

# The Relevant of Information and Communication Technology (ICT) in Teaching of Chemistry on Students' Performance in SS3 in Potiskum Community in Yobe State Nigeria

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**Abstract:** *The study investigated the relevance of Information and Communication Technology (ICT) in the Teaching of Chemistry on Students' Academic Performance in SS3 in Potiskum Yobe State. The study aimed at examining whether or not the use of ICT in teaching has relevant to students' academic performance in Chemistry. The study adopted the theory of Technical Academic And Content Knowledge (TAACK) as a theoretical framework. three research questions and three hypotheses were raised. The correlational research design was adopted using experimental and control groups, random sampling technique was used to select 70 sample population as respondents who were drawn from three secondary schools both in Potiskum. The study collected data through Chemistry Realization Test (CRT) and ICT assessment scale from the two groups (investigational and regulator). The instrument used for data collection was validated by three experts from the field of Measurement and Evaluation, Chemistry Education, and Educational Technologist with a reliability index of 0.75. The mean, standard deviation, and t-test were used to analyze the data collected. The outcome shows that the mean scores of the investigational cluster improved fastest in comparison to the pretest. There was no significant difference based on gender in the students' academic performance. The result also discovered that there was little practice of ICT for the teaching of chemistry in the study area. Similar to the findings of the study, the researcher thinks that students irrespective of gender should be given equal opportunity in science and technology. It could also be categorically inferred that the use of ICT in teaching will improve students' academic performance. The work also acknowledged some of the problems influencing the operative integration of ICT in teaching and learning. The researcher concluded with some recommendations on how to decrease or eliminate the problems identified influencing the use of ICT in the teaching and learning process.*

**Keywords:** Information and Communication Technology (ICT), Effect, Performance, Teaching, Chemistry, and Students.

## Introduction

Information and Communication Technology (ICT) is a conventional egis name for a varied set of technology and technological tools used to communicate, disseminates, store and manage information. The use of ICT in schools by staff and students have become a necessity as it can be used to improve the quality of teaching and learning. Information and Communication Technology (ICT) are often spoken of in a particular context such as ICT in education, health care, or libraries. The Federal Ministry of Education (FME) of Nigeria had created its ICT department and has since been collaborating with several government agencies and other stakeholders in the private sector to initiate ICT-driven projects and programs to affect all levels of the educational sector in Nigeria (Osakwe, 2012). Like every issue of development in the country, the educational sector in Nigeria is struggling to access the needed technology for an effective ICT-driven system as a measure to attend academic excellence.

In this age of information explosion, one's skill in processing and distributing data using computer hardware and software, telecommunications, and digital electronics will largely determine one's value in the workforce. Computer literacy will likely have such an impact on career opportunities in the future just as ordinary or conventional literacy had in the past. Educational technologists have cited many reasons why an education system based on ICT can more effectively result in positive pedagogic outcomes than one based only on conventional techniques popularly known as talk and chalk. Throughout the evolution of ICT, it has been observed that societies that have access to ICT tools and also leverage the availability of the ICT resources or artifacts for teaching and learning have advanced their education and development.

According to Daniel (2009). ICT has become within a very short time one of the basic building blocks of modern society. Many countries now regard understanding ICT and mastering the basic skills and concepts of ICT as parts of the core of education, alongside reading, writing, and accomplishment Information Technology (IT) and Communication (C) was added in-between 'I' and 'T' in 1992 which resulted to ICT and e-mail started to become available to the overall public. Permitting to a United Nations report, ICT covers Internet Service Provision, communications equipment and services, information technology apparatus and services, media and broadcasting, libraries and documentation centers, commercial information providers, network-based information services, and other related information and communication activities.

Information and Communication Technology (ICT) may be regarded as the combination of 'Informatics technology' with other related technology, specifically communication technology. The various kinds of ICT products available and having relevance to education, such as teleconferencing, e-mail, audio conferencing, television lessons, radio broadcasts, interactive radio counseling,

interactive voice response system, audiocassettes and CD-ROM, e-learning, etc have been used in education for different purposes UNESCO (2002)

According to Yusuf, (2017) The field of education has been affected by ICT, which has undoubtedly affected teaching, learning, and research. A great deal of research has proven the benefits to the quality of education. ICT has the potential to innovate, accelerate, enrich, and deepen skills, motivate and engage students, help relate school experience to work practices, create economic viability for tomorrow's workers, as well as strengthening teaching, and helping schools change their methodology). Much has been said and reported about the impact of technology, especially computers, in education. Initially, computers were used to teach computer programming but the development of the microprocessor in the early 1970s saw the introduction of affordable microcomputers into schools at a rapid rate. Computers and applications of technology became more pervasive in society which led to a concern about the need for computing skills in everyday life Tabotndip, (2004)..

### **Background of The Study.**

According to Mudasiru (2005), Information and communication technology (ICT) is an indispensable part of the contemporary world. In fact, culture and society have to be adjusted to meet the challenges of the knowledge age. The generality of ICT has brought about speedy technological, social, political, and economic transformation, which has eventuated in a network society organized around ICT. According to Castells, (1996). The field of education has not been sincere by the penetrating influence of information and communication technology. Undoubtedly, ICT has impacted the quality and quantity of teaching, learning, and research in traditional and distance education institutions.

Hepp, (2015) claims in their paper "Technology in Schools: Education, ICT and the Knowledge Society" that ICT has been utilized in education ever since its inception, but they have not always been massively present. Although at that time computers have not been fully integrated into the learning of the traditional subject matter, the commonly accepted rhetoric that education systems would need to prepare citizens for lifelong learning in an information society boosted interest in ICT.

Computer communications and information access, particularly with the popularity and accessibility of internet-based services such as electronic mail and the world wide web (www). At the same time, the CD-ROM became the standard for distributing packaged software (replacing the floppy disk, popularly known as drive 'A' and quantified as 3.5). As a result, educators became more focused on the use of technology to improve students' performance. Any discussion about the use of computer systems in schools is built upon an understanding of the link between schools, learning, and computer technology. When the potential use of computers in education was first mooted, the predominant conception was that students would be 'taught' by computers. In a sense, it was considered that the computer would 'take over the teacher's job in the same way as a robot computer may take over a welder's job. UNESCO (2002). refers to this as a rather forbidding image where a small child sits alone with a computer. This is quite unfortunate.

The effect of technology in teaching and learning is rapidly becoming one of the most important and widely discussed issues in contemporary education policy. Most experts in the field of education generally and in educational technology specifically, agreed that, when properly used, Information and Communication Technology (ICT) hold great promise to improve teaching and learning in addition to shaping workforce opportunities for students. Poole (1998) has indicated that computer illiteracy is now regarded as the new illiteracy. This has actually gingered a new and strong desire to equip secondary schools with computer facilities and qualified personal necessary to produce technologically proficient and efficient students in developed countries of the world. There is no doubt that ICT can aid the instructional process and facilitate students learning. Many studies have found positive effects associated with technology-aided instruction and students' academic performance.

Today, nearly, everyone in the industrialized nations gained access to ICT and the purchase of computers for school use in such nations as the United States has been increasing at such a pace that is difficult to keep track of how many computer machines are now in American schools Harper (2000).

Visscher, (2012) reported that following the education Reform Act in 2001 in Britain, the central government made available 370 million, over time, to promote the use of computers in school administration and management. Just as the United States and Britain have been budgeting huge sums of money for Cyber education, so have other developed nations been doing the same. In Africa, concerted efforts have been made by many governments to initiate Internet connectivity and technology training programs. Such programs in schools around the world that improve education enhance cultural understanding and develop skills that youths need for securing jobs in the 21st century. In Carlson and Firpo (2011) in Senegal and Kenya, teachers and students are using computers extensively as information tools.

Chemistry as a science is defined as the study of living things which include plants and animals. It is a fascinating study that ranges from microscopic-cellular molecules to the biosphere, encompassing the earth's surface and its living organisms, Sarogini, (2010). Chemistry is a core subject that is mandatory for science students in all secondary schools in Nigeria as it is a pre-requisite to the study of many courses relevant to humanity which include the following; Medicine, Pharmacy, Chemical Engineering, Biochemistry, Industrial Chemistry, Organic Chemistry, Inorganic Physical Chemistry, and Analytical chemistry dynamic, etc. Chemistry can be conveniently taught in a laboratory which is a place designed and equipped with materials for

teaching and learning. It is obvious that most secondary schools lack physical laboratories and where they exist, there is insufficient or lack of equipment. Jegede,(1992). stated that some essential facilities were not available in the school visited.

In recent times when learning is being computerized, global communication has given birth to ICT learning and process learning. This method of teaching and learning is through the internet and the creative use of films and videotapes. Chemistry makes it imperative that there is a need to interact with the students to create the desired learning impact necessary to arouse learners' interest and creativity Sule (et.al 2018). In science, the use of many senses appeals more to the learners and makes learning more meaningful. The use of video tapped as an ICT device appeals to the sense of sight and hearing respectively. ICT Instructional materials are usually self-explanatory and save the energy the teacher would have used in speaking.

The West African Examination Council syllabus (2006-2010) states the objectives of teaching Chemistry as a subject in senior secondary schools as:

- i. Understanding of the structure and functions of the organic chain as well as an appreciation of nature;
- ii. Achievement of laboratory and field skills to carry out and evaluate experiments and projects in the Chemistry field;
- iii. Achievement of necessary scientific skills for example detecting, classifying, and interpreting chemical bonding;
- iv. Relevant knowledge in chemistry, needed for future advanced studies in chemical science;
- v. Achievement of scientific attitudes for problem-solving;
- vi. Ability to apply principles of chemistry in everyday life in matters that affect personal, social, environmental, community health, and economic problems.

The above-stated objectives could be achieved in students offering Chemistry at the end of the three-year course with the use of Information and Communication Technology (ICT) which has such advantages in the teaching and learning process. However, this centers strongly on the ability and capability, as well as the effectiveness of teachers to incorporate teaching strategies that use ICT-Driven instructional aids in achieving the objectives of the lesson at the classroom level.

### Statement of the Problem

The arrangement of the teaching and learning process today is expected to shift from the conventional method to a more dynamic and flexible one, which is learner-centered. Ezekoka,( 2013). This learner-centered approach makes students influence the content, activities, materials and bound of learning, which places them in the center of the learning process and enhances independent learning Collins (2003). However, despite the obvious relevance of ICT in education, coupled with the huge capital investment of both Federal and State governments through ICT driven projects known as school net and donations from Non-Governmental Organizations to Secondary schools in Nigeria, some teachers are still unwilling, ineffective, and unproductive in using ICT facilities to improve students' academic performance, especially in Chemistry.

There could be many reasons responsible for these students' poor performances, but certainly one of these reasons could be the teaching style or method which is conventionally done. That is the use of conversation and chalk methods of teaching.

Chemistry is emerging more rapidly today than in the previous and so the skills and techniques of imparting useful chemistry knowledge through the traditional method of teaching should give way to fresher or contemporary educational techniques that require the use of ICT. This work, therefore, investigates "The Encouragement of ICT in Teaching of Chemistry on Students' Performance in SS3 in potiskum Local Government Area of Yobe State".

### Purpose of the Study

In specific terms, this study is intended to achieve the following objectives:

1. To determine whether or not SS3 Chemistry Students imparted with the use of Computer Assisted Instruction will accomplish better than those imparted without it.
2. To determine the gender-related effect of the use of ICT-driven Instruction on academic performance amongst SS3 Chemistry students in the study area.
3. To examine the extent to which ICT facilities available for teaching and learning in secondary schools in potiskum are put in use.

### Research Questions

This study specifically seeks to provide answers to the following research questions:

1. What is the performance means the total of SS3 Chemistry Students in the experimental and control groups before and after been taught using Information and Communication Technology (ICT)?
2. What is the performance means a total of SS3 Chemistry Students exposed to ICT based on gender?
3. To what level do teachers use ICT in teaching SS3 Chemistry students in potiskum of Yobe State?

### Research Hypotheses

The following hypotheses were formulated to guide the study:

**HO<sub>1</sub>:** There is no significant difference in the achievement mean scores between the investigational and control groups after being exposed to ICT-driven instruction in teaching chemistry.

**HO<sub>2</sub>:** There is no significant difference in the realization mean total between male and female SS3 Chemistry students in the experimental set when they were exposed to treatment.

**HO<sub>3</sub>:** There is no significant difference in the performance mean totals in the investigational and control groups based on the use of ICT in the study area.

### Significance of the Study

The importance of this study scratches across several levels of the nation's educational system, ranging from the stakeholders, policymakers, down to the major beneficiaries who are the students. The significances are carefully computed below:

The study will help the National Information Technology Development Agency (NITDA) to measure the level of success of its organization. Likewise, the study expectation is to help view possible factors delaying the operative application of ICT policy in education, especially in secondary schools, intending to solve them and improve students' academic performance. In fact, the study may attract the consideration of NITDA to see possible areas that will demand review in the ICT policy to meet the current trend in the global market of information technology.

This study will hopefully make the Federal, state, and Education Authorities know the extent to which ICT facilities are available in secondary schools for the teaching and learning process as well as know the level of usage/utilization of these facilities by teachers and students for effective teaching-learning process. More so, it is hoped that the study will bring out areas of inadequacies of the Computer-Assisted mode of Instruction in secondary schools with the hope that the authorities will help them to overcome challenges to increase learning amongst students.

Examination bodies such as WAEC, NECO, NABTEB, and JAMB will also benefit from this study because, if the teachers in secondary schools become active and well-organized in the use of the Computer-Assisted mode of Instruction, the performance of candidates sitting for these examinations will improve. In addition, the more the tutors in secondary schools become more active in using ICT, the more the students acquire the skills which will be of significance to the examination bodies in smoothing a prosperous online registration, examination, and checking of results, a system currently adopted for JAMB candidates and later may be implemented by WAEC, NECO, and NABTEB.

Head educators, principals, or school administrators are expected to have maximum benefits from the study because it is targeted towards eloquent how the use of ICT will improve students' academic performance, especially in Chemistry. This will help them to get the significance of the computer-assisted mode of training and its relevance to effective and functional classroom teaching exercises for better performances of their students academically and this will, in turn, boost the image of the school in the community. More so, the study will make school administrators see the need for continuous training of their teachers who are ICT literate and train those who are not for better service delivery.

It is hoped that scholars and future researchers carrying out studies in the field of ICT/ teaching and learning Chemistry or in related areas will find the product of this work useful and the findings will contribute to the body of knowledge.

More prominently, ICT has introduced a new concept in the teaching and learning process known as 'edutainment (educate through entertainment) which needed to be discovered.

### Methodology

The research design adopted in this study was random sampling techniques. The sample population was divided into two equivalent groups, designated as 'Investigational Group' (IG) and 'Control Group' (CG). With regards to this study, the target population consisted of 500 SS3 Chemistry students in the Potiskum Local Government Area of Yobe State. The questions predominantly come from farming, trading, and civil service families.

The sample of this study consisted of SS3 Chemistry students drawn from two secondary schools in the Potiskum area of Yobe State. The sample comprises both males and females, Christians and Muslims, and with an average of 18 years.

The validity of the instrument was subjected to scrutiny by experts in the field of Educational Technology, Chemistry Education, and Measurement and Evaluation. The experts consisted of two experienced lecturers both of them are from Yobe State University and a Chemistry teacher from one of the sampled schools, all with over 7 years of unceasing active lecturing/teaching. The experts who examined the test instrument certified them free from ambiguity and also made useful suggestions and criticisms which were used to improve the instrument. They rated the instrument as valid to yield the required data considering the research questions and the hypotheses stated above.

A reliability index of 0.75 was obtained. Therefore, the instrument was considered reliable to measure what is purported to be measured in the study.

The researchers again taught the two separate groups from the two different schools the remaining part of the topic by introducing treatment to the Investigational Groups (IG) of the respective schools. In another word, the groups were taught the same topic but while Investigational Groups (IG) were taught using ICT facilities; the Control Groups (CG) were taught the topic using the old-style method of conversation and chalk teaching only (no ICT gadget adopted). The two groups from each school were post-

tested for academic performance and also ICT assessment scale to determine the effect of the treatment (ICT adopted) on the Investigational Groups of the two secondary schools involved in this study.

The researchers controlled the test instruments in the various schools with the assistance of two Chemistry teachers from the two selected secondary schools. The instruments were collected, marked, and recorded as pre-test accordingly. Chemistry teachers from the two schools were used as research assistants to observe and collect test items at the end of the test.

The data collected obtained were analyzed using mean, standard deviation, and t-test for the research questions and hypotheses on a Statistical Packages of Social Sciences (SPSS).

The mean and t-test were used to answer the three research hypotheses. The null hypotheses were tested at a 0.05 level of significance, which formed the basis for the hypotheses to be either accepted or rejected.

## Results

### Research Question One

What is the performance mean score of SS3 Chemistry Students in the experimental and control groups before and after been taught using Information and Communication Technology (ICT)

**Table 1: Comparison of pretest and posttest mean scores of experimental and control groups**

Group	Type of Test	$\bar{X}$	SD
Investigational	Pre-test	13.20	3.11
	Post-test	22.32	4.28
Control	Pre-test	15.28	4.94
	Post-test	16.28	4.75

The table above shows descriptive statistics of the performance of SS3 Chemistry students in the pre-test and post-test. The mean scores of the experimental group indicate that there was an improvement in the result of the posttest in comparison to the pretest. The mean increased from 13.20 to 22.32 showing an attainment gain of 9.12 and the standard deviation increase from 3.11 to 4.28. While the mean scores of the control group also increased from 15.28 to 16.28 giving an achievement gain of 1.00 and the standard deviation decreased from 4.94 to 4.75

### Research Question Two

What is the performance mean score of SS3 Chemistry Students exposed to ICT based on gender?

**Table 2: Comparison of experimental group before and after treatment based on gender**

Gender	Type of Test	$\bar{X}$	SD
Male	Pre-test	11.66	4.33
	Post-test	25.62	5.43
Female	Pre-test	15.00	4.52
	Post-test	23.07	6.76

The result of the analysis in table two shows that the mean of male students in pretest improved from 11.66 to 25.62 with standard deviation increasing from 4.33 to 5.43 while the mean scores of females improved from 15.00 to 23.07 with a standard deviation of 4.52 to 6.76 the result shows that the achievement gain between male and female in the posttest was negligible, hence the achievement is the same.

**Research Question Three**

To what extent do teachers use ICT in teaching SS3 Chemistry students in Potiskum Area?

**Table 3: Comparison of extent of use of ICT among teachers in teaching Chemistry**

Level	N	Percent (%)
High	15	25
Moderate	15	25
Low	25	50

The result above shows that 15 respondents representing 25% believe that the use of ICT in teaching Chemistry in the study area is high while 15 respondents making 25% are of the view that the rate of use of ICT in teaching Chemistry is moderate and 25 respondents constituting 50% felt that the use of ICT in teaching Chemistry in the study area is low. From the foregoing, the researcher inferred that the use of ICT in teaching SS3 Chemistry Students in potiskum area of Yobe state is low

**Hypothesis Testing**

1. There is no significant difference in the achievement mean scores between the investigational and control groups after been exposed to ICT-driven instruction in teaching Chemistry.

**Table 4: Comparison of the experimental and control group**

Group	N	$\bar{X}$	SD	DF	t-cal	t-critical
Experimental	25	24.72	4.75	24	3.9	0.01
Control	25	20.04	3.40			

The result of the t-test analysis as shown in table four above reveals the null hypothesis is rejected since the calculated t-test analysis of 4.8 is greater than the table t-test also known as t-critical of 0.01. It means that there is a significant difference between the experimental and control groups when the investigational group was exposed to ICT in teaching and learning Chemistry.

2. There is no significant difference in the achievement mean score between male and female SS3 Chemistry students in the investigational group when they were exposed to treatment.

**Table 5: Comparison of students' performance taught using ICT based on gender**

Gender	N	$\bar{X}$	SD	DF	t-cal	t-critical
Male	15	22.4	3.5	14	0.112	0.824
Female	10	22.6	4.5			

The result of the analysis in the table above reveals that the null hypothesis was retained meaning there is no significant difference in the achievement mean scores between male and female students who were taught Chemistry using ICT. This is shown in the table where the t-test calculated is 0.112 less than the t-test critical of 0.824; based on the foregoing, the null hypothesis is retained.

3. There is no significant difference in the performance mean scores in the investigational and control groups based on the use of ICT in the study area

**Table 6: Comparison of the two groups on the use of ICT in the study area**

Group	N	$\bar{X}$	SD	DF	t-cal	t-critical
Investigational	25	24.72	4.75	24	4.7	0.001
Control	25	20.04	3.40			

The result of the analysis in table six is evident that the researcher rejected the null hypothesis and accepted the alternative hypothesis, meaning there is a significant difference in students' responses on the use of ICT for teaching and learning in the study area. This was accomplished from the calculation where the t-test calculation of 4.7 is greater than the t-test critical at 0.001 hence the researcher accepted the alternative hypothesis that there is a significant difference in the performance mean scores in the investigational and control groups based on the use of ICT in teaching of Chemistry in the study area.

### Discussion

The main purpose of this study was to determine the effect of Information and Communication Technology (ICT) in the teaching of Chemistry and SS3 students' academic performance in Potiskum community in Yobe State.

It is apparent from the findings that students taught using ICT perform significantly better than those taught without ICT. This, therefore, is in line with the view of the following literature Harrison (2012), and Jegede, (1992). who believed that ICT has the possibility of enlightening student academic performance. The researcher, therefore, believes that ICT is to be used as a method of instruction in the teaching and learning of Chemistry in the study area.

Additionally, findings from the study expose that students' gender has no significant effect on students' performance. This also confirmed the findings of the following literature; in line with the view of Beetheng, (2008) and (2013), Nwike, (2011) who find that students' gender has no significant effect on students' academic performance. The researcher believes that students irrespective of gender should be given equal opportunity in teaching and learning all subjects. Again finding from this study reveal that the extents of the operation of ICT in the teaching and learning of Chemistry are low, this also agrees with the work of Yusuf (2015) who reported that only a few schools used a computer in the teaching and learning of science subjects. The researcher, therefore, believes that teachers should employ the use of ICT in the teaching and learning of Chemistry and other science and technology-related courses for the benefits of the teaching occupation.

This study was conducted on the Effect of Information and Communication Technology (ICT) on students' academic performance. The study aim at examining how the use of ICT in teaching could impact the academic performance of SS3 Chemistry students in Potiskum community Yobe State. The study adopted a correlational research design, specifically, the investigational and control groups (pre-test and post-test). The sample population which was purposively drawn for the study consisted of 70 SS3 Chemistry students from two secondary schools with a large population within the community of the study area.

Data for the study were collected using predominantly Chemistry Achievement Test (CAT) and ICT assessment scale. The researcher developed an ICT Assessment Scale (ICTAS) while Chemistry Achievement Test (CAT) was randomly drawn from several previous WAEC Chemistry question papers. The instrument was validated by experts and had a reliability index of 0.87.

### Conclusion

Unfortunately, students' academic performance in science-related courses in the Potiskum community of Yobe State motivated the researcher to embark on this research work titled "The Effect of Information and Communication Technology (ICT) in Teaching of Chemistry on Students' Performance in SS3 in Potiskum community in Yobe State". From the results and findings of the study, it was safe to conclude that though the use of ICT in the study area is low, it has a positive and significant impact on the academic performance of students and there was no significant difference in the performance of male and female students of the study community. In this circumstance, the researcher believes that students regardless of gender should be given equal opportunity in science and technology.

### Recommendations

1. Government should ensure that ICT policy statements in education are translated into reality. An ICT policy implementation commission should be created. This commission should be fully funded and given the power to provide ICT facilities in Nigerian Secondary schools.
2. The ability to acquire the ICT devices and accessories rests squarely on what is available to the school management as a fund. The Federal, State, Local, Non-Governmental Organizations as well as Humanitarians are encouraged to support secondary schools by providing ICT facilities as there is inadequate funding in secondary schools in Nigeria.
3. Teachers should ensure that both male and female students are equally encouraged in science and technology and there should not be any practice of discrimination, especially against female students.

4. ICT in Education should be the backbone course for teachers' exercise programs to effectively prepare teachers on how they can successfully break ICT in their respective disciplines while in the classroom.
5. Teachers already in the field should be given a time frame within which they should be ICT amenable. Ministry of education and the board for secondary education should organize a workshop, orientation, seminar, and conferences on ICT in education for teachers' improvement in their field.
6. Power failure is another main factor, the ministry of power provides a standby generator in the secondary schools for the successful running of ICT equipment when learning.

## References

- Becker, H. (1986). *Computers in the Schools. A recent update*. Classroom Computer Learning, January, 96-102.
- Beetheng, L. & Sim, C. (2008). *Exploring the Extent of ICT Adoption among Secondary School Teachers: Malaysia*.
- Collins, J.W. & O'Brien, N.P. (Eds.) (2003). *Greenwood Dictionary of Education*; Westport: CT: Greenwood.
- Castells, M. (1996). *The Rise of the Network Society* (vol. 2). Oxford: Blackwell Publishers.
- Daniel, J. (2009). *E-earning for Development: Using Information and Communications Technologies to Bridge the Digital Divide*. Common Wealth Ministers Reference. Henley Media Group.
- Ezekoka, G.K. & Okoli, A.M. (2013). *The Use of Computer in Teaching and Learning in Secondary Schools in Imo State*. Journal of Educational Media and Technology, 17(2), 80-95
- Firpo, J & Carlson, S. (2011). *Integrating computers into teaching: Findings from a 3-year program in 20 developing countries*. In L. R Vandervert, L. V. Shavinina & R. A. Cornell (Eds.), *Cyber education: The future of Distance Learning*. Larchmont, NY: Mary Ann Liebert, Inc, 85-114.
- Federal Ministry of Education (2010). *National Policy on Information Technologies (ICT) in Education*.
- Gbodi, B.E and Laieye, A.M (2006). *Effect of Video tapped instruction on Learning of Integrated Science*: Journal of Research in Curriculum and Teaching 1 (1) 10 – 19.
- Harper, D. O. (2000). *The creation and development of Educational computer technology*. In R. M. Thomas & V. N. Kobayashi (Eds.), *Educational technology: its creation, development and cross-cultural transfer*, Oxford: Pergamon Press.
- Harrison, C. (2012). *Impact: The Impact of Information and Communication Technologies on Pupil Learning and Attainment*. UK. Becta . Accessed [http://www.becta.org.uk/page/documents/research/impaCT2\\_strand1\\_report.pdf](http://www.becta.org.uk/page/documents/research/impaCT2_strand1_report.pdf).
- Hepp, Hinostroza, Laval and Rehbein (2015) *National Policies and Practices on ICT in Education: Chile* (Enlaces) Cross-national Information and Communication Technology Policy and Practices in Education, IAP Information Age Publishing.
- Jegade, O.P. Okebukola and G. Ajewole (1992). *Students Attitude to the use of Computer for Learning and Achievement in Biology concepts*: Science Teachers Association of Nigeria (STAN) 27 (2) P.61 – 65.
- Mudasiru O. Y. (2010) Effects of Computer Assisted Instruction (CAI) On Secondary School Students' Performance in Biology: The Turkish Online Journal of Educational Technology – January 2010, volume 9 Issue 1
- Nwike, M.C. & Chukwudum, E.O. (2011). *Effect of Computer Assisted Instruction (CAI) on Students' Achievement in Secondary School Agricultural Science*. Journal of Educational Media and Technology, 15(2).
- Nwoji (1999). in Baike(2000). *Keynote address Enriching Science, Technology and Mathematics Education in Nigeria; Problems and Prospects*. 41st Annual Conference Proceeding Heineman Educational Books Nigeria Plc.
- Osakwe K Mundi, N (2012). *Using the Video Taped Instructional Technique in Teaching "Saving your Energy"*. Science Teachers Association of Nigeria (STAN 2008) Integrated Science Education Series No. 6 Approaches to the teaching of saving your Energy Akin Press Services.
- Poole, G. A. (1998). A New Gulf in American Education, the Digital Divide. *New York Times*, February 12.
- Sarogini, T.R (2010). *Modern Biology for Senior Secondary Schools P.2* AFP Plc Nigeria.
- Tabotndip, J.E (2004). *Classroom practices in the Nigerian Educational Industry: A need for Redirection* Secondary Education Management Board, Owerri – Imo State.
- UNESCO (2002). *Information and Communication Technology in Education*. A Curriculum for Schools and Programme of Teacher Development: Peru.
- Visscher, A., Wild, P., Smith, D., & Newton, L. (2012). *Evaluation of the implementation, use and effects of computerized management information system in English secondary schools*. British
-



Journal of Educational Technology, 36 (5), 543-551.

Yusuf, I., Kajuru, Y.K. & Musa, M. (2015). *The Effect of a Computer-Mediated Systems Teaching Approach on Mathematics Achievement of Engineering Students in Nigerian Polytechnics*. Journal of Educational Research and Development: 9(2), p.412-420

Yusuf, M. O. (2017). *Information and Communication Technology and Education*. Analyzing the Nigerian National Policy for Information Technology. International Evaluation Journal: 6(3), pp. 320 – 330.