

The Impact of ICT on Cost Efficiency in Higher Institutions in Nigeria

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ABSTRACT

The research work focused on the impact of ICT on cost efficiency in higher institutions in Nigeria. Primary data was used as data. The researcher designed well structured questionnaires, which was distributed and returned. Statistical tools were deployed and results analyzed. This research explored the effect of ICT usage on cost efficiency among tertiary institutions in Nigeria. In addition it looked into the cost of ICT usage in education, the challenges of ICT usage, and the importance of ICT usage in education and conditions and factors necessary for maximum effective use of ICT in education. The result of the study clearly indicated that ICT is not being used in teaching and learning and therefore has no significant effect on cost efficiency; that in the library aspect ICT is used though not well utilized therefore the library aspect to have a significant effect on cost efficiency. Though in the administration aspect ICT is being used but not well utilized it has a significant effect on cost efficiency while in academic planning and development aspect ICT usage has a significant effect on cost efficiency. The costs of developing and maintaining a school's ICT infrastructure are significant. Annual expenditure on maintaining, replenishing and expanding school ICT infrastructure may amount to millions of naira per student. ICT infrastructure costs include: capital costs (including costs to acquire new hardware and software) and recurrent costs (including costs for technical support, software licensing and telecommunications). The capital costs items for enhancing ICT infrastructure and acquiring new components include the costs of: hardware acquisition and replacement, software acquisition and replacement, new data cabling, changes to electrical wiring and equipment, environmental management equipment (including uninterruptible power supplies and air-conditioning units for server rooms), consequential building changes, new furniture and fixtures, technical staff training associated with the purchase of new components, technical staff to design and install new components and disposal of redundant equipment by environmentally friendly means.

Keyword: cost, education, ICT, computer, teaching, learning

1. INTRODUCTION

Knowledge, innovation and information and communication technologies especially computers and computer related peripherals, have grown tremendously and have permeated all areas of our lives. With the invention of Information and Communication Technology, higher institutions now use various types of technologies to aid the services they render. The impacts of new technologies are felt by higher institutions in every aspect. According to Foray (2004) and Boyer (2002) as cited in Kurt and Stephan (2005)¹⁰ Information and communication technologies are a very powerful tool for diffusing knowledge and information, a fundamental aspect of the education process; in that sense, they can play a pedagogical role that could in principle complement with traditional practices of education sector. The education sector has so far been characterized by rather slow progress in terms of innovation development which affects teaching activities [16][17][18][19][20]. In a study, OECD (2003) as cited in Kurt and Stephan (2005)¹⁰ education research and development does not play a strong role as a factor enabling the direct production of systematic knowledge which translates in the "programme that works" in the classroom or lecture hall. Education is not a field that lends itself easily to experimentation, partly because experimental approaches in education are often impossible to describe in precisely enough to be sure that they are being really replicated [1][2][3][4][5][6][7]

The functions of teaching in education process is considered paramount especially when we consider teaching and learning process as the acquisition of knowledge and skills by individuals to enable him become useful member of the society. It involves deliberate activities geared towards the development of less matured and inexperienced. It is obvious that in educational institutions teaching cannot take place without the learner, the teacher, the curriculum; content and instructional materials and any teacher with adequate and professional skills in technology utilization will definitely have his students perform better in classroom learning. Information and communication technology which have been defined by David (2005)⁸ as technology which supports activities involving the creation, storage, manipulation and communication of

information together with their related methods, management and application; have potentially offer increased possibilities for codification of knowledge about teaching and for innovation in teaching activities through being able to deliver learning and cognitive activities anywhere at any time. To Krubu and Osawaru (2011)¹⁸, the introduction of various information technology (ICT) trends has lead to reorganization, change in work patterns, and demand for new skills, job retraining and reclassification positions. Kurt and Stephan (2005)¹⁰ opine that learning at a distance can furthermore be more learner-centered, self-paced and problem solving-based than face to face teaching. They went further to state that many learning activities cannot be coordinated by virtual means only. The emulation and spontaneity generated by physical presence and social grouping often remain crucial. Also face to face exchanges are important when they enable other forms of sensory perception to be stimulated apart from those used within the framework of electronic interaction. However, technology can help teachers to respond to students' diverse learning styles by creating reach environments that engage students' tactile, visual and auditory senses [8][9][10][11][12][13][14][15].

Thus e-learning which is the use of information and communication technologies to enhance or support learning and teaching in higher education. It is a generic term referring to different uses and intensities of uses of information and communication technologies from wholly online education to campus based education through other forms of distance education supplemented with ICTs in some way. E-learning investment in higher institutions in Nigeria can be cost effective and efficient, but this depends on the business model, the profile and number of students and topics, and initial development costs [21][22][23][24][25][27].

2. STATEMENT OF THE PROBLEM

The integration of information and communication technologies in higher institutions in Nigeria is being supported and promoted. Underlining the support and promotion are claims that successful integration will lead to enhanced learning outcomes. However, the usually high value-added effects of classroom technology use have received more critical review than other education tools, especially, cost efficiency which has for many higher institutions been a secondary goal compared to the challenge of developing innovative and high quality e-learning courses at many higher institutions in Nigeria. The problem of the study therefore is to examine the impact of ICT on cost efficiency in higher institutions in Nigeria [1][2].

3. OBJECTIVE OF THE STUDY

The general objective of this study is to examine the impact of ICT usage on cost efficiency in higher institutions in Nigeria; and specifically to ascertain the following:

1. The various aspects of ICT usage in tertiary institutions.
2. The collective effect of all aspects of ICT usage on achieving cost efficiency.
3. The individual effect of each aspect of ICT usage on achieving cost efficiency.
4. To make policy recommendations based on the findings of the study.

4. RESEARCH QUESTIONS

In order to enhance a realistic study on the impact of ICT on cost efficiency among selected institutions in Nigeria, the researcher postulates the following questions to get necessary data for the success of the study:

1. To what extent do the collective aspects of ICT usage affect cost efficiency in tertiary institutions in Nigeria?
2. To what extent does individual aspect of ICT usage affect cost efficiency in tertiary institutions in Nigeria?

5. RESEARCH HYPOTHESIS

On the basis of the statement of the problem, objectives of the study and research questions, the following hypothesis have been formulated:

- Ho₁: the collective aspects of ICT usage have no significant effect on cost efficiency in tertiary institutions
- Ho₂: the individual aspect of ICT usage has no significant effect on cost efficiency in tertiary institutions.

6. SCOPE/LIMITATIONS OF THE STUDY

This research work is on the impact of ICT on cost efficiency in selected institutions in Nigeria. The limitations faced in the course of carrying out this study are:

- i. Limited time
- ii. Inadequate literature and materials
- iii. Reluctance on the part of staff and students to fill the questionnaire.
- iv. Lack of adequate funds.

This research work faced some other limitations which might influence the validity and reliability of the results of the study. First of all, the cost efficiency of ICT usage is relatively a new phenomenon in education; hence finding people with adequate knowledge of the effect of ICT usage on cost efficiency was a difficult task as most people in tertiary institutions were not well informed on the uses of ICT in education. Considering the fact that there are many tertiary institutions in Nigeria and there were no funds at the disposal of the researcher to cover all the institutions, the researcher had to devise an easier way by reducing the sample size of respondents and copies of the questionnaire; hence, adopting a convenience representative sampling method.

7. SIGNIFICANCE OF THE STUDY

The importance of this study, among others is to provide a systematic data on cost efficiency on the usage of ICT in higher institutions in Nigeria. It will also enable educational leaders to make cost efficiency a primary goal compared to the challenges of developing innovative and high quality e-learning courses at higher institutions in Nigeria. It is also hoped that the result of this study and recommendations will serve as a guide especially to educational leaders, policy makers and researchers to know the impact of ICT on cost efficiency in higher institutions in Nigeria. Generally, it is hoped that more would have been contributed to the frontier of knowledge as a result of this study.

8. RESEARCH METHODOLOGY

This research work is based on a well structured method using standard empirical tools. The Research design provides the plan or framework for data collection and analysis. It reveals the type of research, whether exploratory, descriptive or causal and the priorities the researcher (Ghauri and Gronhaug, 2005)¹³. The research design will comprise of combination of descriptive and exploratory approaches. This is because the concept of Information and Communication Technology needs to be clarified. It consist both qualitative and quantitative methods of data collection and empirical analysis will be employed. This section also deals with the plan for investigation that specifies the sources and type of data relevant to research question(s). It is a framework specifying the approach to be used for gathering and analyzing of data in response to administered questionnaire. It presents the methods, tools and techniques adapted to measure the effect of effect of ICT on cost efficiency among selected tertiary institutions in Nigeria. It identifies the various aspects of ICT that affects cost efficiency among tertiary institutions in Nigeria. It

covers the data-type used; the procedure for selection and instrument used population and sample size. It also specifies the techniques used for the data analysis [26][27][28][29][30].

9. RESEARCH DESIGN

A good research design will ensure that collected data is consistent with the study of the objectives in addition to being accurate and economical. Functions of the research design include:

- a. Demand for answers to questions among relationship among variables
- b. Increased certainty and generalization of results.

As a field of survey, this research work focuses on the effects of ICT on cost efficiency in tertiary institutions in Nigeria and sees how ICT affect cost efficiency and development. Data for analysis for this work is exclusive primary data with no attempt is made to include secondary data. The study followed objectivity in the identification of aspect of ICT that affects cost efficiency on the basis of literature review. The above imply that some aspect of ICT (variables or factors) are identified through literature review and analyzed to see how it affect (whether positive or negative) cost efficiency and development among tertiary institutions in Nigeria. The field survey approach was adapted for data collection based on specific application area such as:

- a. Teaching and learning, b. Library; c. Administration; d. Academic planning and development

In this study, the researcher developed a well-structured and standardized questionnaire on perceived aspect of ICT that affect cost efficiency among tertiary institutions in Nigeria based on the Likert five-point ordinal scale and they were administered to staff (management and non-management), and students in the domain of study. The respondents possess technical skills, academic qualification and experience in ICT. A total two hundred (200) questionnaires were distributed.

10. SOURCES OF DATA

The sources of data for this research work are exclusive primary data sources. Primary data sources for this research work were obtained from structured and standardized copies of questionnaires targeted to about 200 respondents. The respondents are professionals or stakeholders in the area of our research interest. When funding permits, primary data gives credibility to the research result for the following reasons:

- a. It reduces the interviewer's biases and interpretations of questions.

- b. It allows the respondent(s) to think twice before answering a question.
- c. It allows some privacy for some sensitive questions
- d. It is a fair fast method of collecting data.

The major sources of secondary data include: textbook, newspapers, and conference and workshop papers and they were used mainly in literature review.

10.1 Method of Data Collection

This section deals with means and techniques through which data was collected for this research work. The primary data (questionnaire) collected here were meant for testing and validating the prior hypotheses postulated through literature review which is the secondary source of data. Data was collected by means of questionnaires from staff and students. This is as a result of the nature of information /data being sought as certain sections required fixed response/s and others were open-ended questions allowing the respondent liberty to discuss his opinion on the problem area and subject matter (Ayadi , and Hyman , 2006)³.

10.2 Method of Primary Data Collection

Primary data collection tools will be used for this project. One form capture information concerning the respondents and their experiences in ICT usage among tertiary institutions in Nigeria and the other form captures detail identification of the several aspects of ICT usage that affect cost efficiency and development. This form that captured data on aspect of ICT usage that affect cost efficiency and development was designed based on the Likert five-point scale. The Likert summated involves statement relating to attitude in question. In this case, the aspects of ICT usage as it affect cost (efforts) efficiency and development. The respondents are required to indicate the degree of agreement or disagreement with each of the statements. A numerical score is assigned to each degree of agreement/disagreement. The scores from the statement are added up to obtain the total score for each respondent. Example:

Strongly disagree

1

Disagree

2

Neutral

3

Agree

4

Strongly agree

5

The use of Likert five-point as an attitude measuring scale is well justified for this study and is rigidly followed as described as listed below:

- i. Responses were selected and subjected to scoring based on the judgmental assessment

on the degree of how the various aspects of ICT usage affect cost efficiency and development of among tertiary institutions in Nigeria.

- ii. Favorable and unfavorable statements of how the aspect of ICT usage affect cost efficiency among tertiary institutions in Nigeria were compiled.
- iii. Collected statements in the form of a questionnaire were administered to a sample deemed to be reasonably representing the population being studied.
- iv. Each respondent's score is obtained by adding up the scores of the responses to each statement.

These steps have been followed rigidly in obtaining data and opinion of respondents regarding aspect of ICT usage that affect cost efficiency (effort)among tertiary institutions in Nigeria. Kauffman (1993)¹⁶ argue that attitude are complex and difficult to measure, and that individuals tends to make inaccurate judgment under difficult circumstances, therefore a scale such as Likert, which improves the measurement of attitudes, is ideal and although, it can be used to rank attitude, but cannot be used to measure difference between attitudes. Also attitude vary, respondents may obtain exactly the same score from agreeing with quite different items.

10.3 Population of Study and Sample Survey

Population is the aggregate or totality in the universe of study. Population could be finite or infinite. The study of the entire population is known as enumeration for the purpose of this work, the researcher has chosen her population all staff and students involved in the usage of ICT in tertiary institutions in Nigeria. The result of this study will be of interest to the entire population. It will determine how the various aspect of ICT usage affect cost efficiency among tertiary institutions in Nigeria. Due to limitation in resource(s) the researcher might find it difficult to conduct total enumeration (studying the whole population). The option is to limit the study to some of the objects selected from the population sample with a view to extending the finding to the entire population. Basic to all statistical inferences and decision based upon them is the uncertainty introduced by the use of a sample instead of entire population of interest. For example, in experimentation, where the population of observations might be infinite, man's inability to observe "all nature" is obvious. In the social and behavioral science or other applications involving a finite population, the large size of this finite population still dictates that samples be taken from the population. In this research, the researcher has taken an approach, which ensures that the sample is representative of the population and at

the same time uses an economically feasible subset of it [26][51][52][50].

There are many institutions involved in ICT usage located in various parts of Nigeria. Instead of getting responses from all the institutions the researcher has selected a few to represent the entire population. This decision was made due to resource constraints. About 200 copies of questionnaires were distributed to the experts who are knowledgeable in the selected areas. The approach used in this survey is the simple random sampling.

10.4 Questionnaire Distributions

The distribution of the questionnaire was purely exclusive because the respondents are expected to be highly involved in the use of ICT in tertiary institutions. The following will guide the researcher in distributing the questionnaire:

- The respondent must be educated, at least possess WAEC/ GCE or higher qualification in ICT related discipline and must be a staff or student of tertiary institutions in Nigeria.
- He must be willing to respond.

The above requirements were satisfied.

11. METHOD OF DATA ANALYSIS

11.1 Multiple Regression Analysis

Multiple-Regression is a multivariate statistical technique which helps to predict one variable from other variables, as long as there are established relationships between the variables (Nworuh, 2004). The variable being predicted is usually known as dependent variables because its value is dependent on the other variables variously referred to as the independent variables. In multiple regressions, the model describing the relationship

between the dependent variable and independent variables is as given in the equation 3.1 below:

$$Y = \beta_1 X_1 + \beta_2 X_2 + \beta_3 X_3 + \beta_4 X_4 + \beta_5 X_5 + \epsilon_i$$

equation 1

Where $X_1, X_2, \dots, X_n$ = independent variables
 β_0 = a constant value of Y when all X values are 0.

$\beta_1 + \beta_2 + \dots + \beta_n$ = net regression coefficients. For instance, β_0 measures the change in $X_{1, \dots, n}$ while holding the other variables constant. ϵ = independent and normally distributed random error term with mean zero.

For the purpose of this study, our

Y = Cost efficiency; X_1 = Teaching and Learning aspect; X_2 = Library aspect
 X_3 = Administration aspect;
 X_4 = Academic planning and development aspect

11.2 Test of Hypotheses 1 And 2

Hypotheses 1 and 2 are to be tested using multiple regressions. In hypotheses 1 and 2 we shall make the Total collective aspects of ICT have significant effect on cost efficiency among selected tertiary institutions in Nigeria (Y) as the dependent variable while the independent variables ($X_1 \dots X_4$) will be:

X_1 = Teaching and Learning aspect; X_2 = Library aspect; X_3 = Administration aspect; X_4 = Academic planning and development aspect

F-test is to be employed in testing the overall significance of the Model (independent variables taken together), while the T-test will be employed in testing the significances of each of the independent variables.

11.3 Test of Model Analysis Of Variance (ANOVA).

ANOVA measures whether or not the equation represents a set of regression coefficients that, in total are statistically significant from zero. In multiple-regression, as in simple regression, the total deviation on each observation Y_i from the mean ($Y_i - \bar{Y}$) can be expressed as the sum of its explained and unexplained variations:

$$\sum (Y_i - \bar{Y})^2 = \sum ((Y_i - \bar{Y})^2 + \sum (Y_i - \bar{Y})^2) \dots \dots \dots$$

SST = SSR + SSE equation 2

Where $(Y_i - \bar{Y})$ = Explained variables
 $(Y_i - \bar{Y})$ = Unexplained variables

$$SST = \sum Y_i^2 - (\sum Y)^2 / n \dots \dots \dots$$

equation 3

$$SSE = \sum Y_i^2 - \sum Y^2 = SST - SSR \dots \dots \dots$$

equation 4

Where SST = Sum of square total
 SSR = Sum of square due to regression;
 SSE = Sum of square due to error

The necessary sum of squares, degree of freedom, mean squares and variance ratio for multiple regression are summarized in the ANOVA table below

Table 1: ANOVA

Source of variation	Sum of squares (SS)	Degree of Freedom (df)	Mean Squares (MS)	Variance Ratio (F-ratio)
Regression	SSR	K	MSR = SSR/K	F* = MSR/MSE
Error	SSE	n – k – 1	MSE = SSE/n-k-1	
Total	SST	N – 1		

11.4 Test of the Model: Coefficient of Determination and the F-test approach.

One method to test statistical significance of estimated model is through the coefficient of determination (R^2), calculated from the Regression. R^2 gives the proportion of the total variation in the dependent variable (Estimated Cost/effort). The value for R^2 ranges from 0 to 1. In setting up the test, the following Hypothesis is tested:

$H_{01}: B^2 = 0$ (i.e. the collective aspects of ICT have no significant effect on cost efficiency among tertiary institutions in Nigeria for hypotheses 1 and 2.

$H_{A1}: B^2 > 0$ (One-tail test of significance, meaning that at least, there is a significant relationship between cost efficiency and development of ICT among tertiary institutions in Nigeria for hypotheses 1 and 2.

Decision Rule

If F-Ratio (calculated) is greater than F-Ratio (tabulated), at alpha level of significance, and (K-1), (N-K) degrees of freedom, then we reject H_0 and accept H_A and then conclude that there is some truth in the estimated model (i.e. the regression model is significant since the independent variables significantly accounts for the variation in the dependent variables. Test for specific strength of independent variables: T-Ratio. Having established the significances of the estimated model, we now proceed to test the specific strengths of the various independent variables. This can be achieved by conducting a T-test statistics.

T-Ratio = $\beta_k / \epsilon(\beta_k)$ equation 5 for $k = 1 \dots 8$

Where β_k = Estimate of population parameter
 ϵ = Standard error of the estimate
 K = Number of variables

N = Number of observation

Decision Rule

If $\beta_k / \epsilon(\beta_k) > t_{n-k, \alpha/2}$ level of significance, we reject H_0 and accept H_A and therefore conclude that the variable belongs to the model.

11.5 Discriminant Function Analysis

Discriminant function analysis is a multivariate statistical technique used commonly to classify persons or objects into various groups. It is also used to analyze known groups to determine the relative influence of specific factors for deciding into which group various cases fall. Discriminant analysis joins a nominally scaled criterion or dependent variables that are interval or ratio scaled. If a discriminant equation is formed, it can be used to predict the classification of a new observation. The linear function representation is of the form:

$$Z_i = d_0 + d_1X_1 + d_2X_2 + \dots + d_pX_p \quad \text{equation 6}$$

Where Z_i = score or discriminant function i

$d_{1 \dots n}$ = weighting coefficient;

d_0 = constant

$X_{s(1 \dots n)}$ = values of the discriminating variables as listed below:

X_1 = Teaching and Learning aspect

11.6 Formulation of Model for Analyzing Effects

The analysis in this research was carried out using well-structured questionnaire. The statistical application software was used to analyze data collected. The method of independent variable and stepwise methods of discriminant function analysis was also applied.

11.7 Stepwise Discriminant Function Analysis

In this method, variables are added to the discriminant function one after the other

until it is found that adding extra variables does not give significant better discrimination.

11.8 Validity of Research Instrument

All data measuring instruments particularly in the social sciences contain some degree of errors no matter how precise and careful the efforts of the observation. Our research instrument (via questionnaires) was duly evaluated by my erudite supervisor and its administration in the selected institution (Olatokun, 2009³⁰; Onwurah, 2008³²). Besides, the instrument was given to professionals outside the pressure audience, and the result also confirms its genuineness and authenticity both in framing and content. Validity and reliability of findings and results will be key issues in this research. Validity has to do with whether the results obtained within the study are true (i.e. internal validity) as well as whether findings can be generalized in other cases and/or contexts whereas reliability has to do with the stability or consistency of the measure employed (Ghuri and Gronhaug, 2005¹³; Pakistan, 2007). The validity of the findings or results will also depend on the truthfulness of the answers and opinions given by respondents when filling the questionnaires. However, this to some extent might not reflect the reality on ground accurately as both parties are bound by non-disclosure and confidentiality clauses and issues. Hence, the researcher was limited in this regard.

12 RESEARCH FINDINGS

This section deals with the findings using empirical quantitative and qualitative analysis performed on the feedbacks obtained from the questionnaire distributed. The data analysis techniques had to be a mixture or a variety of quantitative and qualitative methods due to the nature of phenomenon or variable under study. Some variables are absolute and very easy to measure empirically while others such as service quality

were more relative and hence the researcher relied on statistics tools for its analysis.

12.1 Data Presentation and Analysis

Out of 200 survey questionnaires distributed, 191 copies were returned. The researcher screened the copies returned for incomplete or missing data. Questionnaires with mostly unanswered questions were discarded. After which we had 182 useable survey forms, which is equivalent to 91% response rate. Statistical Package (SPSS) was used to summarize and analyze the data. Frequencies for each demographic variable were computed. Reliability of the data was assessed by using Cronbach's Alpha (Hayes, 1998). Higher Alpha coefficients indicate higher scale reliability (Santos, 1999)⁴¹. Specifically, Nunnally (1978)²⁸ suggests that scales with 0.70 Alpha coefficients and above are considered acceptable. In addition, construct validity was assessed by using Factor Analysis to discover the underlying structure of variables. Respondents

12.2 Multiple Regression Analysis

The researcher conducted multiple regression analysis to examine:

- Ho₁: if the collective aspects of ICT have no significant effect on cost efficiency and usage of ICT among tertiary institutions in Nigeria
- Ho₂: if the individual aspect of ICT has no significant effect on cost efficiency and the usage of ICT among tertiary institutions in Nigeria

The research seeks how well the individual and collective aspects of ICT usage affect total cost and among tertiary institutions in Nigeria. Total cost is an aggregation of cost on teaching and learning aspect, library aspect, administration aspect, and academic planning and development aspect of ICT usage. Table 12 presents the multiple regression analysis between aspects of ICT usage and total cost.

Table 2: Model Summary of the Constructs

Model	R	R Square	Adjusted R Square	Std. Error of the Estimate	Change Statistics					Durbin-Watson
					R Square Change	F Change	df1	df2	Sig. Change	
1	.780 ^a	.608	.599	2.206	.608	68.270	4	176	.000	1.745

Table 2: Predictors: (Constant), Academic Planning and Dev, Teaching and Learning Aspect, Library Aspect, and Administration Aspect

b. Dependent Variable: Cost efficiency

The overall predictability of the model is shown in Table 2 above, it can be seen that the R-Square value for the model showed that 60.8 percent ($R^2=0.608$) of the variance in the total cost can be predicted from the independent variables (teaching and learning aspect, library aspect, administration aspect and academic planning and development aspect).

Table 3: ANOVA for the constructs

Table 3, presents the ANOVA report on the general significance of the model. As p is less 0.05, the model is significant. Thus, the combination of the variables significantly predicts the dependent variable ($F=68.270$; $p < 0.05$). Table 3 shows that the collective aspect of ICT usage in tertiary institutions: Academic planning and development aspect, teaching and learning aspect, library aspect and administration aspect when collocated together have significant effect on cost efficiency. It indicates that the model and data are fit in explaining the effect of ICT on cost efficiency and usage of ICT among tertiary institutions in Nigeria.

Table 4: ICT Aspects and Total Cost Regression Analysis
Coefficients^a

Model	Unstandardized Coefficients		Standardized Coefficients	T	Sig.	95% Confidence Interval for B	
	B	Std. Error	Beta			Lower Bound	Upper Bound
Total cost	2.490	.853		2.920	.004	.807	4.172
Teaching Learning Aspect	-.011	.054	-.013	-.206	.837	-.118	.096
Library Aspect	.144	.056	.179	2.579	.011	.034	.255
Administration Aspect	.138	.053	.207	2.625	.009	.034	.241
Academic Planning and Dev	.398	.061	.486	6.533	.000	.278	.519

Table 4: Predictors: Teaching and learning aspect, library aspect, administration aspect and academic planning and development aspect; Dependent variable: Total cost

Table 4, showed the un-standardized Beta Coefficients that present the contributions of each variable to the model. The t and p-values showed the impact of the independent variables on the dependent variable. From Table 4, it is clear that the Academic planning and development Aspect had the highest impact on overall cost efficiency when used (the independent variable), achieving a β of 0.496 (the large t-value and corresponding low p-value buttressed the result for Academic planning and Development Aspect which had the highest Beta coefficient (both for standardized and un-standardized)), followed by Administration aspect ($\beta = 0.207$), Library aspect ($\beta = 0.179$), and) and The last factor influencing Total cost when Teaching and learning aspect which had a β of -0.013. Results imply that increasing the quality usage of ICT in teaching and learning aspect, library aspect, administration aspect and academic planning and development aspect will inherently reduce Total cost and improve efficiency and development.

Overall COST EFFICIENCY

= 2.490 + -0.13 teaching and learning aspect + .179 library aspect + .207 administration aspect + .496 academic planning and development aspect

12.3 Relationship Model And Interpretation

Table 5 shows the results of the hypothesis tested against the p-values that were obtained from the results above. These were summarily shown.

Table 5: Summary of Values for the constructs

Variables	Beta	P
Teaching and Learning Aspect	-.13	$P=0.000 > 0.05^*$
Library Aspect	.179	$P=0.000 < 0.05^*$
Administration Aspect	.207	$P=0.000 < 0.05^*$
Academic Planning and Development Aspect	.496	$P=0.000 < 0.05^*$

Table 6: Summary of Hypotheses Analysis

	Hypothesis	Results
H ₀	Teaching and learning aspect is negatively related to cost efficiency	Not Significant
H ₀	Library aspect is positively related to cost efficiency	Significant
H ₀	Administrative aspect is positively related to cost efficiency	Significant
H ₀	Academic planning and administration aspect is positively related to cost efficiency	Significant

13. DISCUSSION AND SUMMARY

This research explored the effect of ICT usage on cost efficiency among tertiary institutions in Nigeria. In addition it looked into the cost of ICT usage in education, the challenges of ICT usage, the importance of ICT usage in education and conditions and factors necessary for maximum effective use of ICT in education. The result of the study clearly indicated that ICT is not being used in teaching and learning and therefore has no significant effect on cost efficiency; that in the library aspect ICT is used though not well utilized therefore the library aspect to has a significant effect on cost efficiency. Though in the administration aspect ICT is being used but not well utilized it has a significant effect on cost efficiency while in academic planning and development aspect ICT usage has a significant effect on cost efficiency.

The costs of developing and maintaining a school's ICT infrastructure are significant. Annual expenditure on maintaining, replenishing and expanding school ICT infrastructure may amount to millions of naira per student. ICT infrastructure costs include: capital costs (including costs to acquire new hardware and software) and recurrent costs (including costs for technical support, software licensing and telecommunications). The capital costs items for enhancing ICT infrastructure and acquiring new components include the costs of: hardware acquisition and replacement, software acquisition and replacement, new data cabling, changes to electrical wiring and equipment, environmental management equipment (including uninterruptible power supplies and air-conditioning units for server rooms), consequential building changes, new furniture and fixtures, technical staff training associated with the purchase of new components, technical staff to design and install new components and disposal of redundant equipment by environmentally friendly means. While the recurrent cost items for ongoing management of the ICT infrastructure include the costs of: hardware maintenance, software licensing, software maintenance, the replacement of obsolete

hardware and software components, telecommunications, electricity, insurance, consumables (including paper and ink cartridges), the employment of technical staff, the training of technical staff (separate from the professional learning costs for teachers and school staff), the engagement of suppliers of technical services.

The most common problems associated with the effective implementation of ICT in tertiary institutions are lack of qualified ICT personnel, cost of equipment, management attitudes, inconsistent electric power supply, technology infrastructure, lack of technical support and personnel. The attitudes of various managements toward the development of technology related facilities are rather slow. Again there is need for skilled staff, teachers and technical crew that will handle the technology at all level in order to achieve technology educational objectives, without technical support, much time and energy may be lost due to technical breakdowns. In fact, there are so many barriers to successful implementation of effective technology in schools and they are so prevalent that it is very difficult to isolate and measure just how much effective technology use is actually in place in schools.

Considering the importance of ICT usage in education which could be summarized thus: quick access to information; easy availability of updated data; connecting geographically dispersed regions; wider range of communication media and wider learning opportunities for students, there is need for effective usage of ICT in education. To achieve effectiveness, if technology is used appropriately, the schools must make sure that there are sufficiently available technology support and maintenance; appropriate software should be provided; the uses of technology should have linkages to important educational learning expectations; there should be sufficiency of technology and access to the internet, the ability of the teacher especially to model uses of technology; technology should be integrated with classroom activities and that there should be good teacher

preparation and skills. This was in agreement to Ficklen and Mascara (2001) who suggested that institutions should provide technology support and maintenance as well as appropriate software. They went further to say that most important of all, teachers should have the necessary skills and knowledge to effectively model and teach exemplary uses of technology.

Table 2 and 3 show the ANOVA reports on the general significance of the model. It shows that ($R = 0.780$; $R^2 = 0.608$; Standard error of estimation = 2.206; $P = 0.00$; adjusted $R^2 = 0.599$). As P is less than 0.05, the model is significant. Thus the combination of the variables significantly predicts the dependent variables ($F = 68-270$; $p < 0.05$). It indicates that the model and data are well fit in explaining the effect of ICT usage on cost efficiency among selected tertiary institutions in Nigeria. Therefore H_{01} is rejected while H_{A1} is accepted.

H_{02} : The individual aspect of ICT usage among selected tertiary institutions in Nigeria has no significant effect on cost efficiency.

Table 4 shows the ICT Aspects and Total Cost Regression Analysis when regressed with cost efficiency. It shows that Teaching and Learning Aspect as ($B = -0.011$; $Beta = -0.013$; $p = 0.837$) As p is greater than 0.05, the model is not significant. Thus, this combination of the variables insignificantly predicts the dependent variable ($t = -0.206$; $p > 0.05$). It indicates that Teaching and Learning Aspect has no significant effect on cost efficiency. Therefore, H_{01} is accepted while H_{A1} is rejected. It also shows the Library Aspect as ($B = 0.144$; $Beta = 0.179$; $p = 0.01$). As p is less than 0.05, the model is significant. Thus, this combination of the variables significantly predicts the dependent variable ($t = 2.579$; $p < 0.05$). It indicates that Library aspect has significant effect on cost efficiency. Therefore H_{01} is rejected while H_{A1} is accepted.

It also shows the Administration Aspect as ($B = 0.138$; $Beta = 0.207$; $p = 0.009$) As p is not greater than 0.05, the model is closely significant. Thus the combination of the variables significantly predicts the dependent variable ($t = 2.625$; $p > 0.05$). It indicates that Administration Aspect has significant effect on cost efficiency. Therefore H_{01} is rejected while H_{A1} is accepted. It also shows the Academic planning and development aspect as ($B = 0.398$; $Beta = 0.486$; $p = 0.00$). As p is less than 0.05, the model is significant. Thus, this combination of the variables significantly predicts the dependent variable ($t = 6.533$; $p < 0.05$). It indicates that Academic planning and development Aspect has significant effect on cost efficiency. Therefore H_{01} is rejected while H_{A1} is accepted.

14. CONCLUSION

Conclusively, Information and Communication Technology use in education is an indispensable tool; hence its adoption in education will go a long way towards the enhancement of education process. This is because issues such as good course organization, collaborative learning, library administration, student administration, staff and general administration, data distribution and management will be facilitated and enhanced by the use of technology. Also In order to ensure that ICT investments are cost efficient, ICT activities may need to substitute parts of the on-campus teaching activities (rather than duplication). Educational innovations, like learning objects, could for example allow supporting the re-use and sharing of e-learning materials. That ICT infrastructure costs include capital costs, including costs to acquire new hardware and software and recurrent costs, including costs for technical support, software licensing and telecommunications [1][12][3][5].

The importance of ICT in education among others are quick access to information, easy availability of updated data, connecting geographically dispersed regions, wider range of communication media and wider learning opportunities for students, There are so many barriers to successful implementation of effective technology in schools and they are so prevalent that it is very difficult to isolate and measure just how much effective technology use is actually in place in schools. Some generic reasons for the failure of educational change and reform efforts are lack of qualified ICT personnel, cost of equipment, management attitudes and inconsistent electric power supply.

15. RECOMMENDATIONS

1. Educational planners and policy makers should design and implement the necessary professional development plans to ensure that tertiary institution personnel have the knowledge and skill to successfully implement ICT in tertiary institutions [47][48][49].
2. Educational leaders and stakeholders should develop sufficient knowledge of change process research to anticipate and address change problems and issues in schools.
3. Educational management and their relevant policies should be explicit about the value of technology use [31][32][33][34].
4. School board members should actively demand and support the creation of accountability systems that track the use and impact of technology use [35][36][37][38][39].
5. School board members should ensure that ICT resources and ensure that technology integration is treated as an ongoing endeavor and not isolated from system wide improvement efforts [40][41][42][43][44][45].

6. School board members must support investment in the necessary human infrastructure – such as effective technology use professional development, active assessment alignment and grade-level continuity to ensure effective ICT use and hardware infrastructure [46][46][47][48][49].
7. ICT should not be treated as one-time cost. Ongoing maintenance, support and replacement of software and hardware are large costs that must be added to the educational budget [50][35][36][37][38][38][40].

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