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Assessment of Teachers' Perception On Modern Technology (ICT) And Communication Efficiency: A Case Study

Stephen Olorunsola & Francisca Ogwueleka
Nigeria Defence Academy, Nigeria

ABSTRACT

Modern technology has brought about a revolution in the communication process. The revolution started with the emergence of desktop computers in the 1980's. Today, the Internet and social media have brought about a 360-degree change in the communication process. The purpose of this study is to examine the perception of secondary school teachers in Kaduna State, Northern Nigeria on the impact of ICT deployment for communication efficiency in the teaching and learning process. The population for the study was teachers in five secondary schools in the state. Simple random sampling was used, and 120 teachers were chosen for the sample. Three-way cross tabulation (crosstabs) and means were used to show association between variables and analysis of the research questions. The results from this study show that ICT media such as the computer and the Internet, have a significant impact on communication efficiency in the teaching and learning process by facilitating clarity, ease, speed, security and prompt feedback in the communication process.

Keywords: *Information Communication Technology; Internet; social media; modern technology; mobile telephone; secondary school; computers*

INTRODUCTION

The advancements in technology, from the Stone Age to the Analog Age and now the Digital dispensation have altered the methods of communication. The influence of the advancement in technology does not only affect the communication sector of human endeavors but in every aspect, some of which include health, education, sport, the economy, and the entertainment industry among other sectors. The configuration of modern technology is such that it mimics human activities with a high level of accuracy and avoids bias. Artificial Intelligence and the Decision Support System are some of the modern technological innovations in this class. Fred (2018) defined communication in the context of the process for the transmission of information and the common understanding from one person to another. Alum (2014) posited that the reason for the advancement in communication technology is human response or attempts to judiciously manage the high volume of information traffic. The process of gathering, storing, processing, and disseminating information is largely responsible for our overall development; hence, the need to invent a better and effective medium that will adequately manage the flow of this precious resource known as information.

There are several challenges being faced in handling information such as: gathering and storing information; the processing time of information; and the transmission of information to the target audience (Mehdi & Jafar, 2013). The challenges become more pronounced when the distance between the source and the target is wide and the volume of information is large. The revolution brought about by the advent of modern technology is such that it turns the world into a global village. Distance is no longer a barrier and time is no more a factor to be considered in getting information across to the various information consumers. The emergence of Information and Communication Technology (ICT) has brought about efficiency in handling communication processes by providing a more robust means of handling the various stages involved in acquiring and disbursing information.

A description of ICT has been provided by Christensson (2010) as technologies that provide access to information through telecommunications. Unlike Information Technology, ICT deals with the communication of information via transmission of signals over long distances. ICT can be anything that enables storage, retrieval, manipulation, and transmission of information electronically. Examples range from computers, Internet, digital television, social networks, phones, and other communication media. The emergence of desktop computers in the 1980's marks the beginning of the reform in communication technology. In recent years, the use of social media has been growing at an exceptional rate (Kehinde et al., 2020); today, the Internet and social media have brought about a 360-degree change in communication technology.

Despite the advancement in ICT, the continent of Africa is still lagging behind. Many factors are bedeviling the continent in catching up with the fast-growing technology solutions. We posit that Africa has become the dumping ground for obsolete technology and sometimes for use as a test ground for an upcoming brand. Poor innovative research, inadequate academic curriculum to support quality education, lack of infrastructure and poor government policies are some of the challenges we note that are faced by the developing countries in Africa. However, the development in communication technology has progressively encroached into all nations of the world with many African countries now in the process of fully migrating from the analog to the digital world particularly in the media sector. Failure to do so would mean being isolated from the rest of the world.

This study seeks to assess teachers' perception of the impact of ICT on communication efficiency in the teaching and learning process among secondary schools in Kaduna State, Northern Nigeria. The population for the study was teachers in five secondary schools in Kaduna State. The simple random sampling technique was used, and 120 teachers were chosen for the sample group. Three-way cross tabulation (crosstabs) and means were used to show association between variables and for analysis of the research questions. The research questions seek to ascertain the perception of the respondents on the impact of ICT in seven areas of interest as follows: ease of communication, speed of communication, communication clarity, communication security, cost of communication, communication feedback and teachers/parent communication flow. An expected outcome of this study is the provision of data to motivate the government and other major stakeholders entrusted with public resources to respond positively, by investing more on modern communication infrastructure in the education sector.

Therefore, the aim of this study is to examine the perception of secondary school teachers in Kaduna State, Northern Nigeria on the impact of ICT deployment in communication efficiency for the teaching and learning process.

Research Questions

This study seeks to find answers to the following research questions:

i. How does the use of ICT impact on communication clarity?
ii. How does the use of ICT impact on speed of communication?
iii. How does the use of ICT impact on ease of communication?
iv. How does the use of ICT impact on communication security?
v. How does the use of ICT impact on cost of communication?
vi. How does the use of ICT impact on communication feedback?
vii. How does the use of ICT impact on parent/teacher communication?

LITERATURE REVIEW

In contrast to former eras, technology has radically transformed the method of communicating with each other around the world. The changes are such that some means of communication such as telephone, telegraphs and handwritten letters sent via land mail, are fast fading out in favor of other methods aimed at making communication more effective.

Many researchers have described the impact of effective communication on the overall success of an organization, society, and the world at large. Communication is the reason behind the success or collapse of a society; in fact, Akilandeswari, Dinesh, Philomin & Niranchan (2015) described communication as a matter of life and death. Maurice (2015) defined effective communication as adequate and correct transmission of information from the sender to the receiver. However, we note that to achieve effective communication, the reliability of the medium through which the message is conveyed or disseminated is key (Akilandeswari et al., 2015).

Giving credit to technology development, the process of communication and dissemination of information has consistently changed with time. Amaoge & Jacob (2015) discussed the various eras of communication development; the first era being the appearance of language dating back to 200,000 years; followed by the era of writing; next was the era of printing and now the advent of the era of information and communication technology. This latest era is characterized by a communication process that enables the transmission of information over a distance, across the world, without physically moving an object. The traditional communication methods employed the use of local instruments, town criers and non-written forms, which made communication a one-way process, prone to noise or distortion and time delays to get across to the intended receiver(s).

Communication via recent technology has made it possible to convey messages in various forms and formats to all part of the world within a short time. A study by Loni, Thomas, Stephen, Nic, & Claudia, (2018) described how emerging social media have contributed to crisis management during the Zika virus epidemic in the United States. Using Twitter, vital information to help with curtailing the spread of the virus was disseminated across different communities within a short time frame. Time and size of message are no longer barriers; with just the press of a button you can send communication to several destinations (Amaoge & Jacob, 2015). Modern technology has changed the communication process in three different ways: communication connection, authentication process and elegance. Nick (2013) described the impact of modern technology on communication as flattened hierarchies and complete rearrangement of power between the leaders and the commonalities. Now, a person can garner support, and organize activities using the two main pillars of modern communication technology – the Internet and social media.

The communication era has been described using the acronym "ICE" - Information, Communication and Entertainment (Kaul, 2012). There is an "I" communication device (i-phone, iPad) and an "E" communication mode (e-government, e-voting) prefixed to many events, activities, and groups today. The evidence, which indicates the power of digital communications is made manifest in the increasing use of Short Message Services (SMS) and Over-the-top (OTT) networks, which includes services provided by WhatsApp and Facebook (Hooper, 2016); influence on the present day adolescent age group (Underwood & Ehrenreich, 2017); and a shift from monomedia to multimedia which is the integration of the various message format (text, video, audio, graphic and photo) to interact on a single channel (Orihuela, 2017). Feasibly, the most remarkable technological advancement in modern information and communication technology that changed the communication process is video chats and conferences (Atkinson, 2017), for personalized communication over the information superhighway.

ICT has become a major driving force of the world economy. Considering the dynamism in the drivers of economies across the globe, it is notable that the world has moved to a knowledge-based economy

of which ICT has become one of the principal driving forces (San-Jose, Ituralde, & Maseda, 2009). In the world today, any economy that will grow must make huge investment in ICT to drive the various sectors of the economy, including banking, cash and fiscal policy, budgeting, personnel management, stock market, debt management and all financial transactions. ICT is a veritable means of effectively managing the resources of the economy by providing, in real time, transactions status and all forms of financial reports necessary for monitoring economic indicators.

Technology is evolving and one can only imagine what the future holds. An aspect of communication technology that may likely be developed soon is holographic communication (Atkinson, 2017). Holographic projection is the new wave of technology that will change how we view communication in the new era. It will have tremendous effects on all fields of life including business, education, science, art, and healthcare (Elmorshidy, 2010). Speed, space, and style are major factors that will continue to influence the advancement of modern technology.

ICT in Secondary Education

There is general acknowledgement that the use of ICT in education is a necessity in an era where dissemination of information is through the Internet and satellite technology (Samuel & Ede 2005). According to Adeosun (as cited in Ogunji, 2013), the impact of ICT in education is responsible for higher performance in academic service delivery and the resulting outcomes. Even though Nigeria, like many of the other developing countries, is a late starter in the implementation of ICT policies in the education sector, efforts are ongoing over the past 10 years to make secondary education in Nigeria partially ICT driven. Some of these efforts include teacher training on use of computers, provision of computer laboratory facilities, installation of ICT driven teaching aids and development of new curriculum (Ogunji, 2013). Learning has been made easy by the various components of ICT such as electronic boards, customized application software on different subjects, and the Internet; that help both teachers and students to connect to the rest of the world. Hence, the introduction of ICT is the major step that guarantees the improvement of the quality of the Nigerian secondary education system (Damkor et al, 2015). It will bring about the much-anticipated change and transformation in our educational sector by exposing teachers to state of the art teaching aids and making library facilities available to the students through the use of e-library technology (Agbetuyi & Oluwatayo, 2012).

There are many intervention programs to support the government effort in establishing an ICT driven secondary education system. Prominent among them is SchoolNet Nigeria, a non-profit organization of stakeholders in education committed to the effective use of information and communication technologies (ICTs) for enhancing teaching, learning and management processes in Nigerian schools (Gambari & Oyekoniso, 2013). The focus of SchoolNet is on teachers and secondary school students with the sole aim of providing ICT enabled learning environments. Other private initiatives are Zinox Computers which provide computers to teacher at discounted prices. Many state governments, including Kaduna State, are participating in World Bank assisted projects that focus on driving the government policy on school enrolment and upgrading school infrastructure. The Kaduna State Government and World Bank have concluded plans to collaborate on this basis under a special project called Nigeria Partnership for Education Project (NIPEP) (Premium Times, 2019).

Theoretical Framework: ICT and Impact Assessment on Teaching and Learning

ICT as a modern educational tool for learning and teaching has brought about a revolution in the education sector. However, the major concern is finding the right metrics for measuring the specific impact of ICT on the education system aims and objectives (World Bank, 2003). Several studies show that there are many factors that significantly impact the implementation of new technology in the education sector. Some of the most widely used models are discussed in the following review.

ICT-based model: Solar, Sabattin & Parada (2013) proposed an ICT-based model coupled with a capability-driven model for the assessment of ICT in education capability and maturity of schools. The model ICTE-MM defines three components that are vital in educational processes: ICT resources, Information criteria, and leverage domains. These components are related at a hierarchical level allowing them to be assessed both quantitatively and qualitatively. The propensity of these measuring components is used in evaluating the impact of ICT in the applied field.

The Kirkpatrick model: Kurt (2018) designated the Kirkpatrick model as the best known model for investigating and evaluating the outcome of training and educational programs by considering different types of training, informal or formal, to decide propensity, based on four levels of criteria. Kirkpatrick's four-level model has become the standard across the HR and training communities. Kirkpatrick's evaluation model approaches the measurement of the impact of technology in curriculum using four levels widely known as *reaction*, *learning*, *behavior*, and *results*.

The Context, Input, Process, and Product (CIPP) model: Aziz, Mahmood & Rehman (2018) carried out their study by using the CIPP model for curriculum evaluation in four areas: Context, Input, Process and Product. This model has been described an effective means for evaluating the quality of education at school. Khalid, Abdul Rehman, and Ashraf (2012) explored the connection between the Kirkpatrick and CIPP models to improve effectiveness of training in Pakistan. The study developed a new framework for training evaluation based on the Kirkpatrick and CIPP models.

The inadequacy of some of these model as described by Trucano (2012) is that most of the available assessment methodologies and models suited for evaluating the impact of ICT in the education system were designed for the developed countries. The researcher described the lack of effective evaluation tools and other scientific means of assessing ICT impact on teaching and learning in the developing countries as a great barrier and limitation. After several appraisals of ICT impact in education, some key researchers (Trucano, 2012; World Bank, 2003) have concluded that there is the need to carefully carry out research in the various countries using generally acknowledged methodologies and metrics to assess the impact of ICT on education.

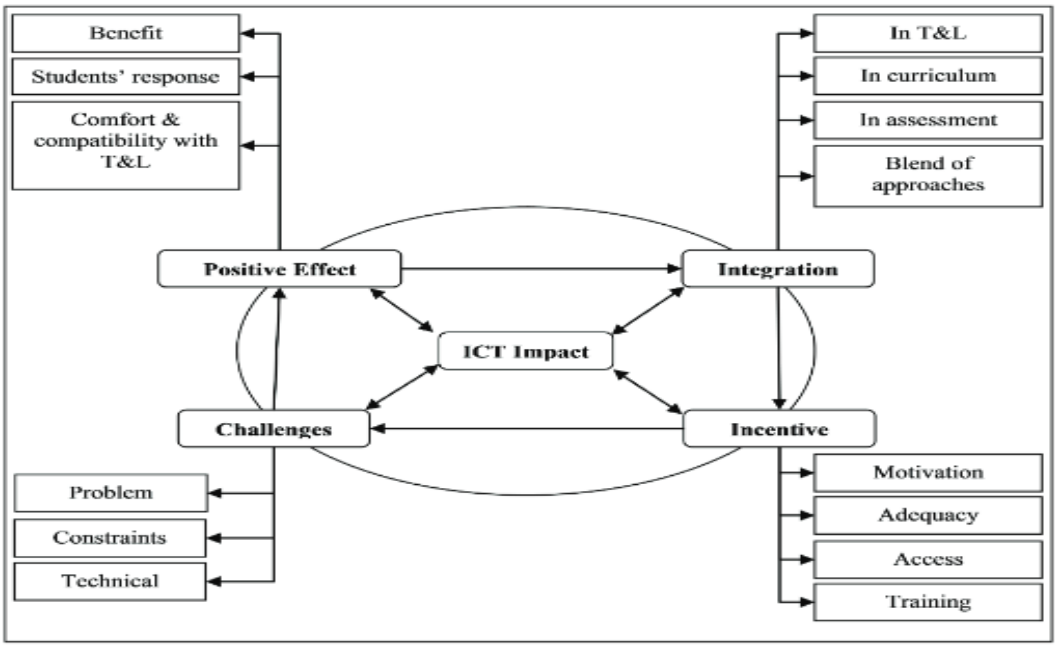

Figure 1: ICT Impact assessment model **(**Adedokun-Shittu, N. & Shittu, A., 2015)

In response, Adedokun-Shittu & Shittu (2015) developed a model shown in Figure 1 above, known as the ICT IMPACT ASSESSMENT MODEL based on four predictors: *positive effects, challenges, incentives, and integration*. The predictors in this operational model are particularly tailored to the needs of researchers in developing countries that are exploring ICT impact assessment. It elucidates the phases required while evaluating the impact of ICT in the education sector, and proposes an additional element (challenges) which is missing in other models. The design of this model is therefore more relevant to the current study. The cyclic form of this model shows the fundamental strength the elements in the model make available to ICT impact assessment and illustrates that the process can start from any of the four elements when assessing ICT impact on teaching and learning.

RESEARCH METHODOLOGY

In this study a quantitative design was used to examine the perception of secondary school teachers in Kaduna State, Northern Nigeria on the impact of ICT deployment in communication efficiency for teaching and learning. The study population consisted of teachers at five secondary schools in Kaduna State. These schools were assessed to be representative of the entire population for the following reasons: the schools are ICT driven; they have a robust population; and finally, they are being managed by the state ministry of education. Using simple random sampling, 120 teachers were chosen for the sample group. Three-way cross tabulation (crosstabs) and means were used to show association between variables and to analyse the research questions.

The Research Tool

A questionnaire was adopted as the instrument for data collection. The instrument contains two sections A and B. Section A classified respondents by gender group and their level of computer proficiency. Section B consisted of twenty-one (21) sub questions under seven main headings. The responses were rated using a Likert scale from Strongly Disagree (1), Disagree (2), Neither (3), Agree (4) to Strongly Agree (5). The main questions assessed the effect of ICT on communication clarity, speed of communication, ease of communication, communication security, cost of communication, communication feedback and teachers/parent communication. The distribution of the questionnaires was done by four (4) research assistants. A total of 120 questionnaires were administered, and 110 completed questionnaires were returned.

Table 1 shows the result of the reliability of the questions, calculated using the Cronbach's Alpha coefficient. The result was approximately 0.85 which is a good measure of internal consistency, and it validates the instrument used in this study.

Table 1: *Reliability Statistics – Study Instrument*

Cronbach's Alpha	Cronbach's Alpha Based on Standardized Items	N of Items
.854	.860	21

Responses from the completed questionnaires were coded and analyzed using SPSS version 23. Descriptive statistics was used to determine the effect of ICT on communication efficiency in the secondary schools under consideration. The data collected was analyzed using three-way cross

tabulation (crosstabs) to determine the association between gender, computer literacy level and use of ICT as tool for teaching activities. The mean was used to analyse responses to the general research questions.

DATA ANALYSIS AND RESULTS

The data in Table 2 below shows that 46.36% of the respondents were male while 53.64% were female. Among the sample, 85.45% of the respondents were computer literate, while, as shown in Table 3, 14.55% indicated they were not familiar with the use of a computer.

Table 2: *Gender distribution*

Gender	Distribution (%)
Male	46.36
Female	53.64

Table 3: *Distribution for computer literacy*

Description	Distribution (%)
Literate	85.45
Non Literate	14.55

The results of the three-way crosstab test in Table 4 below showed that among male and female teachers that are computer literate, 79.2% and 69.6% respectively, use ICT as a tool for teaching activities. Collectively, 74.5% of total respondents (109) that are computer literate use ICT as a tool for teaching activities.

Table 4*: Crosstabulation Literacy *UseICT* by Gender*

GENDER				UseICT YES	UseICT NO	Total
MALE	LITERACY	YES	Count	38	10	48
			% within LITERACY	79.2%	20.8%	100.0%
		NO	Count	2	1	3
			% within LITERACY	66.7%	33.3%	100.0%
	Total		Count	40	11	51
			% within LITERACY	78.4%	21.6%	100.0%
FEMALE	LITERACY	YES	Count	32	14	46
			% within LITERACY	69.6%	30.4%	100.0%
		NO	Count	1	11	12
			% within LITERACY	8.3%	91.7%	100.0%
	Total		Count	33	25	58
			% within LITERACY	56.9%	43.1%	100.0%
Total	LITERACY	YES	Count	70	24	94
			% within LITERACY	74.5%	25.5%	100.0%
		NO	Count	3	12	15
			% within LITERACY	20.0%	80.0%	100.0%
	Total		Count	73	36	109
			% within LITERACY	67.0%	33.0%	100.0%

Using items on the questionnaire, analysis of the main research questions is shown in the tables (5-13) below with mean score values of 3 and above considered as acceptance while mean score values of 2.99 and below were used to indicate rejection. The acceptance mean score value was determined relative to the Likert five-point scale (1-5) used in the study.

The Effect on ICT on Communication Clarity

The data in Table 5 below shows the response means for items on the effect of ICT on communication clarity. The mean sores of 4.5181, 4.091 and 4.6972 respectively indicate respondent agreement that ICT use enhances the clarity of communication for explanations by the teachers, preparation of the lesson plans and for checking student understanding of the lessons.

Table 5: *Effect of ICT on Communication Clarity*

Items	N	Sum	Mean
1. Use of ICT enhances clarity of expression by helping teachers explain better	110	504.0	4.5818
2. Use of ICT enhances clarity in the preparation of lesson plans	110	485.00	4.4091
3. Use of ICT enhances clarity in student learning by giving pictorial examples and checking for understanding	109	512.00	4.6972

The Effect of ICT on Speed of Communication

The data in Table 6 below shows the response means for items on the effect of ICT on the speed of communication. The mean scores derived on all three items indicate respondent agreement that ICT use increases the speed of information dissemination, the preparation of lesson notes and the ability of students to learn using visual aids and Internet facilities.

Table 6: *Effect of ICT on Speed of Communication*

Items	N	Sum	Mean
4. Use of ICT increases the speed of dissemination of information	110	509.0	4.6273
5. Use of ICT increases the speed of preparing lesson notes by the usage of document preparation software	110	485.00	4.4091
6. The use of ICT helps students to learn faster by having access to visual aids and internet facilities	110	506.00	4.6000

The Effect of ICT on Ease of Communication

The data in Table 7 below shows the response mean for items on the effect of ICT on ease of communication. The mean scores for all three items are above 4 and indicate respondent agreement that the use of ICT allows easy access to learning materials, makes it easier to prepare and manipulate student records and enhances the ability of students to complete their assignments.

Table 7: *Effect of ICT on Ease of Communication*

Items	N	Sum	Mean
7. Use of ICT makes access to learning materials easy	109	495.00	4.5413
8. Use of ICT makes preparation and manipulation of student records easy	110	492.00	4.4727
9. Use of ICT enhances the ease of student doing their assignment	110	479.00	4.3545

The Effect of ICT on Communication Security

In Table 8 below, while the response means shown for items on the effect of ICT on communication security, indicate agreement with the items, it is noted that a lower mean was derived for the use of ICT to prevent unauthorized access to restricted access documents. Returns mean scores above 4, respondents agreed that ICT can enable the safe transmission of confidential information and the safe storage of important documents.

Table 8: *Effect of ICT on Communication Security*

Items	N	Sum	Mean
10. Use of ICT prevents unauthorized access to restricted documents (e.g., exam questions)	110	427.00	3.8818
11. Use of ICT enhances safe transmission of confidential information to the right destination (submission of exam question and confidential memo)	110	446.00	4.0545
12. Use of ICT enables safe storage of important documents against natural disaster and theft	110	473.00	4.3000

The Effect of ICT on the Cost of Communication

The data in Table 9 below shows the response mean for items on the effect of ICT on the cost of communication. The mean scores derived on all three items indicate respondent agreement that ICT costs for equipment, training and software increases the overall cost of communication. Mean values for the cost of training and software were lower than for the cost of equipment.

Table 9: *Effect of ICT on Cost of Communication*

Items	N	Sum	Mean
13. Cost of ICT communication equipment increases the overall cost of communication	110	451.00	4.1000
14. Training on use of ICT increases the communication cost	110	435.00	3.9545
15. Cost of software increases the cost of communication	108	430.00	3.9815

The Effect of ICT on Communication Feedback

The data in Table 10 below shows the response means for items on the effect of ICT on communication feedback. The mean scores derived on all three items indicate respondent agreement that ICT use

allows for better assessment of feedback on student learning, facilitates prompt feedback to students and helps teachers to better manage the feedback mechanism.

Table 10: *Effect of ICT on Communication Feedback*

Items	N	Sum	Mean
16. Use of ICT enables you to better assess feedback on student training	110	460.00	4.1818
17. The use of ICT enables student to receive prompt feedback from question asked	110	452.00	4.1091
18. Use of ICT fast track teachers/management feedback mechanism	108	467.00	4.2455

The Effect of ICT on Teacher/Parent Communication

The data in Table 11 below shows the response means for items on the effect of ICT on teacher/parent communication. The mean sores of 4.4727, 4.1927 and 4.1364 respectively, indicate respondent agreement that ICT use enhances the pace of communication from teacher to parent, parental assessment of the school and the involvement of parents in school development.

Table 11: *Effect of ICT on Communication Feedback*

Items	N	Sum	Mean
19. Teacher to parent communication is made faster by ICT	110	492.00	4.4727
20. Parental school assessment is enhanced by use of ICT	109	457.00	4.1927
21. Involvement of parents in school development is enhanced by the use of ICT	110	455.00	4.1364

The total mean values across items were calculated and the results are shown in Figure 2 below. The means data indicate that the effect of ICT has the highest impact on communication clarity (4.5627) and cost has the least impact (4.012).

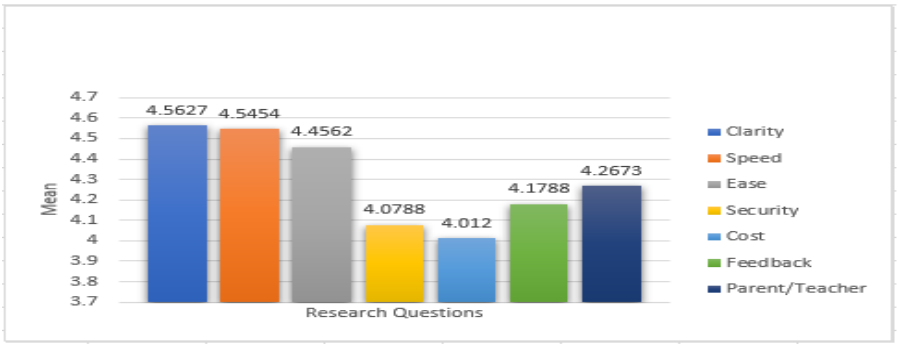

Figure 2: Distribution of questionnaire items by grand mean

Although ICT has been found to impact communication efficiency, the results of the Friedman test in Table 12 below confirms that ICT has the most significant impact on communication clarity with a mean of 4.74. while the cost of communication with a mean of 3.34, had the lowest effect.

Table 12: *Friedman test on group Mean Rank*

	Mean Rank
Clarity	4.74
Speed	4.61
Ease	4.26
Teacher/Parent	3.91
Security	3.62
Feedback	3.51
Cost	3.34

DISCUSSION

The researchers have collected data based on different predictors, in accordance with the theoretical framework adopted for the study. The ICT impact assessment model has been used to inform the discussion below.

Positive Effects

Positive effects comprise benefits, students' response and ICT compatibility/comfort in Teaching and Learning (Adedokun-Shittu, N. & Shittu, A., 2015). The benefits include ease in communication, access to up to date online resources and teacher to student and parent online interaction. Sharma, Gandhar, & Seema (2011) emphasized that the introduction of ICT can effectively assist the interaction between teachers and students by fostering contact between the teacher and the student through the various ICT means such as e-mail, e-learning, web-based learning, CD-ROM, TV, audio and videotape. The development consequently translates into ease, speed, and clarity in the communication process.

The findings from this study show evidence of positive effects of the introduction of ICT to the communication process. This was demonstrated by respondent agreement with items on clarity and ease in conveying messages and information during the teaching and learning process. These benefits are a measure of learners' comprehension which is aided by ICT, inclusive of audio-video infrastructure. By visualizing what the teachers are saying, it enhances the rate of understanding of the learners. Other findings reveal flexibility in communication across the various stakeholders in the teaching and learning process.

Incentives

Incentives comprise four issues that include accessibility, adequacy, training and motivation (Adedokun-Shittu, N. & Shittu, A., 2015). According to Bhattacharjee & Deb (2016), ICT helps teachers in motivating students to develop interest in learning with the aid of various tools and media such as software, the Internet and projectors. However, user training is a major factor in technology acceptability and usability (Olorunsola, OS. Ogwueleka, FN. & Evwiekpaefe AE., 2020)

In this study, about 74.5% of total respondents are computer literate and they also have access to ICT as a tool for teaching activities. This is a commendable incentive. Teachers' capacity development and accessibility to ICT have greatly impacted communication efficiency between teachers and leaners. This was demonstrated from the various responses during the study. Though there is still more to be done, continuous training of teachers on the use of modern technology, as already embarked upon by the government, will further enhance the quality of the teaching and learning process. During the period for this study information was made available that the government is in collaboration with the private

sector in making laptops available to teachers at subsidized rates; and this is expected to serve as a morale booster to the teachers.

Integration

The areas where integration is necessary include teaching and learning, curriculum, and ICT-based assessment (Adedokun-Shittu, N. & Shittu, A., 2015). According to Wagner et al. (2005), any plan to monitor and evaluate ICT should emphasize how ICT is incorporated into the curriculum, the pedagogy, and assessment.

According to the respondents in this study, ICT has been incorporated into the state educational curriculum and is part of student extra-curricular activities. The integration of ICT, particularly into the curriculum, has brought about a reorientation in the mindset of the teachers and students, placing demand on their preparedness for a shift from the old to the new methods. Resources such as computers, computer labs and other ICT learning equipment are available for all users, which is a significant contributor to the quality of education. However, all these facilities are not available for all levels, but the learners can share the facilities based on a schedule. The study results revealed equilibrium between theory and practice since the course content is well-defined with appropriate hands-on problems. Students are prepared for ICT based assessment which is a basic requirement for post-secondary school examinations for entry to the tertiary institutions. In most of the schools, the application of ICT is blended with the traditional teaching learning methods since integration of ICT is an evolving process.

Challenges

Challenge is a distinctive component in this model that is not available in the CIPP and Kirkpatrick models. This component explains how diverse problems, constraints and technical subjects hinder ICT impact on education (Adedokun-Shittu, N. & Shittu, A., 2015). These limitations are reflected in the model chart.

From the findings, we note that one of the issues impacting the educational model in the Nigerian secondary education system is the lack of manpower to teach newly introduced technology subjects in the curriculum which include ICT. Further, there is a lack of material resources and infrastructure to drive the financially intensive system, as reflected in the respondents' agreement that the introduction of ICT will increase the overall cost of communication. These findings are supported by that of Uwaifo & Uddin (2009) in an earlier study. The poor implementation of the major policies by the government is another issue to be addressed. Ige (2012) has described other problems challenging the Nigerian secondary education system. This includes examination malpractice, students' academic performance, lack of motivation for teachers and admission of low quality students. Paul (2017) asserts that the core of the problem is improper management of diversification at the secondary school level. and described management of diversification as the process of combining the various resources, methods, and ways of doing things to achieve the stated aims and objectives. The inadequacy of resources is a small problem when compared to the gross mismanagement of available resources. The emphasis is on the questionable management skill of the various authorities responsible for the day-to-day administration of the secondary school system. As noted by Okeogeoghene (2019), the Nigerian new secondary educational system represents a shift from humanity to science and technology. If the challenges can be reduced or eliminated over time, the positive effects of ICT on communication efficiency will increase proportionally.

CONCLUSION AND RECOMMENDATIONS

The aim of this study was to assess the impact of modern technology (ICT) on communication efficiency in secondary schools in Northern Nigeria using an impact assessment model. In summary,

the findings of this study show the relevance of the Impact Assessment Model and its suitability for assessing the impact of ICT on teaching and learning particularly in developing countries. The four fold predictors of the model: positive impact, incentive, ICT integration and challenges reflect the major factors that need to be improved upon to enhance the impact of ICT in communication efficiency. According to Stufflebeam & Shinkfield, 2007 (as cited in Aziz, Mahmood & Rehman, 2018), the central thing to make quality better is to improve and not just to prove. Developing countries are faced with many challenges that need to be removed in order to enjoy and appreciate the positive effect of ICT in education. In order to improve and bring further development to teaching and learning via the application of ICT, it is important to take steps to eliminate the problems and constrains impeding the way towards creating an enabling environment for ICT implementation and full integration of the new technologies.

Many scholars have written on the way forward for the Nigerian secondary education system suggesting various solutions ranging from provision of adequate funding, encouraging strong political will to implementing a policy framework for the system (Fwangmun, 2015), to proper staffing and equipping of schools (Peter, 2017). Paul (2017) proposed the establishment of an independent body that will oversee the implementation of standards for secondary schools just as it exists for primary schools and tertiary institutions. However, Esharenana & Emperor, (2010) in an earlier study, identified the master solution to the numerous challenges in the Nigerian secondary school system as the sustainability and full integration of ICT and related components for teaching, learning and administration purposes. If the problems and constraints discussed are minimized, the impact of ICT on communication efficiency will increase proportionately.

The recommendations based on the results in this study, some of which are supported by the work of previous researchers, focus on actions for the government and the administration of the schools, for effective deployment of ICT:

1. Improve ICT infrastructure development.
2. Improve incentive for teachers by conducting training on a continuous basis
3. Improve the school curriculum by making it reflect the reality of the 21st century, technologically driven curriculum
4. Encourage teacher to teacher, teacher to learner, teacher to parent online communication
5. Encourage private sector participation in ICT infrastructure development
6. Encourage parent participation in ICT infrastructure development
7. Improve budgetary allocation to the education sector
8. Encourage online student assessment exercises.

Future Research Direction

Without any doubt, the advancement in modern technology has brought about efficiency in managing the communication process compared to the traditional means. This study is limited to the generalization of impact assessment of ICT on the teaching and learning process. The research could be taken further by examining the impact of the various components and media of ICT on the communication process in the school system.

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