

**STAKEHOLDERS' PERCEPTIONS OF THE USE OF INFORMATION
AND COMMUNICATION TECHNOLOGY FOR BIOLOGY
INSTRUCTION IN OYO STATE, NIGERIA**

ORAL DEFENCE

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CERTIFICATION

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DEDICATION

This work is dedicated to God Almighty, My Children and Grandchild.

ACKNOWLEDGEMENTS

All glory and honour to God Almighty for his divine protection, provision, good health, favour and for the abundant life given to me to complete my course of study and to achieve my goal of having a Ph.D. To him alone be all the glory, honour and adoration forever (Amen).

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ABSTRACT

Increasing use of Information and Communication Technology (ICT) for different purposes is evident. However, many Biology teachers and students hardly incorporate ICT into their instructional activities. Considering the major role of teachers and students in the classroom, especially in the use of ICT innovations, their perceptions must be considered as major factor in integrating ICT for classroom purposes. Therefore, this study investigated stakeholders' perception of ICT use for Biology instruction in Oyo State. The objectives of the study were to: (i) examine the utilisation of ICT for teaching Biology in secondary schools; (ii) examine the perceived usefulness of ICT for teaching and learning by Biology teachers and students; (iii) determine the perceived ease of use of ICT for teaching and learning among Biology teachers and students; (iv) examine the gender differences in Biology teachers and students' perceived usefulness of ICT for teaching and learning; and (v) investigate the gender difference on Biology teachers and students' perceived ease of use of ICT for teaching and learning.

A quantitative research design of the survey type was employed. The sample size included multistage sampled 45 biology teachers and 2578 biology students across nine Local Government Areas (LGAs) in Oyo State, Nigeria: nine LGAs were simple randomly sampled across three Senatorial Districts; and purposive sampling technique was used in selecting all the biology teachers, while, Research Advisor was consulted to select 2578 biology students. Data was collected through a validated researcher-designed questionnaire with a reliability value of 0.92. Percentage (<50%>), mean and rank order (<2.50>) were employed to answer the research questions, while, hypotheses were tested using *t*-test and Analysis of Variance at 0.05 level of significance.

The findings of the study were that:

- i. Biology teachers in Oyo State utilised ICT for teaching in secondary schools (54.7%>50%);
- ii. the perceived usefulness of ICT for teaching and learning biology by biology teachers and students was positive in secondary schools in Oyo state (teachers: $X=3.08$; and students: $X=2.68$);
- iii. the perceived ease of use of ICT for teaching and learning biology by biology teachers and students was positive in secondary schools in Oyo state (teachers: $X=2.89$; and students: $X=2.68$);
- iv. there was no significant difference between male and female biology students' perceived ease of use of ICT for learning in secondary schools in Oyo state; and
- v. there was no significant difference between male and female biology teachers' perceived ease of use of ICT for teaching in secondary schools in Oyo state.

The study concluded that the effectiveness of ICT was determined not by its mere presence in the classroom but by teachers and learners' use, perceived ease of use and perceived usefulness of the ICT. This implies that teachers' and learners' role is really critical as they are the ones who have to decide whether or not to use the available ICT resources in schools. This study recommended that ICT-based biology instructional processes should be made open, accessible and interactive to both the teachers and students.

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CHAPTER ONE

INTRODUCTION

Background to the Study

Education is the most powerful tool for all-round development of human beings. It is a powerful instrument for developing intellectual abilities, shaping cultural attitudes and acquiring knowledge and skills. In Nigeria as in other countries of the world, education serves as an instrument per excellence for effecting national development. The Federal Government of Nigeria (FGN) through the National Policy on Education (NPE) (Federal Republic of Nigeria, FRN, 2013) stipulates that Nigeria's philosophy of education is based on the beliefs that education is aimed at maximizing the creative potentials and skills of the individual for self-fulfilment, as well as serving as an instrument for national development and social change.

The FRN(2013) stated that the strategic plans of education have engendered an effective means of developing the full capacities and potentials of human resources, as well as the development of competent work force through the acquisition of practical life skills that are relevant to the world of work for developing sound intelligent learning societies that are fit and relevant to the 21st century. In affirmation to the strategic position of education, researchers such as Durosaro (2002) and Sanubi and Akpotu (2015) explained that in order to fully

realise the Nigerian goals of education and gain from its contribution to the national economy, it is important for Nigerian government to take necessary measures to ensure that teaching is practical, experimental and technologically supported, and also provide special incentives to make the goals of education achievable especially, the study of sciences at every level of education. This provision was promulgated as a result of the realisation of the importance of science in the actualization of the vision 20:2020.

The development and maintenance of a democratic nation where the citizenry would be knowledgeable enough to intelligently participate in decision making on public issues and transform the national woes into blessings must be a scientific and technological literate society. In relation to developing country, Abimbola (2013), Abanikannda and Ajani (2019) explained that countries all over the world, especially the developing ones like Nigeria, are still striving hard to develop technologically, now that all proper functioning of lives depend greatly on technology which is the product of science.

The importance of science and technology in the achievement of national goals, aspirations and economic buoyancy is evident. Realistically, the philosophy of science had made present-day scientists to realize its activities and challenge its concepts and theories with a view to providing for the requirements of rapid technological advancement. Thus, its integration into the educational system as a

subject to be learnt. The role of Science education in the socio-economic development of any nation hardly needs any arguments.

Olorundare (2014) submitted that in the current modern society, no citizen can be said to be literate until he/she possesses a basic understanding and appreciation of science and its work and method of generating knowledge and product. Abimbola (2013) noted that a substantial development in the socio-economic status of a country cannot rise above its level of scientific and technological education. On this note, it is safe to posit that obviously, Science education is a powerful tool in achieving economic growth and development. Based on this realization, nations across the globe adopted the integration of Science education in their educational system (Adegboye, Ganiyu, & Abimbola, 2017).

Science, according to Carpi and Egger (2019) consists of two entities: the body of knowledge; and the processed knowledge production. The author explained that the process of knowledge production provides human with the critical approach to thinking and knowing about the natural components of the universe. Ayeni (2002) further described Science as an organised body of knowledge aimed at solving problems and a search of providing explanation of natural objects and phenomena. In another dimension, Abimbola (2013) described Science as a body of knowledge, a way or method of investigating and thinking in

the pursuit of understanding nature. This understanding helps man to understand phenomenon in his/her environment.

Adegboye, et al., (2017) posited that the ultimate application of science is related to development of theory formulation based on scientific knowledge. Science education plays key roles in the scientific, technological and industrial development of a country hence the achievement of the vision 20:2020 could be made easily realistic. Science education does not solely focus on developing the understanding of science concepts among students, but also on the understanding of the basic nature of science (FRN, 2013). Garba (2009) described Science education as those aspects of education which lead to acquisition of practical and applied skills as well as basic scientific knowledge. Science education is expected to prepare as well as train learners with skills that will make them self-reliant, train them to enter jobs and advance in them.

Kola (2013) prescribed Science education as an important element for the development of any nation, that is why every nation has taken it very seriously in all institutions of learning, particularly in Basic education level. The FRN (2013) had made some frantic efforts in the area of policies as well as resources to engineer the teaching of Science education effectively in the school system. Evidence for the implementation of the policies is the school-wide teaching of Science-focused subjects in all levels of education in Nigeria. Presently in the

Nigerian schools, Science is taught at both primary and secondary levels of education as general studies for all students. This is compulsory both at the primary and secondary levels because, Science teaches about man and his environment and everyone should have basic knowledge of himself in relation to his environment.

In Nigeria, the teaching and learning of Science education starts from the child's basic level. Expectedly, as indicated the NPE, FRN (2013), every Nigerian child who has passed through the first 9-years of basic education is expected to have acquired appropriate level of functional literacy and numeracy, cultivation of positive attitudes leading to cooperation, community and continuous learning that support national development, as well as, ethical, moral, and civic values needed for laying solid foundation for life-long learning as a basic for scientific and reflective thinking.

Science subjects in the Nigerian secondary schools basically comprise basic disciplines such as Biology, Chemistry, and Physics. Studies such as Alebiosu (2017) revealed that students in secondary schools are interested in Science subjects. This may be because many science students want to end up in becoming doctors, engineers and related disciplines. Among the most liked subjects is Biology. Biology as a subject of study has received special attention from educators and researchers, because of its relevance to the field of Science

education. For instance, anybody interested in becoming a scientist or want venture into other related fields cannot do so without passing Biology. Biology is a natural science subject consisting of contents from microscopic organisms to the biosphere in general, encompassing the earth's surfaces and all living things (Okwo & Tartiyus, 2004; Abanikannda, 2018).

Umar (2011) stated that Biology is a natural science which deals with the living world. It explains the structure, function, development and existence of living things, while also providing justifications for their reactions with the environment within which they exist. Peter (2015) declared that the study of Biology provides an ideal preparation for a list of careers ranging from basic science to engineering. Biology as a branch of science and a pre-requisite subject for many fields of learning contributes immensely to the scientific and technological growth of a nation. The study of Biology at all educational levels can equip learners with beneficial concepts, principles and theories that will enable them lead a peaceful life (Ahmad, Abubakar & Yau, 2018).

Abanikannda (2018) stated that part of the objectives of Biology in the secondary school curriculum is to prepare the students to acquire meaningful and relevant knowledge in Biology, as well as, acquire reasonable and functional scientific attitude. Olagunju (2012) posited that Biology is a practical based subject which equips students with concepts and skills that are useful in solving

the day-to-day problems of life. The study of Biology aims at providing the learner with the necessary knowledge with which to control or change the environment for the benefit of an individual, family or community.

In general, the importance of learning Biology to humanity can be outlined as follows: helps to have knowledge about the earth; helps to understand changes in the environment and the factors affecting these changes in order to know how human needs are influenced; helps mankind to find effective ways of preventing, treating and curing diseases and home management techniques such as better methods of food preservation, efficient food preparation and care of the family (Olagunju, 2012).

Biology is a standard subject of instructions at all levels of educational system from primary to tertiary level. It is one of the core subjects at senior secondary school certificate examination (SSCE) which study is very relevant to man's successful living (Akindele, Nwagbo, Nsewi, & Ajewole, 2009). Hence, Biology occupies a unique position in the school curriculum and it is the most popular subject among all the sciences. Besides, Biology being central to many science-related courses such as biochemistry, medicine, pharmacy, science, nursing, microbiology adds to its popularity. It is obvious that no students intending to study these courses can do so without Biology, and a credit in Biology is a basic prerequisite (Yusuf & Afolabi, 2010).

The compulsory subject nature and the numerous benefits associated with Biology could be the reason for its high enrolment in the Senior School Certificate Examination (SSCE) (West Africa Examination Council Report, 2018). Contrarily, students' performance in the subject has been below average despite inputs from concerned stakeholders. Over the years, studies such as Ogunleye (2006), Abimbola (2013), and Abanikannda (2018) have continued to draw attention to the grave consequences of the constant decline in the performance of students in Science subjects in general, and Biology in particular. The study of Abimbola (2013) revealed that the performance level for Biology did not show any significant rise for a twenty-year period (1991 – 2011) and the researcher confirmed that candidates' performance in Biology over those years never rose above 50%.

In fact, the analysis of data obtained from West Africa Examination Council (WAEC) on the performance level of students in Biology revealed the enormity of this problem. The analysis obtained revealed that between years 2006 to 2012, the performance has been below 50%, from 2013 to 2015, the performance increased between 51% to 54%, and in 2016 the performance increased steadily to 75% (WAEC, 2018). This greatly indicates that there are imminent issues that are peculiar with the subject. The despicable performance in Biology in previous years has unfortunately contributed to a great extent in not

achieving the Nigerian educational goals and objectives (Abimbola, 2013; Abanikannda, 2018).

Akinola (2006), Amedu (2015), and Abanikannda (2018) claimed that in spite of all efforts to improve students' performance in Biology, it has been observed that unfortunately the cause of mass failure of students in the subject majorly includes teacher's methodology, structure of the curriculum, the concentration of examination questions on few topics, the inability of students to perform enough practical before the examination and lack of technological tools such as information and communication technology (ICT) integration to Biology instructional process.

Other researchers such as Ayanda, Abimbola and Ahmed (2012) claimed that the cause of the poor performance in Biology could be attributed to the theoretical approach employed in teaching and learning of concepts in the subject. Given that some of the concepts taught in Biology are abstract, students find it difficult to conceptualize when taught theoretically. This has made learners to develop a negative attitude and perception towards the subject leading to poor performance. The trend of these poor performances may change positively if topics and concepts in Biology are taught with ICT devices to enhance instructional strategies.

Researchers such as Abimbola (2013) and Abanikannda (2018) recommend the teaching of Biological concepts using ICT. The use of ICT in teaching can be a relevant and functional way of providing education to students that will equip them with skills and knowledge required to function in the 21st century. It is against this background that the FGN in various policy documents has articulated the importance and the role ICT could play in education, particularly in Biology education (NERDC, 2009).

Information and Communication Technology (ICT) has become a global phenomenon. It has been embraced all over the world due to its importance. Governments all over the world are harnessing the rich potentials of ICT and are using it as a tool for educational development, economic recovery and wealth creation (Olaore, 2014). Today no nation can attain her height educationally without ICT. With the use of ICT, there is an increasing usability of performing impossible experiments by using simulations, as well as creating possible avenues for students to have individual learning programs, rather than everybody having to do the same thing at the same time at the same pace (Olaore, 2014).

The use of ICT has become an integral part of education in many parts of the globe including Nigeria, as ICT is gradually finding its way into the educational system. The FRN (2013), and with particular reference to Science and technology, considered ICT as an important tool for laying a solid foundation of

Science, Technology, Engineering and Mathematics (STEM) education at all levels of Nigerian education system. Despite the limitations brought about by economic disadvantages, it is observed that the influence of ICT on education is to enhance the learners' ability to generate, access, adopt and apply knowledge to solve complex problems (Adedokun-Shittu, Ajani, Nuhu, & Shittu, 2020).

Agommuoh (2015) further observed that the use of ICT in teaching science subjects will make learning more real, relevant and experimental as large amount of data and materials on any topic can be brought to the classroom from all over the world, thereby, greatly facilitating the acquisition and absorption of knowledge and offering students unprecedented opportunities to enhance their learning. From the foregoing, ICT has rapidly transformed the teaching field into a global village and Biology is one of the beneficiaries of this global revolution in teaching and learning process using ICT.

In order to promote an effective instructional process in Biology, the need for innovative methods coupled with ICT for Biology instruction is quintessential. Adedokun-Shittu, Ajani, Nuhu, and Shittu (2019) opined that ICT is indispensable and very important for instructional processes in Science teaching and learning. Adedokun-Shittu et al., (2019) and Eze (2012) noted that education in whatever form is not complete without effective use of ICT and that the significance of ICT in education includes: access to variety of learning resources; immediacy of

information; anytime anywhere learning; collaborative learning; multimedia approach to education; authentic and up to date information; access to online libraries; distance learning; individualization of instruction; reduced time on many routine tasks access to the source of information; and teaching science subjects made interesting, among others.

Information Communication Technology (ICT) is the processing and maintenance of information and the use of all forms of computer, communication, network and mobile technologies to mediate information. Communication technology includes all media employed in transmitting audio, videos, data or multimedia such as cable, satellite, fibre optics wireless (radio, Bluetooth, infrared, Wi-Fi), interactive electronic boards, multimedia projectors, and continuously emerging state of the art PCs. Network technologies include personal area network (PAN), campus area network (CAN), intranets, extranets, CANs, WANs, WMANs, and WLANs and the internet (Iloanusi & Osagwu 2010).

Adedokun-Shittu et al., (2019) and Moursund (2005) posited that ICT has the potential to contribute substantial improvements in educational system. However to date, relatively little of this potential has been achieved, in spite of ICT having significant impact on traditional school system, they have provided innovation for teaching and learning and have engendered advances in

research about how people learn, thereby bringing about education restructuring. It is also widely acknowledged that ICT can be used to improve the quality of teaching and learning in the school system.

In line with competitiveness and emphasis on the use of ICT in teaching and learning, government at various levels and non-governmental organisations have continued to intensify efforts to supply ICT facilities to schools in Nigeria. But evidence in literature tends to show that the available ICT facilities in schools are underutilized (Ojaleye, 2002; Ugwu, 2006; Nzewi, 2010; Adeyemo, 2010; Kola, 2013; Okoye, 2014). In the same vein, Nwagbo and Ugwanyi (2012) argued that despite the afore-mentioned impact of ICT in teaching and learning Science, effective utilization of it is being impeded by some challenges accredited to different stakeholders, in particular students and teachers. These challenges include: lack of confidence by both students and teachers, resistance to change by the teachers, negative attitudes and perception exhibited by both the teachers and students, lack of technical support, insufficiency in the school timetable, among others.

Research on ICT integration in teaching and learning situation that has been conducted over the past 20 years sheds some light on why ICT is not used more (Ogunlade, 2015). ICT integration is a slow and complex process and is influenced by many factors. These include organizational factors, factors

associated with the technology itself, and users' factors, in this case both the teachers and students (Adeyanju, 2015). Teachers' and students' perception towards ICT adoption have been identified as key factors associated with ICT use in the classroom (McNair & Green, 2016).

Teachers and students need to hold a positive perception towards technology in order to use it effectively for instructional purposes. Moreover, teachers' pedagogical beliefs and existing teaching practices will shape how they incorporate ICT in the classroom (Yang, 2015). In order to use ICT effectively for educational purposes, both the teachers and students must not only be familiar with how to operate equipment, but also understand how these tools are effectively used in the subjects they teach and learn, and how to incorporate ICT resources into classroom activities that accomplish important learning goals (Adedokun-Shittu, Olasehinde-Williams, Obielodan, & Salawu, 2017).

According to Damole (2011), Kolawole (2011), Uzowulu and Egbuama (2015) effective teaching is so crucial to learning that the products of teaching such as knowledge, attitude and skills acquisition are much dependent on teachers' effectiveness. Teaching is said to be enhanced when the approach used brings about a desirable change in the life and behaviour of the student. If learning strategies and performance hence to improve then the students have to be introduced to more effective efficient and appropriate teaching strategies in the

classroom. And this can be achieved when research studies are carried out to enhance the teaching and learning of basic science and technology in schools.

Studies such as Adetunla, (2016) have revealed critical factors that affect teachers and students' use of ICT which include; perceived usefulness of computer knowledge; early exposure to computer training; rich home computing environment; and cognitive and affective attitudes. It is however important to understand that ICT is technology dependent, hence, the adoption of Technology Acceptance Model (TAM) becomes imperative. TAM devised by Davis (1986) theorized the acceptability and usage of technological tool via the prediction of two (2) constructs such as Perceived Ease of Use and Perceived Usefulness.

This current study found interest in these two constructs because it has been argued in literature such as Oyeleken (2008) and Oladosu, Adedokun-Shittu, Sanni and Ajani (2020) that difficulty of use can discourage adoption of a useful technological resources, no amount of usefulness can compensate for resources that do not give ease of function. Perceived ease of use is an important factor of user acceptance and should not be ignored by those attempting to design or implement successful electronic information system (Davis, 1986). The perceived ease of use refers to the degree to which the user expects the target system to be free of effort. ICT resources will be perceived easy to use by teachers and students if it becomes easy to teach or learn with, if interaction with it becomes

clear and understandable, if it's flexible to interact with and however, teachers and students must be able to become skilful at using it (Adetunla, 2016).

Furthermore, the TAM model has been used exclusively in educational settings to determine the perceived and actual usage of ICT in educational setting. TAM emphasizes that user' perceptions about how useful an information system is and how easy it is to use are powerful factors that influence the adoption of technology and are fundamental determinants of a user's acceptance. The TAM has been used by various researchers including Oyelekan (2008), Adetunla, (2016), Oladosu et al., (2020) and a host of others.

Teachers and students' personal factors have brought about digital divide and mixed feelings about the ease of use of ICT. Adetunla, (2016) asserted that users' perception of an information system can be explained by several factors some of which are personal factors such as teachers' perception towards computer, years of experience, gender, area of specialisation, teachers and students' location, among others. Similarly, Olorundare (2003) opined that educational products are not only determined by the quality of the material input (knowledge skill) but also by the quality of those who implement and supervise those inputs. The strategic function of teaching is that, more experienced teachers are considered as the most appropriate to teach particular topics to students who differ in their abilities, prior knowledge and background. Many occupations

recognize employees' years of experience as a relevant factor in human resource policies, including compensation systems, benefits packages, and promotion decisions. The idea that experience, gained over time, enhances the knowledge, skills, and productivity of workers. This idea is also observed in the educational sector too.

Another important variable is gender. Gender related problems have contributed greatly to the creation of gender crisis by providing unequal opportunities for males and females. Ambe-Uva, Iwuchukwu, and Jibrin (2008) posited that gender is associated with being a male or female, including the construction of identities, expectations, behaviour and power relationship that derive from social interactions. Gin (2011) observed that in contemporary context, men and women classification is a world where patriarchal values predominate, it is a world where there are general sets of beliefs that women are inferior to men and therefore, the power relations attached to their ideas, and beliefs, give men more power, more opportunities and more concessions over and above women in the society. Nwona (2013) and Amedu (2015) noted imbalance against women in STEM. Researchers such as Popoola and Ajani (2011) have different view on the influence of gender on students' perception and achievement in ICT use in relation to Biology.

Other variable which is important to ICT use is the location of the school. Anibuezechigozie, Ayogu and Abugu (2017) posited that school location is either urban or rural schools. Urban schools are those schools located in the towns. They are schools situated at the major cities while rural schools are schools located at the villages or semi-villages. While Oloda (2017) found that school location contributed to students' achievement and ICT use. Researchers such as Bosede (2010) and Ezeudu and Obi (2013) revealed that location has no effect on students' academic achievement and teachers use of ICT in the classroom.

Following the major role that teachers and students play in the classroom, especially in the use of ICT innovations, their perception must be considered as a major factor while integrating ICT for classroom purposes. In order to better understand teachers' and students' perception towards ICT in teaching senior secondary schools Biology in Oyo state, Nigeria, this study was therefore embarked upon.

Statement of the Problem

Today's learners are categorised as technologically savvy generation who are natural technical and digital literate. They utilise ICT resources such as mobile devices, internet, instant messaging, and other resources for socialization and entertainment, and they do not see technology as a foreign entity. As a result of ICT pervasiveness and the significant impact on most of today's learners, when

they are enrolled in schools, they think and process information differently from their predecessors. Dey, Burn, and Gerdes (2009) lamented that on the first arrival of learners to schools, they are ready to learn in new ways, only to find teachers who are reluctant to alter their traditional and entrenched teaching approaches.

Most of instructional experts agreed that, when properly used, ICT holds great promise to improve classroom instruction. However, studies such as Ogwu and Ogwu (2010) and Khitam (2015) indicated that while ICT is used increasingly, many teachers are not effectively incorporating it and they still lack the required skills and knowledge regarding integrating ICT into their teaching, neither do students utilise it to enhance their learning but they use it for entertainment reasons.

Ogunlade (2015) posits that the studies conducted over the past 20 years on ICT for instructional purpose has shed some light on why ICT is not used more. One of the major reasons attributed to it is the technology itself and users' factors. Researchers such as McNair and Green, (2016) and Adetunla, (2016) claimed that users' (teachers and students) factor such as perception towards ICT is the primary identified key factor associated with ICT use in the classroom. Therefore, this study investigated Biology teachers and students' perception on the use of ICT for instruction in secondary schools in Nigeria.

The interactive teachers and students' personal factors such as gender, school location, teachers' qualification, years of experience, among others could serve as a possible factor that could influence the use of ICT. Supporting this view, Steinerova and Susol (2007) noted that research on these personal factors still remain open. Literatures are also replete with studies on human information behaviour which shows disparity across personal human characteristics when using digital resources. Therefore, this study moderated the personal characteristics of stakeholders and examined their perception based on the perceived ease of use and usefulness of ICT in senior secondary school biology teaching / learning in Oyo state.

Purpose of the Study

The major purpose of this study was to investigate stakeholders' perception of the use of information and communication technology for Biology instruction in Oyo State secondary schools. Specifically, this study:

1. examined the utilisation of ICT for teaching Biology in secondary schools in Oyo state;
2. determined the perceived ease of use of ICT for teaching among Biology teachers in secondary schools in Oyo state;
3. examined the perceived ease of use of ICT for learning among Biology students in secondary schools in Oyo state;

4. examined the perceived usefulness of ICT for teaching among Biology teachers in secondary schools in Oyo state;
5. determined the perceived usefulness of ICT for learning among Biology students in secondary schools in Oyo state;
6. investigated the gender difference on Biology teachers' perceived ease of use of ICT for teaching in secondary schools in Oyo state;
7. investigated the gender difference on Biology teachers' perceived usefulness of ICT for teaching in secondary schools in Oyo state;
8. examined the gender difference on students' perceived ease of use of ICT for learning in secondary schools in Oyo state;
9. examined the gender difference on students' perceived usefulness of ICT for learning in secondary schools in Oyo state;
10. determined the influence of school location on Biology teachers' perceived ease of use of ICT for teaching in secondary schools in Oyo state;
11. determined the influence of school location on Biology teachers' perceived usefulness of ICT for teaching in secondary schools in Oyo state;
12. determined the influence of school location on Biology students' perceived ease of use of ICT for learning in secondary schools in Oyo state;
13. determined the influence of school location on Biology students' perceived usefulness of ICT for learning in secondary schools in Oyo state;

14. examined the influence of Biology teachers' years of experience on their perceived ease of use and usefulness of ICT for teaching in secondary schools in Oyo state; and
15. examined the influence of Biology teachers' qualification on the perceived ease of use and usefulness of ICT for teaching in secondary schools in Oyo state.

Research Questions

The following research questions were raised and answered in this study:

1. Do Biology teachers utilise ICT for teaching in secondary schools in Oyo state?
2. What is the perceived ease of use of ICT for teaching among Biology teachers in secondary schools in Oyo state?
3. What is the perceived ease of use of ICT for learning among Biology students in secondary schools in Oyo state?
4. What is the perceived usefulness of ICT for teaching among Biology teachers in secondary schools in Oyo state?
5. What is the perceived usefulness of ICT for learning among Biology students in secondary schools in Oyo state?

Research Hypotheses

The following research hypotheses were tested at 0.05 level of significance in this study:

H₀₁: There is no significant difference between male and female Biology teachers' perceived ease of use of ICT for teaching in secondary schools in Oyo state

H₀₂: There is no significant difference between male and female Biology students' perceived ease of use of ICT for learning in secondary schools in Oyo state

H₀₃: There is no significant difference between male and female Biology teachers' perceived usefulness of ICT for teaching in secondary schools in Oyo state

H₀₄: There is no significant difference between male and female Biology students' perceived usefulness of ICT for learning in secondary schools in Oyo state

H₀₅: There is no significant difference between Biology teachers located in rural and urban areas' perceived ease of use of ICT for teaching in secondary schools in Oyo state

H₀₆: There is no significant difference between Biology students located in rural and urban areas' perceived ease of use of ICT for learning in secondary schools in Oyo state

H₀₇: There is no significant difference between Biology teachers located in rural and urban areas' perceived usefulness of ICT for teaching in secondary schools in Oyo state

H₀₈: There is no significant difference between Biology students located in rural and urban areas' perceived usefulness of ICT for teaching in secondary schools in Oyo state

H₀₉: There is no significant difference among Biology teachers' years of experience on their perceived ease of use and usefulness of ICT in secondary schools in Oyo state

H₁₀: There is no significant difference among Biology teachers' qualification on their perceived ease of use and usefulness of ICT for teaching in secondary schools in Oyo state

Scope of the study

This study focused on stakeholders' perception of the use of information and communication technology for Biology instruction in Oyo state, Nigeria. The content scope was limited to the perceived ease of use and perceived usefulness of ICT. The study was limited to Oyo state rural and urban areas as the geographical

scope, while employing a quantitative research method of a survey type. The study employed a multistage sampling technique to sample 45 Biology teachers and 2578 Biology students as respondents for the study. The variable scope included perception (perceived ease of use and perceived usefulness) as the independent variable, the use of ICT as the dependent variable, while, stakeholders' gender, school location, years of experience, and academic qualification as the moderating variables. Both the descriptive and inferential statistics were used to answer the research questions and test the stated hypotheses at 0.05 level of significance respectively.

Significance of the study

It is hoped that the findings of this study would be beneficial to teachers, students, school administrators, government, and curriculum developers. This study is hoped to inform teachers on how they can embrace ICT in teaching different subjects, particularly Biology. ICT in Biology teaching and learning process has the possibility to entirely change the way teachers provide instructional lessons to the students due to the ubiquity properties that ICT is characterised with, and also change the way educators treat and approach the instructional process. It is hoped that teachers and students especially Biology teachers will be motivated to use the ICT resources provided by their institutions more purposefully and introduce variety in their teaching and learning process.

This study might also be beneficial to students, students can now utilise the ICT resources in their school and home more purposefully to empower their imagination, creativity and learning. Students' cognitive and psychomotor ability can also be stimulated and empowered in learning concepts. It is hoped that results of the study would popularize sourcing of relevant learning materials in teaching and learning, thereby introducing variety into instructional process.

The outcome of this study would be useful for professional associations like the Science Teacher Association of Nigeria (STAN) as an area to explore in building capacity of their members. It may also serve as a springboard for research in Nigeria to explore the potentials of using ICT to improve students' learning in all school subjects. This research work would also be useful to the textbook writers. Findings from this study could also help to guide examination bodies, such as; WAEC and NECO on the need to organize relevant workshop and seminars for awareness creation on ICT for improving the quality of Biology teachers and Biology students. In addition, government (State) and proprietors of private secondary schools will be encouraged to improve Biology teaching.

The findings and recommendations of this study are expected to provide a process or framework that should assist government, curriculum developers and planners in making decisions on how to adopt and use ICT in schools. With the outcome of this study, curriculum planners would be aware of the perception of

both biology teachers and students on the use of ICT on teaching of Biology in secondary schools, as well as the influence of gender, qualification, year of experience and school location on their perception and as such will be able to structure the curriculum in this direction. Also, the result of the study would help curriculum planners and educators to plan workshops and seminars to train Biology teachers and students in the right perspective.

Further, findings of this study are expected to open areas for further study by other researchers and academicians, hence benefiting the whole community. Moreover, there seems to be little literature evidence of empirical researches in Nigeria and Oyo state in particular, dealing with the perceived ease of use and usefulness of ICT among Biology teachers in Nigeria. This study would provide empirical research information in this regard.

Clarification of Major Terms and Variables

The following terms and variables were clarified

Information and communication technology: The use of technological related gadgets to present instruction to students through an interactive process.

Perception: This is the view of the respondents on the use of ICT for instructional purposes.

Ease of use: Ability of user to navigate, explore and download necessary and relevant electronic materials for teaching and learning purposes effortlessly.

Usefulness: Teachers and students' judgement of the value of ICT to retrieve relevant electronic learning materials for learning purposes.

Stakeholder: This include both teacher and students that teach or learn Biology in the secondary school

Gender: This refers to either male or female teacher or student.

Teaching experience: This refers to the number of years a teacher has spent in teaching.

Academic qualification: This means the various degree certificates possessed by each teacher in the school. That is whether N.C.E; B. (Ed.); M.Ed., Ph.D and others.

School Location: This refers to either rural or urban schools.

Rural schools: These are schools in small communities such as the villages and hamlet where there are no or low basic facilities such as good roads, electricity, access to library, pipe borne water e t c.

Urban schools: These are schools in towns and cities where all the basic facilities are present.

CHAPTER TWO

REVIEW OF RELATED LITERATURE

This chapter reviewed the literature of related past works done under the following sub-headings:

1. Theoretical Framework of the study
2. Objective and Contents of Senior Secondary School Biology Curriculum
3. Availability of Information and Communication Technology Resources
for Biology Instruction
4. Information and Communication Technology Utilisation for Biology
Instruction
5. Teachers and Students' Perceived Ease of Use and Usefulness of
Information and Communication Technology in Biology Teaching and
Learning
6. Influence of Gender on Teachers and Students' Perception on Information
and Communication Technology Utilisation for Biology Instruction
7. Impact of Teaching Experience on Teachers' Perception on Information
and Communication Technology Utilisation for Biology Instruction
8. Effect of School Location on Students and Teachers Utilisation of
Information and Communication Technology Utilisation for Biology
Learning and Teaching

9. Influence of Teachers Qualification on Teachers Information and Communication Technology Utilisation for Biology Instruction
10. Appraisal of the Reviewed Related Literature

Theoretical Framework of the Study

Learning about reality is based on how we capture or how the learning is constructed. In a practical sense, psychologist is more interested in what, when and how people perceive things and the possible effects it has on their behaviours. The Oxford Advance Learners' Dictionary, OADL, (2015) define perception as the result obtained from the human view or understanding of something based on the generated ideal or belief. Many scholars and psychologists such as Gibson's (1966) and Gregory's (1988) among others have worked on perception theories. Some such as Gibson's (1966) propose a direct theory of perception otherwise known as the bottom-up theory. While, others such as Gregory (1988) argued that perception process is not direct, but depends on the perceiver's expectations and previous knowledge, as well as the information available in the stimuli itself.

The direct theory of perception known as bottom-up theory as proposed by Gibson (1966) believed that human cognitive apparatus was created and formed by a long evolutionary influence of external environment which is apparent in its structure and abilities. Learners learn to extract precisely the information which is

necessary for learners' survival. The author described that the process of visual perceptions starts by analysing the basic features of sensory input and then gradually work up to more complex processing.

Gibson proposed perception as hypothesis and submitted that perception involves making inferences about what we see and trying to make a best guess and that prior knowledge and past experience are crucial in perception. Gibson's (1987) theory of perception-in-action shows relationship between perception, experience and action. The simple explanation is that the issues perceived is interpreted by the brain (processing) based on experience in which the resultant effects is the action taken based on the opinion formed through the chain of activities.

Contrary to the Gibson's (1987) theory of perception-in-action, Gregory (1988) believed learner receive information from the environment via their senses, and that the information needs to be processed and organized by the brain which is the major distinction. Gregory (1988) indirect theory of perception known as top-down theories proposes that information and knowledge stored in brain work downwards, helping learners to interpret the basic sensory input which are normally unclear, so humaninterpreted it by dealing with it as a problem-solving task.

Gibson (1988) submitted that perception functions to gather information about object, events and places and what perceiver can do about these things. This is in support of Gibson (1997) who proposed that perception guides actions in a changeable environment. Thus, perception and action operate as continuous cycle, whereby perception obtains information for action and action as consequences that involve perception about both the organism itself and the events that are penetrated.

What learners perceive that eventually lead to formulation of opinion and behavioural pattern is mostly the by-product of previous experience. If the issue perceived has not been previously registered in the sub-conscious part of the perceiver's brain, such perception will hardly result to objective formulation of opinion and change in behaviour. Perception occurs when the relevant sensory faculties become like the object it perceives. This is a clear indication that perception is not an issue that could be haphazardly handled by the perceiver.

In relation to perception towards ICT, Ogunlade (2015) posits that the research conducted over the past 20 years on ICT for instructional purpose has shed some light on why ICT is not used more. One of the major reasons attributed to it is the technology itself and users' factors. Researchers such as McNair and Green, (2016) claimed that users' perception towards ICT have been identified as key factors associated with ICT use in the classroom.

Other researchers such as Adetunla, (2016) have equally revealed that both teachers and students' perception is a critical factor that affects the use of ICT for teaching and learning purpose. However, it is important to understand that ICT is technology dependent, hence, the prediction of Technology Acceptance Model (TAM) becomes imperative. The TAM is one of the most profound frameworks frequently used in studies to explain and predict the use of ICT in the classroom. TAM devised by Davis (1986) theorized the acceptability and usage of information system/technological tool. The model posits that the integration of ICT in the classroom is determined by user's perceptions (Bagozzi, 2007). The TAM claimed that the actual use of ICT is influenced by the user's behavioural intentions, attitude, perceived usefulness and perceived ease of the technology. In addition, the TAM proposes that external factors (self-efficacy, anxiety, motivation, external control, etc.) affect intention and actual use through mediated effects on perceived usefulness and perceived ease of use.

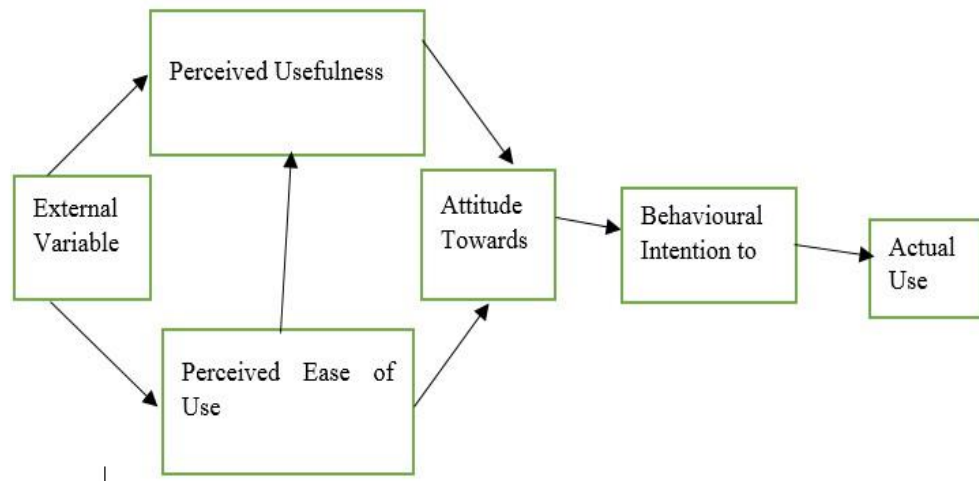


Figure 1: Technology Acceptance Model

Source: Davis, (1986)

With the ongoing development of ICT, various theoretical studies have been conducted in order to better understand concerns such as ICT diffusion, integration, acceptance, and usage. Theoretically, TAM propounded that ICT acceptability and usage can be predicted through two (2) constructs - Perceived Ease of Use (PEOU) and Perceived Usefulness (PU). PEOU and PU are important factors of user acceptance and should not be ignored by those attempting to design or implement successful electronic information system (Davis, 1986).

Perceived Ease of Use (PEOU) depicts the degree to which ICT seems to be free of effort, while, PU indicates the extent to which the use of ICT is promising to advance users' work. The TAM posits that attitudes and behavioural intention mediate the effects of PU and PEOU, the two constructs of extrinsic

motivation. This study is more interested in these two constructs because it has been argued in literature that difficulty of use can discourage adoption of a useful ICT resources, no amount of usefulness can compensate for resources that do not give ease of function. Cassim and Eyono-Obono (2011) stated that the acceptance and use of ICT is affected by users' PU and PEOU of ICT.

In an empirical study conducted by Lee, Cheung, and Chen, (2009) to understand the influence of perceived usefulness and ease of use on the acceptance of ICT. Perceived usefulness and ease of use were found as the main predictors towards intention to use ICT. Generally, PEOU and PU are the key factors in explaining the behavioural intention and usage of teachers and learners to use ICT. PU was also reported by Lee et al. (2009) as key predictor towards ICT participation.

In another study conducted by Alabi (2016) to examine the adoption of ICT by agricultural science and extension teachers in Abuja, Nigeria. The study specifically examined the factors influencing the adoption of ICT by respondents. 60 purposely selected agricultural science and extension teachers were sampled. The study concluded that teachers' experience, age, access to ICTs were significant factors influencing adoption of ICTs by respondents at 1% probability level. Teachers' attitude, teachers' awareness significantly influences adoption of ICTs by respondents at 5% probability level. Word processors are perceived

useful in setting tests and examination question papers, while, photocopy machine was perceived ease to use to make copies of teaching materials. The study recommends easy access, awareness and use of ICTs by instructors and regular supply of electricity to improve and stimulate adoption of ICTs by respondents.

The study of Sani, Kamaludeen, Abbas, Abubakar and Abdullahi (2016) sought to establish relationship between perceived ease of use, perceived usefulness and barriers of ICT in teaching and learning which reveals that teachers enjoy using ICT facilities to enhance productivity, and teachers have will to integrate ICT in to the teaching process, but this rarely occurs. The study of Jegede (2010) discovered that majority of teachers who were ICT trained are responsible for their individual expenses even when trainings are initiated by the authorities, payments in many of the occasions are from their savings.

Sani et al., (2016) posited that the need for the integration of ICT in to the teaching-learning process encourages teachers to participate at individual and group levels to become proficient. The researchers claimed that determining the level of lecturer's perception in using ICT for instructional process revealed some level of available ICT facilities usage but could not effectively and efficiently be put into instructional use. The level of PEOU, PU and barriers in the use of ICT indicated that most teachers believe that the use of ICT resources require high level of mental preparedness and concentration.

Objective and Contents of Senior Secondary School Biology Curriculum

Science has been described as a body of knowledge targeted towards investigating and understanding nature (Abimbola, 2013). This understanding is believed to be of help to man thereby understanding the basic phenomenon and occurrences within and around his/her environment. Other researchers such as Adegboye, et al., (2017) posited that the ultimate application of science in reality is related to development of theory formulation based on acquired scientific knowledge.

In the submission of Olorundare (2014), the researcher submitted that for an individual to be called literate in the current modern society, he/she must possess a basic understanding and appreciation of science as well as its work and method of generating knowledge and product. Abimbola (2013) noted that a substantial development in the socio-economic status of a country cannot rise above its level of scientific and technological education. Based on this realization, nations across the globe adopted the integration of science and technology focus education in their educational system (Adegboye, et al., 2017).

The FGN through the FRN (2013) had made some frantic efforts in the area of policies, as well as resources to engineer the integration of science and technology related education in the Nigerian educational system. The formulation and implementation of these policies are aimed at fostering its teaching

effectively in the school system. Evidence for the implementation of the policies is the school-wide teaching of science-focused subjects in all levels of education in Nigeria, especially in the primary and secondary education levels.

Presently, in Nigerian schools, science is taught at both primary and secondary as general studies for all students. This is compulsory both at the primary and secondary levels because, science teaches about man and his environment and everyone should have basic knowledge of himself in relation to his environment. In the prescription of Kola (2013), science education is an important element to the development of any nation, that is why every nation has taken it very seriously in all institutions of learning, particularly in Basic education level.

The teaching and learning of science starts from the child's basic level. Corroborating this fact, the FRN (2013) posited that every Nigerian child who has passed through the first 9-years of basic education is expected to have acquired appropriate level of functional literacy and numeracy, cultivation of positive attitudes leading to cooperation, community and continuous learning that support national development, as well as, ethical, moral, and civic values needed for laying solid foundation for life-long learning as a basic for scientific and reflective thinking.

Science subjects in the Nigerian secondary schools basically comprise basic disciplines such as Biology, Chemistry, Physics and Mathematics. Among the other science subjects, Biology has received special attention from educators, researchers, and students. This might be because many science students want to end up becoming doctors, engineers and professionals in other related disciplines. Besides, Biology being central to many science-related courses such as biochemistry, medicine, pharmacy, science, nursing, microbiology adds to its popularity. It is obvious that no students intending to study these courses can do so without Biology, and a credit pass in Biology is a basic prerequisite (Yusuf & Afolabi, 2010).

Biology is the branch of science that involves the study of life. Biology is such a broad field, covering the minute working of chemical machines inside human cells, to broad scale concept of ecosystem and global climate change. Biology is a natural science subject consisting of contents from microscopic organisms to the biosphere in general, encompassing the earth's surfaces and all living things (Okwo & Tartiyus, 2004).

Michael, (2015) described biology as a term coined from two Greek words "bios" meaning life and "logos" meaning to study, and this simply can be defined as the study of plants and animals or life. Oxford Science Dictionary (2005) described biology as the study of living organisms, which include origin and

evolution, structure, classification, functioning, and interrelationship. Umar (2011) stated that Biology is a natural science which deals with the living world. It explains the structure, function, development and existence of living things, while also providing justifications for their reactions with the environment within which they exist. Nakano (2017) stated that since Biology is a study concerned with living things, certain recognizable characteristics by which living things are identified which includes; movement, death, respiration, growth, excretion, irritability, reproduction, and nutrition must be manifested.

Olagunju (2012) posited that Biology is a practical based subject which equips students with concepts and skills that are useful in solving the day-to-day problems of life. The study of Biology aims at providing the learner with the necessary knowledge with which to control or change the environment for the benefit of an individual, family or community. Peter (2015) declared that the study of Biology provides an ideal preparation for a list of careers ranging from basic science to engineering. Biology is a standard subject of instructions at all levels of educational system from primary to tertiary level. It is one of the core subjects at senior secondary school certificate examination (SSCE) which study is very relevant to man's successful living (Akindele, et al., 2009).

The objectives of Biology curriculum have been derived from the FRN (2013) and the main objectives are to prepare students to acquire: adequate

laboratory and field skills in Biology; meaningful and relevant knowledge in Biology; ability to apply scientific knowledge to everyday life in matters of personal and community health and agriculture; and reasonable and functional scientific attitude. Abanikannda (2018) stated that part of the objectives of Biology in the secondary school curriculum is to prepare the students to acquire meaningful and relevant knowledge in Biology, as well as, acquire reasonable and functional scientific attitude.

In pursuance of the stated objectives, the content and context of the curriculum places emphasizes on field studies, guided discovery, laboratory techniques and skills along with conceptual thinking. The current senior secondary school science curriculum, which was an outgrowth of the one developed earlier by CESAC, was developed in 1985 to include Agricultural Science, Biology, Chemistry and Physics. The Biology section was organized under seven themes. Meanwhile, the recent edition of the Biology curriculum (NERDC, 2009) now has only four themes: Theme 1: Organization of life; Theme 2: Organization at work; Theme 3: The organisms and its environment; and Theme 4: Continuity of life.

Olutola, Daramola and Bamidele (2016) posited that biology has made a great contribution to human existence including being a solution to the problem of food scarcity, health, poverty eradication, management and conservation of

natural resources, biotechnology, among others. In general, the importance of learning Biology to humanity can be outlined as follows: helps to have knowledge about the earth; helps to understand changes in the environment and the factors affecting these changes in order to know how human needs are influenced; helps mankind to find effective ways of preventing, treating and curing diseases and home management techniques such as better methods of food preservation, efficient food preparation and care of the family (Olagunju, 2012).

The compulsory subject nature and the numerous benefits associated with Biology could be the reason for the high enrolment in the SSCE (WAEC Report, 2018). Over the years, studies such as Ogunleye (2006), Abimbola (2013), and Abanikannda (2018) have continued to draw attention to the grave consequences of constant decline in the performance of students in Biology. The study of Abimbola (2013) revealed that the performance level for Biology did not show any significant rise for a twenty-year period (1991 – 2011) and the researcher confirmed that candidates' performance in Biology over those years never rose above 50%.

In fact, the analysis of data obtained from WAEC on both the performance level of students in Biology revealed the enormity of this problem. The analysis obtained revealed that between the year 2006 to 2012, the performance has been below 50%, from 2013 to 2015, the performance increased between 51% to 54%,

and in 2016 the performance increased steadily to 75% (WAEC, 2018). This greatly indicates that there are imminent issues characterised with the subject. The despicable performance in Biology in previous years has unfortunately contributed to a great extent in not achieving the Nigerian educational goals and objectives (Jekayinfa, Yahaya & Yusuf, 2010; Abimbola, 2013).

Onasanya and Omosewo (2011) and Chukunyeremuwa (2013) reported that the cost of teaching biology effectively is high, since the financial resources that are required to provide adequately equipped laboratories, and adequate instructional materials for the teaching of biology is unavailable. Chukunyeremuwa (2013) asserted that as biology remains one of the basic sciences which teaching and learning is universally known to be efficient and successful, the use of adequate instructional resources and facilities need to be undertaken simultaneously.

Availability of Information and Communication Technology Resources for Biology Instruction

The Government of Nigeria, recognizing the critical importance of education to the development of the nation, has been investing in education. Since independence both federal and state governments have invested over 30 to 40% of their annual budget to provide education at the primary, secondary and tertiary levels (Okolie, 2009). Educators have realized the value of resources towards

effectively enhancing teaching. In this regard, The Federal government of Nigeria through her policies to favour the educational system, enacted a policy on computer education, recognizing the role and integration of information and communication technology (ICT), and also enacted a policy for the establishment of Education Resource Centres (ERCs) in every State of the Federation, including the Federal Capital Territory, Abuja as stated in the National Policy on Education (FRN, 2013).

As a follow-up to this policy, ICT resources such as computer systems and Internet facilities among others, were deployed to some schools. To harness and support the government initiative, many private and public organizations, through their corporate social initiatives, deployed various technology interventions into schools across the country. However, the low level of basic infrastructures in some schools did not allow the interventions to manifest as expected.

The availability of ICT resources as a matter of fact play an important role in Biology curriculum implementation. The learning process will be truncated without educational resources. The purpose of educational resources such as ICT resources for instruction is to enhance the learning process effectively. The ICT resources have the abilities of not only ensuring effectiveness and efficiency in teaching and learning; they have the potentials of removing the administrative duties.

Gbenga (2006) opined that ICT can work in a number of ways: it can be used to help in school administration; it can be used to train students in skills which they will need in further education and as an on-going learning process throughout the rest of their lives and for their future jobs; it can provide access to information and communication outside the classroom; it can be used to support lecturer development via external networks; and it can support and potentially transform the learning and teaching process.

Gbenga (2006) further stated that ICT resources have a number of features which are particularly suitable for learning: it combines and integrates a full range of media essential for effective learning; it incorporates sounds, vision, text and numeric data; it provides teachers and learners alike with new opportunities and in particular, distance learning and involvement in the real-world; there is an opportunity to increase the interest and involvement of students through the one-to-one interactivity; and it provides individualised and personalised learning.

Instruction via ICT resources aims at making up for the deficiency in teaching staff by virtual classes, which would make learning a right for everyone, help in spreading technology in society, and give a wider concept of continuous learning. It, would, also, prepare a generation of teachers and students capable of dealing with technology, modern time skills and successive technological developments, and responding to the requirements of globalization and cognitive

economics. It would, moreover, provide alternative assessment and feedback means (Ajlouni, 2012).

Empowered with ICT resources, teachers would be able to participate in upgrading and modernizing curricula, teaching strategies and methodologies and, also, create a rich and varied interactive environment, overwhelmed by dialogue, educational exchange of ideas, through which some courses, which couldn't be taught in the past, can now easily be taught by simulation and modelling (AlSalem, 2008). New and novel innovations arose as a result of the progress in ICT, which provided varied ICT resources for instructional purposes. Such resources include computers, educational software programs, internet, e-mail, multi-media, interactive video, satellites, local and other nets, both interactive and comprehensive. This led to the appearance of new concepts linked with learning practices, such as: individualized learning, computer- assisted learning, computer-managed learning, e-learning, e-library, e-schools, e- or virtual universities, digital curriculum, distance learning, videoconferencing, e-books and e-encyclopedias, and others (Ajlouni, 2012).

These innovations are some of the factors that supported the learning-teaching process, and have transformed it from the conventional approach, where the teacher is the sole source of knowledge, and the learner in no more than a receptor of this knowledge, to the stage of interaction, developing skills, renewing

knowledge, and forming attitudes within the framework of focusing on the learner himself (AlSalam, 2008).

Learning according to David and Hosam (2013) is the act of acquiring new skills, knowledge, and idea and, also modifying and reinforcing existing knowledge, behaviour, skill and values. Learning involves synthesizing different types of information and good orientation. Learning may occur as part of personal development, training, school activities through various tool and technologies. Information and communication Technology (ICT) tools form important channel of improving learning today. Daramola, (2011) noted that there are still gaps to be filled with regards to appropriate utilization of technology in the Nigerian education.

Information and communication technology resources have helped in the delivering of instruction and achieving educational goals in less time. The use of ICT in education would depend on the understanding of ICT, when, how and where to use ICT (Daramola, 2011). As ICT has found its way into the education system of Nigeria, it is expected that students who are involved in learning activities are expected to have access to, proficiency in the use and a positive attitude towards ICT. Ajayi (2008), noted that the use of ICT resources, involve various methods which include systematized feedback system computer-based operation/network, video conferencing and audio conferencing,

internet/worldwide websites and computer assisted instruction. It must however, be stressed that the effective use of the various ICT resources in teaching and learning not only depends on the availability of these facilities and teachers' competence in using them.

Adedokun-Shittu, et al., (2019) expressed that ICT resources for instructional purposes is an interactive instructional technique whereby a computer is used to present the instructional materials and monitor the learning that takes place. The three major objectives of using ICT in educational delivery among others include; to empower the learners with ICT skills to prepare them for competitiveness in a global environment, integrate ICT into the mainstream education and training, and the establishment of multifaceted ICT institutions as centres of excellence.

Yusuf and Yusuf, (2009) assert that the goal of ICT in education is specifically targeted towards the restructuring of the education system at all levels to respond effectively to the challenges and imagined impact of the information age, and in particular, the allocation of a special development fund for education at all levels of education system. In recognition of the significance of ICT in education system, several governmental and nongovernmental organizations, banks and individuals have funded the implementation of ICT in Nigeria educational institutions at all levels. Some of these organizations include the

Nigeria Communications Commission (NCC) and the Education Trust Funds (ETF) (Ogechukwu & Osuagwu 2010). Therefore, effective utilization of ICT should focus on pedagogy by justifying how the ICT resources is used in instructional process.

Information and Communication Technology Utilisation for Biology Instruction

Awodeji (2007) stated that the strength of a society is mostly measured by its technological strength. Awodeji further stressed that the change that occurs in a society which can be social, economic, educational, religious, and cultural, is due to technology. The author opined that ICT being a product of technology does not only bring about change in the communication and information acquisition but also changes the way human think and view the world. Consequently, countries across the globe are earnestly and continually striving to improve their technological knowledge base in order to achieve better economic growth and development. Nigeria as a nation is no exception. The Nigerian Government thus, enacted the Nigerian National Information and Communication Technology Policy, NICTP, (2012).

The NICTP, (2012) stated that the main objective of the policy enactment is to provide conducive environment for rapid expansion of ICT networks and services that are accessible to all at reasonable costs. The creation and

proliferation of ICT has become a basic foundation on which the modern society is structured. Development in ICT has vastly transformed every sphere of life and permeated all human actions and endeavours. Its ubiquity characteristics, has brought rapid technological, social, political, and economic transformation, which has eventuated in a network society.

Information and communication technologies (ICT) are electronic technologies used for information storage and retrieval. Iloanusi and Osagwu (2010) described ICT as the process and maintenance of information as well as the use of all forms of computer, communication network and mobile technologies to mediate information. These include all media employed in transmitting information such as cable, satellite, fibre optics wireless (radio, Bluetooth, infrared, Wi-Fi), interactive electronic boards, multimedia projectors, and continuously emerging state of the art PCs.

Uzuegbu and Uzuegbu (2013) described ICT as the aggregate of computer, telecommunication gadgets, multimedia resources and other related technologies that are applied and utilized in the total process of information management and dissemination. In other words, ICT are tools used for collecting, processing, storage, transmission and dissemination of information. The authors opined that ICT is made up of three basic components: computer system (hardware and software, input and output devices and other peripherals); storage

media (audio and video tapes, compact discs, flash drives, hard disks, digital tapes, digital versatile disks (DVDs)); and telecommunication gadgets (telephones, facsimile transmission network systems, internet and its services).

ICT is an eclectic application of computing, communication, telecommunication and satellite technology (Yusuf, 2000). The information accessed through digital technologies can promote innovation, increase productivity and enrich the quality of lives. ICT implies the technology which consists of electronic devices and associated human interactive materials that enable the user to employ them for a wide range of teaching-learning processes in addition to personal use. These technologies include computers, the Internet, broadcasting technologies (radio and television), and telephony (Ogunsola & Aboyade 2005).

Okwudishu (2005) posited that ICT is that technology which uses the information to meet human need or purposes including processing and exchanging. Olatokun, (2011) defined ICT as any communication device or application, encompassing: radio, television, cellular phones, computer and network hardware and software, and satellite systems, as well as the various services and applications associated with them, such as videoconferencing and distance learning.

Akpan, (2008) positioned ICT as a convergence of audio-visual and telephone networks through a single cabling or link system. ICT has completely revolutionized the entire world started as information technology (IT) which deals with the aspect of managing and processing information using electronic computers and computer software to convert, store, protect, transmit and receive information (Akpan, 2008). Adeyemo, (2010) defined ICT as a set of technological tools and resources used to communicate, create, disseminate, store and manage information. These technologies according to the author include computers, the internet, and broadcasting technologies (radio and television).

The rapid evolution, pervasiveness, and impact of ICT on almost all spheres of contemporary human life is no longer an unusual phenomenon. It will be utterly difficult, if not impossible to pinpoint one aspect of human life or social institution that has not been changed, if not totally transformed through the influence of ICT. ICT has fundamentally transformed all aspects of human lives including how human learn, and many education reformers agree that it can and must be an important part of current efforts to personalize education (Adedokun-Shittu, et al., 2019).

Akubailo, (2007) contended that ICTs are at the very heart of educational process and consequently ICT use in education has a long history. Bandele, (2006) noted that the groundswell of interest in the newer computer and internet

technologies to improve educational efficiency and effectiveness distracts attention from the longer and richer history of older technologies such as radio, television and print to support instructional delivery. The researcher noted further that, ICT is a revolution that involves the use of computers, internet and other telecommunication technology in every aspect of human endeavour most especially in education. The author regarded ICT as the super highway through which information is transmitted and shared by people all over the world.

Ofodu (2007) referred to ICT as electronic or computerized devices, assisted by human and interactive materials that can be used for a wide range of teaching and learning as well as for personal use. The identification of ICT as a skill for life, informed its introduction in the school curriculum in the developed nations (Ajayi & Ekundayo, 2009). The growing use of ICT as an instructional medium is changing and will likely continue to change many of the strategies employed by both teachers and students in the learning process. Technology has the capacity to promote and encourage the transformation of education from a very teacher directed enterprise to one which supports more student-centred models which is manifested in the moves towards problem-based learning and increased the use of the Web as an information source (Kamal & Banu, 2010).

The National Policy on Education (FRN, 2013) emphasized the need to integrate ICT at all levels of education. The FRN, (2013) viewed ICT as a factor

that can promote quality education. Johnson, (2007) stated that communication is a fundamental act of the education process. Hence, to enhance quality in education, proper attention must be given to ICT. In education, ICT can be viewed as the application of digital equipment to all aspects of teaching and learning. It involves a combination of technologies for collecting, storing, processing, communicating and delivering of information related to teaching and learning processes. According to Angel (2008), the world is gradually being saturated with information. The inevitability of the application of ICT to education has therefore remained incontestable and incontrovertible.

Nwagwu (2006) posited that the rapid rate at which ICT has evolved based on its convergence and pervasiveness has provided a strong and rapid development and globalization across the world. The impact of ICT is evident on all areas of human activity including education. Supporting the evidential role of ICT in education, Yusuf, (2005) and Al-Ansari, (2006) stated that ICT has undoubtedly affected the teaching, learning, and research processes and a great deal of research has proven the benefits to improving the quality of education.

Yusuf, (2005) claimed that ICT has the potential to motivate and engage students, enrich and deepen skills, help relate school experience to work practices, create economic viability for tomorrow's workers, and strengthening instructional processes. NERDC, (2009) posited that the use of ICT in teaching can be a

relevant and functional way of providing education to students that will equip them with skills and knowledge required to function well in the 21st century. The constant evolution of ICT is taking education to new ways, much more attractive to the students, making possible the use of new tools, and opening an evolution on the teaching process (Piovesan, Passerino, & Pereira, 2012).

This technological revolution has been permitting the use of new approaches in the teaching-learning process. In particular, there is a recognition that the traditional, rigid one size fits all design of schools must give way to more personalized, student-centred designs to meet the needs of an increasingly diverse student population that are of the technology evolution era (Siegel, 2009). A key idea behind this model of education is that learning should be driven by a focus on students and their proficiency with specific competencies, and not by archaic school structures and arbitrary age-based benchmarks (Moeller & Reitzes, 2011).

Eze (2012) noted that education in whatever form is not complete without effective use of ICT and that the significance of ICT in education includes: access to variety of learning resources; immediacy of information; anytime anywhere learning; collaborative learning; multimedia approach to education; authentic and up to date information; access to online libraries; distance learning; individualization of instruction; reduce time on many routine task, access to the

source of information; and teaching science subjects made interesting, among others.

Based on the evidential role of ICT in education, Governments all over the world are harnessing the rich potentials of ICT and are using it as a tool for educational development, economic recovery and wealth creation (Olaore, 2014). It is very useful in tackling the ills and problems facing the educational system. ICT has increased the ability to perform ‘impossible experiments’ by using simulations as well as the possibilities for students to have individual learning programs within a topic, rather than everybody having to do the same thing at the same time at the same pace. Advantaged students can be given more challenging work, while, the less advantaged students can access remedial classes.

The FRN, (2013) with particular reference to science and technology, considered ICT as an important tool for laying a solid foundation of STEM education at all levels of Nigeria education system. Nwachukwu (2006) claimed that despite the limitations brought about by economic disadvantages, it is observed that the influence of ICT on education is to enhance the ability of each learner to generate, access, adopt and apply knowledge and information to solve complex problems.

Agommuoh (2015) further observed that the use of ICT in teaching science subjects will make learning more real, relevant and experimental, as large amount

of data and materials on any topic can be brought to the classroom from all over the world thereby, greatly facilitating the acquisition and absorption of knowledge and offering students unprecedented opportunities to enhance their learning. From the foregoing, ICT has rapidly transformed the teaching field into a global village and Biology is one of the beneficiaries of this global revolution in teaching and learning process using ICT.

In a rapidly changing world, as education is essential for an individual to be able to access and apply information, ICT literacy has equally become an important knowledge too. The adoption and use of ICT in education have positively impacted the instructional process. particularly, the delivery of education and enabling wider access to the education. In addition; ICT increases flexibility as learners can access education regardless of time and geographical barriers. It can also influence the way students are taught and how they learn (Alabi, 2016).

Aduwa-Ogiegbean and Iyamu, (2005) claimed that The Economic Commission for Africa has indicated that the ability to access and use information is no longer a luxury, but a necessity for development. Unfortunately, many developing countries, especially in Africa, are still low in ICT application and use. Aduwa-Ogiegbaen and Iyamu (2005) concluded that the computer is not part of classroom technology in more than 90 percent of Nigerian public schools. This

implies that the chalkboard and textbook continue to dominate classroom activities in most Nigerian secondary schools.

Studies have been conducted in the past till present with the expressed aim of assessing the return on investment of ICT in education. In a review-based study conducted by Balanskat, Blamire and Kefala (2006), a review of seventeen such impact studies carried out in Europe between 2002 and 2006 and aimed at determining the benefits and impact of ICT integration in schools in two major areas: learning outcomes and learners, and teaching methodologies and teachers. Six of the studies reviewed were quantitative in nature while the others followed a qualitative orientation.

The quantitative studies attempted to establish causal links between ICT use and learning outcomes. Though the studies revealed some evidence that ICT impacts on learner performance, the general conclusion was that it was difficult to establish a causal relationship between computers and educational outcomes (Balanskat et al., 2006). The findings of these studies led to the conclusion that ICT impacts on educational standards most when there is fertile ground in schools for making efficient use of it.

The qualitative studies revealed that teachers, students and, significantly, parents believe that ICT use has a positive impact on students learning and that students subject-related performance improves with ICT use. The findings also

indicate that teachers believe that the educational achievements of students improve through ICT use and that both strong and weak students benefit from ICT use. Teachers observed that when ICT is used in the classroom, pupils work more in cohesion with their own learning styles resulting in a more favourable impact on both academically strong and weak students. In addition, students assume greater responsibility for their own learning working more independently and effectively when using ICT.

All the studies concluded that the integration of ICT has the greatest impact in the affective domain. The studies revealed that 86% of teachers in Europe reported that students are more motivated, engaged and attentive when computers and the Internet are used in the classroom and that ICT use has positive effects on behaviour, communication and process skills. These conclusions were corroborated by the findings of a three-year study of New Zealand's e-learning initiative conducted by Lai and Pratt between 2001 and 2004. The study aimed at investigating teachers' perceptions of the teaching and learning effects of ICT use in 26 secondary schools. For the purpose of the study both quantitative and qualitative data were collected.

Lai and Pratt (2007) concluded that the integration of ICT in educational practice had a number of positive social and motivational effects on the learners including increased interest and engagement and that the social and motivational

effects were more frequently observed than cognitive and learning effects. Teachers reported an improvement in the presentation of work, an increased sharing of resources, greater collaboration between students and an increased motivation for learning as student engagement was greater. However, the study also revealed a number of negative consequences such as increased plagiarism and a higher level of distraction.

Results from the survey of 360 teachers from an ICT training project in Cambodia conducted by Richardson, (2009) indicated that most teachers make use of acquired ICT skills in some ways after training and some teachers actually re-invented the way to use their acquired skills. However, the results of the same study revealed that the integration of ICT in teaching is still difficult for some teachers as they require some training and practice. In another survey study by Van Mele, Wanwoeka and Zossou (2010) as cited by Cai and Abbott (2013) and Alabi (2016) found that 78% of development organizations, including universities, research institute and non-government organizations (NGOs) that used ICT resources such as multimedia packages have greater potential in helping farmers learn farming concepts easier.

Teachers and Students' Perceived Ease of Use and Usefulness of Information and Communication Technology in Biology Teaching and Learning

Evidences abound on the effectiveness of ICT integration in teaching and learning. It has practically changed educators' role from a traditional teacher to that of a coach and facilitator, while at the same time, developing students' skills for problem solving, cooperation and lifelong learning. Technically, ICT has not only changed the role of educators, but has equally provided them with a large number of instructional resources which can be utilised for instructional purposes (Demirci, 2009; Akinde & Adetimirin, 2017).

Akinde and Adetimirin (2017) posited that in spite of the pervasiveness of ICT utilisation for instructional purposes, ICT integration for teaching and learning in the classroom is observed to be low and slow. The researchers claimed that the observed low and slow ICT integration in the classroom could be due to the complex phenomenon that ICT is characterised with. Therefore, educators' perception could be a factor contributing to the low and slow adoption. If educators perceive a type of technology as easy to use and beneficial for their lessons, ICT integration can be achieved more easily. In other words, providing ICT resources to schools and/or classrooms without taking into account whether educators are comfortable using them for instruction would be a waste (Demirci, 2009).

Agboola (2006) and Akinde and Adetimirin, (2017) warned that the use of ICT for instructional purposes is not, and never will be, transformative on its own but requires educators who can integrate it into the classroom. Based on this warning, it is clear that ICT cannot replace teachers and learners since they are the key to whether ICT is used appropriately and effectively. Akinde and Adetimirin, (2017) asserted that the effectiveness of ICT is determined not by its mere presence in the classroom but by teachers and students' perceived ease of use to use it. This assertion revealed that teachers' and students' role is really critical as they are the ones who have to decide whether or not to use the available ICT resources in schools.

Appreciable ICT integration for teaching and learning may be informed by teachers and students' perceived ease of use and how useful they are in contributing to, enabling, promoting and enhancing teaching and learning. Empirically, the study of Haw (2015) predicated on the view that ICT on itself does not only enhance learning but rather how it is incorporated into learning activities is what makes the difference. However, despite the obvious aversion to ICT use in the classroom, the teachers reported several positive outcomes with regards to ICT integration in the projects implemented.

In a similar longitudinal study conducted by Ruthven, Hennessy and Deaney, (2005) on the examination of the contribution of ICT within various

subject areas through the execution of ten small-scale projects. The study was aimed at assisting teacher-researchers in developing pedagogic strategies involving the use of ICTs within several subject areas. During the initial stages of the project, teachers were asked to articulate their ideas about the pedagogical use of ICT in their specific subject areas and to identify ways in which these ideas could be translated into strategies for incorporating ICT into classroom practice. From the initial responses of the teachers, the researchers were able to garner five interconnected themes related to their perceptions as to the possible contribution of ICT to teaching and learning namely: broadening classroom resources and reference; enhancing working processes and products; mediating subject thinking and learning; and fostering more independent pupil activity and improving pupil's motivation towards learning.

In another study by Achimugu (2016), the researcher studied the senior secondary school chemistry teachers' perception of the factors affecting the effective utilization of ICT in teaching and learning of chemistry in Kogi State. The sample for the study consisted of one hundred and five (105) chemistry teachers randomly selected from two hundred and sixty-two (262) public senior secondary schools in Kogi State through purposive random sampling technique. A 16-item questionnaire ($r=0.88$) was developed, validated and used by the researcher to collect data. Mean and standard deviation were used to answer the

research questions while *t*-test was used to test the hypothesis at 0.05 alpha level. The results showed that chemistry teachers had the perceptions that factors such as lack of training and motivation of teachers, lack of technical support staff, and lack of funds among others affected their effective utilization of ICT in teaching chemistry. It was found that there was no significant difference between male and female chemistry teachers' mean perception scores on the factors affecting effective utilization of ICT in teaching and learning chemistry.

A total of 3380 students from 24 public and private schools from four regions in Ghana participated in this study. Descriptive statistics, Analysis of variance were used to analyze the findings. The study revealed that students' ICT usage to support learning was low. The analysis showed that students' perceived value, expectancy of success and perceived cost were high. Male students value implementing ICT in learning more positively than female students. Also, public school students value using ICT in classrooms more positively than private school students. Generally, students' perceptions of ICT usage were positive.

Etiubon and Akpan, (2017) examined science teachers' perception of ICT capacity building workshop in Akwa Ibom State secondary schools. The design for the study was a descriptive survey. The census of 295 science teachers from Uyo Local Government Area that attended a 3-day ICT capacity building workshop was used for the study. One research question and two hypotheses

guided the study. The instrument for data collection was a questionnaire on ICT capacity building workshop. The instrument reliability was Cronbach's alpha coefficient: .86. Data for answering the research question was analyzed using mean and standard deviation while t-test was used for testing the hypotheses at .05 level of significance.

Findings revealed that science teachers' perception of ICT capacity building workshop was low as most science teachers lacked clear understanding of what benefits ICT capacity building workshop might afford them. The findings also indicated that facilities were grossly inadequate to effectively equip science teachers with knowledge of ICTs during capacity building workshops. The findings also showed that the frequency of use of ICT capacity building workshop was a once- in-a-year event and this was too short a duration for any meaningful utilization of ICT technologies in instructional delivery to adequately enhance ICT knowledge among learners.

Placidius, (2014) studied teachers' perception and attitudes towards the use of ICT as a pedagogical tool in secondary schools in Tanzania. Within this broad aim, the paper provides a better understanding of ICT as a pedagogical tool. The development of this study was influenced by various concerns of educational stakeholders about the level of teachers' competence on the use of ICT as a pedagogical tool. The data collection methods involved questionnaire and

interview. A total of 80 teachers, through random sampling in 10 schools were involved in this study at the first phase of data collection and 10 teachers' responses were obtained through purposive sampling from 2 schools at the second phase.

It was found that teachers have positive attitudes towards the use of ICT as a pedagogical tool but they did not integrate it in their teaching effectively. Also, low familiarity with ICT use as a pedagogical tool among teachers was found to be a problem. The use of ICT as a pedagogical tool in Tanzania seems to be a critical situation among teachers. The paper recommends further in-depth investigation on teachers' willingness, confidence, motivation, feeling, thinking, belief and the actual practices through classroom observations including larger samples.

Fabunmi, (2012) evaluated undergraduate students' perception of the effectiveness of ICT use in improving teaching and learning in Ekiti State University, Nigeria. Four research questions guided the study and the instrument used was the questionnaire, the research method used was survey. The study came out with the results that there was a preference for ICT use in improving teaching and learning, though costlier than the traditional book sources. It was also discovered that students frequently used internet centres as places of accessibility to get information through ICT teaching and learning. It concluded by affirming

the need for the development of ICT use in Nigeria universities for the improvement of teaching and learning for the students. This becomes imperative because ICT culture has come to stay globally in all higher institutions. Information and Communication Technology is now the modern means of improving teaching and learning especially in the University system.

Influence of Gender on Teachers and Students' Perception of Information and Communication Technology Utilisation for Instruction

Gender disparity is not a new phenomenon. It has been seen in various walks of life including education. The term gender has generated controversy over time among authors and researchers. Several definitions abound on gender, among them is the definition of Advanced Learner Dictionary of Current English (2001) which defined gender as the act of being a male or a female.

Abidoye, (2015) posited that gender is a social attributes and opportunities associated with being a male or a female. These attributes and opportunities are socially constructed and learned through socialization process. Gender determines what is expected, allowed and valued in a woman or a man in a given context. The differences in a societal value of men and women in terms of responsibilities, activities undertaken, access and control over resources as well as decision taken are all gender based (Abidoye, 2015).

The sociological theorists viewed gender as being socio-construction rather than biological. The socio-cognitive theory recognized the impact of environment and observation learning on gender adaptation and change. The task is to interpret the adaptation diversity within socio-cultural commonality (Agbatogun, 2010). Tahir (2004) asserted that gender acknowledges the specific contents and meaning of male/female differentiations which are culturally determined and that they can change.

In most set-ups, gender is determined by behaviour, mode of dress, gesture, occupation, social network and more importantly roles played by both sexes in the society. Aiyedun (2000) claimed that behaviour learnt in the process of socializing men and women into gender roles affected their learning when western education came to the shores of Africa.

The report of British Council Gender in Nigeria, BCGN (2012) reveals that the enrolment ratio and completion rates in schools concerning females is significantly lower than that of males. Fomsi and Orduah (2017) therefore asserted that due to the report of BCGN (2012) there is a tendency for female students to experience high dropout rates more than male students.

Another report of Department for International Development (DFID) of session 2016-2017, revealed that girls are particularly disadvantaged. The report indicated that 85% of female children in Nigeria especially in the North East

cannot read at all, compared with 20% in the South-Western Nigeria (Fomsi & Orduah, 2017).

Gender which has continued to be an issue of concern to educators and researchers is also evident from the reports of Ogunneye and Lasisi (2008), and a host of others. Babajide (2010) found that gender has no significant influence on the students' achievement in science. Ogunneye and Lasisi (2008) reported that more ladies were found in Biology than other science subjects.

Empirical studies such as Ayodele (2009) examined gender differences in science subjects' achievement among junior secondary school students. The researcher adopted an expost-facto research design. The population was made up of all the junior secondary school students in Ekiti state, Nigeria, while a sample of 840 students of both sexes were drawn from 2006 and 2007 Junior Secondary School Certificate Examination (JSSCE) results in Ekiti state, Nigeria. The selection was done using stratified random sampling techniques, taking into consideration, the gender of the students from 20 Junior Secondary Schools. The sample was made in such a way that it cut across all the three senatorial districts in Ekiti state. In all, 280 Students were purposely selected. The finding from the study revealed that female students out performed male students in science.

In another study by Femi-Adeoye (2004), a research was conducted on the use of concept mapping on students' performance in ecology. The data collected

was analysed using mean scores and analysis of covariance, (ANCOVA) to determine if a significant difference existed between the study variables. Four hypothesis were generated and tested. There was a significant difference in the performance of male and female students exposed to concept-mapping technique. Also, from the findings of Ayodeyi (2010), result showed that a significant difference existed between gender stereotype belief, attitudes and practices of male and female teachers.

In effects of problematic analogy strategy on students' achievement and retention in balancing chemical equations concepts of secondary school chemistry by Emmanuel Lanshima, Aminu Mohammed Chado, Fatima Mohammed Isa, and Babagana Mohammed (2019). Hypothesis two stated that there is no significant difference in the mean score of male and female subjects taught balancing of chemical equations using problematic analogy. The results showed that there is no significant difference in the mean scores of male and female students. The finding is in agreement with the findings of Bello (2011); Damale and Adebayo (2014) who discovered that there is no significant difference between male and female performance when exposed to activity-based methods of instruction such as concept mapping analogy and problem solving.

The study of Akiri and Ugborugbo (2008) examined the influence of gender on the productivity of secondary school teachers in Delta state, Nigeria.

The result showed that there was significant difference in the productivity of male and female counterparts and the female teachers were more influenced by location than the male teachers. The work of Jacob (2002) showed that girls got higher grades and completed high school at a higher rate compared to boys.

In studies related to ICT use, gender disparity can also be seen in the area of ICT. The introduction of ICT has created a new facet of socio stereotypes and gender disparities. The conventional and orthodox gender disparities that existed in science related subjects were being extrapolated into technology (Agbatogun, 2010). In the observation of Wajcman (2006), the researcher observed that many feminists believe that western technology embodies patriarchal values. The researcher argued that most female are reluctant to go into technology because of the sex-stereotyped definition of technology as an activity appropriate for men.

Sanda and Kurfi (2013) also reiterated that despite much emphasis placed on the use of ICTs in Nigeria, there is an underrepresentation among females in terms of access to and utilisation of ICT. The researchers also observed that though the pivotal role that females play in the development of the societies is evident, yet their impact has been silenced in the current technological era. This might be due to lack of access and the necessary skills for easy operation.

Kirk and Zander (2004) reported that there is a gender digital divide, as result of high versus low literacy, high versus low income and rural urban divide.

According to Alampay (2006) men were more receptive to ICT use than women which may mean that male pre-service teachers would be more receptive to ICT use and satisfaction than female pre-service teachers. Alampay, (2006) further stated that, the difference may be due to the fact that women are more preoccupied with other issues that they do not have time to use the ICT facility.

Research reports on the influence of teachers' gender on the level of utilization of ICT in teaching, had been well documented, but most often the reports contradict themselves. The study of Ahmed, Abimbola, Omosewo and Akanbi (2012) found that gender had influence on the level of utilization of ICT resources in favour of male teachers. Meanwhile, the study of Onwuachu (2011) reported that there is no significant difference between the mean ratings of male and female teachers on their ability to utilize the available ICT facilities in teaching.

The study of Jackson, Erving, Gardner and Schmih (2001) on gender and the internet, reported that females used ICT facilities more than males. Moreover, they were of the opinion that gender gap was narrowed when both genders were exposed to the same amount and type of experiences on a computer. Chen and Tsai (2005) reported that males exhibited more favourable perception towards ICT for learning than females. The study of Mahmood and Bokhari (2012) revealed that both in ICT access and experience for learning opportunities, gender

inequity persisted. The researchers further opined that stereotypical factor such as male dominating computing magazines acted as a deterrent to female involvement in the technology world.

In another study on technology acceptance model (TAM), Venkatesh and Morris (2000) reported that perceived usefulness was more salient for males, while perceived ease of use was more salient for females. Olasedidun (2014) in his study on gender established that there was no significant difference between male and female college of education lecturers on the perceived usefulness, attitude and intension to use ICT for instruction.

Illustrating the role of gender in users' perception and use of ICT, Murphrey, Arnold, Foster and Degenhart, (2012) stated that men and women were nearly diametrically opposite in the perception and acceptance of ICT. Also, Vankatesh and Morris (2000) stated that men consider PU to a greater extent than women, PEOU was more salient to women compared with men and men perceived ICT as easier to use as time went on, compared to women perceiving it as harder to use with the passage of time.

Researchers such as Mahmood and Bokhari (2012) believed that the interaction between gender and ICT is complex, however it is still aggregate. Since ICT has gradually replaced the conventional traditional teacher- centred instructional strategy and the students' learning has evolved, it becomes

imperative that all stakeholders, especially students and teachers irrespective of gender to effectively adopt the use of ICT in facilitating instructional process.

Impact of Teaching Experience on Teachers' and Students' Perception of Information and Communication Technology Utilisation for Instruction

According to Rice, Warner, Kelly, Clough, and Colbert, (2010) many occupations recognize employee's years of experience as a relevant factor in human resource policies, including compensation systems, benefits packages and promotion decisions. The idea is that experience gained overtime enhances the knowledge, skills and productivity of workers. In education, Rice et.al (2010) described teacher's experience as probably the key factor in personnel policies that affect current employees: it is a cornerstone of traditional single salary schedules; it drives teacher transfer policies that prioritize seniority; it is commonly considered a major source of inequality across schools and therefore, a target for redistribution. The underlying assumption is that experience promotes effectiveness.

Over 40 years of teacher productivity, research suggests that the simple assumption that more is better requires greater difference; experience effects are complex and depend on a number of factors. Studies have revealed that less effective teachers are more likely to transfer and leave teaching (Goldhaber, Dan, Betheny & Daniel, 2007). Also, the magnitude of the effects of teachers'

experience varies depending on the teachers' level of education and the subject area. The impact of early years of experience is strongest in the subject (Harris & Sass, 2007).

A number of studies confirmed findings from existing research that on the average, brand new teachers are less effective than those with some experience under their belts (Harris & Sass, 2007). Early career experience has a clear pay off in teachers' effectiveness and the impact is stronger than the effect of most other observable teacher-related variables including advanced degrees, teacher licensure tests scores, National Board Certification at the elementary level, and class size (Ladd, 2008). This and other research shows that on the average, teachers with more than 20 years of experience are more effective than teachers with no experience, but are not much more effective than those with 5 years of experience (Ladd, 2008) suggests that teachers' effectiveness increases dramatically each year during the first ten years of teaching.

Soyibo, (2008) observed that as experience is gained in teaching and other areas of schooling, most individuals get better at what they do. Gautmen (2001) claimed that to improve scientific methods and capabilities, good teachers are needed and for good teachers, effective training is compulsory. Akinleye (2001) argued that experience improved teaching skills while students learn better at the hands of teachers who have taught them continuously over a period of years. In a

study by Rice, et al (2010), findings showed that teachers' experience promotes effectiveness and that there is a higher level of achievement among students when taught by more experienced teachers.

Aldridge and Goldman, (2007) claimed that at the first instance of ICT introduction for instructional purposes, teachers opposed its' integration, and there was a great resistance and lack of confidence among teacher's to integrate it into their respective subject areas. But, today even the teachers themselves are finding it difficult to grow, teach and research without technology use. The use of ICT in the classroom allows teachers to make a smooth shift into individualized instruction and concentrate on developmentally appropriate use of ICT.

Effect of School Location on Students and Teachers Utilisation of Information and Communication Technology for Learning and Teaching

In the USA, rural education is associated with disadvantage in the public discourse. While research on this matter has not yielded consistent results (Roscigno & Crowley, 2001), it is reasonable to hypothesize that, if rural disadvantage does exist, it is likely to be found in significant learning gaps in mathematics and science. Rural schools are disproportionately likely to have an inadequate pool of teachers qualified in these subjects and insufficient funds to maintain up-to-date computers, instructional software and laboratory facilities (Education Alliance, 2004; Williams, 2015).

According to Erin, Travis and Michele (2009) on the study carried out on high school students' perceptions and knowledge about agriculture based upon location of the high school. It was discovered that students in urban High generally disagreed that farmers make a lot of money while 41.7% of students in rural area disagreed with the statement. On average students at Rural Ag High disagreed that most farms were small famously farms while more students in urban High (31.0%) and Rural Non-Ag High 43.7% agreed with the statement Urban High had the highest rate of agreement (78.7%) with the statement Farming is very difficulturban High students' agreement was 10.5% higher than the average agreement of the survey population. Rural Ag High was in highest agreement with the notion that you can tell a farmer just by looking at them; 34.2% of the population agreed with this statement.Of particular note is that majority of students at urban High school disagreed that you could tell a farmer just by looking at him/her.

In a research carried out by Okereke and Onwukwe (2011) on the influence of school location on student achievement in chemistry, it was discovered that the students from urban schools achieved significantly better than students from rural schools. Thomas and Ikuyero (2013) carried out a study on influence of school location and achievement level on integrated science students' perception of their classroom environment. The result showed that school location

(urban or rural) did not significantly influence the students perception of their classroom environment $\{F(1,639)\} = 0.50, P > 0.05$.

Among notable empirical studies in the United State of American (USA) is the study on the effect of school location on mathematics and science achievement trends. A school cannot usually change its location, yet location conceivably may have consequences for how well students learn at the school. The investigation of a rural gap in academic achievement has been recently employed in studies conducted in the USA (Reeves, 2002), in Australia (Young, 1998, 2000; Webster and Fisher, 2000), and in cross-national comparisons (Williams, 2004).

There is a consensus among psychologists and educationist that a child's environment can exert considerable influence on his/her intellectual development (Okonkwo, 2002). Based on past studies, it is believed that there is need to determine the efficacy of school location on students' learning outcomes in chemistry. Many authors have explained the importance of school factors in the achievement of students particularly in science (Maduabum, 1992; Olanrewaju, 2001; Durant, 1995; Onwuakpa, 1998).

Influence of Teachers Qualification on Teachers and Students'Utilisation of Information and Communication Technology for Instructional Purpose

Educational products are not only determined by the quality of the material input (knowledge skill) but also by the quality of those who implement and supervised those inputs (the teachers) (Olorundare, 2003). Olorundare (2003) claimed that what students at all levels aim and achieve intellectually depend largely on what their teachers teach, how these are taught and the characteristics of the teacher is a major factor that could contribute to the expected outcome.

The qualification of teacher is an important factor in teaching and learning. The strategic function of teaching is that, more experienced teachers are considered as the most appropriate to teach particular topics to students who differ in their abilities, prior knowledge and background (Abdulkadri 2011). Across the world, studies have been conducted to ascertain the influence of teachers' qualification on teaching as well as learning outcomes. Teachers' academic success and few specific teachers' characteristics influence classroom outcomes.

Empirically, the study conducted by Omosewo (2008) investigated the effects of teacher's academic qualifications on senior secondary student's performance in physics and discovered that teacher' academic qualifications was a necessity for student's performance in physics. A similar study conducted in Israel by Maagan (2007) revealed that 63% of science teachers in Israel had no

formal qualification of their subjects and this critically affected students' performance and teachers teaching methodology in the subjects taught.

Mubenga (2006) stated that there has been a serious discrepancy in the academic achievement of minority students, the evidence is shown in the wide gap between the performance of white students and minority students. Mubanga stated that may be differences in teacher quality and/or the effect that teachers' quality has on students of different ethnic background may be responsible for the differences in the performance of the white students and the Black. The result of Khalid (2003) which was delimited to two male government and private schools and three females private and government schools with eighty students and eighty-seven teachers as sample showed that the performances of the students taught by the untrained teachers with B.A/B.Sc. qualifications were better than the students taught by trained teachers with professional qualifications like B.Ed. and M.Ed. the subjects used were English, Islamic studies, Pakistan studies, Maths, Physics, chemistry and Biology.

In the study of Fakeye (2012) on achievement in English Language, the result showed that teachers' teaching qualifications have significant relative contribution on students' academic achievement in English language. Also, the finding of Omosewo (2008) showed that teachers' academic qualifications were a necessity for students' performance in physics at the secondary school level of

education. Opara (2007) studied the relationship between teachers' qualifications and students' performances in technical subjects in selected schools in Northern Nigeria. The result showed that, teachers' qualification affected students' performance in external WASSCE (technical).

Furthermore, among the notable studies on teachers' qualification and students' performance is the work of Akinsolu, (2010) with twenty-one sampled public schools in Osun State. The data collected revealed that teachers' qualifications, experience and teacher-student ratios were significantly related to students' academic performance. Another relevant study is the work of Ona and Ugune (2010) which concluded that gender, teachers' qualifications and laboratory facilities affected students' performance in physics.

In the studies of Owolabi and Adebayo (2012) that examined the effects of teachers' qualifications on the performance of senior secondary school students in physics, it was discovered that students taught by teachers with high qualifications performed better than those taught by teachers with lower qualifications. More so, the study of Richard and Zamaro (2009) reflected that teachers' qualification test scores are unrelated to teachers' achievement and also not affected by whether classroom teachers have advanced degree; however, students' achievement increases with teachers' experience. The needs for our educational planners to

employ qualified teachers to facilitate teaching and learning in our secondary schools is compulsory.

Appraisal of the Reviewed Related Literature

From the reviewed literature, it is clear that there have been past studies both within and outside Nigeria which investigated stakeholders' perception towards ICT for teaching and learning Biology and the interaction effect of students and teachers' gender, school location, qualification and year of experience. Various studies such as Adeyemo, (2010), Kola, (2013), Okoye, (2014) and Achor and Ukwuru, (2014) have established links, relationships, effects and potency of the use of ICT in Biology teaching and learning. However, most of these studies were carried out outside Nigeria and the few that were conducted in Nigeria were in other disciplines than Biology and the perception of the stakeholders who are the one to implement whatever policy or strategy put in place were not examined. This study therefore examined the stakeholder's perceptions on the use of ICT for teaching Biology in senior secondary schools in Oyo state, Nigeria.

Existing literature such as Richard and Zamaro, (2009), Omosewo, (2008), Abidoye, (2015), and Okerenke and Onwukwe, (2011) among others also revealed that teachers' qualification, year of experience, gender and school location of the stakeholders in education industry are very important in their perceptions on the

use of ICT. They play major roles in determining individual's perceptions. Thus, there is the need for further studies to establish teachers' and students' perception on ICT related instructional strategies. In summary, the empirical review of literature demonstrated that there is a significant gap in teachers' and students' perception towards ICT in Biology teaching and learning. Therefore, this study addressed this subject by approaching perception from the perspectives of perceived ease of use and usefulness.

CHAPTER THREE

METHODOLOGY

This chapter deals with the methodology that was used in the course of this study, it has been discussed under the following sub headings: Research type, Population, Sample and Sampling Technique, Research Instrument, Validation Research Instrument, Procedure for Data Collection and Data Analysis Techniques.

Research Type

The study adopted a quantitative research design of the survey type. This study adopted a survey method because the researcher intended to sample the opinion of larger population through a sample size which are considered to be the representative of the entire group and would give the report of event as it occurs in actual reality.

Population, Sample and Sampling Techniques

The study population comprised all Biology teachers and students in secondary schools in Oyo State, while, the target population included senior public secondary schools in Oyo state, Nigeria. The sample size was sampled through a multistage sampling technique: the first stage included a stratification sampling along the Senatorial District in Oyo State; the next stage included three simple randomly sampled Local Government Areas (LGAs) in the three

Senatorial Districts, making a total of nine LGAs; the next stage employed a proportionate sampling technique of 2:1 to select 6 LGAs that are more urban-dominated and 3 LGAs that are more-rural dominated; the next stage advanced on a purposive sampling technique to select senior secondary schools where ICT resources were available. From each of the nine LGAs, a total of 33 schools were generated in the urban area while, 12 schools were generated in the rural area. A sum total of 45 schools were generated for the study; and the last stage included a purposive sampling technique to select all the Biology teachers, while, Research Advisor was consulted to select the sample size for the students from the population. This is shown in Table 1 below:

Table 1: Population and Sample Size of Respondents for the Study

S/N	Local Government	Population	Sample Size
1.	Afijio	734	260
2.	Akinyele	738	260
3.	Atiba	673	248
4.	Ibarapa Central	847	269
5.	Ido	2006	333
6.	Ibadan Southwest	2185	333
7.	Iseyin	1130	291
8.	Irepo	937	278
9.	Ogbomoso	1348	306
Total		10598	2578

Source: Data Generated from Education Liaison Offices in the LGAs

Research Instruments

For this study, a researcher-designed questionnaire was employed. The questionnaire was tagged “Questionnaire on Stakeholders’ Perception of the Use of Information and Communication Technology for Biology Instruction (QSPUICTBI)” The questionnaire was designed to examine both the teachers and students’ perceived ease of use and usefulness of ICT for teaching and learning Biology. The questionnaire was segregated into four sections (A, B, C and D). The Section A elicited information on the demography of the respondents; Section B consisted of 10 items to examine Biology teachers’ utilisation of ICT for teaching in secondary schools; Section C consisted of 10 items to examine the perceived ease of use of ICT for teaching and learning Biology, while, Section D consisted of 10 items to examine the perceived usefulness of ICT for teaching and learning Biology. Both Sections C and D were rated on a four-point Likert scale of Strongly Agree (SA), Agree (A), Disagree (D) and Strongly Disagree (SD) using a benchmark of 2.5.

Validation of Research Instrument

The researcher’s supervisor, two lecturers in the Department of Science Education, University of Ilorin, validated the questionnaire. This was done to determine the effectiveness and the appropriateness of the instruments and to ascertain their face and content validity. The validators corrections and

modifications were used to improve the quality of the instrument. The reliability of the researcher-designed questionnaire was determined after conducting a pilot testing on 25 students from one of the high schools in Kwara state who were not part of the main study. The reliability coefficient of the questionnaire was determined through test-retest method. Thereafter, the data collected were subjected to statistical analysis using Cronbach alpha at 0.05 level of significance, and the instrument yielded a reliability index of 0.92.

Procedure for Data Collection

A letter of introduction of the researcher seeking permission to administer the questionnaire was collected from the Department of Science Education, Faculty of Education, University of Ilorin to the Principals and the Heads of Science Department of the selected Secondary Schools prior to the administration of the questionnaire. The questionnaire was distributed to the students and biology teachers with the help of two trained research assistants. The research assistants were trained to understand the aim and objectives of the research as well as how the respondents were expected to respond to the instrument. The completed questionnaires were collected for collation and subsequently analysed.

Ethical Consideration

The researcher certified that the study substantially complied with the general stated standards and procedures of research in education as required by the Postgraduate School, University of Ilorin, Nigeria. Due to the sensitive nature of the study, the researcher solicited the permission of the respondents and assured them of confidentiality before administering the instruments. Furthermore, no respondent was compelled to give a response to the instruments.

Data Analysis Techniques

The data collected for the study were subjected to both descriptive and inferential statistics. The descriptive analysis employed the use of frequency count, percentage, mean, and rank order to answer the research questions, while, inferential statistics of *t*-test was employed to test hypotheses 1 to 8, while, Analysis of Variance (ANOVA) was employed to test hypotheses 9 and 10 at 0.05 level of significance. The statistical analysis was done with the aid of Statistical Package for Social Science (SPSS) version 23.0. Since the items of the researcher- designed questionnaire was structured on a four-point Likert scale, the decision rule was based on the bench mark of 2.50. Therefore, items with mean scores of 2.50 and above were regarded as agreed or positive responses while items with below 2.50 were regarded as disagreed or negative responses.

CHAPTER FOUR

DATA ANALYSIS AND RESULTS

This chapter presents the data analyses and interpretation of data collected for the study through the administered instrument (questionnaire). The study is a descriptive research; hence, the results are presented in a descriptive format using frequency count and percentage for the demographic information and the research questions were answered using summated mean and rank order, while, *t*-test and ANOVA were used to test the hypotheses where necessary at 0.05 significant level. All analysed data are represented on tables.

Demographical Representation of the Respondents

The data collected and analysed in this section represents the variables of focus for the study and background information of teachers and students that were actively involved in the study. The demographic information in which data were collected and analysed includes gender, school location, teaching experience and academic qualification which are presented on tables as follows:

Table 2: Teachers and Students Demographic Information According to Gender, School Location, Teaching Experience and Academic Qualification

Demography		Teacher		Student	
		Freq.	%	Freq.	%
Gender	Male	26	57.80	1083	42.00
	Female	19	42.20	1495	58.00
Total		45	100.0	2578	100
School Location	Rural	11	24.40	816	31.70
	Urban	34	75.60	1762	68.30
Total		45	100.0	2578	100
Years of Experience	1-10	20	44.44		
	11-20	15	33.33		
	21-30	8	17.79		
	31+	2	4.44		
Total		45	100.0		
Academic Qualification	N. C. E	4	8.90		
	B. Sc. Ed./ B.Sc.	20	44.44		
	M. Sc./ M. Ed.	10	22.22		
	PhD.	06	13.33		
	Others	05	11.11		
Total		45	100		

Table2 revealed the demographic characteristics of respondents in the study. A total of 45 Biology teachers and 2578 Biology students participated in the study. The distribution of the Biology teachers was based on their gender, school location, academic qualification, and years of teaching experience respectively, while, the Biology students were distributed into two classes of gender and school location. The table revealed that majority of the teachers were male (57.8%); their school was located in the urban area (75.6%); they have taught Biology for almost 10 years and not above; and they have Bachelor degree.

On the part of the students, majority were female (1495) and their school was located in the urban area (58.0%). Deductively, the respondents that participated in the study were appropriate for the study.

Results

Research QuestionOne: Do Biology teachers utilise ICT for teaching in secondary schools in Oyo state?

Table 3: Biology Teachers Utilisation of ICT for Teaching in Secondary Schools

S/N	ICT Resources for Biology Teaching	Yes		No		Rank Order
		Freq.	%	Freq.	%	
1	I use projector to project my lesson contents for my students in the classroom.	34	75.6	11	24.4	1 st
2	I use audio, visual, and audio-visual materials such as recorded voice notes, podcast, television and so on to teach my students	31	68.9	14	31.1	2 nd
3	I use computer in my classroom to surf the internet	29	64.4	16	35.6	4 th
4	I surf the internet to generate lesson contents for my students	30	66.7	15	33.3	3 rd
5	I use the public address system (PAS) in my classroom to teach a larger population	19	42.2	26	57.8	8 th
6	I use computer to typeset the exams, grade the scripts, and generate result.	21	46.7	24	53.3	7 th
7	I use computer to transfer files, video clips, images and so on to my students	27	60.0	18	40.0	6 th

8	I create learning channels and groups for my students through ICT devices like mobile phones	29	64.4	16	35.6	4th
9	I use teleconferencing and videoconferencing to communicate with my students	14	31.1	31	68.9	9th
1	I send lesson contents to my students through email	12	26.7	33	73.3	10th
TOTAL		246	54.7	204	45.3	

Table 3 revealed the utilisation of ICT for teaching Biology in secondary schools in Oyo state. The table indicated that majority of the respondents utilised projector to project their lesson contents (75.6%); use audio, visual, and audio-visual materials such as recorded voice notes, podcast, television and so on to teach their students (68.9%); surf the internet to generate lesson contents for their students (66.7%); create learning channels and groups for their students through ICT devices like mobile phones and use computer in their classroom to surf the internet (64.4%); and use computer to transfer files, video clips, images and so on to their students (60.0%).

On the other hand, majority claimed that they did not: use computer to typeset their exams, grade the scripts, and generate result (46.7%); use the PAS to teach a larger population (42.2%); used teleconferencing and videoconferencing to communicate with their students (31.1%); and sent lesson contents to their students through email (26.7%). In summative, the result indicated that

54.7% teachers utilised ICT for teaching Biology in secondary schools in Oyo state against 45.3% which indicated that they did not use ICT in their Biology teaching. Therefore, Oyo state Biology teachers utilised ICT for teaching in secondary schools.

Research Question Two: What is the perceived ease of use of ICT for teaching among Biology teachers in secondary schools in Oyo state?

Table 4: Perceived Ease of Use of ICT for Teaching among Biology Teachers in Secondary Schools

S/N	Perceived Ease of Use of ICT for Teaching Biology	Mean	Rank Order
1.	Moderate technical skills is needed to operate an ICT gadget such as computer and projector in order to be used in teaching Biology	3.09	2 nd
2.	Regular power supply is needed in order to use ICT in teaching Biology	2.83	6 th
3.	Navigation on the web spaces that are designed for teaching Biology is easy	2.91	5 th
4.	The instructional contents on the Internet are not ambiguous but easy to understand	2.69	10 th
5.	Not much of internet connectivity is necessary to surf the internet in order to generate content for my lessons	3.13	1 st
6.	The web interface of webpages for learning/teaching Biology online is not clumsy. Hence, locating needed materials are easy to come by.	2.97	4 th
7.	Interacting on some of the ICT resources such as videoconferencing and teleconferencing is flexible and easy to use	2.99	3 rd

8.	The location of the ICT resources is convenient for me to access and use for my teaching.	2.75	8 th
9.	The E-books are structured in an easy way. Thus, I find it easy to move around in different units.	2.84	7 th
10.	Creating/joining channels and groups for teaching is easy when I use social media platforms through the computer.	2.70	9 th
Grand Mean		2.89	

In Table 4, Biology teachers were solicited to determine the perceived ease of use of ICT for teaching Biology in secondary schools in Oyo state. The mean responses generated were all above the benchmark of 2.5, indicating that Biology teachers claimed that most of the Items were genuine factors contributing to their perceived ease of use of ICT for teaching Biology. Majorly, most of the respondents claimed that not much internet connectivity was needed to surf the internet in order to generate content for their lessons (3.13); the second ranking mean (Item 1, 3.09) revealed that Biology teachers perceived that to operate ICT gadget, medium technical skill was needed; Item 7 ranking 3rd with mean score of 2.99 revealed that teachers perceived that interacting on some of the ICT resources such as videoconferencing and teleconferencing was flexible and easy to use.

The 4th highest ranking mean score (2.97) indicated that the web interface of webpages for teaching Biology online was not clumsy. Hence, needed materials

were easy to come by; The 5th ranking mean (2.91) shows that navigation on the web spaces that were designed for teaching/learning biology was easy; Regular power supply was perceived to be a factor contributing to the perceived ease of use of ICT for teaching Biology having ranked 6th with mean score of 2.83; The 7th ranking mean score of 2.83 revealed that the E-books that were available for biology teaching were structured in an easy way. Thus, teachers found it easy to move around in different units.

2.75 mean score ranked the 8th revealing that the location of the ICT resources for biology teaching was convenient for use in teaching; 2.70 mean score ranking 9th indicated that creating channels and groups for teaching was easy when social media platforms through the computer was use; and the least ranking mean 2.69 revealed that the instructional contents on the Internet were not ambiguous but easy to understand for Biology teachers. Conclusively, based on the benchmark of 2.5, the grand mean score of 2.89 which was above the benchmark indicated that Biology teachers' claim that their perceived ease of use of ICT for teaching Biology in secondary schools in Oyo state was positive.

Research Question Three: What is the perceived ease of use of ICT for learning among Biology students in secondary schools in Oyo state?

Table 5: Perceived Ease of Use of ICT for Learning among Biology Students in Secondary Schools

S/N	Perceived Ease of Use of ICT for Teaching Biology	Mean	Rank Order
1.	Moderate technical skills is needed to operate an ICT gadget such as computer and projector in order to be used in learning Biology	2.34	10 th
2.	Regular power supply is needed in order to use ICT in learning Biology	3.01	1 st
3.	Navigation on the web spaces that are designed for learning Biology is easy	2.62	7 th
4.	The instructional contents on the Internet are not ambiguous but easy to understand	2.73	5 th
5.	Not much of internet connectivity is necessary to surf the internet in order to generate content for my lessons	2.41	9 th
6.	The web interface of webpages for learning Biology online is not clumsy. Hence, locating needed materials are easy to come by.	2.63	6 th
7.	Interacting on some of the ICT resources such as videoconferencing and teleconferencing is flexible and easy to use	2.83	4 th
8.	The location of the ICT resources is convenient for me to access and use for my learning.	2.89	3 rd
9.	The E-books are structured in an easy way. Thus, I find it easy to move around in different units.	2.94	2 nd
10.	Joining channels and groups for learning is easy when I use social media platforms through the computer.	2.57	8 th
Grand Mean		2.68	

In Table 5, Biology students were solicited to determine the perceived ease of use of ICT for learning among biology students in secondary schools in Oyo state. The mean responses generated were all above the benchmark of 2.5 except Items 5 and 1 ranking 9th and 10th, indicating that the students' claim that most of the Items were genuine factors contributing to their perceived ease of use of ICT for learning biology. Majorly, aside from the Items 5 and 1 where they claimed otherwise that the technical skills needed to operate an ICT gadget such as computer and projector in order to be used in learning biology was not moderate and that not much internet connectivity was needed to surf the internet in order to generate content for their lessons, every other Item was responded to positively. Summarily, based on the benchmark of 2.5, the grand mean score of 2.68 which was above the benchmark indicated that Biology students' claim that their perceived ease of use of ICT for learning Biology in secondary schools in Oyo state was positive.

Research Question Four: What is the perceived usefulness of ICT for teaching among Biology teachers in secondary schools in Oyo state?

**Table 6: Perceived Usefulness of ICT for Teaching among Biology Teachers
in Secondary Schools**

S/N	Perceived Usefulness of ICT for Teaching Biology	Mean	Rank Order
1.	ICT resources are a very good resource where expansive instructional materials can be used to enhance my teaching	3.18	4 th
2.	The use of ICT for Biology teaching has the potential of providing personalised learning through self-experienced presentation.	3.23	1 st
3.	The e-resources that are present on the Internet can enhance learning better than hardcopies of materials that are made available for my teaching.	3.11	5 th
4.	The sharing and upload of instructional resources to the Internet by teachers can reduce the work load and time spent in the classroom in order to engage in other productive responsibilities.	3.02	8 th
5.	Using ICT can help in keeping Biology students abreast with latest development in the subject	3.10	6 th
6.	The use of ICT resources can help Biology teachers in providing relevant material for teaching and research purpose.	3.21	2 nd
7.	ICT in Biology teaching is a great educational tool by bridging the gap among learners	3.20	3 rd
8.	Using ICT in Biology teaching can make the instructional process relevant to all learners irrespective of individual characteristics	3.05	7 th
9.	Instructional resources that are available through the ICT for Biology teaching is more convenient to use than the traditional resources	2.98	9 th
10.	Resources for Biology teaching can be easily accessible at all time when needed than the traditional system	2.67	10 th
Grand Mean		3.07	

Table 6 examined the perceived usefulness of ICT for teaching among Biology teachers in secondary schools in Oyo state. The table revealed that all the items were responded to positively based on the benchmark of 2.5. Biology teachers claimed that their perceived usefulness of ICT includes: the potential of providing personalised learning through self-experienced presentation (3.23); help Biology teachers in providing relevant material for teaching and research purpose (3.21); bridging the gap among learners (3.20); a very good resource where expansive instructional materials can be used to enhance Biology teaching (3.18); enhancing learning better than hardcopies of materials that are made available for Biology teaching (3.11); help in keeping Biology students abreast with latest development in the subject (3.10); make the instructional process relevant to all learners irrespective of individual characteristics (3.05).

Sharing and upload of instructional resources to the Internet by teachers can reduce the work load and time spent in the classroom in order to engage in other productive responsibilities (3.02); convenience of use of instructional resources that are available through the ICT for Biology teaching (2.98); and easy access to resources for Biology teaching than the traditional system (2.67). Cumulatively, the grand mean of 3.08 indicated that the perceived usefulness of ICT for teaching among Biology teachers in secondary schools in Oyo state was positive.

Research Question Five: What is the perceived usefulness of ICT for learning among Biology students in secondary schools in Oyo state?

Table 7: Perceived Usefulness of ICT for Learning among Biology Students in Secondary Schools

S/N	Perceived Ease of Use of ICT for Teaching Biology	Mean	Rank Order
1.	ICT resources are very good resource where expansive instructional materials can be used to enhance my learning	3.09	2 nd
2.	The use of ICT for Biology learning has the potential of providing personalised learning through self-experienced presentation.	2.83	8 th
3.	The e-resources that are present on the Internet can enhance learning better than hardcopies of materials that are made available for my Biology learning	2.91	6 th
4.	The sharing and upload of instructional resources to the Internet by students can reduce the work load and time spent in the classroom in order to engage in other productive responsibilities.	2.99	4 th
5.	Using ICT can help in keeping Biology students abreast with latest development in the subject	2.69	10 th
6.	The use of ICT resources can help Biology students in providing relevant material for learning purpose.	2.84	7 th
7.	ICT in Biology learning is a great educational tool by bridging the gap among diverse learners	2.70	9 th
8.	Using ICT in Biology learning can make the instructional process relevant to all learners irrespective of individual characteristics	2.97	5 th
9.	Instructional resources that are available through the ICT for Biology learning is more convenient to use than the traditional resources	3.06	3 rd
10.	Resources for Biology learning can be easily accessible at all time when needed than the traditional system	3.13	1 st
Grand mean		2.92	

Table 7 examined the perceived usefulness of ICT for learning among Biology students in secondary schools in Oyo state. The table revealed that all the items were responded to positively based on the benchmark of 2.5. The students claimed that their perceived usefulness of ICT includes: easy access to resources for Biology teaching than the traditional system (3.13); a very good resource where expansive instructional materials can be used to enhance Biology teaching (3.09); convenience of use of instructional resources that are available through the ICT for Biology teaching (3.06); sharing and upload of instructional resources to the Internet by teachers can reduce the work load and time spent in the classroom in order to engage in other productive responsibilities (2.99); make the instructional process relevant to all learners irrespective of individual characteristics (2.97); enhancing learning better than hardcopies of materials that are made available for Biology teaching (2.91); help Biology teachers in providing relevant material for teaching and research purpose (2.84); the potential of providing personalised learning through self-experienced presentation (2.83); bridging the gap among learners (2.70); and help in keeping Biology students abreast with latest development in the subject (2.69). Cumulatively, the grand mean of 2.92 indicated that the perceived usefulness of ICT for learning among Biology students in secondary schools in Oyo state was positive.

Results of Hypotheses Tested in the Study

The results of hypotheses tested in this study are presented in tables. All hypotheses were tested at significant level of 0.05.

Hypothesis One

H₀₁: There is no significant difference between male and female Biology teachers' perceived ease of use of ICT for teaching in secondary schools in Oyo state

Table 8: *t*-test Analysis of Male and Female Biology Teachers Perceived Ease of Use of ICT for Teaching

Gender	N	X	SD	df	T	Sig. (2-tailed)	Remark
Male	26	3.60	.27	43	-.018	.986	Not rejected
Female	19	3.60	.24				

From Table 8, it can be deduced that there was no significant difference between male and female Biology teachers' perceived ease of use of ICT for teaching in secondary schools in Oyo state. This was reflected in the findings of the hypotheses tested df (43), $t = -.018$, $p > 0.05$. Thus, the hypothesis which states that "there is no significant difference between male and female Biology teachers' perceived ease of use of ICT for teaching in secondary schools in Oyo state" was not rejected.

Hypothesis Two

H₀₂: There is no significant difference between male and female Biology students' perceived ease of use of ICT for learning in secondary schools in Oyo state

Table 9: *t*-test Analysis of Male and Female Biology Students' Perceived Ease of Use of ICT for Teaching

Gender	N	X	SD	df	<i>t</i>	Sig. (2-tailed)	Remark
Male	1083	3.50	.19	2576	.810	.418	Not rejected
Female	1495	3.49	.18				

From Table 9, it can be deduced that there was no significant difference between male and female Biology students' perceived ease of use of ICT for learning in secondary schools in Oyo state. This was reflected in the findings of the hypotheses tested df (2576), $t = .810$, $p > 0.05$. Thus, the hypothesis which states that "there is no significant difference between male and female Biology students' perceived ease of use of ICT for learning in secondary schools in Oyo state" was not rejected.

Hypothesis Three

H₀₃: There is no significant difference between male and female Biology teachers' perceived usefulness of ICT for teaching in secondary schools in Oyo state

Table 10: *t*-test Analysis of Male and Female Biology Teachers Perceived Usefulness of ICT for Teaching

Gender	N	X	SD	df	T	Sig. (2-tailed)	Remark
Male	26	3.59	.27	43	-.232	.818	Not rejected
Female	19	3.61	.24				

From Table 10, it can be deduced that there was no significant difference between male and female Biology teachers' perceived usefulness of ICT for teaching in secondary schools in Oyo state. This was reflected in the findings of the hypotheses tested $df (43)$, $t = -.232$, $p > 0.05$. Thus, the hypothesis which states that "there is no significant difference between male and female Biology teachers' perceived usefulness of ICT for teaching in secondary schools in Oyo state" was not rejected.

Hypothesis Four

H₀₄: There is no significant difference between male and female Biology students' perceived usefulness of ICT for learning in secondary schools in Oyo state

Table 11: *t*-test Analysis of Male and Female Biology Students' Perceived Usefulness of ICT for Teaching

Gender	N	X	SD	df	<i>T</i>	Sig. (2-tailed)	Remark
Male	1083	3.51	.21	2576	2.018	.044	Rejected
Female	1495	3.49	.18				

From Table 11, it can be deduced that there was significant difference between male and female Biology students' perceived usefulness of ICT for learning in secondary schools in Oyo state. This was reflected in the findings of the hypotheses tested df (2576), $t = 2.018$, $p < 0.05$. Thus, the hypothesis which states that "there is no significant difference between male and female Biology students' perceived usefulness of ICT for learning in secondary schools in Oyo state" was rejected.

Hypothesis Five

H₀₅: There is no significant difference between Biology teachers located in rural and urban areas' perceived ease of use of ICT for teaching in secondary schools in Oyo state

Table 12: *t*-test Analysis of Difference in Biology Teachers Perceived Ease of Use of ICT for Teaching Based on School Location

Gender	N	X	SD	df	<i>t</i>	Sig. (2-tailed)	Remark
Rural	11	3.60	.24	43	-.018	.986	Not rejected
Urban	24	3.60	.27				

From Table 12, it can be deduced that there was no significant difference between Biology teachers located in rural and urban area perceived ease of use of ICT for teaching in secondary schools in Oyo state. This was reflected in the findings of the hypotheses tested $df (43)$, $t = -.018$, $p > 0.05$. Thus, the hypothesis which states that “there is no significant difference between Biology teachers located in rural and urban area perceived ease of use of ICT for teaching in secondary schools in Oyo state” was not rejected.

Hypothesis Six

H₀₆: There is no significant difference between Biology students located in rural and urban areas' perceived ease of use of ICT for learning in secondary schools in Oyo state.

Table 13: *t*-test Analysis of Difference in Biology Students Perceived Ease of Use of ICT for Learning Based on School Location

Gender	N	X	SD	df	<i>t</i>	Sig. (2-tailed)	Remark
Rural	816	3.51	.20	2576	2.127	.034	Rejected
Urban	1762	3.49	.18				

From Table 13, it can be deduced that there was significant difference between Biology students located in rural and urban area perceived ease of use of ICT for learning in secondary schools in Oyo state. This was reflected in the findings of the hypotheses tested df (2576), $t = -2.127$, $p < 0.05$. Thus, the hypothesis which states that “there is no significant difference between Biology students located in rural and urban area perceived ease of use of ICT for learning in secondary schools in Oyo state” was rejected.

Hypothesis Seven

H₀₇: There is no significant difference between Biology teachers located in rural and urban areas' perceived usefulness of ICT for teaching in secondary schools in Oyo state

Table 14: *t*-test Analysis of Difference in Biology Teachers Perceived Usefulness of ICT for Teaching Based on School Location

Gender	N	X	SD	df	<i>t</i>	Sig. (2-tailed)	Remark
Rural	11	3.53	.24	43	1.012	.317	Not rejected
Urban	24	3.61	.24				

From Table 14, it can be deduced that there was no significant difference between Biology teachers located in rural and urban area perceived usefulness of ICT for teaching in secondary schools in Oyo state. This was reflected in the findings of the hypotheses tested df (43), $t = 1.012$, $p > 0.05$. Thus, the hypothesis which states that “there is no significant difference between Biology teachers located in rural and urban area perceived usefulness of ICT for teaching in secondary schools in Oyo state” was not rejected.

Hypothesis Eight

H₀₈: There is no significant difference between Biology students located in rural and urban areas' perceived usefulness of ICT for learning in secondary schools in Oyo state

Table 15: *t*-test Analysis of Difference in Biology Students' Perceived Usefulness of ICT for Learning Based on School Location

Gender	N	X	SD	df	<i>t</i>	Sig. (2-tailed)	Remark
Rural	816	3.53	.21	2576	3.722	.000	Rejected
Urban	1762	3.49	.18				

From Table 15, it can be deduced that there was significant difference between Biology students located in rural and urban areas' perceived usefulness of ICT for learning in secondary schools in Oyo state. This was reflected in the findings of the hypotheses tested df (2576), $t = -3.722$, $p < 0.05$. Thus, the hypothesis which states that “there is no significant difference between Biology students located in rural and urban area perceived usefulness of ICT for learning in secondary schools in Oyo state” was rejected.

Hypothesis Nine

H₀₉: There is no significant difference among Biology teachers' perceived ease of use and usefulness of ICT for teaching in secondary schools in Oyo state based on years of experience

Table 16: ANOVA Analysis of Biology Teachers' Perceived Ease of Use and Usefulness of ICT for Teaching Based on Years of Experienced

	Sum of Squares	Df	Mean Square	F	Sig.
Between Groups	3746.011	3	1248.670	197.184	.000
Within Groups	259.633	41	6.333		
Total	4005.644	44			

Table 16 revealed the ANOVA analysis of Biology teachers' perceived ease of use and usefulness of ICT for teaching in secondary schools in Oyo state based on years of experience. The result revealed that "there was a significant difference in the perceived ease of use and usefulness of ICT for teaching in secondary schools in Oyo state based on years of experience" ($F_{(3,44)} = 197.18$, $p < 0.05$). The null hypothesis was therefore rejected.

Table 17: Scheffe Post-hoc Analysis of Biology Teachers' Perceived Ease of Use and Usefulness of ICT for Teaching Based on Years of Experience

(I) Teachers' Year of Teaching Experience	(J) Teachers' Year of Teaching Experience	Mean Difference (I-J)	Sig.
1 - 10 Years	11 - 20 Years	-11.96667*	.000
	21 - 30 Years	-20.70000*	.000
	Above 31 Years	-30.20000*	.000

In order to locate the sources of the significant difference among the groups, Scheffe Post-hoc analysis was carried out at 0.05 level of significance. The result showed that there was a significant difference between 1 – 10 years and above 30 years. This indicated that Biology teachers that were above 30 years in service perceived ease of use and usefulness towards ICT for teaching in Oyo state secondary schools better than their counterparts.

Hypothesis Ten

H₁₀: There is no significant difference among Biology teachers' perceived ease of use and usefulness of ICT for teaching in secondary schools in Oyo state based on qualification

Table 18: ANOVA Analysis of Biology Teachers' Perceived Ease of Use and Usefulness of ICT for Teaching Based on Qualification

	Sum of Squares	Df	Mean Square	F	Sig.
Between Groups	5101.344	4	1275.336	55.096	.000
Within Groups	925.900	40	23.148		
Total	6027.244	44			

Table 18 revealed the ANOVA analysis of Biology teachers' perceived ease of use and usefulness of ICT for teaching in secondary schools in Oyo state based on qualification. The result revealed that "there was a significant difference in the perceived ease of use and usefulness of ICT for teaching in secondary schools in Oyo state based on qualification" ($F_{(4,44)} = 55.10, p < 0.05$). The null hypothesis was therefore rejected.

Table 19: Scheffe Post-hoc Analysis of Biology Teachers' Perceived Ease of Use and Usefulness of ICT for Teaching Based on Qualification

I (Academic Qualification)	J (Academic Qualification)	Mean Difference (I-J)	Sig.
NCE	Degree	-11.00000*	.005
	Masters	-21.80000*	.000
	Ph. D	-32.50000*	.000
	Others	3.20000	.911

In order to locate the sources of the significant difference among the groups, Scheffe Post-hoc analysis was carried out at 0.05 level of significance. The result showed that Biology teachers that had Ph. D. certificates perceived ease of use and usefulness towards ICT for teaching in Oyo state secondary schools better than their counterparts.

Summary of the Findings

The followings are the summary of the major findings of this study:

1. Oyo state biology teachers utilised ICT for teaching in secondary schools (54.7%, above 50% benchmark);

2. the perceived ease of use of ICT for teaching biology among biology teachers was positive in secondary schools in Oyo state (Grand Mean 2.89, above 2.5 benchmark);
3. the perceived ease of use of ICT for learning biology among biology students was positive in secondary schools in Oyo state (Grand Mean 2.68, above 2.5 benchmark);
4. the perceived usefulness of ICT for teaching among biology teachers in secondary schools in Oyo state was positive (Grand Mean 3.08, above 2.5 benchmark);
5. the perceived ease of use of ICT for learning biology among secondary school students in Oyo state was positive (Grand Mean 2.68, above 2.5 benchmark);
6. there was no significant difference between male and female biology teachers' perceived ease of use of ICT for teaching in secondary schools in Oyo state (df (43), $t = -.018$, $p > 0.05$ (.986));
7. there was no significant difference between male and female Biology students' perceived ease of use of ICT for learning in secondary schools in Oyo state (df (2576), $t = .810$, $p > 0.05$ (.418));

8. there was no significant difference between male and female biology teachers' perceived usefulness of ICT for teaching in secondary schools in Oyo state (df (43), $t = -.232$, $p > 0.05(.818)$);
9. there was a significant difference between male and female biology students' perceived usefulness of ICT for learning in secondary schools in Oyo state (df (2576), $t = 2.018$, $p < 0.05(.044)$);
10. there was no significant difference between biology teachers located in rural and urban areas' perceived ease of use of ICT for teaching in secondary schools in Oyo state (df (43), $t = -.018$, $p > 0.05(.986)$);
11. there was a significant difference between biology students located in rural and urban areas' perceived ease of use of ICT for learning in secondary schools in Oyo state (df (2576), $t = -2.127$, $p < 0.05(.034)$);
12. there was no significant difference between biology teachers located in rural and urban areas' perceived usefulness of ICT for teaching in secondary schools in Oyo state (df (43), $t = 1.012$, $p > 0.05(.317)$);
13. there was asignificant difference between biology students located in rural and urban areas' perceived usefulness of ICT for learning in secondary schools in Oyo state (df (2576), $t = -3.722$, $p < 0.05(.000)$);

14. there was a significant difference in the perceived ease of use and usefulness of ICT for teaching in secondary schools in Oyo state based on years of experience” ($F_{(3,44)} = 197.18, p < 0.05(.000)$); and
15. there was a significant difference in the perceived ease of use and usefulness of ICT for teaching in secondary schools in Oyo state based on qualification” ($F_{(4,44)} = 55.10, p < 0.05(.000)$).

CHAPTER FIVE

DISCUSSION, CONCLUSION AND RECOMMENDATIONS

This chapter presented the discussion of findings, conclusion and recommendations based on analyses in chapter four.

Discussion

This study had examined stakeholders' perception towards ICT for teaching and learning, placing particular emphasis on perceived ease of use and perceived usefulness of ICT. The study revealed that biology teachers utilised ICT for teaching in secondary schools in Oyo state. This revelation is in line with the assertion of Deane, et al., (2006), and Balanskat, et al., (2006) that teachers' use of ICT is based on the fact that education in whatever form is not complete without the effective use of ICT. The researchers claimed that the evidential role of ICT in education has necessitated governments all over the world to provide ICT for classroom and teachers are now harnessing the rich potentials of ICT in their respective teachings.

The findings of this study also revealed that both the teachers and students had a positive disposition of perceived ease of use and usefulness of ICT for teaching and learning Biology. This finding is in support of the study of Akinde and Adetimirin, (2017) who claimed that the effectiveness of ICT is determined not by its mere presence in the classroom but by teachers and learners' perceived

ease of use and usefulness of it. This assertion revealed that in order for ICT to be integrated for teaching and learning, teachers and students' perceived ease of use and usefulness are major factors and this might be the reason for its utilisation among teachers and students.

This study also indicated that the personal traits of students and teachers such as gender, school location, academic qualification and years of experience are critical factors to be considered in ICT integration for teaching and learning. This study indicated that there is no gender difference among teachers and students' perceived ease of use and usefulness of ICT for teaching and learning. This is against the claims of Femi-Adeoye (2004), Ayodeyi (2010) and Akiri and Ugborugbo (2008) who claimed that gender difference is a major dichotomous factor that influences students and teachers' perception towards ICT use in the classroom. Supporting the claim of the researchers, this study however revealed that gender differences do exist among students' perceived usefulness of ICT for learning.

This study found out that irrespective of the location of biology teachers, their perceived usefulness of ICT for teaching in secondary schools was the same. Unlike the biology students, location was a considerable factor to recognise. This might be due to the fact that both the teachers in rural and urban areas were exposed to the same educational opportunities in the various tertiary institutions.

they attended with parallel in-service trainings, against students who are separated within urban exposure and were not exposed to equal technological opportunities in their respective school locations. Okerenke and Onwukwe, (2011) who revealed that school location of the teachers and students are very important in their perceptions on the use of ICT. On the other hand, this finding is at variance with that of Thomas and Ikuyero (2013) where school location (urban or rural) was found not to have significantly influenced the students' perception of their classroom environment.

In this study, teachers' qualification was examined as a moderating variable alongside other variables, and the findings revealed that there was a significant difference in the perceived ease of use and usefulness of ICT for teaching in secondary schools in Oyo state based on qualification. This implies that additional qualification leads to additional knowledge on the use of ICT. This is in support of Omosewo (2008), Etiubon and Benson (2014), Owolabi and Adedayo (2012) who discovered that students taught by teachers with higher qualifications performed better than those taught by teachers with lower qualifications. However, this is contrary to the assertion of Musau and Abere (2015) who found out that there was no significant difference between teacher qualification and students' performance in science subjects.

This study revealed that there was a significant difference in the perceived ease of use and usefulness of ICT for teaching in secondary schools in Oyo state based on years of experience. This may be due to the fact that many occupations recognize employee's years of experiences as a relevant factor in human resources productivity. This is in support of Cloffelter (2007), and Harris and Sass (2007) which indicated that brand new teachers are less effective than those with many years of experiences.

Conclusion

Information and communication technology (ICT) is one of the globally acknowledged learning and teaching space today, as well as, one of the key propellants of globalisation. Development in ICT has vastly transformed every sphere of life and permeated all human actions and endeavours. The use of ICT for instructional purposes is not, and never will be, transformative on its own if educators and learners who are supposed to integrate it into their teaching and learning are not utilising it. Based on this, it is clear that ICT cannot replace teachers and students since they are the key to whether ICT is used appropriately and effectively.

The effectiveness of ICT is determined not by its mere presence in the classroom but by teachers and students' perceived ease of use and perceived usefulness of ICT. This assertion revealed that teachers' and students' role is

really critical as they are the ones who have to decide whether or not to use the available ICT resources in schools. The appreciable characteristics of ICT integration for teaching and learning may be informed and gained by teachers and students when their perceived ease of use and perceived usefulness of ICT is positive, then will the purpose of its integration be achieved. This purpose among others include contribution to the promotion and enhancement of the teaching and learning process. This study has provided empirical evidence towards this.

Implication of the Study

Based on the findings of this study, the following implications can be drawn. Both the Biology teachers and students can now be influenced positively towards using ICT since they have a positive perception towards ICT use, thereby, embracing personalised and individualised teaching and learning of the subject. The adoption and utilization of ICT for instructional purposes in subjects such as Biology should be prioritised and encouraged among teachers and students, this will be aimed at improving academic performance, maintenance of interesting, engaging, interactive, and entertaining lesson experience.

Recommendations

Based on the research findings the following recommendations were made:

1. Biology instructional processes should be made open, accessible and interactive to both the teachers and students, so as to improve teachers and learners' use of ICT and enable their capability towards achieving instructional objectives.
2. Institutions of learning should make ICT available to their academic community. This should be a pursuit towards achieving institutional goals.
3. The use of ICT should be encouraged among teachers and students. This will provide avenue for both teachers and students to have a better perception towards ICT use for Biology instruction.
4. School administrators should embrace and provide ICT resources to their schools. Such provision will enhance both teachers and students' perception towards ICT use for Biology instruction.
5. Biology teachers should proceed to have higher academic qualifications that will make them to be technologically advanced in their use of ICT for instruction.
6. Biology teachers should be given opportunity by their employers to attend seminar and workshops so that their knowledge in the use of ICT will be

up to date in comparison with the experiences the old Biology teachers are using.

7. The female Biology teachers should be more technologically-oriented in the use of ICT by attending ICT seminar and workshop.
8. The female Biology students should be exposed to the use of ICT more than the male who are advanced in the use of ICT.
9. The school in rural areas should be supplied with adequate technological equipment by the government so that they will be conversant with the use of ICT.
10. Biology students in rural areas and urban areas should be given equal opportunity in the use of ICT in learning biology

Suggestion for further Study

1. This research is a descriptive study of the survey type. Experimental study should be conducted to confirm the findings of this study and to determine if skills and attitude can be developed in students through the use of ICT in learning biology.
2. Another study should be carried out in other states of Nigeria to examine the perception of other stakeholders (parents and principals) in the use of ICT in teaching and learning biology.

3. This study involved the participation of teachers and students as respondents, other researchers should examine the perceptions of other stakeholders (e.g school administrators, ministry of education officials, curriculum planners) in Oyo State Nigeria.

Limitation of the Study

This study was limited to Oyo State Nigeria because of the financial implications and during the course of the study, the researcher met with some problem which made the project a little bit difficult, some of these problems are: lack of similar study to serve as a guide; inability to identify the school that were using ICT in teaching and learning of biology; and problem of transport fare as repeated journeys were made to some rural areas between the three senatorial districts used in order to get the instrument retrieved.

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APPENDIX I

DISSEMINATION OF MAJOR FINDINGS

The findings of this research would be as disseminated as discussed below:

Research Article Publication in Reputable Journals: The result of this study would be published in reputable journals. Preference would be given, first to journals of biological education and science-based journals such as International Journal of Science Education, STAN.

Workshops: The researcher would plan to organize workshop for biology teachers to communicate the major findings of the research work to them on how to improve teaching and learning of biology via the use of ICT.

Organization of Seminars: Seminars would be organized by the researcher for the biology teachers and the students to equip the teachers and the students with the importance of using ICT in the classrooms.

Print Media Engagement: Print media would be engaged through monthly write-up to educate and bring to the knowledge of the general public, the benefits of ICT in teaching and learning.

Memo Writing: The researcher would communicate the results of this finding to the Federal and State Ministries of Education to push through the ideal of national acceptance of the results of the findings. National examination bodies and agencies would also be involved with the quality of teaching and learning of biology through the use of ICT.

APPENDIX II

DEPARTMENT OF SCIENCE EDUCATION, FACULTY OF SCIENCE,

UNIVERSITY OF ILORIN, ILORIN, NIGERIA

QUESTIONNAIRE ON STAKEHOLDERS' PERCEPTION OF THE USE

OF INFORMATION AND COMMUNICATION TECHNOLOGY FOR

BIOLOGY INSTRUCTION (QSPUICBTBI)

Dear Respondent,

The purpose of this questionnaire is strictly for research. It is aimed at collecting information for a study titled 'Stakeholders Perception on the Use of Information and Communication Technology for Biology Instruction in Secondary Schools in Oyo State, Nigeria'. Please ensure that you tick the option that truly represent your opinions. There are no right or wrong answers. The only correct responses are those that are true for you. The data obtained through the questionnaire will be used for research purpose only.

Thank You.

Femi-Adeoye K. O
(Researcher)

SECTION A: DEMOGRAPHIC INFORMATION

For teachers and students-----Gender: Male () Female: ()

School Location: Rural (); Urban ()

For teachers only-----Highest Academic Qualification: NCE () B. Ed ()

M. Ed () Ph. D () Others

Teaching Experience: 1-10 years () 11-20 years () 21-30 years () Above 31years ().

SECTION B: Biology Teachers Utilisation of ICT for Teaching in Secondary Schools

Please read each statement carefully and respond to each of them with all honesty. You are please required to indicate your response by putting a tick (✓) in the appropriate column against each statement. The options are: **Yes** and **No**

S/N	ICT Resources for Biology Teaching	Yes	No
1.	I use projector to project my lesson contents for my students in the classroom.		
2.	I use audio, visual, and audio-visual materials such as recorded voice notes, podcast, television and so on to teach my students		
3.	I use computer in my classroom to surf the internet		
4.	I surf the internet to generate lesson contents for my students		
5.	I use the public address system (PAS) in my classroom to teach a larger population		
6.	I use computer to typeset the exams, grade the scripts, and generate result.		
7.	I use computer to transfer files, video clips, images and so on to my students		

8.	I create learning channels and groups for my students through ICT devices like mobile phones		
9.	I use teleconferencing and videoconferencing to communicate with my students		
10.	I send lesson contents to my students through email		

SECTION C: Perceived Ease of Use of ICT for Learning among Biology Students in Secondary Schools

Please read each statement carefully and respond to each of them with all honesty. You are please required to indicate your response by putting a tick (✓) in the appropriate column against each statement. The options are: Strongly Agree (SA); Agree (A), Disagree (D), and Strongly disagree (SD).

S/N	Perceived Ease of Use of ICT for Teaching/Learning Biology	SA	A	SD	D
1.	Moderate technical skills is needed to operate an ICT gadget such as computer and projector in order to be used in teaching/learning Biology				
2.	Regular power supply is needed in order to use ICT in teaching/learning Biology				
3.	Navigation on the web spaces that are designed for learning Biology is easy				
4.	The instructional contents on the Internet are not ambiguous but easy to understand				
5.	Not much of internet connectivity is necessary to surf the internet in order to generate content for my lessons				
6.	The web interface of webpages for learning Biology online is not clumsy. Hence, locating needed materials are easy to come by.				
7.	Interacting on some of the ICT resources such as videoconferencing and teleconferencing is flexible and easy to use				
8.	The location of the ICT resources is convenient				

	for me to access and use for my learning.				
9.	The E-books are structured in an easy way. Thus, I find it easy to move around in different units.				
10	Joining channels and groups for learning is easy when I use social media platforms through the computer.				

Section C: Perceived Usefulness of ICT for Teaching among Biology Teachers in Secondary Schools

S/N	Perceived Usefulness of ICT for Teaching Biology	SA	A	SD	D
1.	ICT resources are a very good resource where expansive instructional materials can be used to enhance my teaching				
2.	The use of ICT for Biology teaching has the potential of providing personalised learning through self-experienced presentation.				
3.	The e-resources that are present on the Internet can enhance learning better than hardcopies of materials that are made available for my teaching.				
4.	The sharing and upload of instructional resources to the Internet by teachers can reduce the work load and time spent in the classroom in order to engage in other productive responsibilities.				
5.	Using ICT can help in keeping Biology students abreast with latest development in the subject				

6.	The use of ICT resources can help Biology teachers in providing relevant material for teaching and research purpose.				
7.	ICT in Biology teaching is a great educational tool by bridging the gap among learners				
8.	Using ICT in Biology teaching can make the instructional process relevant to all learners irrespective of individual characteristics				
9.	Instructional resources that are available through the ICT for Biology teaching is more convenient to use than the traditional resources				
10	Resources for Biology teaching can be easily accessible at all time when needed than the traditional system				

APPENDIX III BUDGET PROPOSAL

DESCRIPTION OF ITEM	EXPECTED FROM TOTAL SPONSOR	STUDENT
1.0 Personnel Costs/Allowances		
1.1 Research Assistant (6)	TETFUND	190,000
1.2 Research Information	TETFUND	35,000
1.3 Technical Assistants (3)	TETFUND	NIL
Sub Total (not>20% of budget)		225,000:00
2.0 Equipment (List & Specify)		
2.1 Laptop	TETFUND	150,000:00
2.2 Printers (1 Colour and 2 black and white)	TETFUND	85,000:00
2.3 Flash/Moderm	TETFUND	15,000:00
2.4 Generator (Alternative Power Supply)	TETFUND	50,000:00
Subtotal (not>20% of budget)		300,000:00
3.0 Supplied Consumables		
3.1 Papers/Toners	TETFUND	120,000:00
3.2 Purchase of Textbooks and pen	TETFUND	6,000:00
3.3 Monthly Subscription of modem at N2500 per month x 30	TETFUND	76,000:00
Sub Total		202,000:00
4.0 Data Collection & Analysis		
4.1 Analysis	TETFUND	20,000:00
4.2 Cost of administering the Questionnaire	TETFUND	50,000:00
Sub Total		70,000:00
5.0 Travels		
5.1 Researcher	TETFUND	120,000:00
Sub Total		120,000:00
6.0 Dissemination		
6.1 Seminar 1 (Proposal)	TETFUND	30,000:00
6.2 Seminar 2 (Protocol Panel)	TETFUND	25,000:00
6.3 Seminar 3 (Mock Defence)	TETFUND	150,000:00
6.4 Seminar 4 (Oral Defence)	TETFUND	300,000:00
Sub Total		505,000:00
7.0 Others/ Miscellaneous		
7.1 Accommodation on Research trip	TETFUND	130,000:00
7.2 Miscellaneous	TETFUND	120,000:00
Sub Total		250,000:00
Student		
GRAND TOTAL		1,672, 000:00

APPENDIX VIII
Ph.D. Research Plan and Timeline

	25/02/2017	28/03/2017	31/03/2017	28/04/2017	26/05/2017	30/06/2017	28/07/2017	25/08/2017	29/09/2017	27/10/2017	24/11/2017	29/12/2017	12/01/2018	19/01/2018	15/02/2018	30/03/2018	27/04/2018	05/05/2018	29/05/2018	05/06/2018	12/06/2018	19/06/2018
MONTH	11	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22
TASK																						
Survey of Literature																						
Write Proposal																						
Data Gathering																						
Thesis Writing																						
Write Introduction																						
Revise Introduction																						
Write Methodology																						
Revise Methodology																						
Protocol Device																						
Field Work																						
Results and Discussion																						
Revise Results and Discussion																						
Write Conclusions																						
Revise Conclusions																						
Acknowledgements, Appendices etc.																						
Revise First Draft																						
Proofreading																						
Printing and Binding																						