructs, is necessary. TAM neglects examination of different information systems and environments (cultural and social factors). TAM assumes that Technology use is at an individual level [57] and hence organizational level seem to be missing in.

A comparison by [55] indicate that TAM and the IS success model (ISSM) have strengths and weaknesses: while TAM gives detailed comprehensive on system use than the ISSM, ISSM evaluates the relationships between actual system usage, user satisfaction, and it's influence on overall impact (individual and Organization). In view of this, [55] proposed integration of the two to create a more comprehensive solid model. GETAMEL model on the other hand was developed based on most used external factors of TAM (experience, subjective norm, enjoyment, computer anxiety and self-efficacy) which seems not to cover information quality, system quality and service quality factors extensively [7].

TAM also assumes that technology use is by voluntary acts. Due to TAM's limitations, [30] recommended that an extended TAM is mandatory for any pre-implementation study of Information Communication Technology (ICT) among health workers in sub-Saharan Africa. To overcome TAM's limitations and implement [30] recommendation, [7] proposed a General Extended Technology Acceptance Model for e-Learning (GETAMEL) based on the commonly used external factors of TAM. Though their work was undertaken using samples from Africa, emphasis was not on the African context: instead, it was on the commonly used external factors of TAM in e-learning [7]. As a result, environmental factors (both cultural and social) are missing in GETAMEL.

Though TAM has widely been applied to various technological innovations globally and has successful predicted adoption behavior, it may not hold true in all cultures [42]. Since [7] work did not focus on the African context,

GETAMEL may also not hold true in the African context. There is therefore the need to develop an extended TAM that takes into consideration the African context for evaluating quality, user satisfaction and acceptance of e-learning.

Considering the fact that TAM and GETAMEL may not hold true for all cultures [16] this study proposes an extended TAM, specifically for the African context, for evaluating quality, user satisfaction and acceptance of e-learning.

II. LITERATURE REVIEW

Several conclusions have been made on the impact of e-learning on learners. According to [21], learning management systems (e-learning) allow for longer-term access to training material and newer modules (containing current and relevant training material) for workshops to be developed to replace older modules and hence keep learners skills up to date, which could result in learners' performance and productivity being improved. According to [39], usage of e-learning ends in a significant positive impact on learners' academic accomplishments. Studies by [24] support [39] findings.

Like any technology, e-learning has critics. Issues raised by critics include quality, effectiveness and value addition. Critics question whether e-learning ensures quality, effectiveness and value addition in learning process ([31]; [37]). E-learning critics assert that in a face-to-face learning environment, physical cues are noticed by learners' and used to refine delivery mode: however, in e-learning physical cues are missing [31]. The study findings of [37] supports the findings of [31] that teaching certain courses through e-learning isn't appropriate.

The above discussion suggests that there are challenges regarding e-learning quality (compared to the traditional learning mode). One way to verify this is by measuring the perceived quality of e-learning and its effect on e-learning acceptance. Tools that can be used to examine perception and expectation of e-learning quality include TAM (1, 2 and 3), Information Systems Success Model ([18]; [19]), Theory of Reasoned Action (Ajzen & Fishein and Ajzen & Fishein as cited by [49]), Cognitive Dissonance Theory (Anon, nd) and the TOE framework [5]. The most popularly used model is TAM.

Technology Acceptance Model (TAM), propounded by Davis as cited by [20], has two constructs (Perceived Usefulness-PU and Perceived Ease of Use-PEOU) that influence technology acceptance. The model propounds that these two factors influence an individual's belief in adopting information technology. Additionally, the theory has three other constructs: Attitude Towards Use (ATU), Intention to Use (IU) and Actual Usage (AU). PU and PEOU influence ATU and ATU influences IU and this in turn influences actual usage. Between PU and PEOU, [20], finds PU as the strongest influencer of IU. Davis, Bagozzi & Warshaw (as cited by [35]) concluded that PU and PEOU are influenced by some external factors and hence modification on the original TAM as demonstrated in Fig 1 below.

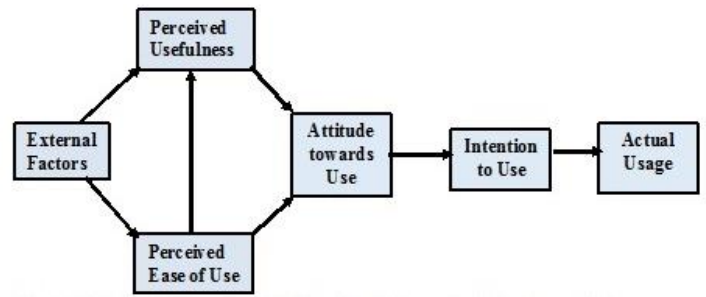


Fig 1: Technological Acceptance Model (Davis, Bagozzi and Warshaw as cited by [35])

Theory Reasoned Action (TRA), propounded by Fishbein & Ajzen as cited by [49], models attitude-behavior relationships. The theory postulates that two factors (attitude and subjective norm) determines an individual's behavior intention. Some external factors (behavior belief, behaviour, evaluation normative norm and motivation to comply with the normative norm) influence these factors. Attitude influenced by behavior belief and behaviour evaluation. In other words, the belief about behaviour and its evaluation influence attitude, (Ajzen as cited by [49]). Subjective Norm is influenced by normative norm and motivation to comply with the normative norm. Fig 2 below is depicting theory of reasoned action.

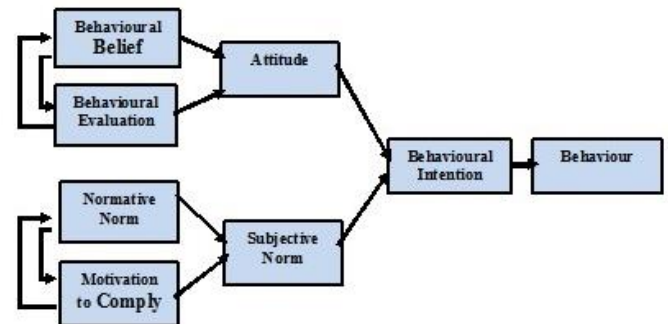


Fig 2: Theory Reasoned Action [49]

Information System Success Model (ISSM) postulated by [18] has six variables that make's an information system successful. These variables are system quality, information quality, use, user satisfaction, individual impact, and organizational impact. Fig 3 bellow depicts the ISSM model.

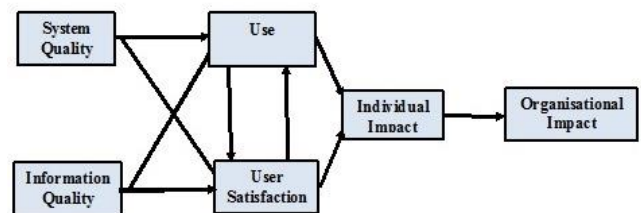


Fig 3: Information System Success Model [18]

TAM, ISSM and TRA relates to each other very much as they postulate factors on Technological Acceptance (TA). TAM, TRA and ISSM postulates Perceived Ease of Use (PEOU) & Perceived Usefulness (PU), Attitude (Att) & Subjective Norm (SN), System Quality (SystQ), Service Quality (ServQ) & Information Quality (InfQual) as constructs for TA respectively. Using SystQ, infQ, ServQ & User Satisfaction (UsS) from ISSM, Perceived Ease Of Use (PEOU) & Perceived Usefulness (PU) from TAM1, voluntary & experience from

TAM3 and Subjective Norm (SN) from TRA, a semi structured interview guide was developed to aid in data collection for this study. The constructs above were chosen because they are the main constructs in the model or theory in which they are found.

III. METHODOLOGY

A Mixed methodology was applied for this study. To increase the value for the study and make it more representation, a wide range of research subjects from Africa was included in the study. The participants were chosen from public universities that have implemented e-learning system(s). One university was chosen from each region of Africa (North, South, East, West and Central).

Using semi structured interviews guide (developed from variables that constitutes the said variables above), data were gathered from 50 students in five universities: Durban University of Technology (South Africa, Southern Africa), Sudan University of Science and Technology (Sudan, Northern Africa), Kenyatta University (Kenya, East Africa), Federal University of Agriculture, Abeokuta (Nigeria, West Africa) and University évangélique en Afrique (DR Congo, Central Africa).

In each country, research assistants assisted in collecting the data. Though there is debate on the number of interviews needed to reach data saturation for themes in a survey research, the general rule-of-thumb is that, one choose as many subjects as possible for interviews until interviewee responses have reached saturation. This is confirmed by [60] who concluded from their research that 16 or fewer interviews were enough to identify common themes from sites with relatively homogeneous groups: however larger sample sizes: ranging from 20 to 40 interviews were needed when using interview as an instrument. Though larger sample sizes tend to be used for collecting quantitative information, there should always be a trade-off between the representativeness, diversity of a sample, efficiency and timeliness with which data can be collected [61] With above and considering the nature of this research, it was expected that responses would reach saturation by the time the researcher reaches the 50th interviewee and hence the choice of the sample size of 50. Due to the different e-learning market consumption size of each country [62] [63] as in Table I below, the sample was stratified as below and subjects chosen from each country as such.

TABLE I: E-LEARNING MARKET PERCENTAGE IN AFRICA

No	Region	Country	E-learning Market Percentage	Sample
1	Southern Africa	South Africa	30%	15
2	West Africa	Nigeria	25%	12
3	Northern Africa	Sudan	20%	10
4	East Africa	Kenya	13%	7
5	Central Africa	DR Congo	12%	6
Total			100%	50

Source: (IT News Africa, 2016; Zealousys, 2017)

IV. ANALYSIS

The data gathered were analyzed by assessing the semi-structured interview guide items. Reliability of the instrument was checked through Cronbach's α measure (item by item through model component). The sampling adequacy of analysis was checked using the Kaiser-Meyer-Olkin (KMO) measure and Bartlett's test of sphericity.

Though the sample has limitations (could be bigger, for a confirmatory factor analysis: but because interviews were conducted and the sample still fell within range), a confirmatory factor analysis was conducted. In addition, descriptive statistics (average mean and standard deviation) of each construct was calculated.

V. RESULTS

Results of the study is presented using a seven-column table as in Table II below. The first column consist of the various constructs. Corresponding variables to the constructs are in the second column. The third column represents the number (N) of learners from who data was gathered. The fourth contains the Cronbach's α value. The Eigen Value & Explained Variance(EV), KMO & Bartlett's test, factor loading and average mean & Standard Deviations are in the fifth, six and seventh columns respectively.

Data in Table II below enabled the researcher to verify whether the constructs proposed for the extended model correlate of not. The data was generated from the Cronbach's α measure of variables that formed the questionnaire. Of the 17 variables in the questionnaire, six correlated closely (with a Cronbach's α of 0.77) to form the Perceived Usefulness construct in the proposed model (fig 4). Four correlated closely (with a Cronbach's α of 0.82) to form the Perceived Ease of Use construct in the proposed model (fig 4). Another four correlated closely (with a Cronbach's α of 0.75) to form the Benefit construct in the proposed model (fig 4). The remaining variables (three) correlated closely (with a Cronbach's α of 0.70) to form the Perceived Performance construct in the proposed model (fig 4).

The construct rated highest is 'Perceived Ease of Use' with the highest average mean of 2.58 and a standard deviation score of 1.26. This indicates that experience on use of e-learning prior to using it, training on use of e-learning, e-learning information quality and students leading the process of teaching & learning in an e-learning system enhances intention to accept and use e-learning systems.

Giving the fact that 50% of the questions for the construct 'Benefit' were reverse phrased, it follows that it rated low than Perceived Performance construct with an average mean of 1.94 and standard deviation of 0.79. This indicates that influence by peers and important persons (referred to as subjective norm in literature), voluntary use and satisfaction are variables that account low for students' intention to accept and use e-learning systems. 'Perceived Usefulness rated lowest with the lowest average mean of 1.87 and a standard deviation score of 0.78. This indicates that frequency of Use, System Quality and Satisfaction accounts lowest for technology acceptance in Africa.

TABLE II: CONSTRUCTS, CRONBACH'S A, KMO, FACTOR LOADING, MEAN AND AVERAGE VALUES

Construct	Variable	N	Chron Alpha	Eigen Value, Explained Variance	KMO, Bartlett's test	Factor Loading	Average Mean, SD
Perceived Usefulness	Ease of Use	50	0.77	4.3, 30	2.9, 20	0.717 P < 0.0001	0.8
	Usefulness						0.45
	Frequency Of Use						0.75
	System Quality						0.82
	Culture						0.54
	Satisfaction						0.49
Perceived Ease of Use	Experience	50	0.82	2.8, 18	2.7, 19	0.72 P < 0.0001	0.9
	Student Led T/L Process						0.73
	Training						0.88
	Information Quality						0.67
Benefit	Voluntary Use	50	0.75	1.3, 10	2.4, 17	0.73 P < 0.0001	0.7
	Influence (Peers)						0.83
	Influence (Important Persons)						0.67
	Satisfaction						0.6
Perceived Performance	System Quality	50	0.7	1.2, 8	1.4, 10	0.7 P < 0.0001	0.8
	Influence (Important Persons)						0.7
	Culture						0.6

The construct 'Perceived Performance' was rated second highest with the average mean of 2.04 and a standard deviation of 0.88. This indicates that culture of Africa, system quality and influence by important persons enhances intention to accept and use e-learning systems. However, these variables enhances acceptance and use less than the variables in construct 'Perceived Ease of Use'. The variables, influence by important persons and system quality & culture, sometimes even rated lower when compared other variables in construct 'Perceived Performance' as it rates equally like the variables in construct 'Benefit' (with an average mean of 1.34) or 'Perceived Usefulness' (with an average mean of 1.87) respectively.

Ease of Use, frequency of use and usefulness are variables that enhanced acceptance and use of e-learning system. The Construct (Perceived Usefulness) from which they emanate was rated an average mean of 1.87 and standard deviation of 0.78. However, these variables enhances acceptance and use of e-learning than the variables in the constructs: Perceived Ease of Use and Perceived Performance. Fig 4 below is the developed extended TAM in the African context.

VI. DISCUSSION AND CONCLUSION

The aim of this paper was to develop an extended TAM in the African context for evaluating quality, user satisfaction and acceptance of e-learning. As a result, five main constructs (made up of 13 variables) were identified from literature. The identified constructs are System Quality [18], Information Quality [18], Service Quality [19], Behaviour Intention [49] and Actual Usage [20].

Results of the study indicated that the 13 variables obtained from literature to model the proposed extended TAM, correlated with each other: hence all 13 variables confirmed. Further analysis of the 14 variables resulted in four main constructs: Perceived Ease of Use, Perceived Usefulness, Perceived Performance and Benefits. Except Benefit, Each of these constructs influence Behaviour Intention directly. Hence in addition to the factors (PEOU and PU) postulated by (Davis, Bagozzi & Warshaw as cited by [35]), Davis & Venkatesh (2004) and Venkatesh & Bala (2008), two additional factors (Perceived Performance and Benefit) that influences BI were established. Contrary to Davis (as cited in [20]) finding,

Perceived Ease of Use rated higher than Perceived Usefulness. Perceived Ease of Use rated as the strongest influencer of Behaviour Intention, followed by Perceived Performance, then Benefit and Perceived Usefulness rated as the lowest influencer of Behaviour Intention. As in Davis (as cited in [20]) research findings, this study confirmed that Perceived Ease of Use influence Perceived Usefulness. Two factors and an additional variable that were identified from literature is Behaviour Intention, Actual Usage and External Factors respectively. The Extended TAM model below was generated.

In terms of factor analysis: though within range, the sample size was small. In future studies, a bigger sample size should be considered. Considering that this study developed the extended TAM in the African context, it is recommended that the model is tested using different information systems in Africa. Though data was collected from three different language (national official) speaking countries (English, French and Arabic), analysis was not carried out on the effect of Language on TAM. It is recommended that future studies consider analyzing the effect of language on TAM.

VII. RECOMMENDATION

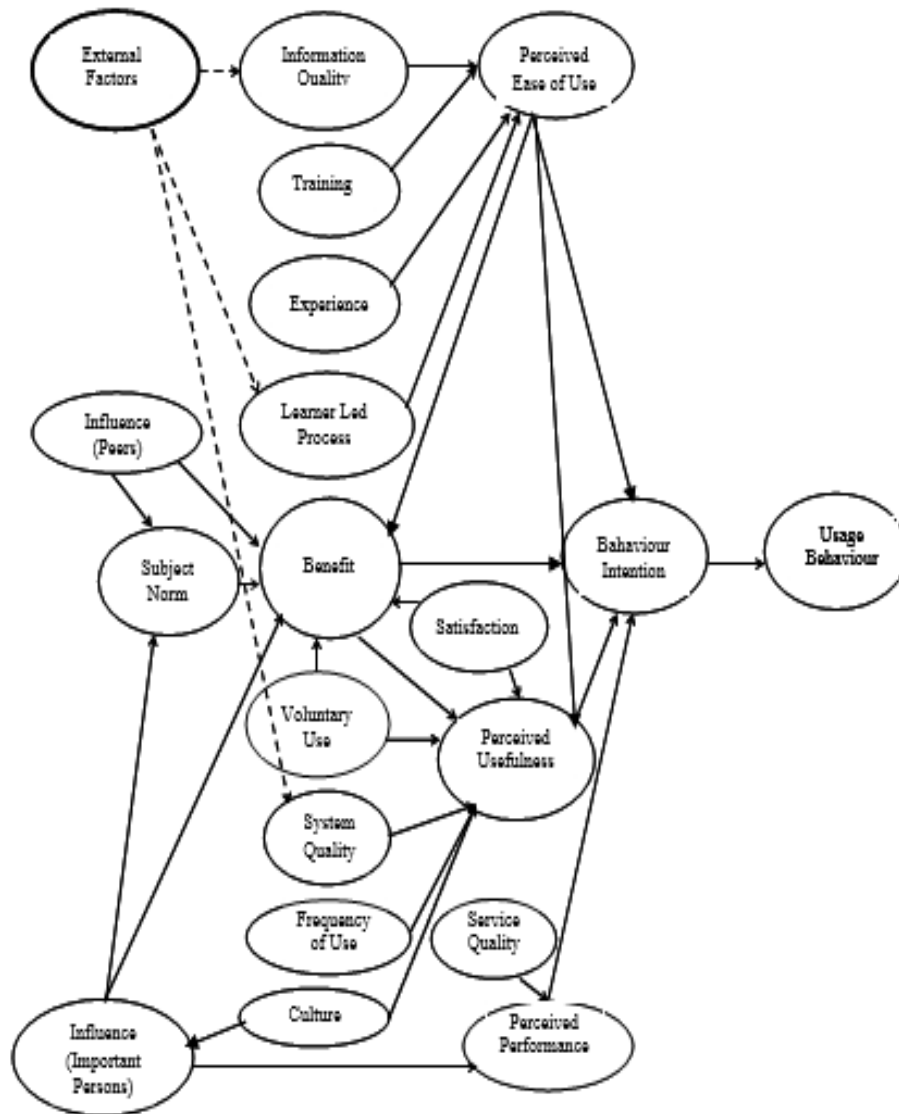


Fig 4: extended technological acceptance model in the African context

VIII. REFERENCES

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