Introducing Learner Infrastructural Capabilities into Information Systems Success Model using E-learning

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Abstract: The study introduces learner infrastructural capabilities into the field of information systems success. The introduction of this construct in information systems success is important due to lack of consideration for the individual infrastructural ability that has not been addressed by the success factors with respect to individual, environment, developing countries and digital divide. An explanatory mixed method research design is considered using questionnaire for the survey and an open-ended interview for data collection. Four hundred and twelve responses were used from survey and ten people for interview. The Information Systems success dimensions include system use, system quality, service quality, content quality, user satisfaction and net benefit and the learner infrastructural capabilities which include the computer ownership, internet access and energy generation. The study found a good model fit for learner infrastructural capabilities when dimensions of information systems success model of DeLone and McLean are used, forming a success model that inculcate the individual Information Systems infrastructure.

Keywords: Infrastructure, E-learning, Information Systems, Developing countries, Digital divide

I. Introduction

Delone and McLean developed an Information Systems success model which witnesses a wide coverage by information systems researchers, indicating its success as a success model in the field of information systems though, suggestions by [1] to involve the technology and individual traits were less considered by the researchers. This study tends to involve the individuality and technological aspect into the Information systems by considering only the end-user in eLearning, i.e. the students.

The eLearning pace can be seen as a game-changer to the traditional way of the educational theorists. With this new pace, educationists are forced to think out of the box by creating new theories and strategies around teaching and learning online [2]. According to [3] theories from social practice, learning, technology are look into in order to systematically explain the concept of eLearning. These therefore, introduce different concept on the development of models and theorist to which eLearning can lay a concrete foundation. These theories and models were design to help implement, adopt and make eLearning a success around the globe. Nigerian factors to which eLearning can be implemented, adopted and be successful may be different as a developing country, perhaps its implementation and adoption is not only to safe cost, its flexibility, the global trend, creation of presumes but also to meet educational demand due to the overwhelming population of the candidates who seek to study in institutions of higher learning in Nigeria. A successful eLearning with reduced cost and flexible learning could improve the performance of students and later provide job placement.

Learner Infrastructural capabilities which can be considered to be "fit with various information systems activities" by [4], in this study refers to learners' capabilities to personally access the eLearning system in the developing countries. While developing countries are faced with different infrastructural problems in order to have access to learning facilities, developed countries are faced with digital divide. Therefore, consideration should be given to the end-users for personally having the ability to learn without facing any problem due to the environment and technology. In a survey of eLearning in Africa, Unwin [5] suggest access to computer, reliable electricity and faster connectivity perhaps might makes eLearning effective based on the response from the survey.

Having these infrastructures in learning institutions within Africa seems to be a dream which is yet to see the light of the day when compared with other continents, and was highlighted to be issues facing eLearning in developing countries by [6]. Perhaps, personally having these infrastructures by learners might help to achieve their eLearning goal. This study therefore, identified these infrastructures as factors and then grouped together as a construct and are refers to as "Learner Infrastructural

Capabilities," and these factors are: energy generation, computer ownership, and internet access.

II. INFORMATION SYSTEMS SUCCESS MODEL OF DELONE AND MCLEAN

Information Systems Success model begins with the work of DeLone and McLean in 1992, it plays an important position in determining the success of an IS either in an organization or individually. DeLone and McLean describe their work using the work of Shannon and Weaver (1949) and that of Mason (1978) that describes the concept of level of output from communication theory with the linear nature of information. This inform the Information systems initiation of information then communicates to the recipient who is then influenced by the information, showing information from production through the use has an influence on individual or organization or both.

When evaluating system success, researchers postulate relationship between the "organizational performance" and different factors of IS success [1]; [7]; [8]. However, successful review of nearly Two hundred papers in 1980s, DeLone and McLean (1992) come up with taxonomy of Information systems and developed an information systems success model with six important components. These are system quality, information quality, use, user satisfaction, individual impact and organizational impact.

In [7] their evaluation using four constructs i.e. system quality, information quality, use and user satisfaction, modified "use" with "usefulness" that, mandatory system, "usefulness" is better measure than "use", and positive significant relationship was found among the variables. The following year, [9] argued that, while "IS use" is a behavior different from IS success, systems failed due to lack of benefit and not because it lacks usage. In [10] argued that the "use" is important even in mandatory systems therefore, developed a modified model.

In [10] the study claimed the model to exceeded expectation, with more than 300 papers referenced their model between 1993 and 2002. [11] and [12], tested and validated IS success model, some researchers check relationship among the variables [13]; [14], integrated the variable with Technology Acceptance Model [15], in E-learning [16]; [12] in Leaning Management Systems [17], some researcher in knowledge management [18]; [19].

These therefore, give the model strength and make it an important model in the field of information systems however, the need to consider other factors had aroused when looked carefully the issue of information systems in the developing countries and the case of digital divide in the developed nations.

III. INFORMATION SYSTEMS SUCCESS COMPONENTS IN ELEARNING

This study focuses on the DeLone and McLean information system success factors of 2003, having five constructs, namely service quality, system quality, system use, user satisfaction, net benefit, while 'information quality' is replaced with 'content quality.'

A. Service Quality

According to [20] refers service quality to an aspect of support system users gained from the IS department and IT support personnel, to [21] skill, capabilities and experience of support personnel were included to the existing measures. Service quality was not found to predict intention to use knowledge management system and years of experience of support personnel was found to relate to frequency and willingness of use [22]; [23]. [24] found external computing support to relate to perceived system usefulness.

B. System Quality

System quality is an attribute of an information system[20], by which the system must be easy to use, flexible, available, reliable, and to ease learning. While it requires high response rate, it also measures usage and performance characteristics. [25]in his work, identified 26 ways for which system quality can be measured and this include efficiency of hardware utilization. System quality and system use are found to relate [26];[27].[11]found a good relationship between system quality and user satisfaction. Indirect relationship exists between system quality and eLearning system success through user satisfaction [12]. These indicate the more the flexibility of a system, ease learning and availability, the more the usage and level of satisfaction by the students. A quality eLearning system must be user friendly, available, and effective to allow easy learning using the eLearning platform.

C. System Use

This is the manner and level whereby users maximally utilized the information system capabilities [20] and according to [1] it is an important measure of IS success. It measures the amount, extent, purpose, frequency, nature and appropriateness of utilization.

Many measures are adopted by researchers, such as actual use, frequency of use, intention to use, and self-reported use. Significant difference was found between self-reported use and actual use [28]; [29],System use is considered to have positive effect on students learning performance [12], significant relationship between 'intention to use' and 'actual usage'[30], significant relationship between 'intention to use' and 'satisfaction' [31], significant relationship between 'intention to use' and 'net benefits' of a system was measured on improvements in job performance [22].[12] found low relationship between system use and eLearning system success, however suggest further extension of their study.

System use increases when learners perceived the importance to their academic success. In eLearning platform, using eLearning system is mandatory though, the level, frequency and intention to use are important and can vary among users.

D. User Satisfaction

User satisfaction is the degree to which a user is satisfied with Information system and its support services

[20]. [32] described it as the extent of IS meeting students need. If students' requirements are met then it enhances their satisfaction with the system [33]. User satisfaction measures the students' satisfaction of the entire system. According to [20], instruments developed by [32] and [34]to measure users' satisfaction were considered the most widely used. These instruments contain items relating to information quality, system quality, and service quality. User satisfaction is suggested as a measure of IS success [20],[12],[35],[36].

User satisfaction has positive relationship with use [11], usage frequency and duration [37], and intention to use [38],[19]. [39]iterates that when system use is not voluntary then success should be measured on educational outcome of the students. E-Learning success is shown by the value given to students learning outcome and results to their satisfaction.

E. Net Benefits

Net benefit measures the success IS contributes to individuals, organizations, and the nation, in economic development, human welfare, good productivity, cost effectiveness and knowledge acquisition. It can be measured at individual level with perceived usefulness [20]. Perceived usefulness is the level at which people agree that a system contribute to their livelihood, job or organizational performance [26].

[16] developed four items to measure positive aspects of net benefit, she further suggests understanding students' learning needs, and attitude towards eLearning toachieve successful development and delivery of eLearning. Learners give the outcome of the system on quality, service, content, knowledge gained and job placement.

F. Content Quality

A well-designed content with efficient and effective delivery will allow learners satisfaction. Content quality is important for learning to take place and should be on a web in an eLearning system [12]. Content includes information, features and services on the website [40], and must be accurate, relevant, reliable, current, understandable, meaningful and complete for learning to take place. Information, is part of content, it expresses the rigor and flexibility of educational objectives of a program, way of teaching, and assessment [41]. A significant relationship between information quality and use, and also user satisfaction of an eLearning system was found [12].

The content contains course information, objective and infrastructure as its structural elements [12],these information's are topic, credit unit, class participation in an online forum, assignment, group project, and infrastructure includes the technological way of using and assessing learning materials.

IV. LEARNER INFRASTRUCTURAL CAPABILITIES

This comprises of computer ownership, energy generation and internet access within the context of eLearning. It is the ability of individual learner to personally own these infrastructures to avoid lack of provision by the eLearning Centre. These infrastructures equipped the learners with the technological know-how in order to achieve their eLearning goal.

A. Computer Ownership

This simply means; learners having personal computer for study. The computer is either laptop, desktop, palmtop computer, smart mobile phone or personal digital assistant [6]. Having computer for educational purpose is identified to boost students' academic performance [42]; [43]; [44]. Technological diffusion within a society could motivate individual to increase their ability to personally own a computer [45].[46] found a relationship between computer ownership and frequency of internet usage. [47] in their study, found a significant positive relationship between computer ownership and higher performance in examination. These indicate that personal computer could perhaps have some relationship with internet access and using the computer will increase the students' performance academically and relate socially.

B. Internet Access

This study refers to internet access as the accessibility of learner to the world wide web and other related systems that connect through the personal computer. According to [42] in her study conducted in Britain ascertain not having access to internet by students in their households due to poverty could results to poor performance at school. And according to[48]in their study found students to face problem of internet access in the developing countries, and these problems of lack of internet facilities could cause low performance by students. However, motivation to own a computer and connect to internet increases fast due to technological spread [45].

The spread of technology in the developing countries had increased and individuals are motivated to own a computer in all work or as a student. These allow learners to search for information online with the aid of the internet and adapt to online learning environment that shows flexibility in terms of learning methodology and pedagogy approaches [48]. These also indicate a relationship between having a computer and internet access, as it becomes difficult for an individual to have internet access without having a personal computer as defined by this study. The study shows that access to internet may assist learners in their successful study and acquiring more knowledge by staying active online.

C. Energy Generation

Electricity generation is making electricity available by individual through the government grid or by an alternative means such as batteries, solar power, wind power and power bank. [5] identified lack of electricity to be one of the issues when delivering eLearning in Africa. The electricity plays a great role in the information systems field, without electricity, all the infrastructures are down and nonfunctional. This makes electricity an important aspect of information system which get less

attention. [48]ascertain electricity to be problem facing eLearning in Tanzania.

According to [49] end-user communication and computing equipment such as personal computers, local servers, wireless routers, set-top, switches, computer monitors and smart TVs account for a total of 55 percent of electricity usage, data centres accounting for almost 30 percent of electricity usage. This shows the capacity of electricity needed by the end-user, and if Information systems should be successful, it requires a great capacity of electricity, and for developing countries where electricity is less or epileptic, Information systems is less active and problems are encountered. Power interruption by national grid might be an issue for information systems success in developing countries however, individuals can get alternative means of power source such as, the use of power generator set, solar energy and power bank.

V. METHOD

The study employs an explanatory mixed methods design by using a questionnaire for the survey and interview as the second part. The study uses 412 responses and a one-on-one interview were conducted for 10 individuals. The responses from survey were obtained from 6 students who enrolled for eLearning within Nigerian Universities and 4 were conducted with IT professionals.

The study review literature to formulate three dimensions for the constructs in which each dimension is having four to five items, making a total of 13 items for the learner infrastructural capabilities construct, and four to seven items for IS success dimensions. A content analysis was carried out among senior academic staff, pilot study was conducted among students giving a Cronbach's Alpha of 0.878. After preparing data following thoroughly the steps by [50] analysis were conducted using both IBM SPSS and AMOS (version 21.0). Exploratory factor analysis (EFA) and reliability test were performed to check the reliability and validity of the construct and found to be satisfactory. And confirmatory factor analysis (CFA) was used for validity and assessing the fitness of the measurement model of the construct, and Structural Equation Model (SEM) for testing the structural model fit was employed.

Descriptive Statistics was conducted to identify missing values however, no missing value was found. Correlation Matrix to identify singularity issues, by checking items that has correlation of more than 0.2 with other item and determinant greater than 0.00001, no singularity issue identified. Kaiser-Meyer-Olkin (KMO) is 0.922 and Bartlett's test with significant value of 0.000 showing sample adequacy and no identity matrix found. Anti-image matrix was checked, all values are greater than 0.5 showing satisfaction. Communalities shows no item less than 0.5 showing satisfaction and Total variance explained was satisfactory and no cumulative percentage is greater than 90 percent, showing satisfaction. Reliability was conducted on the construct; all items are found to be satisfactory with the lowest and highest

having Cronbach's Alpha of 0.914 and 0.917 respectively. This shows that the items are reliable and valid.

After a successful exploratory factor analysis (EFA) and the check for reliability of the factors and their items, then Confirmatory Factor Analysis (CFA) is used according to [51] to test the reliability of the observed variables, examine interrelationships and correlation among the latent construct, to find the best indicators for latent variables before the full fledge Model. CFA was performed on the construct to find the observed variables that best described the latent variable and the interrelationship and correlation among the factors.

VI. RESULTS

According to [52]which suggest reporting Chi-Square Test (X^2), degree of freedom (df), p-value, Root Mean Square Error of Approximation (RMSEA), Comparative Fix Index (CFI) and parsimony fit index such as the PNFI having cut-offs of RMSEA < 0.1 is acceptable and best < 0.08, CFI > 0.9 is good while > 0.95 is best, Normed Chi-Square (X^2/df) < 5.

Fig. 3 to 12 shows the model fit for each of the IS success factors and the learner infrastructural capabilities. Based on the three dimensions used to measure the leaner infrastructure capability, variables showing the factor correlation, factor loading, and error variance are assessed. The model fits results are shown, indicating a good model fit to data (X^2 = 201.372, df = 62, p = 0.000, X^2/df = 3.248, CFI = 0.947, RMSEA = 0.074). Likewise, in a second order, the result also show a model fit without difference (X^2 = 201.372, df = 62, p = 0.000, X^2/df = 3.248, CFI = 0.947, RMSEA = 0.074).See figure 10.
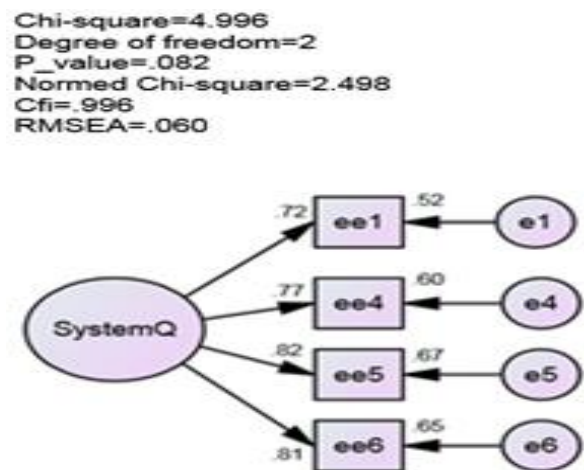

Figure 1. CFA of System Quality

Chi-square=.531
Degree of freedom=2
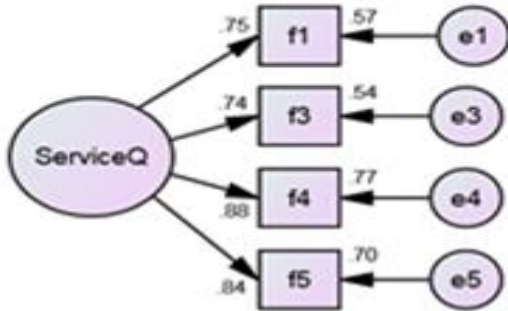P_value=.767
Normed Chi-square=.265
Cfi=1.000
RMSEA=.000

Figure 2. CFA of Service Quality

Chi-square=5.530
Degree of freedom=2
P_value=.063
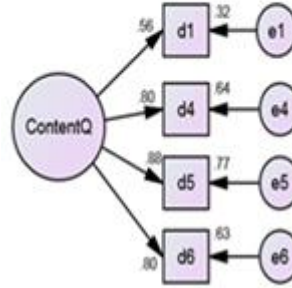Normed Chi-square=2.765
Cfi=.995
RMSEA=.066

Figure 5. CFA of Content Quality

Chi-square=.176
Degree of freedom=1
P_value=.675
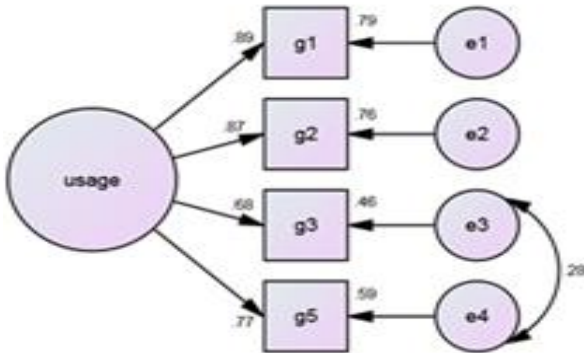Normed Chi-square=.176
Cfi=1.000
RMSEA=.000

Figure 3. CFA of System Use

Chi-square=53.294
Degree of freedom=12
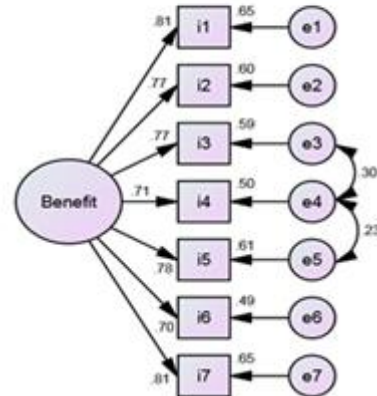P_value=.000
Normed Chi-square=4.441
Cfi=.976
RMSEA=.092

Figure 6. CFA of Net Benefit

Chi-square=5.342
Degree of freedom=2
P_value=.069
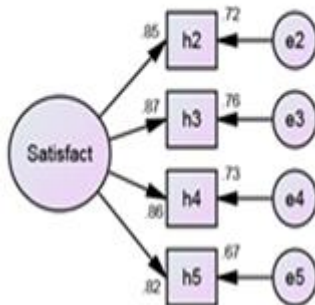Normed Chi-square=2.671
Cfi=.997
RMSEA=.064

Figure 4. CFA of User Satisfaction

Chi-square=.869
Degree of freedom=2
P_value=.648
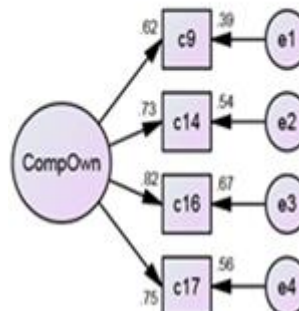Normed Chi-square=.434
Cfi=1.000
RMSEA=.000

Figure 7. CFA of Computer Ownership

Chi-square=1.445
Degree of freedom=2
P_value=.486
Normed Chi-square=.723
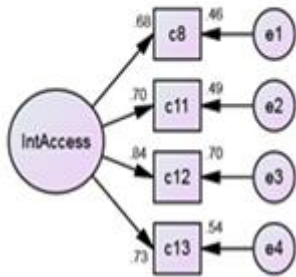Cfi=1.000
RMSEA=.000

Figure 8. CFA of Internet Access

Chi-square=6.870
Degree of freedom=5
P_value=.230
Normed Chi-square=1.374
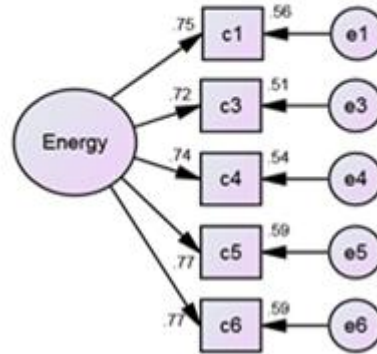Cfi=.998
RMSEA=.030

Figure 9. CFA of Energy Generation

Chi-Square=201.372
Degree of Freedom=62
P_value=.000
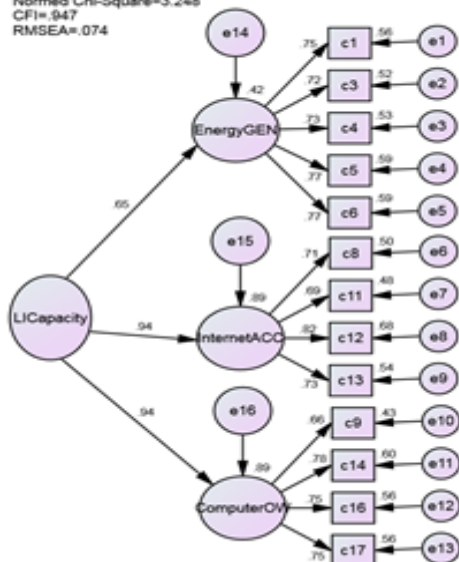Normed Chi-Square=3.248
CFI=.947
RMSEA=.074

Figure 10. CFA of Learner Infrastructural Capabilities

Chi-Square=855.613
Degree of Freedom=310
P_value=.000
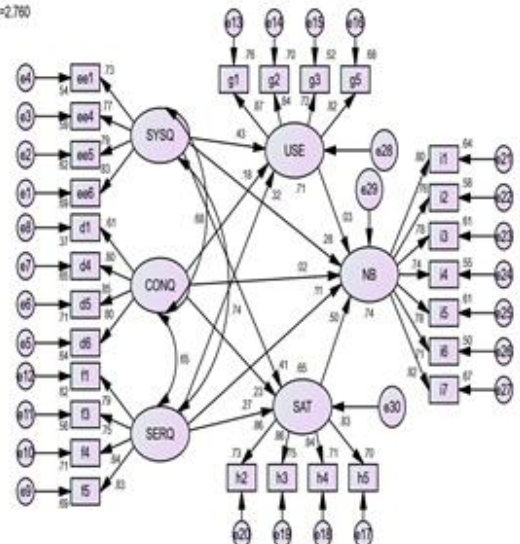Normed Chi-Square=2.760
CFI=.932
RMSEA=.065

Figure 11. Model for Information Systems Success using eLearning

Considering the structural equation model, having the dimensions of the Information systems success models and the Learner infrastructural capability, the model is found to be fit using the suggestion by [52]. The IS success model was found to be fit in the study, having ($X^2 = 855.613$, df = 310, p = 0.000, X^2/df =2.760, CFI = 0.932, RMSEA = 0.065) and the model that introduced Learner infrastructural capabilities into the Information systems success model was also found to be fit, having the following readings: ($X^2 = 184.901$, df = 81, p = 0.000, X^2/df =2.283, CFI = 0.975 RMSEA = 0.056).
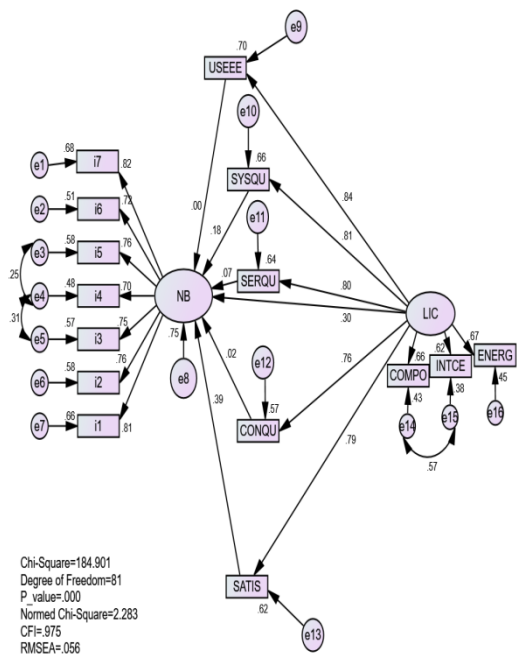
Figure 12. Learner Infrastructural Capabilities in Information Systems Model using eLearning

VII. CONCLUSION

Upon the success shown by the information systems success model in the field of Information systems, a consideration was given to individual, environment in developing countries, and the digital divide which had been an issue within the developed countries. This study thereby, show that in achieving success in information systems, consideration need be given to the ability of the individual in personally having the infrastructure it takes to meet up with the technological challenges. Having the "learner infrastructural capabilities" which include the computer ownership, internet access and energy generation will go a long way in determining the success of information systems.

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