KIU Journal of Social Sciences Copyright©2019
Kampala International University ISSN: *2413-9580*; 5(4): 317–326

Improving Students' Academic Achievement in Biology, Using Information and Communication Technology Aided Instruction

ADEDOYIN ADEWALE ADEBANJO
Olabisi Onabanjo University, Ago-Iwoye, Nigeria.

Abstract. Information and communication technologies (ICT) have changed the pedagogy in education from teacher-centered approach to student-centered approach and also enhance teaching and learning. The purpose of this study was to investigate how students' academic achievement in Biology can be improved using information and communication technology aided instruction**.** The moderating effect of gender was also examined. The study adapted pre-test, post-test, control group quasi-experimental design, involving 2x2 factorial matrix. The sample consisted of sixty four (64) SS 2 students offering Biology selected using purposive sampling technique from two out of thirty six schools in Sagamu Local Government Area of Ogun State. Randomization was used to place the schools into experimental and control groups. The experimental group was taught using ICT aided instruction powered by computer applications and while conventional method was used for control group. Three hypotheses were formulated and tested at 0.05 level of significance. A validated Biology Achievement Test (r=0.67) was used to measure students' achievement in Biology. Data were analyzed inferentially by analysis of covariance (ANCOVA) and also multiple classification analysis (MCA) was used to explain the magnitude of the mean post test achievement scores across the different levels of instructional strategy and gender. Findings indicated that there was significant effect of ICT aided instruction on students' achievement in Biology ($F_{(1,59)}$=183.103, P< 0.05). However, no significant main effect of gender was found on students' achievement in Biology ($F_{(1,59)}$= 0.052, P>0.05). No significant 2-way interaction effect of gender was found in students' achievement in Biology ($F_{(1,59)}$= 0.190, P>0.05). In view of the findings, it was recommended that government should provide ICT resources to secondary schools in Nigeria and also educational authorities should lay more emphasis on modern educational resources that promote effectiveness in teaching and learning process.

Keywords: Information and Communication Technology, ICT- aided Instruction, Students' Academic Achievement, Gender, Achievement in Biology

1. Introduction

Education is a lifelong process which enhances the individual's quality of life, build up his personality and enable him or her to contribute meaningfully and effectively to the development of his or her society. It is also the process which a society reproduces itself by passing on its quality and mode of life to younger generations. No matter what we do in the classroom or educational principles, we adopt in the process of teaching, all efforts would be fruitless if the learners do not understand the contents taught effectively (Mumtaz, 2013).

Biology is a subject in the field of science and also one of the science subjects at the senior secondary school (Federal Republic of Nigeria,

2014). Biology is the science of life that studies living matter, structure, function and behaviours of organism and also concerned with evolution, distribution and taxonomy of life. Research results have shown that despite the importance attached to Biology, students' academic achievement in the subject at the secondary level has been dwindling over the years (Adebanjo, 2019; Ayuba, 2016; Awobodu, 2016; Raji, 2017). Also, the performance of students in Biology has reported been low in Nigeria, especially in Senior Secondary School Certificate Examination (WAEC Chief Examiners' Report, 2018). Adebanjo (2019); Kurah (2015); Yusuf and Afolabi (2010) attributed that poor performance is caused by poor teaching methods, faulty instructional strategies among others. Furthermore, Adebanjo (2019) and Raji, 2017 reported that most Biology teachers in secondary schools were using lecture method and this has consistently lead to poor academic performance of the students especially in Biology. This is because according to Ajayi, (2017), the responsibility of the classroom teacher is to help students attain maximum achievement in their learning tasks.

In addition to teaching problem, the poor performance of Nigerian candidates in the School Certificate Biology Examinations conducted by the West African Examination Council has also attributed to some topics in Biology which students find difficult to answer correctly especially in the area of Ecology (Adebanjo, 2019; Raji, 2017). It is important to point out that proper understanding of Ecology by the students could assist in improving their performance in Biology, because according to Adebanjo (2019), difficulties exist in the teaching and learning of Ecology.

In spite of the prospect of Ecology for improving students' knowledge of their environment and helping them solve problems arising from its use, students performance in Biology continue to be poor (Chief Examiners' Reports 2009 - 2018).

However, questions are being set (i.e. pollution, conservation, ecosystem balance, population growth and quality of environment fall) consistently on ecological concepts in school certificate Biology examination as shown in the table 1

Table 1: Ecology Questions set by WAEC and the Year

Year of Exam	Theory Questions	Objective Questions
2009	Question 3 & 7	Questions 32 - 48
2010	Question 3 & 8	Questions 30 - 35, 41 - 43
2011	Question 3 & 7	Questions 34 - 49
2012	Question 3	Questions 37 - 49
2013	Question 3, 4 & 7	Questions 32 - 47
2014	Question 3 & 6	Questions 25 - 39
2015	Question 4 & 8	Questions 35 - 51
2016	Question 3 & 8	Questions 29 - 45
2017	Question 3 & 8	Questions 34 - 44
2018	Question 3,4 & 6	Questions 30 - 40

A detailed analysis of the questions in biology in Senior School Certificate Examination shows that from 2009 to 2018, at least one of the six (6) essay questions was on Ecology and out of the sixty (60) multiple choice items, at least ten were on Ecology.

Ecology is an area of Biology which deals with the interaction living things have with one another and with their environment as well as the problems arising from such interactions. It follows therefore that a study of Ecology can adequately equip students with the information, knowledge and skills needed for effective environment management. According to Okebukola (1990), an understanding of ecological principles will assist students in the rational use of the earth's resources to achieve the highest quality of living for mankind while reducing the likelihood of major environmental destruction.

Teachers are indispensable in any educational system and good teachers are necessary for good

education which in turn is indispensable for social change and national development (Ajayi, 2017). Teachers are learning facilitators, consultants, guides, innovators, mentors, inspirators and moderators. Therefore, teachers constitute the pivot upon which schooling rotates (Alebiosu & Bamiro, 2007). Teachers play an important role in terms of implementation of school curriculum, and influencing students' academic achievement. They play crucial role in educational attainment because teachers are responsible for translating educational policies into action during their interaction with the learners (Ajayi, 2017; Oni, 2017).

Teachers use innovative instructional strategies to attain higher performance and positive attitude of learners to school subjects. Also, the ability to use appropriate instructional strategies in teaching is among the competencies expected of a teacher. Hence, the instructional format provided by the teacher seems to be the medium of effective learning because good teaching helps the learners while poor teaching leads to poor learning and poor performance (Adebanjo, 2019).

Some researchers like Genry (2004) and Smith & Ragam (2011) stated that difficult concepts are better taught through learners' participations and using effective instructional strategies that attend to the needs of the learners. If teachers succeed in making instruction clear, students will grasp difficult concepts easily. Most of the teachers are using strategies that are not effective for teaching resulting in poor performance of secondary school students in Biology. The problem of poor performance in Biology sometimes is not limited to the students alone but could also be traceable to teachers' pedagogical strategies (Adebanjo (2019). Therefore, methods for teaching Biology should be made stimulating, interactive and attractive to students. As Biology includes complex relationships of unfamiliar and abstract concepts, it is quite difficult to learn and teach. Students often experience difficulty in understanding certain biological subjects and try to learn them via memorization without understanding (Raji,, 2017). The use of ICT can help understanding a difficult subject easily.

Information and communication technology (ICT) has become an important source of innovation and improvement of efficiency for many sectors across the globe. According to National Policy on Education (FRN, 2014), teachers shall continue to take cognizance of changes in methodology, curriculum and regularly be exposed to innovations in their profession. This is because teachers are the primary agents of educational innovation. As part of innovation, United Nations Educational, Scientific, and Cultural Organization (UNESCO, 2002) stated that it is mandatory for education system globally to adopt the use of Information and Communication Technologies (ICTs) for delivery of classroom instructions to the students in order to impart the knowledge and the skills needed to function in the 21st century society.

Onwuagboke, Singh and Fook (2015) described Information and Communication Technology as a system that has the capacity to capture, store, retrieve, manipulate, transmit or receive information or data. They include television sets, bulletin boards, radio, record players, disc players, still camera, video camera, projectors, internet and the internet resources. They are electronic technologies used for information storage and retrieval, whose growth is partially determined by ability to establish a complementary interaction between technological innovation and human component (Mathew, Joro & Manasseh, 2015). This implies that the effectiveness of technologies depend on the ability of people (teachers) to interact with them. Adeoye, Oluwole and Loto (2013) observed that ICTs have revolutionized individuals' ways of life to the level of bringing unprecedented rapid technological, social, political and economic growth which makes it the pivot upon which other sectors (education inclusive) of economy revolve.

It is well established in the literature that the use of ICT in teaching facilitates better understanding, enhances better memory retention and improves learners' achievement (Alkan & Kocak, 2015; Arista & Kuswanto, 2018; Yusuf & Balogun, 2011). ICTs that are useable in the classroom include: Multimedia Projector, Photocopier, Desktop Computer,

Laptop Computer, Tablets, Microphones, Scanners, Pen Drive, Digital Cameras, Printer, Ipods, Webboards, Ipads, DVDs and CDs, Interactive Whiteboards, Flash Discs, Internet Moderm, Television Set, Presentation Clicker, Visualiser or document camera for displaying students' work, or presenting live feedback, Recording hardware/software for podcasting e.g. microphone, headphone and speakers (Yusuf & Balogun, 2011).

There is substantial evidence that ICT promotes quality education and effective teaching-learning atmosphere for both the students and teacher. Several research studies indicate that ICT provides educational opportunities and environment readiness for classroom instruction (Aiyebelehin, 2012; Olakulehin, 2007; Yusuf, 2000). ICTs have become very potent tools for teaching and learning. Many of these digital technologies have been produced specifically for use in delivering instruction to learners in the classroom for better performance (Yusuf & Balogun, 2011).

Technology in many ways is expanding globally and the need to adopt technology based packages to improve the teaching and learning of Biology for effective performance of students cannot be overemphasized. The use of technology in the classroom has proven to be effective in the teaching and learning of sciences (Biology is inclusive). One of the factors that may influence students' achievement in Biology is students' gender irrespective of the instructional strategies used. Several studies confirmed this (Awobodu, 2016 and Oludipe, 2015). However, Adebanjo (2019) found no significant difference in students' academic achievement with regard to gender. Raji (2017) found that male students had higher academic achievement in Biology than the female students These contradictory results showed that issue of gender in students' achievement in biology has not yet been conclesive and that is the reason why gender was included in this study. Therefore, this study was therefore geared towards investigating how students' academic achievement in Biology can be improved using information and communication technology aided instruction**.** The moderating effect of gender on the students' academic achievement was also investigated.

2. Statement of the Problem

The persistent poor performance of students in both internal and external Biology examinations is a pointer to the fact that teachers used faulty instructional strategies which do not promote teaching and learning but most teachers still use it in secondary school Biology classrooms. Moreover, WAEC attributed the dismal performance in Biology to some concepts that appear to be difficult for the students to answer correctly in the area of Ecology. It was established that the problem of poor performance in Biology sometimes is not limited to the students' factors alone but also to teachers' pedagogical strategies.

Despite all the numerous benefits inherent in the adoption of information and communication technology aided instruction approach, it has been observed that there is not much evidence that Biology teachers have integrated this approach into their teaching. Although a variety of approaches to the teaching of Biology abound, the use of information and communication technology aided instruction approach has not been integrated by teachers in Ogun State. Infact, literature revealed that most secondary schools teachers use lecture method in Biology classrooms which does not enhance teaching and learning resulting to poor performance in internal and external examinations.

In order to address the problem of the difficulty in teaching some Biology concepts, this study therefore, intends to investigate how students' academic achievement in Biology can be improved using information and communication technology aided instruction**.**

3. Hypotheses

The following hypotheses were generated to guide the study:

H_{o1}: There is no significant main effect of instructional strategy on students' achievement in Biology.

H_{o2}: There is no significant main effect of gender on students' achievement in Biology.

H_{o3}: There is no significant interaction effect of instructional strategy and gender on students' achievement in Biology.

4. Methodology

The study adopted a pre-test, post test, control group quasi-experimental design with 2x2 factorial matrix. The population for the study consisted of all SS II students offering Biology in public secondary schools in Ogun State, Nigeria. The sample for the study consisted of sixty four (64) students offering Biology while purposive sampling technique was used to select two schools out of thirty six secondary schools in Sagamu Local Government Area of Ogun State, Nigeria using the following criteria: they are public co-educational school with good number of male and female students because of the inclusion of gender as moderator variable in the study, schools not very close to another school participating in the study in order to prevent subject contamination that could affect the internal validity of the study. One instrument was used to collect data for the study named Biology Achievement Test (BAT).

Biology Achievement Test (BAT)

Biology Achievement Test (BAT) was a multiple choice test consisting of 30-items with four-options per item. The BAT measured students' achievement in Biology. The items selected were from the past questions of Senior School Certificate Examination (WAEC and NECO) from 2015 to 2018 that corresponded to Ecology topics (pollution, conservation, ecosystem balance, population growth and quality of environment). The validity of the BAT was ascertained by two experts in Biology for face and content validity. The researcher also made use of table of specification. Necessary corrections arising from their advice was effected before the final draft of the instrument. The 30 –item BAT was then administered on a sample of forty SS 2 students that are not part of the main study. Trial testing of BAT was done in an interval of two weeks and the reliability coefficient using test-retest reliability statistics was 0.67.

The data were collected by administering the BAT at the pre-test and the post-test stages of the experiment with the help of two research assistants. The teacher taught the experimental group with ICT aided instruction and also the control group was taught with conventional method. The students were exposed to four contacts lessons, one lesson per week for four weeks. At the end of the four weeks, a post-test was administered on the students to determine their achievements in Biology. Altogether, the study lasted for six weeks. The same BAT served as both the pre test and post test but the re-arranged items was administered the second time as post test. Data collected from this study were analyzed using ANCOVA and the pre-test scores served as covariate to test the null hypotheses at 0.05 level of significance. Multiple classification analysis (MCA) was used to show and explain the magnitudes of the mean post-test achievement scores across the different levels of instructional strategy and gender.

5. Results

Hypothesis 1: There is no significant main effect of instructional strategy on students' achievement in Biology.

Result of the Main and Interaction effects of Instructional Strategy and Gender on students' achievement in Biology

Table 1: Summary of Analysis of Covariance of students' achievement in Biology according to Treatment and Gender

Source of Variation	Sum of Squares	Df	Mean Square	F	Sig. of F
Main Effects	**167.215**	**1**	**167.215**	**117.743**	**.000**
Covariates (pre-test)	82.348	1	82.348	57.984	.001
TREATMENT	260.037	1	260.037	183.103	.000*****
GENDER	.073	1	.073	.052	.821
2-Way Interaction					
TREATMENT * GENDER	.269	1	.269	.190	.664
Explained	**687.615**	**4**	**62.510**	**44.016**	**.000**
Residual	**124.975**	**59**	**1.420**		
Corrected Total	**812.590**	**63**			

*** Indicate significant F at 0.05 level R Squared = .607 (Adjusted Squared = .582)**

Table 1 presents the summary of the analysis of covariance (ANCOVA) test on the effect of treatment and gender on the students' achievement scores in Biology. Table 1 shows the outcome of the main and interaction effects of the two levels of instructional strategy (ICT aided Instruction and Conventional Method used in the study) and two levels of gender (male and female) on students' achievement in Biology. The result shows significant main effect of treatment ($F_{(1, 59)} = 183.103$, $P < 0.05$) and this implies that there is significant difference in the mean post-test achievement scores of the students after their exposure to the two levels of instructional strategy. Therefore, the null hypothesis one (H_{01}) is rejected.

The multiple classification analysis (MCA) presented in table 2, shows the mean post-test achievement scores of the participants in the two levels of treatment and two levels of gender according to order of magnitudes as well as the contributions of the independent variables to the variance in the dependent variable (achievement in Biology).

Table 2: Multiple Classification Analysis of students' achievement in Biology according to Treatment and Gender

Grand Mean = 11.565

Variable+ Category\ Treatment	N	Unadjusted Deviation	Eta	Adjusted for Independent + Covariates	Beta
ICT Aided Instruction	30	2.388	**.855**	2.417	**.865**
Conventional Method	34	-2.486		-2.516	
Gender					
Male	25	0.085		-0.192	
Female	39	-0.067	**.027**	0.150	**.060**
Multiple R Square					**.607**
Multiple R					**.858**

*** Indicate significant F at 0.05 level**

Table 2 presents the summary of the MCA analysis and it shows the magnitudes of the adjusted mean post-test achievement scores of students in Biology after exposure to the two levels of learning strategy. The result shows that with a grand mean of 11.565, the students exposed to ICT Aided Instruction recorded higher adjusted mean post-test achievement score of 13.982 (i.e. 11.565 + 2.417) than the students exposed to conventional method who recorded adjusted mean post-test achievement score of 9.049 (i.e. 11.565 - 2.516). This outcome thus shows that ICT Aided Instruction, with the higher adjusted mean post-test achievement score appears to be a better strategy for teaching and improving students' achievement in Biology than the conventional method. The result in table 2 further shows that

learning strategy as a variable contributed 86.6% of the variance in students' achievement scores in Biology while the independent and moderator variables jointly accounted for 73.7% $(0.858)^2$ of the variance in students' achievement scores in Biology.

Hypothesis 2: There is no significant main effect of gender on the students' achievement scores in Biology.

The results of the main effect of gender in table 1 shows non-significant main effect of gender on the students' achievement scores ($F_{(1, 59)} = 0.052$, $P > 0.05$). This outcome implies that there was no significant difference between the scores obtained by the male and female participants in Biology achievement test. Therefore, the null hypothesis two is retained.

However, the result of multiple classification analysis (MCA) on gender in table 2 showed that with a grand mean of 11.565, the female students with adjusted mean post-test achievement score of 11.715 (i.e. 11.565 + 0.150) recorded higher mean achievement score than the male students with adjusted mean post-test achievement score of 11.373 (i.e. 11.565 - 0.192). This outcome shows that the female students recorded higher and better achievement scores than the male students in the experiment but the obtained difference is not statistically significant. The result in table 2 further shows that gender as a variable accounted for 5.4% of the variance in the students' achievement in Biology in the experiment.

Hypothesis 3: There is no significant interaction effect of instructional strategy and gender on students' achievement in Biology.

The results of the 2-way interaction effect of instructional strategy and gender in table 1 shows no significant interaction outcome of ($F_{(1, 59)} = 0.190$, $P > 0.05$). This outcome implied that the students' mean post-test achievement scores do not vary significantly between male and female students after their exposure to the treatment. This means there is no significant difference in the mean post-test achievement scores of the male and female participants exposed to the two learning strategies (ICT aided instruction and Conventional Method of Teaching). Hence, the null hypothesis three is retained.

6. Discussion

The result of the analysis of the null hypothesis which stated that 'There is no significant main effect of Instructional strategy (ICT aided instruction and Conventional Method of Teaching) on students' achievement in Biology revealed that the experimental group performed significantly better than the control group. It is evident and was clearly indicated that treatment was statistically significant on the students' achievement. A plausible reason for this outcome might be due to the fact that students exposed to ICT aided instruction were actively involved in the learning process. Active engagement helps students to construct knowledge and organize information into meaningful schema (Mayre, 2003). Thus, when learners are actively involved in the process of learning, they construct new information from his/her existing mental framework for meaningful learning to occur either through the process of accommodation and assimilation (Erinosho, 2015 and Raji, 2017). This is in line with one of the principles of learning that says students learn well when they are actively involved in the learning process (Smith, 2002).

The finding corroborated earlier findings of Alkan & Kocak, 2015; Arista & Kuswanto, 2018 who reported that the use of ICT in teaching and learning process facilitates better understanding, enhances better memory retention and improves learners' achievement.
The finding also agrees with Aiyebelehin, 2012 who reported that the use of ICT aided instruction in delivering instruction to learners in the classroom enhances better performance was more effective than Conventional Method of Teaching

The non-significant effect of gender on students' academic achievement may be an indication that the sequential stages of proper instructional design and presentation provided in the ICT aided instruction produced the same learning

effect on both gender. Hence, this implies that when appropriate stages of delivering instruction are employed and relevant instructional materials were used, the learners could acquire the best in whatever lesson or course of study irrespective of sex difference. The finding of this study regarding academic achievement base on gender is in agreement with that of Adebanjo (2019) who found that there was no significant difference in the performance of boys and girls. However, the result negates the findings of Awobodu (2016) who submitted that the male students perform better than the female students in sciences while Adekunle (2015) agreed that female students perform better than the male students in sciences.

The 2-way interaction effect on table 1 shows no significant interaction effect of the instructional strategy and gender on the students' achievement scores in Biology. This implies that there was no significant difference in the mean post-test achievement scores of the male and female participants exposed to the two learning strategies (ICT aided instruction and Conventional Method of Teaching). The effect of ICT aided instruction in improving students' achievement in Biology is the same for the male and female students who took part in the study. The reason might also be due to the equal treatment and equal opportunities given to both sexes during the treatment. This finding agrees with Adebanjo (2019) who reported that no gender differences in learning strategy and students' achievement in secondary school Biology. However, it contradicts Ayuba (2016) who reported that gender had significant difference in academic achievement in Biology, Similarly, the finding disagrees with Omoniyi (2004) who reported that gender had significant main effect on the performance of learners in tele-video instruction.

7. Conclusion and Recommendations

The poor performance of the Biology students in WASCE and NECO results was an indication that they were poorly taught and difficulty exists in teaching and learning Biology. The findings of the study led to the conclusion that ICT aided instruction proved more effective than the conventional method and it thus has the capacity of improving the performance of students in Biology. Also, gender is not a barrier to students' achievement in Biology.

In the light of the findings in this study, the following recommendations are suggested:

- Government should provide ICT resources to secondary schools in Nigeria.
- Policy makers and curriculum planners should lay more emphasis on modern educational resources that promote effectiveness in teaching and learning.
- Government should enforce biology teachers to attend relevant workshops, seminars and conferences on digital technologies for effective instructional delivery.

References

Adebanjo, A. A. (2019). Effects of Dick and Carey Instructional Model on Students' Learning Outcomes in Secondary School Biology. Unpublished Ph.D Thesis Submitted to the Department of Science & Technology Education, Olabisi Onabanjo University, Ago Iwoye, Ogun State. pp. 1-7.

Adekunle, M. O. (2015). Problem Solving and Concept Mapping strategies: A determinant of student achievement and attitude to some environment education concepts in Social Studies. Unpublished PhD Thesis,University of Ibadan, Ibadan. pp. 9 – 16.

Adeoye, Y. M., Oluwole, A. F. & Loto, A. B. (2013). Appraising the role of Information and Communication Technology (ICT) as a change agent for higher education in Nigeria. *International Journal of Educational Administration and Policy*, 5(8), 177-183

Aiyebelehin, J. A. (2012). The influence of Teachers' Information Needs and Seeking Behaviour on ICT use in Secondary Schools. Unpublished MLIS

Dissertation. University of Ibadan, Ibadan, Nigeria.

Ajayi, E. O. A. (2017). Global Trends and Emerging Issues in Teacher Education in Nigeria. Keynote address delivered on the 2nd Teachers' Registration Council of Nigeria (TRCN) Induction for Graduates of Education, Olabisi Onabanjo University. p. 1.

Awobodu, V. Y. (2016). Problem-Based Learning and Programme Instruction as strategies for enhancing learning outcomes in Biology. Unpublished Ph.D Thesis Submitted to the Science and Technology Education Department, Olabisi Onabanjo University, Ago Iwoye, Ogun State. pp. 40 – 50.

Alebiosu, K. A. & Bamiro, O.A. (2007). Teaching Chemistry as activity oriented teachers' knowledge and practice of science activities. Nigeria *Journal of Curriculum Studies*, 4(3), 47 - 64.

Alkan, F. & Kocak, C. (2015). Chemistry laboratory applications supported with simulation. Procedia – Social and Behavioural Sciences, 176, 970-976. Retrieved from https://cyberlennika.org/article

Ayuba, B. (2016). Impact of Peer Tutoring on the Academic Achievement in Sciences Among Secondary School Students within Bauchi Metropolis. Unpublished B. Tech (Ed) Project, Abubakar Tafawa Balewa University Bauchi. pp. 2 – 10.

Arista, F. S. & Kuswanto, H. (2018). Virtual Physics Laboratory Application based on the android smartphone to improve Learning Independence and Conceptual Understanding. *International Journal of Instruction*, 11(1), 1-16. Retrieved from https://eric.ed.gov//id

Erinosho, S.Y. (2015). Engaging Girls in 'Learn Science by Doing' as Strategy for Enhanced Learning Outcome at the Junior High School Level: A Study in Nigeria. *International Journal of Educational Studies*. 02 (02), 101-107.

Federal Republic of Nigeria (FRN, 2014). National Policy on Education. Lagos. Nigerian Educational Research and Development Council.

Genry, C. (2004). Introduction to Instructional Development. Belmont, Califonia: Wad Publishing Co. pp. 5 - 7.

Kurah, J. R. (2015). Teacher Factors Influencing the Implementation of Biology Curriculum in Secondary Schools Kaduna State. Unpublished M.Ed Dissertation, Department of Science & Technology Education, University of Abuja. pp. 11 - 14.

Mathew, D. Joro, I. D. & Manasseh, H. (2015). The role of Information and Communication Technology in Nigeria Education System. *International Journal of Research in Humanities and Social Studies*, 2(2), 64-68.

Mayer, R. E. (2003). Learning and Instruction. Upper Saddle River. New York: Cambrige University Press. pp. 15 – 17.

Mumtaz, K. (2013). Relationship between students' learning style and academic performance in Mara professional College. Malaysia. *Journal of Personality Assessment*, 78(1). 176-186

Okebukola, P. O. A. (1990). Comparative Education in Nigeria Schools of the 90s. Science Teachers Association of Nigeria Conference Proceedings. 38-49.

Olakulehin, F. K. (2007). Information and Communication Technologies in Teacher Training and Professional Development in Nigeria. *Turkish Online Journal of Distance Education*, 8(1). 135-142

Oludipe, O. S. (2015). Effects of '5E'and 'PDEODE' learning models on secondary school students' learning outcomes in Chemsitry. Unpblished Ph.D Thesis submitted to the Science and Technology Education Department, Olabisi Onabanjo University, Ago Iwoye, Ogun State. pp. 20 – 27.

Omoniyi, Tayo (2004). Effect of Tele-Video Instruction on Distance Learners Performance in Educational Technology at Olabisi Onabanjo University, Nigeria. Unpublshed Ph.D Thesis submitted to the Department of Curriculum Studies and Educational Technology, University of Ilorin, Ilorin. pp 65-67.

Oni, J. O. (2017). The Changing Faces of Nigerian Primary and Secondary Education and the Challenge of Management. 78th Inaugural Lecture, Olabisi Onabanjo University, OOU Mass Communication Press, Nigeria. p. 11.

Onwuagbuke, B. B. C., Singh, T. K. R. & Fook, F. S. (2015). Need for ICT integration for effective instructional delivery in Nigerian Colleges of Education. *Journal of Education and Practice*, 6(3), 51-56.

Raji, R. A. (2017). Sequential Teaching Model with Enhanced Cognitive Entry Characteristics as Strategy for Improving Learning Outcomes in Ecology among Secondary School Students. Unpublished Ph.D Thesis Submitted to the Department of Science and Technology Education, Olabisi Onabanjo University, Ago Iwoye. pp. 30 – 35.

Smith, P. & Ragan, T. (2011). Instructional Design. Upper Saddle River, New Jersey: Prentice-Hall, Inc. p. 20.

Smith, M. K. (2002). 'Jerome S. Bruner and the Process of Education'. *The Encyclopedia of Informal Education*. Retrieved on 30 November, 2017 from *http://www.infed.org/thinkers/bruner.htm*.

United Nations Educational, Scientific and Cultural Organizations (UNESCO, 2002). Information and Communication Technology in Education- A Curriculum for Schools and Programme of Teacher Development. Retrieved 25th March, 2018 from www.unesdoc.unesco.org

West African Examinations Council (2018). WAEC Chief Examiners' Report. Retrieved from https;//waeconline.orgng/e-learning/Biology/Bio227mw.html

Yusuf, M. O. & Afolabi, A. O. (2010). Effects of Computer Assisted Instruction (CAI) on Secondary School Students' Performance in Biology. T*he Turkish Online Journal of Educational Technology*, 9 (1), pp 62-69

Yusuf, M. O. & Balogun, M. R. (2011). Student-teachers' competence and attitude towards Information and Communication Technology: A case study in a Nigerian University. Contemporary Educational Technology, 21(1), 18-36. Retrieved August 30, 2019 from www.acarindex.com/dosyalar/makalle/acarindex

Yusuf, O. Y. (2000). Integrating Information and Communication Technologies in Nigeria Tertiary Education. The African Symposium, *An Online Journal of African Educational Research Network.*