

**SENIOR SCHOOL BIOLOGY TEACHERS' PERCEPTIONS ON
THE APPLICATION OF STUDY TECHNOLOGY PRINCIPLES TO
INSTRUCTION IN KWARA STATE, NIGERIA**

Ph.D. ORAL DEFENCE

BY

ABDULKADIR, Saadat Abike

06/68ON001

**DEPARTMENT OF SCIENCE EDUCATION,
FACULTY OF EDUCATION,
UNIVERSITY OF ILORIN, ILORIN, NIGERIA**

SUPERVISOR: DR G. BELLO

CERTIFICATION

This is to certify that this study was carried out by ABDULKADRI, Saadat Abike (06/68ON001) in the Department of Science Education, Faculty of Education, University of Ilorin, Ilorin, Nigeria.

.....

Dr. G. Bello
Supervisor

.....

Date

.....

Dr. A. O. Akanbi
Head, Department of Science Education

.....

Date

.....

Prof. A. A. Adegoke
Internal External Examiner from Related
Department of Counselor Education

.....

Date

.....

Dr. Khadijat S. Ameen
Departmental Postgraduate Programmes
Coordinator and Internal Examiner

.....

Date

.....

Prof. Felicia A. O. Olasehinde Williams
Dean, Faculty of Education

.....

Date

.....

External Examiner

.....

Date

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ABDULKADRI, Saadat Abike

06/68ON001

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DEDICATION

This research work is dedicated to my father, Mallam Jimoh Ibrahim and my late mother, Mrs Salimat Abeke Jimoh.

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ABSTRACT

Application of study technology principles fosters perfect understanding of concepts in teaching and learning. Misunderstood words, lack of mass and steep a gradient have been widely reported in literature to be barriers to students' meaningful learning of Biology. There is dearth of information on Biology teachers' usage of study technology principles in Kwara State. This study investigated Senior School Biology teachers' perceptions on the application of study technology principles to instruction in Kwara State, Nigeria. The objectives of the study were to: (i) examine the perceptions of Biology teachers on application of checksheet to instruction; (ii) assess the use of word clearing to instruction; (iii) evaluate the perceptions of Biology teachers on the use of demonstration kit for instruction; (iv) examine the use of the clay table training to instruction; (v) evaluate the use of communication skills to instruction; (vi) determine the differences in academic qualification and years of teaching experience of Biology teachers' perceptions on study technology principles to instruction; and (vii) determine differences in Biology teachers' perceptions of study technology principles to instruction based on gender, school type and school location.

A descriptive research design of the survey type was adopted for the study. The population comprised 964 Biology teachers in Kwara State, Nigeria. A sample of 720 Biology teachers who volunteered to participate in the study were selected using purposive sampling techniques. A researcher-designed questionnaire with reliability coefficient of 0.78 was used for data collection. The data analysis was through Mean ($\bar{X}$) with cut-off score of 2.50, while independent sample *t*-test and Analysis of Variance (ANOVA) were used to test the hypotheses at 0.05 level of significance.

The findings of the study were that:

- (i) Biology teachers had positive perceptions on application of checksheet to instruction ($\bar{X} = 3.05$);
- (ii) positive perception was reported by the Biology teachers on the use of word clearing ($\bar{X} = 3.17$);
- (iii) Biology teachers had high perceptions on the use of demonstration kit ($\bar{X} = 2.95$);
- (iv) application of clay table training was positively perceived by the Biology teachers ($\bar{X} = 3.25$);
- (v) there was positive perceptions by Biology teachers on the use of communication skills ($\bar{X} = 3.29$);
- (vi) there was no significant difference in the perceptions of Biology teachers on the application of study technology principles to instruction based on their academic qualification and years of teaching experience; and
- (vii) there was significant difference in the perceptions of Biology teachers on the application of study technology principles to instruction based on their gender ($t_{(2717)} = 0.06, p > 0.05$), school type ($t_{(2717)} = 0.04; p < 0.05$) and school location ($t_{(2717)} = 0.02; p < 0.05$).

The study concluded that most Biology teachers were favourably disposed to the use of study technology principles in their class instruction. This implies that study technology principles are effective for the teaching and learning of Biology in the senior secondary schools. The study recommended that Biology teachers should make use of study technology principles for better learning.

CHAPTER ONE

INTRODUCTION

Background to the Problem

Science is the foundation upon which the bulk of present day things around us are built; it is also a field of study. It has made it possible for man to know more about the universe. It is described as a body of knowledge, a way or method of investigating, and a way of thinking in the pursuit of an understanding of nature (Abimbola, 2013). Olorundare (2014) describes science as a multidisciplinary human activity which involves a planned systematic investigation and understanding of the world, nature and the universe. This activity culminates into testable falsifiable and verifiable body of knowledge. Science education emphasises the teaching and learning of science process, skills and principles.

The intention is to lead to fundamental, applied research and innovation in sciences at all levels of education in order to cultivate inquiring, rational mind for the conduct of a good life and democracy, produce science for national development, service studies in technology and cause the technological development and understanding of the complexity of the physical development and conduct of life (FGN, 2014).

The accomplishment of these tasks, amongst others, forms the basis of science teaching and learning activities in the classroom. The standards for science education provide expectations for the development of understanding

for students through the entire course of their education. In Nigeria, science is taught in the Senior Secondary School as Biology, Chemistry, as well as Physics; they all constitute the main branch of pure sciences (Ababio, 2013). Biology could be defined as a natural science that deals with how the world is structured, how it functions and what these functions are, how it develops, how living things come into existence, and how they interact with one another and with their environment (Umar, 2011). Biology, as a discipline, is an integral component of many fields of studies contributing greatly to the technological growth of the nation. Such fields include medicines, pharmacy, nursing, biotechnology, nanotechnology, and many other areas.

Biology has helped in breakthroughs like test-tube babies, production of hybrids, production of genetically modified fruits and new methods of disease control and prevention in genetics, biotechnology, and agriculture. Biology is designed to produce educated individuals some of whom may or may not take to biological sciences in their professions but find it useful in their daily activities. However, in whatever professions they finally find themselves, it is hoped that biology education, which they have acquired in the school, would be of value to the totality of their education.

Abimbola (2017) posited that, the teaching of Biology should give students the opportunities to develop the following:

1. Knowledge of the concepts, models, theories and working methods of biology, and an understanding of their development.

2. The ability to analyse and find answers to subject-related questions, as well as to identify, formulates and solves problems.
3. The ability to reflect on and assess chosen strategies, methods and results.
4. The ability to plan, carry out, interpret and report field studies, experiments and observations, and the ability to handle materials.

Biology is a natural science and an important science subject, which must be passed at credit level by students willing to study biology- related courses such as medicine, pharmacy, nursing, or even study biology as a course in the tertiary institution. It is certain that plants and animals are the focus of biology since both groups of organisms are living things. In this wise, biology teaching requires skilful, trained personnel with a sound mental aptitude coupled with effective strategies and methods to effectively impart the knowledge of biology in order to promote quality biology education. Biology education exposed learners to principles, concepts, processes and equip them with necessary practical skills, as the knowledge of nature may help in solving many social problems relating to health, poverty, food shortage, crop production, environmental pollution and conservation (Adeoye, 2015).

In order to benefit greatly through offering biology as a subject, students need quality and qualified teachers to facilitate all these knowledge. Teachers' effectiveness has proven to be the most influential school-related

factor in students' performance. If a teacher's quality is one of the pillars of success in education, it follows then that a serious teacher-evaluation system should be put in place mainly because the purpose of evaluation is to recognise, cultivate and develop good teaching process (Ibekwe, 2015). Teachers' quality is directly proportional to students' performance. This implies that teachers' role in the preparation of students to succeed in examinations cannot be undermined. Teachers' qualifications in any educational system determine to a great extent, the quality of the system itself. Teachers' quality is widely thought of as an essential determinant of academic performance (Ibeawuchi, 2012). Academic performance is a measure of the output and the main changes in knowledge, skills and attitude of individuals as a result of the experiences acquired from the school.

Adeyemi and Bolarinwa (2013) emphasised the use of grades in examinations. They reported that grades could serve as predictive and criteria measures. Teachers stand as facilitators of knowledge, values and skills in the learning process. If the teacher is ineffective, students under his/her tutelage will achieve inadequate progress academically. Teachers cannot be dissociated from the schools where they teach and the academic results of the schools because teaching and learning depend on teachers. No wonder, an effective teacher has been conceptualized as one who produces desired results in the course of duty as a teacher (Uchenna, 2012).

In Nigerian senior secondary schools, Biology is a popular subject which many students enrolled for when compared to other science subjects like Chemistry, Physics, and Agricultural Science among others. Today, biology is no longer a core subject (FME, 2013). Despite the importance of biology to human being, the performance of Students in the Senior Secondary School Examinations (SSCE) is not encouraging. The aftermath of this in education is that many students that were affected may find it difficult to gain admission into higher institutions to study their heart-desired courses. This may result into shortage of human resources in science and technology-related disciplines. This may equally affect Nigeria's vision to be one of twenty industrialized nations in the world by the year 2020 (Gambari, Yaki, Gana & Ughovwa, 2014).

Students have the tendency to score a 100% grades if they have perfect understanding of the concepts taught by the teachers, evidence of this, is Farida Mustapha who graduated with a perfect score of 5.0 cumulative grade point achievements (CGPA) from the department of petroleum engineering, Kuban State University of Technology, Russia in the 2016/2017 academic session. Also, in (2013), Osemade Imafidan in University of Texas, Arlington, who had M.S. Microbiology with CGPA of 4.0 out of 4.0. Therefore, similarly, students in Nigeria senior secondary schools could be encouraged to obtain a 100% score in all the subjects especially in biology as a case study.

Table 1 shows the evidence of students' performance in biology in the WASSCE result from 2010 – 2019.

From Table1, it could be seen that the results have not been stable. Judging from the years reviewed, students performed below average from year 2010 to 2012 but the performance of students improved above average from year 2013 to 2019 with the highest percentage of 75.01 in year 2019. Although there was a remarkable improvement but this is still not good enough for a country like Nigeria that is in dare need of scientific knowledge such as biology.

Table 1

Candidates' Performance in May/June Senior School Certificate Examination in Biology in Nigeria

Year	Total Sat	Credit	%	Below	Credit	%
		Pass		Pass		
2010	1,300,418	427,644	33.90	872,774		66.10
2011	1,505,199	578,432	38.50	926,767		61.10
2012	1,646,150	587,044	35.66	1,059,106		64.34
2013	1,648,363	852,717	51.73	759,646		48.27
2014	1,365,384	766,971	56.17	598,413		43.83
2015	1,390,234	798,246	57.42	591,988		42.58
2016	1,200,367	740,345	61.68	460,022		38.32
2017	580,449	394,898	68.03	185,551		31.97
2018	1,087,063	679,299	62.48	407,764		37.52
2019	1,033,304	775,103	75.01	258,201		24.99

Source: Statistics Section, WAEC Office, Yaba, Lagos 2019.

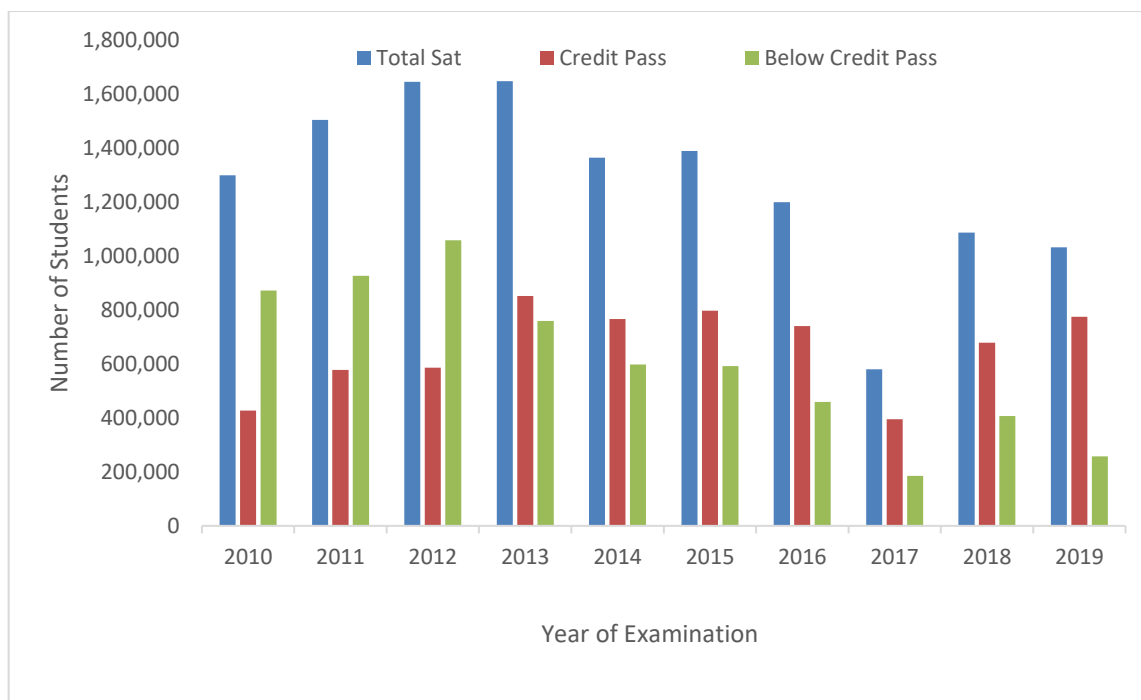


Figure 1: *Students' performance in WAEC Biology, 2010 – 2019*

In order to further improve on students' academic performance in any field of work, an eminent educator, Hubbard (2005) identified three barriers to learning which affect students' performance in the field of study. These are: lack of Mass, too steep a gradient, and the misunderstood words. Abimbola (2015) posited that a barrier is something which blocks the way. It is something which blocks studying by students thereby preventing them from learning. Mass is the actual physical object of the subject matter under treatment in a teaching-learning situation. Lack of mass simply refers to endeavouring to educate someone lacking the mass (or object) that he is going to be involved with. This can make study exceedingly difficult. This is a situation whereby the learning process is done in an abstract situation that is without the materials that can be used to describe the lesson by modification

or real material (Church of Scientology International, 2019). The Teachers are expected to provide students with the mass they need during lessons. If biology students are being taught about animals, they should be provided real examples of animals as are found in the zoo or in the community (Appendix X (A)).

When a teacher intends to teach a topic, the first thing to think about is how to find a real physical thing or object to use to illustrate the topic. In a situation where it is extremely difficult to find the real physical object, the following are reasonable examples of what can be used as substitutes: Picture, movie, demonstration, demonstration (demo) kit, clay demonstration, and sketching. Abimbola (2015) further explained that a gradient is a way of doing things level by level and step- by- step.

A steep gradient is the second barrier to study, and this is a way of doing things, which does not follow the systematic order by jumping steps. A gradient can be easy or difficult. If it is easy, the level and steps can be done easily. If it is difficult, it means the levels and steps cannot be done easily. It is when the gradient is steep or skipped that the levels and steps will not be done easily. A steep or skipped gradient means that some levels and steps are missing or left out. Skipped levels or steps leave steep gradient, which makes learning difficult to cope with. Just like skipping a step in a ladder when climbing which could lead to an accident in the process, so are students likely to have an accidental brain or accidental damage during the learning

procedures. When one hits too steep a gradient, a sort of confusion or realigns is experienced. At any time when learners try to ignore any learning process, the next stage will be affected which could in turn affect the learning outcome at the latter end (Appendix X (B)). Commonly, the difficulty is ascribed to the new action, when in fact it really stems from the previous action (Church of Scientology international, 2019)).

The third barrier to study is the misunderstood word which is a word that is not understood at all, it is called a misconception, and misconceptions are clearly wrong knowledge while alternative conceptions are clearly wrong or right (Abimbola, 2020). This is the most important barrier because it is capable of making learners quit what they are studying about or drop out from school completely (Appendix X(C)). If all these barriers to study are removed, students will perform better. A misunderstood is capable of thoroughly block one's understanding of a subject and can even reason one to abandon the subject wholly (Church of Scientology international, 2019).

The figure below illustrates the three barriers to learning (Abimbola, 2015).

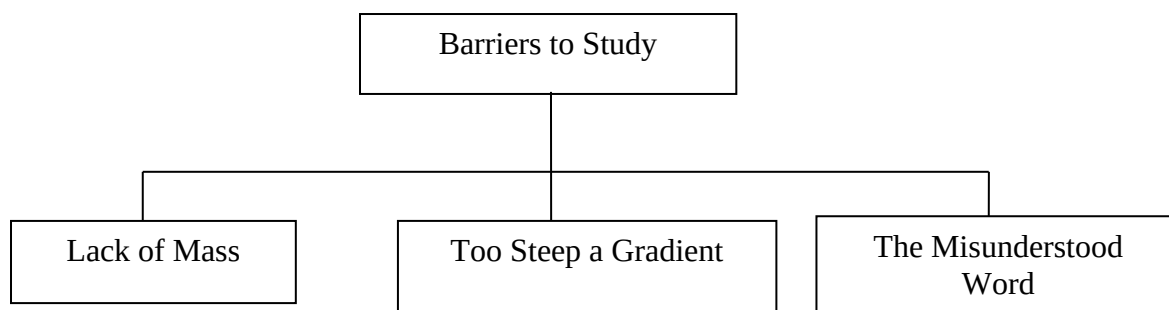


Figure 2: *The three barriers to learning (Abimbola, 2015).*

In order to promote an effective teaching and learning of biology, there is the need for innovative methods of teaching Biology in the senior secondary school. Innovation is the application of an idea or invention, adapted or refined for specific uses or in its particular contexts, (Gertner, 2012). Innovation in Biology education can therefore, be viewed as introducing new method of teaching and ideas, and accompanied by new changes in evaluating the outcomes of biology learning. Example of such innovative method is the use of study technology principles which was recommended by Hubbard (1998).

In Biology, like in any other subject, innovation can be, using new ideas in the curriculum content, learning experiences, and introducing new/modern instructional materials to any subject. Such innovation is introduced into the subject, in form of methods and ideas to promote dissemination of biology knowledge, skill acquisition, and attitude training in students.

Study technology, is an innovative instructional strategy in Nigeria which produces the materials and rules to study and learn efficiently so that learners can actually apply what they have learnt in school, and not just repeat it back to pass an examination. While passing an examination is important, it is not nearly as important as students being able to use what they learnt. If students cannot use what they have learnt in school, they will fail at work, in relationships, and ultimately in life.

Hubbard (1998) defined study technology as the basis of all applied scholastics programme and teaching methods. It consists of tools and techniques teacher can use to improve the learning rates of their students. This can be used by students to improve their ability to understand and use the material they read and study. Study technology is a spearhead to a bright new world of understanding and achievements and it forms the basis of the success of all applied scholastic educational programmes.

Study technology, developed by Hubbard (1998) is a unique programme enabling a student to overcome the basic barriers to studying and learning the subject so that he/she can understand and retain the data, which he/she is trying to absorb and can effectively apply. The introduction of study technology into educational system could assist in achieving the following objectives, which was highlighted by Ahmed (2017). These are also directly related to the role of study technology in the teaching of Biology:

1. The knowledge of types of barriers to study

2. Ability to identify mental and physiological reactions to barriers to study
3. Knowledge of remedies to barriers to study
4. Application of knowledge gained in improving teaching and learning
5. Knowledge of effective communication skills for teachers and students
6. Drills in effective communication skills
7. Ability to handle student disciplinary problems and
8. Awareness of the usefulness of study technology principles and strategies.

Therefore, there is the need to constantly update instructors and learners on innovative strategies and tools of teaching and learning that showcase best practices in unlocking the barriers to study, thus creating a self-regulated learner. Study technology was introduced by the Federal Government of Nigeria in (2004) through a basic training program sponsored by the Educational Trust Fund now TETFUND (Tertiary Education Trust Fund). Abimbola (2013) identified some of the principles of the study technology which could be used for instruction at any level of education as follows:

1. Availability of standard, subject and reference dictionaries.

2. Availability of demonstration (Demo) kits containing miscellaneous objects.
3. Availability of course materials, in form of textbooks
4. Check sheet or study guide based on the textbooks in each subject.
5. Student partnership – twins (a form of cooperative learning).
6. Absence of verbal data
7. Word-clearing is in use with the aids of standard, subject and reference dictionaries.
8. Clay table training is provided for mound objects of study
9. Chinese school is in use to practice and aid remembering of concepts processes, and so on
10. Projection equipment is available to project learning materials
11. Self-discipline is practised by students
12. Study technology is in continual use.

Science education experts like Abimbola (2013), Danmole (2011), and Olorundare (2011) also noted that teachers need to employ different learning methods and strategies to ensure students understanding of scientific concepts. The majority of teachers who have been employed to teach science particularly biology are specialists in only one area of science discipline such as agricultural science, basic or integrated science, or physical and health education. This may account for the reasons why students' performance in

Biology is low. In order to solve this problem, a shift is therefore advocated by these researchers, on methods that facilitate understanding as stated in the curriculum. Olorundare (2014) reported that students are not doing well in biology as compared to other science subjects. Factors responsible for these poor performances are numerous among which is teachers' poor quality (Omorogbe & Ewonsiha, 2013).

Abimbola (2009) defined teaching as a process of facilitating students' learning through a proper management by the teaching of the interrelationship among the students' interest, the content for learning and the materials he/she tends to use in teaching and learning of the content materials.

Biology is a science subject which is taught in the senior secondary school and tertiary institution. Biology teachers are those who teach or impact biology subject matter, knowledge or course in teaching and learning situation. An effective Biology teacher is an individual person who has been trained in order to teach the subject meaningfully and manage the teaching-learning process effectively, helps the learners to imbibe ideas and impart knowledge to develop skills and understand the good word so that he can develop his own innate potentials. This is also someone who has a high intellectual capacity to understand the child's growth and development, the psychology of learning and the management of teaching systems (Okunloye, 2015). Biology teacher should work towards instructing students for perfect understanding; teachers only facilitate learning while students construct their

own learning; when instructions deliberately remediate misconceptions and alternative conceptions, only correct knowledge remains, leading to possible perfect understanding by the students (Abimbola, 2020).

Biology emphasizes practical knowledge which would allow the teachers to guide their students to involve all their sense organs in the learning process for proper understanding so as to aid students' proper perception of the learning task. Perception is one of the concepts that are critically studied in psychology. Psychologists are more interested in what, when and how people perceive things and the possible effect it has on their behaviours.

Mcshane and Glinow, (2008) defined perception as the process of receiving information and the making sense of the world around us. It entails deciding which information to notice, how to categorize this information, and how to interpret it within the framework of our existing knowledge. In other words, perception is the process of receiving information and stimuli from the surrounding environment, then interpreting the information and categorising it in the framework of knowledge appropriately.

Thoha (2010) argues that perception is more complex and broader compared to sensing process because perception includes difficult interactions from selection, compilation and interpretation activities. Perception also depends on sensing which then occurs as a cognitive process of filtering, simplifying, and changing or perfecting the information received.

Experience can be said to be those attitudes or skills acquired by the teacher through his perception and participation in instructional programmes. Experience in any profession is considered an asset. Teachers teaching experience is a vital tool in any science teaching and learning situation. Experience can be said to be that attitude or skills acquired by the teachers through their participation in an instructional programme (Lawal, 2011).

The teacher gender could be key facilitator for the success of any educational endeavour at all levels of the system. In order to help different learners master more challenging contents, teachers must go far beyond dispensing information giving tests and grades. The teacher's gender, academic qualifications, knowledge of subject matter, competencies and skills, as well as his/her commitment, have a great impact on the teaching and learning process. Poor quality of Biology teachers in terms of adequate knowledge base and pedagogic skills is another factor identified to influence students' achievement (Ngwu, Ellah&Emmadiole 2019). Adigun and Yusuf (2010) studied the influence of school types, sex and location on students' academic performance and found out that the level of students' academic performance was low; it was also revealed had no influence on students' academic performance.

More so, Elayelogba,(2010) saw the teacher as an individual who has specific professional training, who is certified and also engages in the enterprise of teaching. The happiness and success of individuals, as well as

the progress of society, have always been on the quality of the teaching-learning process and also they are of the view that probably recognition regarding the teaching profession is very poor. In Nigeria, teaching is seen as a stepping-stone to greener pastures, even among trained teachers, teaching is a job of last resort.

The National policy on education emphasized that the knowledge and applications of science, Technology, and mathematics are indispensable for the transformation of Nigeria economy into an industrial and self-reliant one (FGN 2014). It stipulated that students at the senior secondary school level should be taught by the adequate number of qualified teachers. It further stipulated that there should be a teacher to only twenty-five students and that teacher should possess at least a first degree in their relevant field of teaching.

This research study focused on senior school biology teachers' perceptions on the application of study technology principles to instruction in Kwara State, Nigeria. This is an innovative instructional strategy that could be adopted by the teachers to improve biology teaching and learning in the senior secondary schools in Kwara State so that students can have perfect understanding of biological concepts. In order to consider the senior school biology teachers' perceptions as regards application of study technology principles to instruction, there is the need to put into consideration the following variables: Teachers' academic qualification, teachers' years of teaching experience, teachers' gender, their school type, and school location.

Statement of the Problem

Study Technology, a meta-learning instructional method has been documented in literature to foster the elimination of the three major barriers to learning namely misunderstood words, lack of mass and steep a gradient, and thereby enhance meaningful learning. These barriers to learning have been widely reported in literature to be responsible for students' poor performance in Biology. There is no evidence in literature on biology teachers' usage of study technology principles to instruction in Kwara State. Although, few studies have shown that the application of study technology principles enhanced students' perfect understanding of the concepts taught by the teachers, however, there seems to be dearth of studies on teachers' perceptions on application of study technology principles to instruction in Kwara State.

Few among these studies are: Applied Scholastics international that have applied study technology to instruction with about hundred (100) African-American students in Mississippi. Before study technology was applied, the teachers and administrators were struggling to achieve adequate yearly progress and to overcome the hopelessness that characterized their students' body (Applied Scholastics International, 2019). Edukugho (2017) reported that in Mexico City, study technology was introduced into a private high school in which one class had a 95% failure rate on their materials. After

the students learned how to use study technology, the same class achieved 90% pass rate.

Adeoye (2021) investigated the effects of modelling clay and demonstration kit on senior school students' performance in cell division in biology in Omu-Aran. Adeoye observed that those students, on whom modelling clay and demonstration kit were used to teach them, performed better than the other group. In addition, Adeosun (2015) investigated the impact of applied scholastics for 377 teachers on how to break the barriers to study in western part of Nigeria. The result of the experimental group was later compared to those students whose teachers were not exposed to the training; significant results were noted. Also, a considerable impact was felt among the students whose teachers were exposed to the training.

All these researchers reported that study technology is an effective instructional strategy which can bring about perfect understanding by the students if used appropriately. These studies were experimental studies involving few biology teachers in an attempt to sample the opinions of a large number of biology teachers. This present study focused on investigating the senior school biology teachers' perceptions as regards the application of study technology principles to instruction. This is because teachers are the major factors in the effective use of study technology principles as instructional strategies.

Hence, their adequate knowledge about this method would promote effective learning of biology by the students. Also, few teachers in some selected schools were involved in the previous studies in some parts of Kwara and Ekiti States but the present research work involved all biology teachers in all the Senior Schools in Kwara State. The past studies were focused on few principles of study technology but this present study involved all the principles of study technology.

Purpose of the study

The main purpose of this study was to investigate the perceptions of senior school biology teachers on the application of study technology principles to instruction in Kwara State, Nigeria. Specifically, attempt was made in the study to investigate:

1. Perceptions of senior school biology teachers on the application of study technology principles to instruction;
2. Perceptions of qualified and unqualified senior school biology teachers on the application of study technology principles to instruction;
3. Perceptions of senior school biology teachers on the application of study technology principles to instruction based on their years of teaching experience;
4. Perceptions of senior school biology teachers on the application of study technology principles to instruction based on gender;

5. Perceptions of senior school biology teachers on the application of study technology principles to instruction based on the school type and;
6. Perceptions of senior school biology teachers on the application of study technology principles to instruction based on school location.

Research Questions

In this study, answers were sought to the following research questions:

1. What are the perceptions of senior school biology teachers on the application of study technology to instruction?
2. What are the perceptions of senior school biology teachers on application of chechsheet to instruction?
3. What are the perceptions of senior school biology teachers on the application of word clearing to instruction?
4. Do biology teachers have different perceptions on application of demonstration kit to instruction?
5. Is there any significant difference in the perceptions of senior school biology teachers on the application of Chinese school to instruction?
6. Do biology teachers have different perceptions on application of clay table training to instruction?
7. What are the perceptions of biology teachers on the application of use of projection equipment to instruction?

8. Do biology teachers have different perceptions on application of the communication skills to instruction?
9. What are the perceptions of biology teachers on the application of study technology principles to instruction based on their academic qualification?
10. Does biology teachers' years of teaching experience influence their perceptions on the application of study technology principles to instruction?
11. Does gender have, any influence on the perceptions of the senior school biology teachers on the application of study technology principles to instruction?
12. Is there any difference in the perceptions of senior school biology teachers on the application of study technology principles to instruction based on the school type?
13. Does school location influence the perceptions of the senior school biology teachers on the application of study technology principles to instruction?

Research Hypotheses

The following research hypotheses were tested:

- H₀₁ There is no statistically significant difference in the perceptions of senior school biology teachers on the application of study technology principles to instruction based on academic qualification.

- H₀₂ There is no statistically significant difference in the perceptions of experienced and less experienced senior school biology teachers on the application of study technology principles to instruction.
- H₀₃ There is no statistically significant difference in the perceptions of male and female senior school biology teachers on the application of study technology principles to instruction.
- H₀₄ There is no statistically significant difference in the perceptions of senior school biology teachers on the application of study technology principles to instruction based on the school type.
- H₀₅ There is no statistically significant difference in the perceptions of senior school biology teachers on the application of study technology principles to instruction based on the school location.

Scope of the Study

The geographical coverage of this study was Kwara State, Nigeria. The content scope was Biology; the sample scope was seven hundred and twenty (720) senior school biology teachers in Kwara State.

The following variables were considered;

1. Teachers' academic qualifications
2. Teachers' years of teaching experience
3. Teachers' gender
4. School type, and
5. School location.

Significance of the study

Results of this study would be of use to major stakeholders in the field of biology education such as students, teacher, curriculum designers, teacher educators, teacher education institutions, textbook authors and researchers among others.

Specifically, biology teachers may be encouraged by the findings of this study to consider regular application of study technology in the class lessons to enhance effective and efficient teaching. This will enhance perfect understanding of the topics of biology lessons. Consequently, students' achievement at the final senior school certificate examination would improve significantly; findings of this study could stimulate biology curriculum designers to consider the application of study technology principles when reviewing the curriculum. Biology textbook authors could equally consider the application of study technology principles when writing or revising biology textbooks.

The outcome of this study might be useful for Professional Associations like the Science Teachers Association of Nigeria (STAN) as an area to explore in building the capacity of their members. It may also serve as a springboard for research in Nigeria to explore the potentials of using study technology to improve students' learning in all the 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; West African

Examination Council (WAEC), NECO, and NABTEB on the need to organize relevant workshops and seminars on awareness of the study technology principles for improving the quality of biology teachers

Clarification of Major Terms and Variables

Perceptions: is a process of receiving information and making sense of the world around us.

Study Technology: is a research-based system of learning how to learn which includes basic principles and workable methods for application in the field of study.

Principles: A law or fact of nature that explains how something works or why something works or why something happens.

Qualified Biology Teachers: These are the biology teachers who possess at least the Bachelor of Science in Biology Education. It also includes graduate teachers with Bachelor and Masters of Education degrees in biology.

Unqualified Biology Teachers: Biology teachers who do not possess at least the Nigeria Certificate in Education or any degree in the field of education.

Experience Biology Teachers: Teachers who have consistently taught biology for at least five years and above in Senior Secondary Schools.

Less Experienced Biology Teachers: Biology teachers with less than five (5) years teaching experience of teaching biology in Senior Secondary Schools.

Gender: A socially ascribed attribute, which differentiated what, is generally referred to as feminine or masculine i.e. the fact of being male or female.

School type: These are the private and public secondary schools where biology teachers are teaching biology.

Private Schools: These are the schools owned and managed by the missionaries, Religious bodies, individuals and private organizations.

Public Schools: These are the Schools that are owned and managed by the Government.

School location: These are the places where schools are sited, either urban or rural area.

Applied Scholastics: Is a non-governmental organization which is secular in nature, used in study technology.

Biology Teachers: These are the teachers teaching Biology in the senior secondary schools

Instructional Strategy: Set of guidelines, methods or techniques in sequential manner, adopted to represent instructions in order to achieve the objectives of instruction.

CHAPTER TWO

REVIEW OF RELATED LITERATURE

This chapter presents a review of the related literature to this study. The review has been presented under the following sub-headings:

- Theoretical Framework for the Study
- The Objective and Contents of Senior Secondary School Biology Curriculum.
- Studies on Teaching Methods and its Influence on Science.
- Study Technology as an Instructional Strategy.
- Empirical Studies on Teachers' Qualification and its influence on Teaching of Science
- Empirical Studies on Teachers' Years of Teaching Experience and its influence on Teaching of Science
- Empirical Studies on Teachers' Gender and its influence on Teaching of Science
- Empirical Studies on Teachers' School Type and its influence on Teaching of Science
- Empirical Studies on Teachers' School Location and its influence on Teaching of Science
- Appraisal of the Reviewed Literature.

Theoretical Framework for the Study

The first theoretical base for this study originated from Piaget (1964) and Von Glasersfeld (1996) constructivist theory of learning by Hubbard (1971) study technology principles of learning. The constructivists believe that learning is an active process of creating meaning from different experiences. In other words, students will have perfect understanding by trying to make sense of something on their own with the teacher as a guide to help them along the way. Piaget (1964) defined knowledge as the ability to modify, transform and operate on an object or idea, such that it is understood by the operator through the process of transformation. Good teaching therefore according to Piaget is built around the operational abilities of the students such that they can excel in their operational stage and build on pre-existing structures and abilities.

Piaget's theory of constructivism is based on the principle of equilibration brought about by adaptation through the process of assimilation and accommodation of new information into existing cognitive structures and thus leading to the formation of new schema (Berkeley Graduate Division, n. d.). Piaget (1977) also contended that "cognitive equilibriums are closer to those stationary but dynamic states, which are capable of building and maintaining a functional and structural order in an open system, and they resemble above all the biological dynamic equilibriums" .

Fosnot and Perry (n.d.) described assimilation as the organization of experience based on an individual's self-assertive tendency to view, understand, and act on the "surround" with one's own activity or ideas in order to preserve one's autonomy as a part of a whole system. Accommodation, on the other hand, comprised of reflective, integrative behavior (reflective abstraction) which serves to change how an individual explicates the object, in order to function with cognitive equilibrium in relation to it. Thus, assimilation causes an individual to incorporate new experiences into the old experiences while accommodation involves the restructuring of the world and new experiences into the pre-existing mental capacity.

The cognitive development of children according to Piaget can be classified into four main stages which are the sensor motor, preoperational, concrete operational, and formal operational stages (Abimbola, 2017). The age range of children at the formal operational stage of Piaget's cognitive development as shown in Table 2 cohere with the average age of 14 years of the senior secondary school biology students in which the biology teachers teach in the present study.

Table 2

Piaget's Cognitive Developmental Stages

Stages	Age Range	Description
Sensor motor	0-2years	Coordinating of senses with motor response, sensory curiosity about the world. Objects permanence developed.
Preoperational	2-7 years	Symbolic thinking, use of proper syntax and grammar to express full concepts. Imagination and intuition are strong, but complex abstract thought still difficult. Conservation developed.
Concrete Operational	7-11 years	Concepts attached to concrete situations. Time, space, and quantity are understood and can be applied, but not as independent concepts
Formal Operational	11+	Theoretical, hypothetical, and counterfactual thinking. Abstract logic and reasoning. Strategy and planning become possible. Concepts learned in one context can be applied to another

Adapted from Kohlberg's Theory of Moral Development, by Psychology NotesHQ2012, Retrieved from <https://www.psychologynoteshq.com/kohlbergstheory/>

Von Glaserfeld (1996) on the other hand identified two main aspects of constructivism. First, learning is a process of knowledge construction instead of absorption and since each learner has to construct his or her

knowledge, concepts cannot be transmitted from the teacher to learners by means of words. Second, knowledge is highly related to the environment in which the learner experiences and constructs the knowledge. This made Chen (2003) concluded that learning occurs only when the learners are actively involved in the construction and reorganization of concepts. Therefore effective teaching and learning of biology concepts requires the learners being able to construct and reorganize the concepts as submitted by the learning theories of Piaget (1964).

It was as a result of this that Hubbard(1971) identified three major barriers to learners' study namely, absence or lack of mass, too steep a gradient and the misunderstood words which also constitute the principles of Applied Scholastics International.

The present study is majorly based on the three basic barriers to study which states that, when introducing a new concept, it is important to have an example physically present to "get its mass". If it is not possible to present a physical example, then a picture or diagram or a demonstration of the concept should be provided and why the study technology classrooms are equipped with principles of study technology such as use of course guide, basic word clearing with reference dictionary, demonstration kit, clay table training, Chinese school and use of projection equipment (Abimbola 2013). This tally with the submission of Kafaai and Resnick (1996) that one of the recommendations of constructivism is to engage students in building objects

and this conforms with Duyilemi and Bolajoko (2014) that constructivism helps students to contribute their own ideas to learning which implies that their minds are not totally empty and vacant. Constructivism is a promising approach to assist learners in building theoretical constructs because it creates the means of objectifying constructs, that is building physical displays that allow the explicit representation of key theoretical constructs'' Resnick's work (as cited in Chen, 2003). Nee (2014) reported that students' cognitive thinking is best developed when various mediums are incorporated together.

The role of teachers is fairly important within the constructivism learning theory, instead of giving a lecture the teachers in this theory function as facilitators whose role is to aid the student when it comes to their own understanding. This takes away focus from the teacher and lecture and puts it upon the students and their learning. The facilitator, in this case, must make it so that the students come to the conclusions on their own instead of being told. The constructivist appreciates the essence of building constructs and internalizing the knowledge given, rather than accepting information as presented through rote-memory. This view of learning is based on the perception that knowledge cannot be given to a learner by the teacher but that rather it is constructed by the learner through an active mental process of development (Olorundare, 2014).

Jonassen (1996) stated that learners must be given opportunities to be active in ways that will promote self-direction, creativity and critical analysis

of problems requiring a solution. Brown *et al.*, (1989) affirm that learning that becomes a continuous, life-long process results from acting on situations. Chen (2003) observed that learners, not the teacher, are responsible for defending, providing, justifying, and communicating their ideas to the classroom. These types of task place a very high cognitive demand on the learners as they are no longer able to simply memorize contents and repeat it on tests and assignments.

Numerous educational and psychological studies all converge on one key point, that responsibility for learning lies within the individual and no person can learn something for another (Manning and Payne, 1996; Winne, 1995; Zimmerman and Schunk, 1989). Wilson (1997) created a list of opportunities for learners to develop more active constructions of meaning. They included simulations, strategy and role-playing games, toolkits and multimedia learning environments, intentional learning environments, storytelling structures, case studies, Socrates dialogues, coaching and scaffolding, learning by design, learning by teaching, group cooperation, collaborative learning and holistic psycho-technologies.

Thus, constructivism is a model of learning in which students learn not just by receiving a message but by interpreting the message (Nwagbo & Obiekwe, 2010). The principles of study technology developed by Hubbard (1998) coincides with the theory of constructivism because students versed in study technology principles of learning constantly assess where they are

having difficulties and apply appropriate strategies to solve the problems they encounter while studying (Kyhl, 2003). Teachers can also use the same strategies to improve the learning rates of students because the end results of the application of study technology are students who know how to learn, how to study and are motivated independent lifelong learners (Abimbola, 2013b).

Olowoye and Odunade (2016) also noted that study technology is an intensive and innovative teaching strategy that looks at learning from the learner's perspective. Study technology as principle of teaching and learning also upholds the constructivists idea of learning how to learn due to the belief that "students fail to learn because no one ever taught them how to learn that is, how to identify the barriers to learning and how to overcome those barriers" (Applied Scholastics International, 2019).

The role of teachers is fairly important within the constructivism learning theory, instead of giving a lecture the teachers in this theory function as facilitators whose role is to aid the student when it comes to their own understanding. This takes away focus from the teacher and lecture and puts it upon the students and their learning. The facilitator, in this case, must make it so that the students come to the conclusions on their own instead of being told. The constructivist appreciates the essence of building constructs and internalizing the knowledge given, rather than accepting information as presented through rote-memory. This view of learning is based on the perception that knowledge cannot be given to a learner by the teacher but that

rather it is constructed by the learner through an active mental process of development (Olorundare, 2014).

Based on Constructive learning theory, the role of teachers as facilitator for effective construction of concepts by learners cannot be overemphasized. Hence, there is the need for teachers to have enough perceptions of strategies that are required to put the learners on the right track as regard learning of concepts such as that of biology which has major role to play in human lives. For instance, Hubbard recommended the use of study technology principles for effective teaching and as a result to make use of these principles appropriately for learners, there is the need to know the perceptions of the teachers about the study technology. Knowing the perceptions of the teachers about study technology will go a long way in determining whether they will be able to act as facilitator or not. Since as a teacher you can only offer what you know. Therefore, the theory of perception is the second theory for this study.

Perception is one of the concepts that are critically studied in psychology. Psychologist is more interested in what, when and how people perceive things and possible effects it has on their behaviours. Oxford Advanced Learners Dictionary (2015) defined perception as an idea, a belief or an image you have as a result of how you see or understand something. Perception is the cognitive impression that is formed of 'reality' which in turn

influences the individual's actions and behavior toward that object (<http://www.ifla.org/vii/s34/pubs/glossar>).

Mcleod (2012) is of the view that in the process of perceiving a physical object and an issue perceived. Input refers to senses, processing is the brain while output refers to the reactions. Then object or issue which a perceiver perceives will be registered in his senses. This could be through sight for vision, hearing for audio or audiovisual when the two sense organs are combined for proper perception, it could be by feelings something or tasting.

Biology as one of the science subjects emphasizes practical lessons which would allow the teachers to guide their students to involve all their sense organs in learning processes for proper understanding as to aid the students' proper perception of the learning task. Mcleod (2007) further submitted that, whatever may be the case, the perceived object (material or immaterial) will be first of all register in the sense(s) as the case may be. The stimuli are processed in the brain where most of the incoming stimuli are selected while others are rejected. This process leads to output which is the reaction or change in behaviours as a result of the opinions formed based on the stimuli that are stored in the brain.

The combinations of the four major factors mentioned above that work together in the process of perception are as follows:

Surrounding (object or issue) ➤ input (senses) ➤ processing (brain) ➤ output (reaction). This study, senior school biology teachers' perceptions on the application of study technology to instruction in Kwara State, Nigeria is being carried out to bring about changes in behaviours of the Senior School biology teachers which will enhance their students' perfect understanding of biological concept.

Many scholars and psychologists have worked on the theories of perception. Some proposed a direct theory of perception which is a bottom-up theory. Some argued that perceptual processes are not direct, but the information available in the stimuli itself. These theories are relevant in these studies because of the students taught by their teachers' individual differences and intelligent quotients.

Gregory (1970) proposed perception as hypothesis; he 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. This is in support of Gregory's (1988) theory who was of the opinion that we receive information from the environment via our senses, and that the information need to be processed and organized by the brain so that we can make sense out of it. This is a top-down theory which is a constructivist (indirect) theory of perception.

Gibson's (1966) direct theory of perceptions known as bottom-up theory, proposes that perception is direct. According to Gibson, there is enough information in our environment to make sense of the world in a direct way and that perception is a bottom-up process, which means that sensory information is analysed in one direction, from simple analysis of raw sensory data to ever increasing complexity of analysis through the visual system. The process of visual perception starts by analyzing the basic features of sensory input and then gradually works up to more complex processing. Gregory (1988) indirect theory of perception known as top-down theories propose that information and knowledge stored in the brain works downwards, helping us to interpret the basic sensory input, which are normally unclear, so we interpret it by dealing with it as a problem-solving task. We need knowledge stored in the brain to do this.

According to Gibson (1988a) perceiving is an active process, we don't just see, we look, we don't just hear, we listen. The visual system, for example, is a motor system as well as a sensory one. It involves more than the retina or even the moving eye. (Gibson 1988b) submitted that perception functions to gather information about objects, events and places and what the perceiver can do about these things. This is in support of Gibson (1997) who proposed that perception guides action in a changeable environment. Thus, perception and action operates as a continuous cycle, whereby "perception obtains information for action, and action has consequences that inform

perception about both the organism itself and the events that it perpetrates”, p.25.

McLeod, (2007) visual perception theory made it clear that in order to receive information from the environment we are equipped with sense organs e.g. eye, ear, nose. And each sense organ is part of a sensory system which receives sensory inputs and transmits sensory information to the brain. He submitted that when one thinks, then he understands, without having thought, one does not know; it is only after thought that one understands. He conceived the mind as having two compartments viz, the thinking portion and the perceiving portion.

And that it is easy to stop the thinking portion but it is extremely difficult to stop the function of the perceiving portion. So also McLeod (2007) submitted that psychologists distinguish between two types of processes in perception: bottom-up processing and top-down processing. Bottom-up processing is also known as data-driven processing, because perception begins with the stimulus itself. Processing is carried out in one direction from the retina to the visual cortex, with each successive stage in the visual pathway carrying out ever more complex analysis of the input. Top-down processing refers to the use of contextual information in pattern recognition. For example, understanding difficult handwriting is easier when reading complete sentences than when reading single and isolated words. This is

because the meaning of the surrounding words provides a context to aid understanding.

Herz (2010) worked on associative learning showed the extent to which experience plays a vital role in perception. Associative learning is the process by which one event or item comes to be linked to another through experience. According to Torpev (2010), experience plays a vital role in perception. What people perceive that eventually lead to formulation of opinion and behavioral pattern is mostly the bi-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 behavior.

The students are exposed to the contents of the biology curriculum in the Senior Secondary Schools by their teachers (biology teachers); the learning experience of students in biology is to bring about change in their behavior. Gibson's (1997) theory of perception-in-action shows relationship between perception, experience and action. The simple explanation is that the issue perceived is interpreted by the brain (processing) based on experience in which the resultant effect is the action taken based on the opinion formed through the chain of activities, perception, experience and action can be classified as birds of the same feathers that always move towards the same direction. So, it is expected of the senior school biology teachers who have the right perception of what study technology principles are all about to be

able to put into action as some of the instructional strategies used during the teaching and learning of biology.

Glaserfeld (1996) theory of social constructionist maintains that continual adjustment of perception and action to the external input is what constitutes the entity. By implication, there should be constant review of people's perception as nothing in life is permanent. Herein lies the significance of research focusing on teachers' perceptions on wide range of issues in teaching and learning. The focus of this study is on senior school biology teachers' perceptions on the application of study technology principles to instruction in Kwara State, Nigeria.

Gestalt psychology is another theory on perception which deserves attention. The theory was propounded by three Germans namely Max Wertheimer, Kurt Koffka and Wolfgang Kohler. Gestalt is a German word which means pattern, shape form or configuration. The theory posits that the operational principle of the brain is holistic, parallel and analog, with self-organizing tendencies. Gestalt effect refers to the forming capability of our senses, particularly with respect to the visual recognition of figures and whole forms instead of just a collection of simple lines and curves.

The gestalt psychologist opposed the behaviorists' view that everything we see or think is put together in tiny pieces like those jigsaw puzzle, instead they advocate that we perceive and think of whole (Wertheimer, 1923). They further assert that our perception of the world of

meaningful whole and that is different from one more than an accumulation of sensations, images or idea. In order word, better appreciation or understanding of an object perceived could be achieved when such object is perceived within an environment according to all of their elements taken together as a whole.

According to khalid (1999) the Gestalt equally oppose to atomism just as they did to behaviorisms. Atomism examines parts of things with the idea that these parts could be put back together to make whole. The Gestalt argument is that what will happen if the perceiver does not have the organizational ability to put the parts as whole. The object or issue will be segmental presented without connotation of any meaning. Gestalt psychology theory is relevant to study technology principles. This is because the ability of the perceiver to holistically perceive the objectives of biology will enable him to form opinion and behavioral pattern in regards to the issue perceive.

In order to have a clear basis in which perception could be rooted on, the Gestalt psychologist came out with five basic laws of perceptual organization. These laws of perceptual organization were developed based on series of experiments in the field of perception. The basic laws are described below:

Law of Figure-Ground: this law states that everything we perceived stands against a background. There is a close relationship between figure and ground. The national objectives of any society which are endorsed as

necessary foundation for national policy on education are based on the people culture, needs and aspirations, etc. just as a figure cannot be recognized if it is not against a background, any educational programme that does not meet the public desires and expectations will not stand the taste of time.

Principle of Pragnanz: The principle states that our perceptual pattern always tends to be simple, regular and complete with no loose ends. The gaps are closed by the perceiver. This law of closure operates with the principle of pragnanz in all sensory modalities. This principle goes in with perception sequences of events in perception process as mentioned earlier. This means that perception can only effectively take place when the sense organs are able to properly decode what is perceived which will in turn be interpreted by the brain. It is at this point that selection is done based on the experience of the perceiver. For instance, a student may choose a career in biology due to his/her experience.

The law of Transportation: The principles states that because Gestalten are isomorphic to stimulus patten, they may undergo extensive changes without losing their identity. Changes are inevitable but once an issue is rooted on a background, no matter how it will be altered, it will still maintain its identity. For instance, no matter how objective of an educational programme e.g. biology education are altered, it may not lose its identity because it is rooted on national objectives which are expression of people's need and aspiration putting their culture into consideration.

Law of Similarity: The law maintains that similar words, numbers and objects that tend to associate in a group are easy to recall than dissimilar ones. In a classroom setting, concepts, theories and principles which have similar characteristics could be easily understood by learners. According to Soyibo *et al* (2013), classification simply means arrangement into groups. Visually, things which share visual characteristics such as shape, size, colour, texture, value or orientation will be seen as belonging together and could be easily understood.

The Law of proximity or Contiguity: The law states that things which are closer in time and space tend to form a Gestalt. This law explains the reason why students tend to perceive current educational issues particularly those that take place in their immediate environment. According to Gestalt psychology perception deserves attention. Perception of Educational Objectives: For instance the objective of the biology curriculum could be achieved if it is given attention.

Attention according to Oxford Advanced Learner's Dictionary (2006), is defined as the act of listening to, looking at or thinking about something. The contents of biology curriculum are taught to the Senior Secondary School Science students in order for them to listen to, look at and think of what could be benefited from it. The topics of perception and attention merge into each other since both are concerned with the question of what we become aware

of in our environment. We can only perceive things we are attending to, we can only attend to things we perceive.

This is in agreement with Okunloye (2009) that it is only when attention is adequately given to sensation that organization and interpretation of information leading to perception will come to play. This is in agreement with Wallace, Goldstein & Nathan (1987) that a thing may be presented to a man hundred times but if he persistently fails to notice it, it cannot enter his experience. Attention therefore, plays significant role in people's perception.

Sensation and attention are a coin of different faces that is inseparable. This is because attention can only be given to issues through sensation. On the other hand, there has to be enabling environment in the perceiver for effective functioning of the senses for easy perception which is attention.

Attention on the other hand is a phenomenon that involves filtration of information that could be conveyed by the sense organs to the brain. According to Okunloye (2009), filtration at this point connotes that is not everything in the environment that human being pay attention to neither do they attend to all the stimuli registering information, or signal on the sense organs.

Gleitman (1995) support this view as he observes that people's perceptual system shapes and organizes the patchwork of different sensation, into a coherent whole that has depth, motion and form which results from bottom-up and top-down processing, however, not all that is perceived

is given equal weight. Our ability to observe and interpret stimuli around us is finite; therefore, our perceptual system is forced to choose among them. The various ways in which we exercise such choices and perceive selectively is what is often referred to as attention. This biological explanation is supported by Deutsch and Deutsch (1963) as they opined that biological limitation on the amount of information that can be processed at one time compelled the perceiver to give attention to the only ones that can be accommodated as such a particular time.

The new biology curriculum is organized around just four themes. These themes are expanded into contents to ensure the attainment of the goals of biology in the society. The contents are broken down into three years to be taught by the teachers in order to gain the attention of the students.

Aristotle's theory of perception explains the significant role attention plays in perception. According to the theory, 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. This has to be total commitment of his faculties that will be involved in perception. More so, he has to be practically involved directly or indirectly in the issue he perceives. This is the more reason why it was stated in the general objectives of the biology curriculum as provided in the National Policy of Education(FRN, 2013) to equip the learners with adequate laboratory and field skills in biology.

The objective and contents of Senior Secondary School Biology

Curriculum

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 our cells, to broad scale concept of ecosystem and global climate change. Eldon (2007) stated that the nature of science and the fundamental biological concept is so important for any person, regardless of his or her occupation. Biology as a subject covers various topics that are life's processes, e.g. movement, respiration, nutrition, irritability, growth, excretion and reproduction. The life's processes are characteristics of all living things that have life and carry out life's activities. Biology education is beneficial to individuals in the following ways;

1. It prepares the individual for their choice of careers such as medicine, agriculture, and teaching.
2. It helps human beings to understand the parts of their bodies and their functions.
3. It enables human beings to question superstitions due to sustained interests arising from the comprehension of causes and events.
4. It brings into focus, the need to maintain good health, for example; good sanitation, eating an adequate diet, vaccination against diseases, exercise and adequate rest.

5. It powers the understanding of the relation of human beings to their environment as well as knowledge of the inter-relationships existing between living and non-living things in their environment (Sarojini, 2011).

The National Policy on Education emphasizes the teaching and learning of science at all levels of our educational system. The policy stated that science education should emphasize the teaching and learning of science process and principle. This will lead to fundamental and applied research in the science at all levels of education (FRN, 2014).

Curriculum according to Wikipedia (2016) is the planned interaction of pupils with instructional contents, materials, resources and processes for evaluating the attainment of educational objectives. Olorundare (2014) described it as a structured, series of intended learning outcomes. The biology curriculum was jointly developed by the Comparative Education Study and Adaption Centre (CESAC) University of Lagos and the Science Teachers Association (STAN). In 1985, curriculum was introduced into Nigeria Secondary Schools for implementation. The new biology curriculum was adapted and revised from 1985 edition developed by Comparative Education Study and Adaptation Centre (CESAC). The objectives of this curriculum have been derived from the National Policy on Education (FRN, 2014) and the main objectives are to prepare students to acquire:

- i. Adequate laboratory and field skills in biology;
- ii. Meaningful and relevant knowledge in biology;

- iii. Ability to apply scientific knowledge to everyday life in matters of personal and community health and agriculture;
- iv. 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 (Federal Ministry of Education, FME, 1985) to include Agricultural Science, Biology, Chemistry and Physics. The biology section was organized under seven themes. The 2009 edition of the Biology Curriculum (NERDC, 2009) now has only four themes.

These four themes include:

Theme 1: Organization of life

Theme 2: Organization at work

Theme 3: The organisms and its environment

Theme 4: Continuity of life

Science subjects have lost out in the new senior secondary school curriculum because it is no longer a requirement for senior secondary school students to offer one science subject as a part of the core subjects. The new

core subjects are: English studies, General Mathematics, Civic Education, Computer Science, and One Trade/Entrepreneurship subject (Abimbola, 2013). How do we then produce a scientifically literate society devoid of ignorance and diseases when the themes that are of direct relevance to the society and the learners are no longer available to all students?

In planning the new biology curriculum, the spiral approach to sequencing a science course was adopted. In the approach, the concepts to be taught are arranged in such a way that they run throughout the three-year post basic course, with the concepts being discussed in greater depth as the course progresses.

The curriculum is organized into six sections:

1. Topic
2. Performance objectives
3. Content
4. Activities-Teacher and Students
5. Teaching and Learning Materials
6. Evaluation Guide

According to West African Senior Secondary School Certificate Examinations' Syllabus (2015), the inclusion of biology in the Secondary School Curriculum is aimed at achieving the following objectives:

- i. Understanding of the structures and functions of living organisms as well as appreciation of nature;
- ii. Acquisition of adequate laboratory and fields skills in order to carry out and evaluate experiments and projects in biology.
- iii. Acquisition of necessary scientific skill, for example, observing, classifying and interpreting biological data.
- iv. Relevant knowledge in biology needed for future and advanced studies in biological science.
- v. Acquisition of Scientific attitudes for problem solving
- vi. Ability to apply biological principles in everyday life in matters that affect personal, social, environmental, community health and economic problems.

According to the National Examinations Council (SSCE) Syllabus (2015), the aims and objectives of biology as derived from the National policy of Education (FRN, 2014) are as follows:

- a. Mastery of the structure and function of living
- b. Appreciation of nature and the needs of its conversation.
- c. Acquisition of adequate laboratory and field skills in biology necessary to carry out and evaluate experiments and projects in biology.
- d. Ability to observe, classify, and interpret Biological data (the Scientific Skills).

- e. Acquisition of meaningful and relevant knowledge in biology as a Pre-requisite for pursuit of careers in Biological Science and related discipline.
- f. Acquisition of acceptable scientific attitude for solving problems and;
- g. Ability to apply biological knowledge/thoughts to everyday life in matters of personal, social, economic, environmental, and community health (P.39).

The biology curriculum has topics that are organized into instructional units in order to enable the concepts and skills to be treated throughout the three years duration of the senior secondary school. The topics are arranged in segmental and concentric forms that create a room for the recurrence of the concepts in previous years. This as therefore raise the need for biology teachers to be creative and use instructional strategies such as study technology principles that can encourage and develop students' conceptual thinking rather than encourage them to be a passive receiver of knowledge who are totally dependent on the teachers.

Studies on Teaching Methods and their Influence on Science

A method of teaching is the psychological or systematic way of imparting knowledge to attain set objectives for learners. Teaching strategy could be teacher or student-centred. Teaching method is the systematic plan

and procedures employed by the teacher to deliver class instruction. There are numerous teaching methods derived from the approaches to teaching such as the teacher-centred method and the learner-centred method. Teacher-centred methods are the methods which their activities are been controlled by the teachers.

Examples of these are Lecture method and Demonstration method. Methods which their activities are controlled by the students are regarded as Student-centred Methods. Examples of these include laboratory method and project method Bello, (2017). Teaching method can also be classified based on the manner the teacher presents the lesson. When the content material is been presented by the teacher from specific to general, this is called an inductive Method. Deductive method is when the content material presented by the teacher is from general to the specific.

Instructional Strategy is the systematic activities employed by the teacher in order to facilitate meaningful learning by the students. An instructional strategy includes the way the teacher communicates the content information, selects the instructional materials and activities that the students will undertake during the lesson. Instructional strategies are designed to organize the content for meaningful learning, motivate, and assist the students to focus attention on the content of the lesson as well as monitor and assess learning. Generally, the focus of instructional strategy is to assist the students to become independent strategic learners Bello, (2017).

Salman, Mohammed, Ogunlade and Ayinla (2012) also noted that the teaching strategies employed by teachers in an attempt to impart knowledge to learners could influence the learners' academic achievement. Efuwape and Omofonmwan (2015) on the other hand identified the various methods and strategies used in teaching students at the various levels of education to include lecture method, question and answer, project, textbook teaching, discussion, tutorial, audio-tutorial, demonstration, and problem solving methods.

Ameh and Dantani (2012) conducted a study on the effects of lecture and demonstration methods on the academic achievement of students in chemistry. They used the pre- test, post- test control group design and found out that, students perform better in chemistry when taught using the demonstration method as compared to the lecture method.

Muraya and Kimamo (2011) in their study of the effects of cooperative learning approach on biology mean achievement scores of secondary school students' in Machakos district, Kenya found out that, cooperative learning approach promote higher academic achievement of secondary school students in biology as compared to the regular teaching methods and that the approach also enhanced higher academic achievement of secondary school students in biology at knowledge, comprehension and application levels of the cognitive domain as compared to the regular teaching method. Bello (2017) identified several strategies for teaching biology.

In deciding what instructional strategies to use, a teacher should always reflect on the content of the topic to be taught, the objectives of the lesson, available, available instructional materials, and his/her capacity to improvise unavailable instructional materials. In addition, the teacher needs to consider the evaluation, and follow-up activities of the lesson, the class size, students' age and individual differences.

A few of the strategies which are suitable for presenting biology content to the students at the secondary school level is as follows: i) Problem solving as an instructional strategy: Developing problem solving skills is an important goal of biology education. Problem solving skills enables students to apply biology knowledge in innovative and creative manners, in order to promote meaningful learning. It allows students to use logic, critical and creative thinking to solve all identified problems that have been well defined. Problem solving is not similar to solving exercise, where students are required to arrive at a predetermined solution by following a well-defined route.

On the contrary, problem solving is open-ended with no specific route to follow to arrive at impulsive outcomes. It thus enables the students to transfer their ability to solve problem in one specific situation and context, into new context and situation.

Specific Instructional Strategies for teaching Biology Concepts/Terminologies: there are many biology words, which should be

clarified by the teacher especially if such words are new to the students. Teaching biology concepts or word is vital to prevent misconceptions in biology. It is profitable to employ multiple brain pathways to enhance meaningful learning of biology concept words/terms.

However, the conclusion was that any study carried out on influence of teaching methodology cannot be a wasted effort because the teaching/learning situation must be crowned with reputable method before an effective communication which can bring ideal permanent change in students' behaviour can be achieved. A number of research studies have been carried out on the effect of laboratory activities on achievement of students in some physical sciences. Some science educators have compared the laboratory method with other methods of teaching through research studies.

The comparisons have been between- laboratory method and the following methods; lecture methods, discussion method and project method while some educators had investigated the relative effect of laboratory activities on students' cognitive development/academic achievement in different science subjects. There is no one right method for teaching a particular lesson, but there are some criteria's that relates to each that can help a teacher make the best decision possible.

Fayyaz, (2011) examined the physics teacher use of instructional methods as perceived by their students, a sample of 20 schools offering zero level syllabus randomly from Islamabad, from each school, 15 science

students were randomly selected and questionnaire were administered on them, it was found out that the physics teacher in Pakistan were good in using lecture and demonstration methods but not in activity oriented method which is required in the teaching of science subject. Also, that the teacher are not good in using combination of teaching methods in the classroom.

Ajaja (2013) observed that Biology Students taught with guided discovery and invention methods regained biology knowledge longer than those taught with lecture method, this tends to suggest that poor science learning by students is traced to the teachers fault in the area of method used to teach the student by the teachers. This was supported by Ahmed & Abimbola (2011) which identified poor teaching method adopted by the teachers at Senior Secondary School level in Nigeria as one of the major factor contributing to poor performance of student in biology.

Also, Arokoyu and Chukwu (2017) examined teacher's methods of teaching and academic performance of secondary students in Biology in Abia state. The study comprised 180 Biology teachers from three educational zones in Abia state which were randomly selected. Two research objectives and two null hypotheses were used in the study. The data was analysed using mean and rank order statistics to answer the research questions while z-test was used to test the hypotheses at 0.05 level of significance. The reliability co-efficient obtained using Pearsons Product Moment Correlation Co-efficient was 0.70.

The study found that teacher's methods of teaching has affect positively and negatively on students' performance in Biology. In addition, it was found that teachers' attitudes in delivery of instruction have great influence on students' performance. It was recommended amongst others that teachers' methods of teaching should be student friendly as this will enhance Biology students' assimilation and performance in both internal and external examinations.

A veteran teacher should know that giving a straight lecture with no models, visuals, or interaction between students is a recipe for disaster as students quickly turn off because the mass of the topic being discussed is simply missing. Instructors trained in the study technology methods routinely utilized such observable phenomena as clues to determining which barrier the student is manifesting. Similarly, students trained in these skills have the tools of a learning strategy that will help them in all subjects (Chapman, n.d.).

Study technology equips both the teacher and student with teaching and learning strategies which are required for successful classroom practice as well as in professional life thereafter (Ekudugho, 2009). The teaching methods of study technology as described by Khyl (2003) first equip students with knowledge of the barriers to learning and the specific physical and mental reactions each barrier can cause.

The student is then provided with simple strategies to efficiently and effectively handle each barrier. Equipped with this critical information,

students can determine precisely which barrier they have met and which tools needed to be applied to handle their study problem. Many students fail to learn because no one ever taught them how to study, that is, how to identify the barriers to learning and how to overcome those barriers.

Abimbola (2013b) remarked that teachers who know how to use the study technology methodologies become new teachers who know how to teach students how to learn and they become lifelong learners and teachers who are capable of learning anything and teaching anything and any type of learner. Also, Abimbola, (2021) highlighted the following ways on how teachers can instruct the students so as to achieve perfect understanding:

- 1) Find out what students know and don't know and instruct them accordingly
- 2) Instruct correct knowledge always, no oversimplification
- 3) Structure instruction with the correct gradient- logical order complexity-from simple to complex, concrete to abstract
- 4) Always clear unknown words as a habit, and encourage students to do the same using dictionary
- 5) Encourage students to understand every word in their notebooks as they study
- 6) Adopt cooperative learning strategy (twins)

- 7) Use the Chinese School strategy to train students to memorize the following: i) spellings of words ii) Labels/Names of things iii) Definition of terms and iv) List of things.

Study technology has been described as a tool which can be used by students, teachers, children and parents alike as it can be applied to anything: homework, home-schooling, teaching, tutoring, sports, work, reading, etc (Association for Better Living and Education International, n. d.).

Also, study technology according to (Mitee & Obiatan, 2015) has been known to cause positive attitudinal change in students and this is very important in producing high academic achieving learners who more confident of their learning abilities and optimistic about the future, through a learning strategy that emphasizes mastery technique in step-by-step fashion, use of dictionary, graphic aids, hand-on materials and manipulative with cooperative learning (twin partnership), peer tutoring and communication skills as elements of methodology. Mastery learning technique has been identified as an effective instructional strategy of teaching which should be encouraged among students in order to enhance their cognitive learning outcome.

Study Technology as an Instructional Strategy

Hubbard (1972) introduced the idea of study technology in the United States as instructional strategy. This is today in use worldwide, including the

developing countries of the: Gambia, Ghana, Sudan, South Africa and Zimbabwe. The idea was introduced to Nigeria in 2004 by the Applied Scholastics International through the Trust Fund (now Tertiary Education Trust Fund, TETFUND). One hundred and ten (110) teachers from thirty-six (36) states participated in study technology Basic Training programme that took place in Lagos, Nigeria for one week in 2004. Also, eighty-eight (88) teachers participated in study technology master training programme that took place for five weeks in Akure, Nigeria, in 2006 (Abimbola, 2018).

The fundamentals of study technology were first described in a series of 1964 lectures at the scientology training academy of Saint Hill manor in Sussex, England. Study technology is developed by an American Author and Educator, known as Hubbard. It is a method involving the application of specialized academic skills and principles that equip students with methods of learning. Programs which are conducted using study technology are licensed under Applied Scholastics International, a non-profit organization based in St. Louis, Missouri (Applied Scholastics International, 2005a). This allows a person to learn any subject successfully empowering them to achieve the goals they have set in life for what they want to be and what they want to do. Study technology consists of tools and techniques teachers can use to improve the learning rate of students.

These same tools and techniques can be used by students themselves to improve their ability to understand and to use the materials they read and

study. And it remains vital for continued learning as one leaves school and faces the challenges of life. Study technology centres on the understanding of three main barriers to study namely: Lack of mass, too steep a gradient, and the misunderstood words. Knowledge of these three barriers can make it possible for student to recognize when they encounter one or more of these barriers and proceed to overcome them. Despite all that has been written on the subject of education, these barriers have only recently come to be broadly recognized as critically important in effective education. A research conducted by (Onojah, Olumorin and Abimbola 2020) investigated that study technology is a student-centred learning technique that helps the learner to study successfully by providing solution to all barricades come upon in the progression of studying. This study designed a model on study technology with the barriers that hinder students from studying effectively, the psychological reactions as well as the solutions to the barriers. The findings established that the major barriers to successful study are absence of mass, misunderstood words, obscurity and skipping gradient. In addition, the proffered solutions to the barriers include use of learning materials, use of dictionary, applying mnemonics and adopting a systematic learning style. The study concluded that with study technology, 100% performance is achievable. It was however recommended that students at all levels should assist themselves by adopting the study technology principles.

Also, the study conducted by (Onojah, Abimbola, Obielodan, Olumorin, Aderogba and Adeyanju, 2019) examined Study technology as the technology of learning it all, knowing it all, using it all and recalling it all. In this study, the researchers examined the undergraduate students' readiness toward the adoption of study technology for learning. The research adopted cross-sectional studies descriptive research of the survey type. The sample comprised of four hundred and fifty undergraduate students. A structured questionnaire was utilized in collecting data while percentage and mean were used to answer the research questions, independent t-test was used to analysed the data collected. The results of the finding revealed that undergraduate students are ready to adopt study technology for learning. There was no significant difference between male and female undergraduate students readiness towards the adoption of study technology for learning. It was however recommended that learning environments in the schools should be equipped to enhance the readiness of undergraduate students to learn effectively.

Tanimola, Bello and Hamzat, (2019) identified and analysed the classroom interactions and students reactions toward study barriers in biology lessons in Ilorin, Nigeria. This study was a descriptive research of the survey type. Intact biology classes of three hundred and twenty-four (324) senior secondary school students (SS II) and ten (10) biology teachers participated in the study. The instruments used for data collection were an Adapted

Flanders Interaction Analysis Categories System (AFIACS) and an Adapted Study Technology System Tool (ASTST).

Three research questions were answered from which one research hypothesis was generated and tested at 0.05 level of significance. Teacher talk (78.25%) was the predominant pattern of classroom interaction in biology lessons. The misunderstood word was the predominant (48.46%) study barriers in teachers dominated classroom, while lack of mass (46.29%) was the predominant study barriers in students' dominated classrooms. There was a significant difference between the number of study barriers encountered by students under each pattern of classroom interaction during biology lessons ($\chi^2(5)=405.36, p=0.05$).

The study concluded that classroom interaction influences the type of study barriers that students encounter during biology lessons. The study recommended that there is a need for biology teachers to involve students more in the teaching and learning process so as to aid students talk classroom interaction pattern and also, take note of the study barriers in the classroom, thereby improving the performance of students.

Since study technology has been introduced, applied scholastics international has worked with underachieving students in both rural and urban schools, teaching and applying the educational discoveries of humanitarian educator Hubbard. The Applied scholastics Achievement Program (ASAP) was developed as an outgrowth of this experience and of the subsequent

structure and successful field-testing with thousands of students of the curriculum and materials that now make up the ASAP (Applied Scholastics International, 2007)

Hubbard (1998) developed study technology to help students truly understand what they study and essentially learn how to learn. The educational method employed by applied scholastics was created by humanitarian and educator, who researched and wrote on a wide range of educational issues, taken together as a body of knowledge. This method is known as study technology. The pedagogy includes both structural and strategic components. Aside from the humanitarian impulse to reach out to struggling students and educators, applied scholastic sought to accomplish several goals in senior secondary schools particularly in Kwara State, Nigeria:

1. to reduce the achievement gap for students
2. to bring students self- confidence, hope and new attitudes toward learning
3. to demonstrate the sheer power of study technology by applying it under thoroughly adverse circumstances
4. to demonstrate the efficacy of peers as tutors and small group instruction in place of one-on-one contact when study technology is employed; and

5. to demonstrate the power, practicality, and adaptability of study technology for today's classrooms (Applied Scholastic International, 2019).

Study technology also causes an attitudinal change in students that can be very important in producing academic achievement. Students become more assertive in their learning abilities and become more optimistic about the future and a more responsible partner for their own learning. The power practicality and adaptability of study technology have been demonstrated in this project. Teachers have many goals for their students. These include but are not limited to, helping learners develop a passion for different subjects, building a literacy level that permits students to function in their present culture, and acquiring sufficient knowledge so that the students can perform well on various assessments. (Applied Scholastics International, 2019).

Therefore, it can be asserted that the ultimate goal of education is to liberate students from reliance upon teachers so that students can sustain independent learning throughout their lives. Students who possess this ability to continue to learn independently throughout their lives are called self-regulated learners. Self-regulated learners demonstrate a combination of academic learning abilities and self-discipline that facilitate studying. They maintain both “the skill and the will” to learn (Abdulkadri, 2011).

The study technology employed in applied scholastics program effectively help students and teachers in achieving this ultimate educational

goal of developing self-regulated learners. Self-regulated learners have the skills to learn and learning comes easier, hence, they are more motivated. Their actions are self- determined. This permits them to take initiatives in their studies. It should also be noted that the classrooms rated highly by students are those in which students have opportunities to monitor themselves and their performance (Abimbola, 2013).

Students in applied scholastic programs study under their own volition; they also know how to monitor their own work. Self- Regulated learners are actually expert students who are knowledgeable about the learning process. Expert students are aware of what to do to prevent themselves from becoming distracted. Applied scholastic materials first equip students with the knowledge of the barriers to learning and the specific physical and mental reactions barriers can cause Appendix X (A). The students are then provided with simple strategies for effectively and efficiently handling those barriers.

Students trained in applied scholastic methods are not unknowing and passive recipients of information. Instead, they are aware and engaged in constructing meaning for themselves. Students versed in study technology consistently assess where they are having difficulties. They apply appropriate strategies to solve the problems they encounter while studying. Research is actively involved in their learning, like those in applied scholastic programs, have increased achievement and show a better personal adjustment to school (Skinner & Cornwell, 1990).

Students trained in study technology readily develop into the type of self-governed, high-achieving expert learners that educational systems worldwide are striving to create. In study technology, the teachers serve as instructors, they will only direct and instruct the student on what to do because there wouldn't be any verbal communication (Applied Scholastics International, 2019).

In study technology, some principles are employed to help students prevent or overcome the effects of barriers to study; these were identified by Hubbard (1998) as follows:

1. Availability of standard, subject and reference dictionaries.
2. Availability of Demonstration (Demo) kits containing miscellaneous objects.
3. Availability of course materials, in form of text books
4. Checksheets or study guide based on the textbook in each subject
5. Student partnership –twins (a form of cooperative learning)
6. Absence of verbal (data) communication
7. Word clearing
8. Clay table training is provided for round objects of study
9. Chinese school
10. Projection equipment.

Use of Standard/Reference/Subject Dictionaries: The procedure used by learners to locate and clear up misunderstood words is called, “word

clearing.” A standard or subject dictionary is used in word clearing for proper understanding. Specialized dictionaries may also be used for the same purpose, e.g., a small word dictionary or a reference dictionary could be used as appropriate. The method of word clearing recommended for learners is what instructors are also to use by themselves. Abimbola (2015) identified the following steps which are involved in clearing any word or symbol, which learners may not understand during reading or studying:

- (i) The learner needs to search for the misunderstood word from the earlier part of the reading materials.
- (ii) Look up the word in a standard dictionary
- (iii) Quickly read through all the definitions and find the one that fits.
- (iv) Read out the definition that fits.
- (v) Make several sentences with definition until proper understanding of the meaning of the word is achieved.
- (vi) Learn each of the remaining definitions of the same word the same way.
- (vii) The learner re-reads the passage from where the earliest misunderstood word was found.
- (viii) Reading should normally proceed well if all the misunderstood words had been identified; otherwise, other misunderstood words are searched and cleared using a standard dictionary.

Also, keyword clearing is a process of removing any barrier to studying. The World Literacy Crusade Report of 2005 by Applied Scholastics International affirmed the need for students to monitor their reading process and repair breakdowns in understanding when they occur, thus becoming self-regulated, self-directed, self-purposeful and independent learners. In Brixton, England, a group of pupils received a short course in study technology consisting of approximately nine hours of instruction over a 12-day period, while a control group received no instruction in study technology. Both groups otherwise continued their routine studies and both were tested before and after.

- (ix) The experimental group gained an average of 1.29 grade levels in reading ability after the short course with the control group showing no significant change in test scores over the same period.

In addition, the Southern United States, children ranging in age from 8 to 16 took part in a seven week programme utilizing study technology for a stated purpose of increasing reading vocabulary and comprehension. Pre- and post-program standardized tests revealed an average increase of eight months per student in vocabulary and comprehension. One student improved from second-grade level to sixth-grade level in five and a half weeks on the program (Church of Scientology International, 2015).

In addition, Daudu (2006) in a report of keyword clearing carried out in four rural and urban schools in the midland province of Zimbabwe (formally known as Rhodesia) using one hundred and twenty four students

(sixty two students each for the experimental and control group) revealed a high achievement gain in the teacher-made test of punctual ability when the pre-test and post-test scores of the experimental and control groups were compared. Gbigbadua (2014) reported that a misunderstood word until one clears the meaning of the word is fully understood by the students, it is said to be cleared. The procedure used to locate and clear up words the student has misunderstood in his studies are called word-clearing. The first thing to learn is the exact procedure to clear any word or symbol one comes across in reading or studying that he does not understand.

Some research study had been carried out on keyword clearing, few among them includes the work of Gbigbadua, Abimbola, and Ahmed (2014) who investigated on the effects of pre instructional word-clearing strategy on achievement in Biology among senior secondary school students in Ilorin, Nigeria. The findings from that study shows that teacher's use of pre-instructional word clearing strategy can enhance students' achievement in biology especially the low and medium scoring students.

Also, a lecture was delivered by Abimbola (2013) on one of the study technology principles. The misunderstood word which could be cleared with the use of standard or reference/subject dictionary and used to overcome study barriers was the focus of the lecture. Emphasis was made from the lecture on how to clear a misunderstood word which is one of the barriers to

study. It was therefore recommended that for better understanding to take place, misunderstood word must be cleared.

Demonstration (demo) kit: A demonstration kit is a collection of odds and ends such as paperclips, corks, used phone recharge cards, pen tops, thumbtacks, erasers crown covers and thread which are easily available everywhere and are kept in a box or container (Adeoye, 2021). The demonstration is a good way to show learners something and how it works. Thus, in a teaching-learning situation, demonstration is about showing learners beyond the theory or abstraction, the way something works (Abimbola, 2015). A demonstration kit is composed of different objects collected together and used to carry out demonstrations.

The demonstration kits (according to study technology principles) can be used to teach or learn anything (topics, concepts, processes, situations, actions,) or used while reading, watching films, listening to tapes and looking up words, unlike the content specific demonstration kits which are designed and used to teach specific content or topic (Adeoye & Abimbola, 2016; Applied Scholastics International, n.d. Hubbard, 2007).

The use of demonstration kits requires students to pick objects from the kits and assign them significance as symbolic representation of ideas, objects, interrelationships, or how something works, The objects selected from the demonstration kits can also be moved about in relation to each other

to show the mechanics and actions of a given concept.(Church of Scientology International, 2015).

Adeoye (2016) carried out a research on effects of senior school students' use of Demonstration kit on their achievement in biology in Omu-Aran, Nigeria. It was a quasi-experimental design of $2 \times 2 \times 3$ factorial matrix and followed the non-randomized, pre-test and post-test control group. Four secondary schools were purposively selected for the study. Two research instruments which consisted of Biology Achievement Test (BAT) and Demo kit were used to collect the data. The instruments were validated appropriately while the reliability of the BAT was determined using test re-test method and Cronbach alpha was used to analyse the resulting data. Three research questions with corresponding null hypotheses were analysed with the Analysis of covariance (ANCOVA) to test the hypotheses.

From the study, it was revealed that there was a significant difference in the achievement of students who learned Biology using demo kit and those who learned without demo kit. The study revealed that when demo kit was used, the performance of the students were improved with increases in all measures of central tendency, the scores were more widely distributed, the trend of performance tended toward the negatively skewed distribution and the two hypotheses were not rejected.

It was further recommended that there is need to introduce more innovative, participatory and intensive method of instruction like Study

Technology in order to achieve the aims and goals of education as stated in the National policy on Education of Nigeria.

Use of Checksheet/Course guide: The use of course materials inform of textbooks is a principle of study technology. The course guides or checksheet could be formed from the textbooks, which sets out the exact sequence of items to be studied or done by a student, in order, item by item on a course (Abdulkadri, 2011). A checksheet according to Hubbard (1998) is a list of the materials that are needed to study and the practical demonstration, drills, exercises, and essays one needs to do. They are given in the order in which they should be treated. The checksheet is laid out to provide the most optimum path through the subject. The theory is interspersed with practical parts to present the subject in a balanced manner.

Also, a checksheet is a programme that the student follows to complete a course. The data of the course are studied and its drills performed in the order on the checksheet.

The student does not “jump around” or study the material in some other order. The materials are set out in the checksheet in the best order for study by the student so that he covers all the materials in a logical sequence. Furthermore, following the exact order, the checksheet has a disciplinary function which assists the student to study. The student’s initial, beside an item is an attestation that he knows in detail and can apply the material contained in that article or lecture, or that he has done and can do that drill.

The initial of the instructor or another student against a star-rated item is an attestation by him that he has given the student a star-rated checkout on the item and that the student has passed. Star-rated is an attestation by the instructor that the student's work has been checked and scored. The course instructor must inspect students' checksheets daily to ensure that all students are following the checksheet in its correct set-out order and that the student is making good progress through it.

Abdulkadri (2011) investigated on the effects of teachers' use of checksheet on the performance of students in biology in Ilorin metropolis. Results of the findings indicated that there was a significant difference in the performance of students that were exposed to treatment by using checksheet as an instructional strategy for teaching biology and the control group who were not exposed to treatment. A 2×2×3 quasi-experimental design of pre-test, post-test, non equivalent control group was adopted for the study. Two seventy-two senior secondary school(SSS) 2 biology students participated in the study and Analysis of covariance (ANCOVA) was used to analyse the data collected from Biology performance Test (BPT).

Clay table training: Clay demonstration is another way to show something and how it works or how it is put together. Clay is a type of soil. It is a soft, earthy material, which is usually flexible when it is wet. It is used to make pots and bricks. Plasticine is the brand name of a form of artificial clay used in schools for modelling things. Clay can also be made, for instructional

purposes, using dough from flour. Clay models can be used for demonstrating or representing facts, ideas, procedures, add mass, reality, and doingness to the significance of concepts so as to help students study (Hubbard, 2004).

Clay according to Hornby (2015) is a type of heavy sticky earth that becomes hard when it is baked and is used to make things. The use of clay has been recognized as a sensual way of learning and acquiring active problem-solving abilities needed for young children to a mass, new concepts and skills within their limits of understanding (House, 2007). Modelling clay is a flexible and colourful material that can be used for modelling different things (Adeoye, 2021). It usually come in different colours and forms, which include the natural earthy material (clay soil), play dough (usually produced from flour), and plasticine (an artificial form of clay).

The use of clay models for demonstration based on study technology strategy of learning involves giving student words, actions, situations, or processes to demonstrate. The learner then uses modelling clay to demonstrate or show the words, actions, situations, or processes, labelling every part. A clay table (platform on which a student, standing or sitting, can work comfortably) is also provided for the demonstration (Independent Checksheets Foundation, 2011). Clay models has been identified as an innovative strategy of permitting students to physically construct and label ideas in order to represent concepts (Oyelekan, Igbokwe & Olohundare, 2016). This is because working with clay

characters and models allows students to explore abstract concepts in a tangible way (Chapman n.d.; Kolk, n.d.).

Student partnership-twins: This is a component of study technology whereby students are paired together in form of cooperative learning to check themselves out. A check out is the act of finding out if a learner actually understands what has been studied. The partnerships are created with students' similarity of ability and speed in mind so that they can successfully assist each other and move at a similar pace through the materials. The students have regular assessments throughout the study guide mastery is the objective of the guides (Abimbola, 2020)

A Chinese School: A Chinese School is a strategy which is similar to the Quranic school strategy, which is used to help students memorize important contents in the course. The instructor reads materials to be memorized one by one and the students repeat after the instructor. The instructor then reads everything together at once and the students repeat all at once Abimbola (2015).

A Projection Equipment: This is used with a screen in Chinese school.

Absence of Verbal Data: The media of communication in a study technology format is structured. Instructors are expected to use a two-way communication mode to find out how the learner is doing and learners who are busy with their work are usually not disturbed at all. Since study

technology is a material-based strategy, verbal communication between the instructors and learner is limited. Learners are usually directed to study information directly after the instructor has directed them to the source of information. Several media of communication are to be provided in the classroom to appeal to as many sense organs of the learners as possible, and to ensure reinforcement of learning.

Communication is the process of passing the information and understanding from one person to another. It is essentially a bridge of meaning between the people. By using the bridge a person can safely across the river of misunderstanding, Katte and Joshi (2019). It is an important ingredient of life and living. Communication is the action of conveying information. Thus, it is at the heart of any formal or informal teaching-learning process. Teaching involves a lot of communication; good teachers are therefore always good communicators.

Good students are also good participants in the information cycles by being good receivers and responders. It is therefore important that teachers and students should learn the art, science and technology of good communication. In study technology, instructors are expected to use two-way communication mode to find out how the learner is doing and learners who are busy with their work are usually not disturbed at all. Since study technology is a material-based strategy, verbal communication between the instructor and learners is limited.

Edukugho (2006) reported that in Southern Africa, Education Alive, an Applied Scholastics affiliated organization, introduced study technology into a teachers' college. The dropout rate for teacher trainees fell dramatically to only 2% as a direct and immediate result of the programme and that in Los Angeles, California, USA, Students at a school which uses study technology throughout its curriculum regularly score 30 % above the national average on pre-college aptitude.

Again, Edukugho (2017) reported that in Mexico City, study technology was introduced into a private high school in which one class had a 95% failure rate on their material. After the students learned to use study technology, the same class achieved 90% pass rate. In England, it was discovered that students improved in their reading levels by 1.3 years after 10 hours of using the study technology. In South Africa, a literacy programme produced an average gain in reading level of 2.25 years. Also, the pass rate of students enrolled in 19 government schools increased from 43 to 78 percent after study technology had been in use for only six months.

Study technology has been known to cause positive attitudinal change in students and this is very important for teachers in producing high academic achieving learners who are more confident of their teaching and learning abilities and optimistic about the future of their students through a learning and teaching strategy that emphasizes mastery technique in step-by-step fashion, use of dictionary, graphic aids, use of demo kit, checksheet, key

wording clearing, Clay table training and manipulative with twinning partnership and communication skills as elements of methodology.

Bagayoko (2007) stated that Applied Scholastics has developed proprietary materials that guide a student in a very systematic method to high achievement in mathematics. They start by creating a foundation of the basic terms and symbols necessary and then radiantly sequence into more complex terms and functions, building on each step through a series of exercises and practical applications. All students have their own study guides that are done on a partnership basis so that two students work together on exercises and practical applications or function drills. Members of the partnership move through the study guides at their own pace with the teacher or tutor overseeing and assisting as needed as well as setting targets for them to achieve each study period.

Bagayoko (2007) distinguished Professor of Physics and Director of Timbuktu Academy at Southern University Baton Rough was involved in authoring the school improvement plan with the superintendent and other district staff. He was then closely involved in and monitored Prescott's activities including the Applied Scholastics Achievement Program (ASAP). The Prescott project had a three-pronged approach: Motivating and engaging students in the learning process by teaching them how to learn;

1. Reducing the students' literacy gap with systematic and explicit instruction using remediation materials targeted at specific academic deviancies in math and language arts;
2. Demonstrating the efficacy of peer tutoring as a strategy in utilizing this method and its materials. Some students were on a daily schedule, some on an every - other day schedule. All participating students were tutored in small group of six or seven throughout the school year.

Applied Scholastics International (2007) also reported that due to scheduling necessities, not all of the 174 eighth graders at Prescott were able to participate in the ASAP program. The student body breakdown is as follows: 93 ASAP, 56 Non-ASAP, and 25 ASAP reading. Many of the students in the ASAP program were designated in some class of special education. However, twelve of those had sufficient issue to be granted alternate testing and graduation routes. Six of the twelve were pre-and post-tested and the results are included in this report. The other six were not tested due only to scheduling or administration difficulties at the end of the school year.

It was noted here that the school year started with well over 250 students registered, however with transfers, no-shows and expulsions the overall student population decreased in the first 30 days by a significant number. Of the 118 students who did participated, 102 students were both pre-and post –tested. The following is a discussion of only the students who

were pre-and post- test and thus reported on herein. At the start, twenty-one of the students were unable to read at the 4th grade level; those students were split-off. Instruction of these twenty-one students, including five of the special designation students, focused entirely on the skills of reading.

The 81 students who could read at 4th grade level or above, which included one special designation student, were tutored first on learning and comprehension skill and then language arts concepts. There were 36 of these students – the ones who attended on a daily schedule- who completed three components of the ASAP language arts program and also received tutoring in the ASAP math component. A notable aspect of the program was the manner of service delivery. Tutoring was performed by high school students in fulfilment of community service requirements for graduation. The tutors arrived in group of 4 and remained in service for about 2 weeks. Each group of student tutors received continuous in- service training and supervision.

The 102 students who were pre-and post-tested were tested with the Wide Range Achievement Test (WRAT 4), word Reading subtest. The students received an average of 45.1 contact hours of learning and comprehension skills, language arts and/or reading remediation and then language arts in group tutoring. In that short time the standard score for the group on the WRAT Word Reading Subtest increased from 90.91 to 102.94 – from well below average on the normal curve to slightly above average. Six of the students tested and included were the special designation students

noted earlier. This is a very substantial jump in standard scores, similar in magnitude to a 12-point increase in Intelligent Quotients (IQ) score.

Due to test administration difficulties only forty-one of the students completed the WRAT comprehension subtest. On average, these students increased their standard score by 5.1 points. However, ten of these students improved their standard score by double digits. Only seven students did not improve either their standard score or grade level score on the comprehension test. ASAP was first implemented in Prescott Middle School in the 2005-2006 school years. A historical analysis of the English Language Arts results of the Louisiana state wide achievement test (LEAP) for 8th grade Prescott students in the years from 2005 (before ASAP) through 2007 was undertaken. It should be noted that in year it was first introduced (2006) ASAP addressed at risk students pulled from all grades (6th, 7th and 8th) such that a smaller number of ASAP students are represented in the eighth grade results on LEAP for that year.

The analysis reveals an increase in the number of ASAP students achieving the level of basic or above on the state test (from 13% in 2005, before ASAP, to 33.3% in 2006 to 38.7% in 2007). At the same time the number of non-ASAP students achieving the level of basic or above on the test declined (from 13% in 2005 to 10.1% in 2007). The impact of ASAP on math achievement is assessed with results from the Louisiana state achievement test (LEAP), the mathematics component of which is administered each year

to eighth grade students. Historical analysis shows a steady reduction after the introduction of ASAP in the percentage of ASAP students categorized as “underperforming” and a steady increase in the percentage of ASAP students scoring in higher categories. In 2005, before the introduction of ASAP, 54.5% of eighth grade students were classified as underperforming. Among ASAP students the percentage was reduced in 2006 to 33.3% and further reduced to 23.7% in 2007.

Since its founding 35 years ago, Applied Scholastics International has worked with underachieving students in both rural and urban schools, teaching and applying the educational discoveries of humanitarian and educator, Hubbard. The Applied Scholastics Achievement Program (ASAP) was developed as an outgrowth of this experience and of the subsequent structured and successful field-testing with thousands of students of the curriculum and materials that now make up the ASAP. The objectives of ASAP are two-fold:

1. The first objective is to teach participating students how to study and learn. Students are taught how to recognize and overcome their personal learning barriers in any subject and to become self-sufficient, responsible, life-long learners who are no longer passive recipients in the classroom but instead are capable partners in the educational process.
2. The second objective is to identify and repair the academic deficiencies of underperforming students in the essential core subjects of reading,

language arts and mathematics. Identification of deficiencies is accomplished through academic assessment. Eliminating the academic performance gap between where students are and where they should be is accomplished using systematic and explicit instruction and proprietary materials. Hence, their achievement gaps have been closed; students are able to perform successfully at their appropriate age/grade level.

In another related study, a science teacher in a large public middle school received study technology training on his own initiative. The teacher then persuaded the school administration to allow him to deliver a course in study technology to his students for two years in a row, during the first six weeks of the school year, the teacher taught Learning How to Learn, a basic course in study technology, to his five sections science students of eighth-grade. Students learned Vocabulary and Comprehension tools as well as strategies for monitoring and correcting their learning problems. Throughout the training the students were encouraged to apply and practice all the learning tools and strategies.

Applied scholastics international (2019) defines successful learning the same to define proficiency. Someone who learns a subject successfully should be able to use that subject to accomplish something. They should be able to accomplish it quickly, without error and with good judgment. These are the ingredients for success in any field of endeavour. Study technology is the breakthrough that undercuts the reasons people are illiterate, it is not just

another system. Study technology is a workable methodology that makes it possible for a person to recognize and handle the barriers to successful study.

In a comparative study of the effect of study technology mode of instruction and lecture methods on the academic performance of university students in Nigeria; Oladipo, Olawoye and Adenaike (2012) found out that the use of study technology greatly reduced the failure rate and increased the distinction level of students exposed to the techniques. The research sample for the study was 300 level students and the researchers adopted an explorative, descriptive and quasi-experimental design while percentage, frequency table and t-test was used to analyse the data obtained and to describe the performances of both the experimental and control groups. Based on study technology principles, the researchers observed the students during the course to identify and remove the barriers to learning and students were directed to interact with their twins. However, while the result before the use of study technology was generally poor, the researchers discovered that exposure of the university students to study technology greatly improved their performance when compared with the lecture method.

In addition, Adenaike, Biyi and Oladipo (2012) in a study technology included a course guide and checksheets containing series of programmed instructions for each course hour in the course room, exercise books for noting students' responses, course test items and the examination results of the control and experimental groups. The researchers observed the students

during this investigation to identify and remove the barriers to learning as the course room activity progressed.

Olowoye and Odunmade (2016) investigated into the efficacy of Study Technology an innovative instructional method on the learning outcomes of undergraduates' in a Nigerian University. The study was both comparative and descriptive in design. Two thousand (2000) undergraduates were involved as a population and 413 undergraduates were exposed to Study Technology as a means of instruction, as sample. Qualitatively and quantitatively, students were taught with the same course outline, at the same lecture time-table hours, under the same conditions but with different methods of instruction. One group was taught with Study Technology instructional method and the group was taught with lecture method by the same lecturer under the same condition within two consecutive sessions. The data that were obtained from the score sheets of both groups were analysed using descriptive statistical techniques. Frequency curves were drawn to show trends of performances of both groups. The study therefore concluded that with study technology, the learning outcomes of the students were improved.

With study Technology techniques, students of all ages have gotten outstanding improvement in various discipline of knowledge like in reading level, comprehension, vocabulary and Mathematics (Applied Scholastics International, 2017). The problems of learning how to learn, some students

find it difficult to learn and how to apply what they learn into their day to day situation.

Ahmed (2018a) wrote a report on how to promote science, Technology, Engineering, Arts and Mathematics (STEAM) with study technology, the implication for Teacher Education. It was emphasized that when the three barriers to learning are used appropriately, any difficulties of learning STEAM could be tackled with ease. Hence, justification of using study Technology for promoting STEAM has basis on the fact that:

1. Communication and teamwork are encouraged with “Twinning”.
2. No verbal communication and too much activity for teacher of Study technology than instructions.
3. With activity-based of study technology, new discoveries could be achieved because teaching and learning STEAM, would be more interesting.
4. Research has proved that STEAM is still hardly appreciated and productive in Nigeria because it is expensive, but instructions with study technology principles, although it may be time consuming but it is not expensive.

It was then recommended that instructional materials required in study technology lessons are not expensive; therefore, both students and teachers across all STEAM disciplines should use it frequently. Also, workshops and seminars on study technology should be organized for teachers and students

at all levels of Education. Also, school principals and proprietors of school should support teachers using study technology by providing the enabling environment for learning.

Ahmed (2018b) also carried out a research work on effects of study technology learning strategies on senior school students' Achievement in Ecology in Ilorin, Nigeria. It was a quasi-experimental research design of the pre-test, post-test control group design of 5×2×3 experimental design, non randomized control group. Five senior public secondary schools 2×3 were purposively selected for the study. Three research instruments were used, these were: Study Technology Training Manual (STTM), Ecology Achievement Test (EAT) and Systematic lesson plans. The instruments were validated appropriately while reliability of the instruments was determined. Seven research questions with corresponding null hypotheses were analysed with the Analysis of covariance (ANCOVA) to test the hypotheses.

The study revealed that there was a significant difference in the achievement of students who learned Ecology using study technology learning strategies and those who learned with conventional method of instruction. This means that the students who were taught using demo kit combined with learning on a gradient strategy performed better than other students in the control group. It was further recommended that biology students need to be taught using different study technology learning strategies that could make them to be actively engaged in their study.

Tanimola, Bello and Hamzat, (2019) identified and analysed the classroom interactions and students' reactions toward study barriers in biology lessons in Ilorin, Nigeria. This study was a descriptive research of the survey type. Intact biology classes of three hundred and twenty-four(324) senior secondary school students (SS II) and ten (10) biology teachers participated in the study. The instruments used for data collection were an Adapted Flanders Interaction Analysis Categories System (AFIACS) and an Adapted Study Technology System Tool (ASTST).

Three research questions were answered from which one research hypothesis was generated and tested at 0.05 level of significance. Teacher talk (78.25%) was the predominant pattern of classroom interaction in biology lessons. The misunderstood word was the predominant (48.46%) study barriers in teachers dominated classroom, while lack of mass (46.29%) was the predominant study barriers in students' dominated classrooms. There was a significant difference between the number of study barriers encountered by students under each pattern of classroom interaction during biology lessons ($\chi^2(5)=405.36$, $p=0.05$). The study concluded that classroom interaction influences the type of study barriers that students encounter during biology lessons. The study recommended that there is a need for biology teachers to involve students more in the teaching and learning process so as to aid students talk classroom interaction pattern and also, take note of the study barriers in the classroom, thereby improving the performance of students.

The term ‘communication’, is derived from the Latin word “communis”, meaning “common”, i.e., to share. It is a two-way process between the sender and the receiver, which requires a sender, a message, and an intended recipient. Communication requires that the two parties should have something in common concerning the subject of the communication. In addition, communication can occur across long distances in time and space because the receiver does not need to be present or aware of the sender’s intention to communication process to be complete, the receiver sends to understand the message and be able to respond effectively to the message.

The initiator of the communication sends it over a distance to the receiver of the initial communication. This requires that the receiver of the initial communication correctly interpret the communication to be able to understand it and know how to respond to it, the receiver of the initial communication who is now the initiator of return information responds to the information based on his/her understanding for the original initiator of his earlier communication to now receive the return communication with understanding, too. This is an example of one cycle of complete communication that is very useful in the classroom situation. For it to be a two-way communication cycle, the receiver of the initial communication has to initiate his or her own communication, which will go through another complete cycle to qualify for a two-way communication.

Empirical Studies on Teachers' Academic Qualification and its Influence on Teaching of Science

The qualification of biology teachers is an important factor in teaching and learning of biology in schools. The most important factors in improving students' achievement in biology is by employing seasoned qualified teachers. In accordance with this, the National Policy on Education (FRN, 2014) stated that in recognition of the pivotal roles of quality teachers in the provision of quality education at all levels, teacher education shall continue to be emphasized in educational planning and development. Also, the minimum qualification for entry in to the teaching profession shall be Nigeria Certificate in Education (NCE).

The goal of Teacher Education shall be to:

- a. produce highly motivated, conscientious and efficient classroom teachers for all levels of the educational system.
- b. further encourage the spirit of enquiry and creativity in teachers.
- c. help teachers fit into the social life of the community and the society at large and enhance their commitment to national goals.
- d. provide teachers with the intellectual and professional background adequate for their assignment and to make them adaptable to changing situations; and
- e. enhance teachers' commitment to the teaching profession (p.43).

According to Musau and Abere (2015), a qualified teacher can be defined as one who holds a teaching certificate and or licensed by the state, owns at least a bachelor's degree from a four year institution and well qualified in his or her area of specialization he also quotes Pakistan ministry of education official who described a qualified teacher as one who possess knowledge. If their subject matter, human growth and development, ethical value, instructional planning and strategies, assessment learning environment communication and advocacy, collaboration and partnership, continuous professional development code of conduct and skilful use of ICT. The science educators, government parent and society in general have constantly interested in the academic performance of student.

Abe and Adu (2013) reported that there is significant difference in the performance of students taught by professionally trained teachers and non-professional teachers in Senior Secondary School examination (SSCE) in Biology. Okobia (2012) revealed that level of qualification of Biology teachers did not influence their attitude towards the use of improvised instructional materials. A high quality biology teacher is one who can competently achieve the objectives of science education and affect students' performance positively.

Akinsola (2010), asserted that availability of qualified teachers determines the performance of students in the schools. Also, Abimbola and Abidoye (2013a) observed the effect of qualification and experience of

Biology teachers on the status of ecology teaching in Kwara State, One hundred and forty two (142) Secondary Schools were selected by random sampling technique. A researcher designed teachers' questionnaire which was administered to four hundred and fifty (450) teachers. Researcher-designed validated questionnaire was used to elicit information from the respondents on the status of ecology teaching. Frequency counts and chi-square statistics were used to analyse the data collected. The finding of the study revealed that 68% of Biology teachers agreed with the contents while 32% disagreed. However, both qualified and unqualified teachers viewed ecology teaching the same way that is, ecology teaching was not properly done due to the fact that some Biology teachers skip certain areas of the syllabus that they find difficult to teach.

Achufusi (2015), examine the influence of the qualification of science teachers on the performance of secondary school students in external examination. The population of the study was 2036 physics students in twenty-two schools in Akwa Education Zone from where a sample of 623 students and four teachers were drawn by purposive sampling from four secondary schools. Teachers' academic qualification and the performance of students in external examination like, West African Examination Council formed the data which were analysed using simple Percentage and Pearson Product Moment Correlations. Findings of the research revealed that there is a high relationship between the teachers' academic qualification and

students' performance, and the researcher stated further that teachers' professional qualification greatly influence students academic achievement.

Thomas (2014) examined the effect of teachers' qualification on students' Achievement in Mathematics in 10 selected schools in Ikere Local Government Area of Ekiti State. The result showed that a significant difference existed in the performance of students taught by professionally trained teachers' and non-professional trained teachers. Wiki (2013)¹³², stated that qualification of biology teachers is one of the major factors that militate against effective teaching of Biology because some biology teachers in some secondary schools did not undergo enough training to enable them get skills, qualities and enough knowledge of the subject matter and how to improvise materials to share knowledge with the students.

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.

Furthermore, among the notable studies on Teachers qualification and students' performance is the work of Akinsola, (2010) with Twenty-one sampled public schools in Osun state. The data collected were the teachers' qualifications, experience and teacher-student ratios were significantly related to students' academic performance. Owolabi and Adebayo (2012)

examined the effects of teachers' qualification on the performance of senior secondary school students in physics. The purpose was to determine whether the status of the teachers has any impact on the performance of students in physics. The survey type of descriptive research design was adopted. The sample for the study consisted of 100 Senior Secondary schools physics students in Ekiti State and the teachers that prepared and presented the students in each school for 2009/2010 West Africa School Certificate Examination.

The year's result summary for each school was collected with the bio data of their respective physics teachers. Four hypotheses were postulated and tested at 0.05 significance level. The data collected were analysed using inferential statistics. The results revealed that students taught by teachers with higher qualifications performed better than those taught by teachers with lower qualifications. It was also showed that students performed better in physics when taught by professional teachers.

Mahdum, Hadrena and Safriyat (2019) investigated on exploring teacher perceptions and motivations to ICT use in learning activities in Indonesia. This study aims to investigate the perceptions and motivations of state senior high school teachers in rural districts in Indonesia towards ICT use in learning activities. The data of this study were collected through a set of questionnaires administered to 616 senior high school teachers from four

rural districts in Indonesia. The questionnaire reliability was analysed using the Cronbach Alpha with the help of SPSS Software.

The percentage was mainly used in the descriptive analysis. Whereas, Mann-whitney U-test was used for inferential statistics as the data were not normally distributed. Findings revealed that there is no statistically significant relationship between teachers' perceptions and motivations towards ICT integration. The results of this study indicated that the teachers had a good level of perception and motivation toward ICT integration in learning activities. Melisa (2019) identified teachers' perceptions of difficult areas in senior secondary school biology curriculum in Lagos State Nigeria. Five research questions were raised and three research hypotheses were tested. A survey design was used for the study. A multi-stage sampling random sampling technique by balloting and cluster sampling techniques were adopted to compose the sample of 120 biology teachers in for education zones of Lagos state. A structured Questionnaire (BTAQ) was used to collect data from the respondents.

The data collected were analysed using mean, standard deviation and one-way ANOVA to t-test the hypotheses at 0.05 levels of significance. The analysis of the data yielded the following results: The teachers find the teaching of chromosome, Evolution, Glycolysis, Germination, Genetics and skeleton difficult. Gender, academic qualification and location of services of the teacher have no significant influence in the biology curriculum.

Empirical Studies on Teachers' Years of Teaching Experience and its Influence on Teaching of Science

Teaching experience is a vital tool in the science teaching and learning situations. Experience can be said to be the attitude or skill acquired by the teacher through his perception and participation in instructional programmes. The experience of the teachers will help him to be able to cope and adapt to change in the educational programmes (Lawal, 2011).

Ewetan and Ewetan (2015) investigated the influence of teachers' teaching experience on academic performance of public secondary school students in Mathematics and English Language in Ado-Odo/Ota and Ifo Local Government Areas in Ogun State. The study adopted descriptive research design. Study population comprised all the 31 Senior Secondary Schools in the selected two local government areas. Using simple random sampling technique, a sample of 20 schools was drawn, comprising of 14 schools in Ado-Odo/Ota, and 6 schools in Ifo Local Government Areas. An inventory schedule was the instrument used for data collection. 400 questionnaires, 20 questionnaires per school were administered. 388 (97%) questionnaires were returned. Their responses were analysed through content analysis. The regression analysis and t-test were used to test hypotheses generated for the study at 0.05 alpha levels.

Findings revealed that teachers' teaching experience has significantly influenced students' academic performance in Mathematics and English

Language as measured by their performance in the SSC examinations and as perceived by the respondents. Schools having more teachers with above 10 years teaching experience achieved better results than schools having more teachers with 10 years and below teaching experience.

Ahmed (2007) worked on the personality factors and biology lecturers' assessment of difficulty levels of genetics concepts in Nigerian colleges of Education. The study was a descriptive research of survey type. Purposive random sampling technique was used to select 336 Biology lecturers lecturing from 68 colleges of Education in the six geo-political zones of Nigeria. The instrument used for data collection was a researcher-designed questionnaire. The data collected were analysed using frequency curves, percentages and t-test. The study revealed that no significant difference existed between the experienced, and the less-experienced Biology lecturers.

Atotileto (2017) carried out a study on science process skills perceived difficult to teach by upper Basic science teachers in Kwara State, Nigeria. The study was a descriptive research of survey type. Proportionate, simple random and purposive sampling techniques were used to select sample of (305) and upper basic science teacher were randomly selected from Kwara central, three hundred and eighteen (318) from Kwara North and (382) from Kwara South. The instruments used for data collection were researcher-design questionnaire and clinical interview protocol. The data collected were

analysed using chi-square. Findings revealed that teachers teaching experience had no influence on the perception of less experienced, moderately experienced, and experienced Upper Basic science teachers.

In addition, Yunus (2019) investigated on the senior school chemistry teachers' perception of the utilization of improvised laboratory materials on the influence of their years of teaching experience in Abeokuta. The study was a descriptive research of the survey type. The target population was all the senior school chemistry teachers from 117 public and private senior schools constituted the sample for the study. A researcher designed questionnaire on Chemistry Teachers' Perceptions on Utilization of Chemistry Improvised Laboratory Materials was used to gather data which was subjected to test-retest reliability test and a reliability coefficient of 0.71 was obtained. The data gathered were analysed using frequency, percentage, mean and chi-square. The findings revealed that there was a significant difference between the chemistry teachers' years of teaching experience and the extent at which they utilized improvised laboratory materials for the teaching of chemistry as p-value was less than 0.05.

The adage which says experience is the best teacher, this is in the sense that the more a professional stay on the job, the more he becomes skilled and perfect in techniques of going about his profession. Shamsudeen (2016) investigated on the teachers' perception on the use of Digital Microscope in teaching biological concept and processes among senior secondary schools

in Sokoto State, Nigeria. The study answered three research questions. The researcher selected fifteen (15) secondary schools out of the 49 secondary schools in Sokoto metropolis using random sampling techniques which represents 30.6% of the populations. 30 biology teachers including Head of Department from the selected schools were chosen to represent the population of teachers, which represents 25.8% of teachers' population.

The instrument used is a questionnaire titled Biology Teachers Perception Questionnaire (BTPQ). Data collected were analysed using simple descriptive statistics. The study found that, secondary schools in Sokoto metropolis does not have sufficient microscopes but those available are in good condition.

Similarly, in some other studies, teaching experience was found to be related to students' achievement but that the relationship could not be ascertained to be linear. Jennifer (2010) viewed the teachers' characteristics and students' achievement, evidence from teacher surveys. The researcher reported that experience matters but is not always better. Impact of experience is strongest during the first few years of teaching and after some years those marginal returns diminished.

Also, in a study conducted by Oyelekan, Igbokwe and Olorundare (2017) on science teachers' utilization of innovative teaching strategies in teaching senior school science subjects in Ilorin, Nigeria, a sample of two hundred and fifty six (256) science teachers were selected from secondary

schools in Ilorin East, South and West Local Government Areas using stratified random sampling technique. Data was obtained using a researcher-designed questionnaire.

Results showed that out of the thirty-six (36) selected innovative teaching strategies, most science teachers frequently used only two (2), while the rest were rarely used. The results showed no significant difference in science teachers' level of utilization of the innovative teaching strategies based on experience and qualifications.

Empirical Studies on Teachers' Gender and its Influence on Teaching of Science

Gender is referred to as social attributes and opportunities associated with being a male or a female. It has to do with the relationship between women and men, boys and girls. 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 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).

Personality traits and characteristics are biological as well as environmental. Gender is a universal dichotomy in any given culture and strict gender behavioural traits are believed to produce inhibitions, especially for females, which may lead to inhibitions in achievement and success

situation. Males inhibit females from subjects, careers and specialization which have been stereotypically ascribed to them Abidoye(2015).Awodun, Oni, and Oyeniyi (2015) examined the influence of teacher's gender in secondary school students' performance in Physics in Ekiti State, Nigeria. A total of 200 SS II Physics students in randomly drawn from ten secondary schools in Ikere Local Government Area of Ekiti State constituted the sample. ANOVA was used to analyse the three hypotheses formulated for the study.

The findings showed that there is significant difference in the performance mean scores of boys taught by male and that of those taught by female Physics teachers, there is significant difference in the performance mean scores of girls taught by male and that of those taught by female teachers and there is significant difference in the performance mean scores of students taught by male and that of those taught by female Physics teachers.

Igberadja (2016) investigated the effects of teachers' gender and qualification on students' performance in industrial safety. Purposive sampling technique was used to select the TED112 result of students for 4 sessions. Two sessions each was selected based on the lecturers' gender and qualification. However, 2007/2008, 2008/2009, 2009/2010, and 2013/2014 Session results were used as sample of the study. Therefore, the sample of the study was 91 undergraduate students. No instrument was developed in this study rather a letter was used to request for data. Data collected was analysed using mean for the research questions and ANOVA (Analysis of variance) to

test the hypotheses. The result revealed that the teachers' gender and qualification do not have any significant effects on students' performance in Industrial Safety.

Babajide (2010) found that gender has no significant influence on the students' achievement in science. 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. Babalola and David, (2011) carried out an investigation on Biology teachers on difficulty level. The study showed that there is no significant difference in perception of difficult topics based on their gender. Akinsola, (2014), the study revealed that the gender of Biology teachers affect, their attitudes towards Improvisation of instructional materials. Kola and Taiwo, (2013), also observed in their various studies that there is no significant difference between the attitudes of males and females Biology teachers towards the use of improvised instructional materials.

Ejifugha and Oguari (2011) investigated the problem with gender equity, an analysis of the data obtained in the study revealed that the emerging enrolment statistics in Science teacher education is female dominated, leaving the males trailing behind and they also found out that male dominated science and technology education in the nation's educational development.

It was observed by Adebayo (2010) investigated on the science teachers' perception towards using information and technology for

instruction and she observed that population of female teachers was higher than the population of male teachers in the area of ICT. She reported that gender inequality is also noticed. This has probably led the World Bank to start the gender ad ICT Seminar in the year 2000 (Gender). The purpose was to bridge the gender digital division. Ahmed, Ismail and Danmole, (2017) carried out a research on senior secondary school Biology teachers' perception of their needs in Kwara state; purposive and stratified random sampling technique were used to select two hundred and fifty (250) biology teachers from the three senatorial districts in the state. Descriptive statistics in form of frequency counts and mean were used to rank the needs of biology teachers. Chi-square statistical tools were used to analyse the data collected. Two research questions and four hypotheses were raised and tested. The findings revealed that there was a significant difference between perceptions of teachers' on their academic needs based on gender and that male biology teachers want more of academic needs than their female counterparts.

Okoro, Ekanem and Udoh (2012) investigated the effect of teachers' gender on the academic performance of children in primary schools in Oyo Metropolis. Using the stratified random sampling technique, three schools were selected for the study from which 60 pupils were co-opted using stratified purpose sampling technique. Using an ex-post facto design, the researchers collected academic performance data based on the first term examination and continuous assessment of the selected students for data

analysis which was carried out using 2-factor analysis of variance (ANOVA) with replication of the three schools. The results showed that teacher-pupil gender interactions do significantly affect pupils' academic performance as evidence in the differences between the performances of boys taught by male teachers and boys taught by female teachers and girls taught by male teachers.

Udousoro (2012) viewed the effect of gender and mathematics ability on academic performance of students in chemistry. The sample size comprises of 100 SS1 Chemistry students in two sec schools in Oyo metropolis. The instruments used were the chemistry achievement test (CAT) and the Mathematics ability test (MAT). Independent t-test statistics tools were used to analyse the data collected. The results of the test indicated that gender does not have any significant effect on the academic performance of students in Chemistry.

Odogwu, Adeyemo, Jimoh and Yewonde (2011) examined the gender differences amongst science, mathematics and technology (SMT) teachers with regards to the school environment variables as the association of these variables with teachers' professional background and school characteristic. A questionnaire was used to collect data from a sample of 275 female and 260 male SMT teachers. A multiple analysis of variance revealed a statistically significant gender difference on the combined nine school environment variables. Analysis further revealed a significant gender differences in SMT

teachers' perceptions of work pressure and principal leadership persisted after controlling for teachers' background and characteristics.

In the study of Oyedeji (2005) examined the influence of sex on the teaching of ecology. The researcher used Chi- square (χ^2) instrument to rate male and female biology teachers. For the study, the researcher sampled 500 teachers 290 males and 210 females across all the 6 geo-political zones in Nigeria. The result of the findings revealed that male and female biology teachers were not significantly different in their views on the opinion that ecology is difficult, on methods they employed, no knowledge of the subject matter content and attitudes toward their teaching, Hence sex had no influence on the teachers teaching of ecology.

The study of Abiri and Ugborugbo (2008) examined the influence of gender on the productivity of secondary school teachers in Delta State, Nigeria. The study was descriptive in nature and involved 979 teachers made up of 460 males and 519 females. Two sets of questionnaires and a rating scale were used to collect data for the study. The results showed that there was a significant difference in the productivity of male and female teachers, the male teachers were generally more productive than their female counterparts but the female teachers were more influenced by location than the male teachers.

Also, Lawrence (2016) examined the perception of chemistry teachers on the factors affecting effective utilization of information and

communication technology (ICT) in the teaching and learning of chemistry in Kogi State. The sample for the study consisted of 105 chemistry teachers randomly selected from a total population of 448 chemistry teachers in the public secondary schools in Kogi State through purposive random sampling. A 16- item questionnaire was developed, validated and used by the researchers to the data. Mean and standard deviation were used to analyse the research questions while t-test was used to analyse the hypothesis. The results revealed that chemistry teachers had the perception that factors such as lack of funds and training among others affect their effective utilization of ICT in teaching chemistry. The results also showed 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 relationships.

Ngwu, Ellah and Emmadiole (2019) investigated on the strategies for improving human capital development in biology as perceived by biology teachers. The study was carried out in Aguatta Education zone, Anambra state. Fifty (50) biology teachers in senior secondary schools in Aguatta Education zone formed the sample for the study. Biology Teachers capital Development Scale (BTCDS) developed by the researchers with a reliability coefficient of 0.83 obtained through Cronbach's alpha method was used for data collection. The data obtained was analysed using mean, standard deviation and t-test statistics. The findings revealed that there is no significant

difference between male and female biology teachers' perceived strategies for improving human capital development in biology education for the enhancement of Science Technology, Engineering and Mathematics (STEM) education. Findings also shows that there is no significant difference in biology teachers' perceived challenges facing human capital development in biology education based on gender.

Empirical Studies on Teachers' School Type and its Influence on Teaching of Science

The issue of school type and teaching has generated a lot of interest among various researchers. Evidence derived from a variety of surveys undertaken by different researchers using different tests in various parts of the world showed that the measured ability and attainment of public school students are not the same with those in the private schools. Gamze (2018) investigated on the biology teachers' perceptions about field trips and related pre-service preparation. Survey data was collected from 10 public and 04 private schools in Ankara. Findings revealed that as the years of teaching increased, the teachers considered field trips more challenging especially for providing students safety and being supported by administrators.

Additionally, the results indicated that the biology teachers with an undergraduate degree considered field trips more challenging than teachers who had earned their master's degree. Furthermore, while private school teachers had higher confidence levels and considered field trips more

beneficial, public school teachers focused more on the challenges. There were notable difference between male and female teachers regarding perceptions of financial constraints, parental support for field trips and confidence level.

Grace, Mark, and Fred (2015) investigated on the secondary school biology teachers' perceptions of scientific creativity; cross sectional survey research design was employed. The population of the study comprised all biology teachers in public secondary schools in Kericho and Kajiado Community in Kenya. A sample of 205 biology teachers was selected from a population of 347 using proportionate random sampling technique. A biology teachers' questionnaire was used to collect data. Data were analysed using descriptive statistics. The findings showed that a high percentage of biology teachers have high perceptions of general creativity but only a small percentage have the low perceptions of scientific creativity.

The findings have also yielded valuable information that informed curriculum developers, teacher trainers and policy makers that the majority of teachers have inadequate perceptions of scientific creativity and this may influence practices.

Adigun and Yusuf (2010) studied the influence of school type, sex and location of students' academic performance in Ekiti State secondary schools. The sample of the study consisted of forty (40) sec schools. Four (4) Government College (State Unity Colleges) were purposely selected for the study while 36 public secondary schools were randomly selected for the

study. An instrument, school type, sex, location and students' academic performance inventory was used to collect data for the study. Data collected were analysed using percentage scores and t-test statistics.

Three null hypotheses were generated and tested at 0.05 level of significance. Findings from Adigun and Yusuf (2010) study showed that the level of students' academic performance was low, it was also revealed that school type, sex and location had no significant influence on students' academic performance. Based on the finding, it was recommended that educational planners, administrators and evaluators should appreciate the fact that the Parent Teachers Association, Guidance and Counsellors, Philanthropists, students and society at large have crucial role to play in improving students, academic performance and solicit their supports in this regard.

Alimi, Ehinola and Alabi (2012) observed the school types, facilities and academic performances of students in private and public sec schools. Descriptive survey design was used to select 50 schools in Ondo State. Two sets of research instruments named school facility, descriptive and students' academic performance Questionnaire (SFDAPQ) for the teachers were used for the study, *t*-test was used to analyse the data. Their results revealed a significant difference in faculties available in public and private schools in Ondo State. It however revealed no significant difference in academic performance of students in the two types of secondary schools. Suggestion

for the procurement of more facilities in public secondary schools was made in order to enhance students' academic performance.

Renu and Sudipa (2012) investigated whether the private school premium as manifested in student learning outcomes, is the result of better quality teaching in private schools. This paper provided a detailed comparison of 227 government and private schools attended by the students in the sample. They looked at the effect of teaching quality on student's test score, controlling for lagged test scores of students and for several household, class and school level characteristics. The results from the regression analysis suggested that students in private schools have a significantly higher (at 1 percent) mathematics score than student in public schools. A major finding is that specific teacher characteristics and practices have emerged as important factors in determining students' learning outcomes.

Abidoye, (2015) carried out a study on assessment of science teachers' attitudes towards teaching in senior secondary school in south-west Nigeria. The study was a descriptive research of survey type. Simple random sampling techniques were used to select a total of 1020 science teachers in 204 senior secondary schools in all the six states in the zone. Both public and private secondary schools were randomly selected. The instrument used was a modified adaptation of Patchaziamman and Krishnamurthy. The data collected were analysed using t-test. The study revealed that there was a

significant difference in the attitude of science teachers towards science teaching based on their school type.

Khursid and Zahur (2013), examined the extent of teachers' awareness and utilization of innovative teaching strategies in private and public sector secondary schools, it further aimed to identify differences in the responses to teachers across teaching experiences and professional background. They sampled 100 secondary schools in Islamabad. In the study, 16 selected teaching strategies were used to analyse teachers' awareness and its utilization in classrooms settings. Result revealed that level of teachers' awareness and utilization of innovative strategies was high in the private sector schools compared to the public sector schools.

Empirical Studies on School Location and its Influence on Teaching of Science

Urban schools are those schools in the municipalities or schools found within the towns while rural schools are those located in the villages or semi-urban areas. Umesh and David (2013) investigated on teachers' perceptions of the educational value of new topics in a revised physical sciences high school curriculum in South Africa, the teachers' content knowledge competency of these topics and their pedagogical content knowledge in teaching them. Focus of the study was comparison of these perceptions of teachers based at schools which are diverse in terms of location, student population, and availability of resources. Mixed methods approach in

collecting and analysing data from a large-scale survey of teachers through a structured questionnaire, and this was followed with interviews with 10 teachers in seeking more in-depth explanations of the findings. The study revealed that teachers at township and rural schools previously designated for black students and sub-urban and city schools previously reserved for white students, have a positive perception of the new topics introduced into the revised curriculum. However, teachers at all these schools expressed uncertainty as to their content knowledge and pedagogical knowledge of the new topics.

Also, Oyedeji (2005), conducted a study on analysis of biology teachers' views on the problems of teaching ecology in Nigerian secondary schools, the research was a descriptive research type, researchers design questionnaire was the instrument used, 500 biology teachers were sampled with stratified sampling technique in the six geo- political zones, the study revealed that there was significant difference in the views of biology teachers from rural and urban schools. Ezechi (2014) stated that the location of a school determines to a large extent the level of students' performance in biology. This means that the performance of students is by the location of the school. Therefore, the area in which a school is located can affect the educational performance of a student.

Owoeye and Yara (2011) in their studies on school location and academic performance of secondary school students in Ekiti State, Nigeria

asserts that the various review of literature of school location influence on academic performance is not the same. While some maintain that urban students perform better in examination than their rural counterparts, others found out that rural students (in spite of all odds) perform better. Some have submitted in their findings and concluded that no particular set up (urban or rural) can claim superiority over the other because their performances are the same. In addition, Owoeye (2002) and Onah (2010) in their separate studies indicated that schools in urban areas achieved more than schools in the rural areas in science subjects. Conversely, Onah and Ugwu (2010) in their study to determine factors which predict performance in secondary schools Physics in Ebonyi North educational zone of Ebonyi State, asserted that the influence of school location on the performance of students in secondary schools was not significant, hence they concluded that school location does not influence Physics performance of students in secondary school.

In addition, Kolawole and Popoola (2011) in their study revealed that the mean performances of students from urban and rural locations in mathematics are not statistically different. 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 $\{F(1,639)\} = 0.50, P > 0.05$. This means that location of schools (urban or rural)

did not influence the junior secondary school integrated science students' perception of their psychological classroom environments.

Melisa (2019) identified teachers' perceptions of difficult areas in senior secondary school biology curriculum in Lagos State Nigeria. Five research questions were raised and three research hypotheses were tested. A survey design was used for the study. A multi-stage sampling random sampling technique by balloting and cluster sampling techniques were adopted to compose the sample of 120 biology teachers in for education zones of Lagos state. A structured Questionnaire (BTAQ) was used to collect data from the respondents.

The data collected were analysed using mean, standard deviation and one-way ANOVA to t-test the hypotheses at 0.05 levels of significance. The analysis of the data yielded the following results: The teachers find the teaching of chromosome, Evolution, Glycolysis, Germination, Genetics and skeleton difficult. Gender, academic qualification and location of services of the teacher have no significant influence in the biology curriculum.

Agummuoh (2014) investigated on physics teachers' perception of effective teaching/learning of physics in senior sec school for Global competitiveness, the study employed a descriptive survey design. The sample size for the study was seventy-nine (79) senior sec school physics teachers from Umuahia Education zone of Abia state of Nigeria. Two (2) research questions and one (1) null hypothesis tested at 0.05level of significance

guided the study. The instrument for data collection is a researchers' developed structured questionnaire of the Likert type. Data collected was analysed using mean for the research questions and chi-square (χ^2) statistics for the hypothesis. The study revealed that six main principles of effective teaching learning for global competitiveness were identified by physics teachers.

In a research carried out by Okereke and Onwukwe (2011) on the influence of school location on school achievement in chemistry, it was discovered that the students from urban schools achieved significantly better than students from rural schools. Lawal (2013) investigated the levels of scientific literacy among senior secondary school students in Oyun Local Government Area of Kwara State, Nigeria and found out that there was no significant difference in the levels of scientific literacy between students in rural and urban areas in Oyun Local Government as revealed in the study.

Also there was no significant difference in the levels of scientific literacy of students' location based on their knowledge, skills and attitude having χ^2 -value of 12.95 which is lower than the table value (15.51), χ^2 value (7.87) also lower than the table value of (14.07) and χ^2 value of 7.20, which is also lower than the table value 14,07 respectively. This implies that the urban secondary schools have benefit in terms of science equipment in the laboratory and science teachers teach the subjects effectively but the equipment are not frequently used by the teacher.

Juma (2015) carried out a study on exploring the development of biological literacy in Tanzanian Junior Secondary school students, the finding revealed that students in rural areas did not feel that what they learn in biology classes at school is useful or relevant to them, this is in contrast with the responses of the urban students. It was seen in this study that urban participants are less interested in pursuing biology or science related career compared with their rural schools. The percentage of both rural and urban participants interested in a biological related career were 72% and 39% respectively and of those who were not interested in pursuing a career in biology, 61% were located in urban schools and 28% were based in rural schools.

It was then submitted that students from schools in rural area have fewer career role models in rural areas are nurses and doctors who are highly respected in rural communities, but urban students have a wider range of career role models to learn from. They are having more choices available for them. It was also seen that the rural students did not know how to apply the knowledge of biology taught in school to their day to day activities but could only be used in chosen career. Therefore, the present study wants to add to the debate because from the literature above, studies on school location are inconclusive.

Appraisal of the Reviewed Literature

In this study, much research work has not been carried out on biology teachers' perceptions on application of study technology principles to instruction but the few once carried out were majorly on students. The reason alluded for this was that, study technology is a learners-centred instructional strategy. Hubbard (1972) concluded that study technology allows a person to study any subject successfully empowering them to achieve the goals they set in life for what they want to be and what they want to do. Abimbola (2015) concluded that study technology centres on the understanding of three main barriers to study which are lack of mass, too steep a gradient and the misunderstood words. Knowledge of these three barriers can make it possible for students to recognize when they encounter one or more of these barriers and proceed to overcome them.

Hubbard (1998) also identified the study technology principles and concluded that if these were applied as instructional strategies in the classroom, the performance of students would improve drastically. Other researchers such as Abdulkadir (2011), Gbigbadua (2014), Edukugho (2006), Bagayoko (2007), olawoye and Adenaike (2012) and Ahmed (2018) concluded that study technology principles improves students' performance when applied as instructional strategies.

Also in the study reviewed on the perceptions of teachers generally, teachers' perceptions were majorly positive or higher based on the variable

used for the study such as Atotileto (2017) and Ahmed et al (2017) whose work were on perceptions of biology teachers on their academic needs based on gender and science process skills perceived difficult to teach by upper basic science teachers based on teachers' years of teaching experience. Also, Gamze (2018) worked on the perceptions of biology teachers about fieldtrips and related pre-service preparation; findings revealed that significant difference existed on the biology teachers' perceptions based on school type. Melisa (2019) investigated on biology teachers perceptions of difficult areas in senior school biology curriculum; school location has no significant difference on their perceptions.

In the studies reviewed, none of them worked on perceptions of biology teachers on application of study technology principles to instruction. Also, in the studies reviewed, questionnaire, clinical interview were used as this present study involve the use of questionnaire items for data collection. Finally, in the studies also reviewed, the percentage, factor analysis, ANOVA were used as statistical analysis whereas the present study used t-test, ANOVA and the mean score as the statistical tool for analysing the data.

CHAPTER THREE

RESEARCH METHOD

This chapter presents the procedures that were employed in conducting the study. These were discussed under the following sub-headings: Research Type, Population, Sample and Sampling Techniques; Research Instrument; Validation and Reliability of the Instrument; Procedure for Data Collection and Data Analysis Techniques.

Research Type

This study was a descriptive research of the survey type in which data were collected from a sample of individuals from a specific population. Akweziulo and Agu (2011) defined survey research as one in which a researcher studies a group of people or items by collecting and analysing data from only a few people or items considered to be the representative of the entire group. Descriptive research of the survey type was considered appropriate for this study because data were collected, analysed and reported as they exist. The sampled population was asked questions according to standardized procedures, with the aim of obtaining a composite report on their perception, with regards to particular aspects of their work. Data obtained were used to describe the population and the way they relate to their perception.

Population, Sample and Sampling Techniques

The population for this study comprised all the senior school biology teachers in both public and private schools in Kwara State, Nigeria. The sample was drawn from all the senior secondary schools in the sixteen Local Government Areas of Kwara State, Nigeria. The purposive sampling techniques were used to select a total of 720 senior school Biology teachers from four hundred and seventy-eight (478) schools in the sixteen Local Government Areas in Kwara State. The reason alluded for this was that, the biology teachers who were available when administering copies of the questionnaire in both public and private senior secondary schools in the state were selected.

The lists of selected Biology teachers in the sixteen local government of Kwara State are presented in (Appendices III and IV) respectively. Seven hundred and twenty Biology teachers were sampled because those selected were those that filled the copies of the questionnaire appropriately. Seven hundred and twenty (720) Biology teachers were sampled from all the Biology teachers in Kwara State. Four hundred and seventy-four (474) Biology teachers from the Two- hundred and fifty-nine (259) public senior secondary schools in Kwara State were selected (Kwara State Teaching Service Commission, 2019) and Two- hundred and forty-six (246) Biology teachers were selected from Two hundred and nineteen (219) private senior secondary schools in Kwara state (Quality Assurance Bureau Headquarters

Ministry of Education and Human Capital Development, Kwara State Ilorin 2019).

Research Instrument

The instrument that was used for this study was a researcher- designed questionnaire on Senior School Biology Teachers' Perceptions on the Application of Study Technology Principles to Instruction (BTPASTPIQ) which consists of two sections (Section A and B).Section A of the questionnaire requested for personal information of the Biology teachers such as name of school, subject, teacher's areas of specialization, teacher's academic qualification, teacher's year of teaching experience, teacher's gender, school type and school location.

Section B of the questionnaire contains 50 statements used to measure the perceptions of the Biology teachers. The responses to the questionnaire items were used on a four Likert scale such as Strongly Agree (SA), Agree (A), Disagree (D), and Strongly Disagree (SD).

Validation of Research Instrument

Content and face validity of the research instrument (BTPASTP) was ascertained by three lecturers in the Department of Science Education, Faculty of Education, University of Ilorin, Ilorin. Furthermore, the instrument was also given to three secondary school Biology teachers for their opinions. The input of these validations and suggestions were taken into consideration when producing a final version of the copy of questionnaire.

The reliability of the research instrument was determined using the test- retest method. That is, by administering the instrument to twenty (20) senior school Biology teachers from schools that were not part of the actual population. The resultant data were analysed using the Cronbach alpha Statistics and a reliability index of 0.78 was obtained.

Procedure for Data Collection

In collecting the data for this research, the researcher organised a workshop on study technology awareness for all the Biology teachers in the sixteen Local Government Areas in Kwara State. This was done to create awareness on study technology principles to the world at large. The researcher visited some of the stakeholders in charge; among these people are the Permanent Secretary of the Ministry of Education and Human Capital Development Ilorin Kwara State, the Teaching Service Commission State Chairman, the President of National Association of Proprietors of Private Schools in the State (NAPPS), the State Chairman of All Nigerian Confederation of Principals of Secondary Schools (ANCOPSS) and the State Chairman of the Nigerian Union of Teachers (NUT) to seek permission to organise Study Technology Awareness workshop for all the Senior School biology teachers in the state. Few weeks after, invitation letters were distributed to them through the Permanent Secretary of the ministry of Education and Human Capital Development. A sample of this letter is shown in (Appendix VIII A, B and C). Queen Elizabeth School Ilorin was the venue

of the workshop. The researcher also organised an interview section of 30 minutes on FM radio with the Resource Person at Radio Kwara, Ilorin in order to create more awareness on study technology principles.

The workshop included morning and afternoon sessions. The morning session was used to interact with the officials from the State Ministry of Education and Human Capital Development and all the Biology teachers that were present in the workshop. The Resource Person introduced the Concept of Study Technology and the Principles of Study Technology. The afternoon session was used for different hands-on activities on the Principles of Study Technology.

The participants (Biology teachers) were grouped into four in which each group was assigned to one or two principles of Study Technology. Biology teachers were paired so as to demonstrate the principle of Twin Partnership. Members of group 'A' were assigned to work on the use of standard/Referenced/Standard Dictionary for Keyword clearing on some Biological Concepts like Genetics and Nervous Co-ordination, Group B' to work on the Use of Demonstration (Demo) Kits and Clay table training, Group 'C' were working with Checksheet/Study guide with Biology textbooks, Group 'D' were working on Projection Equipment for Chinese School, while the Instructor and Assistant Instructors were moving round to supervise the Biology teachers.

A letter of introduction of the researcher seeking permission to administer the questionnaire was obtained from the Department of Science Education, University of Ilorin, Ilorin to the Principals, Heads of Science Department, and the biology teachers of the selected secondary schools. In addressing the ethical issues arising from research design, the researcher through the consent forms wrote letter to seek permission from the principals, and the Biology teachers of each selected school to administer the questionnaire. Informed consent form was made available to the teachers to seek their consent to participate in the study.

The teachers' names, schools and results were not disclosed; their schools and results were kept in the custody of the researcher and were used solely for the purpose of the research. Distribution of the copies of questionnaire were done by the researcher and the research assistants during the teachers' free period to avoid the disturbance of their lesson; hence no risk was envisaged to the teachers during this period and the benefits of this to the teachers are to acquaint them of the knowledge of study technology principles so that they can develop positive attitude toward the use of this strategy.

Also, the participants who wished to withdraw from the research study did so without question at any time. The copies of the questionnaire were distributed to the Biology teachers with the help of research assistants. The researcher involved assistant instructors in the field of study technology as research assistants who were given instruction on how to share and retrieve

the copies of the questionnaire from the respondents and were given adequate instruction on how to complete the questionnaire. The completed copies of the questionnaires were collected for collation and subsequent analysis. Out of the eight hundred (800) copies of questionnaire administered, seven hundred and twenty (720) copies were properly filled and returned, giving a completion rate of 90%.

Data Analysis Techniques

To analyse the data collected, the descriptive statistics of the mean score, and pie charts were employed for the personal information section of the questionnaire and the research questions were answered using percentages, mean scores, and standard deviation, while the inferential statistics of the t-test and Analysis of Variance (ANOVA) were used to test the hypotheses. Hypotheses 1 and 2 were tested using the ANOVA statistics, this is because the two hypotheses consisted of independent variables with more than two levels that is, teaching qualification with more than two (2) levels and teaching experience with three levels dependent variable while hypotheses 3, 4, and 5 were tested using independent t-test at 0.05 alpha level of significance because the three hypotheses had an independent variable with two levels each, that is, gender which was either male or female, school type which has private and public schools and school location which are rural and urban. The dependent variables are the Biology teachers' response to the questionnaire items.

Four-point, Likert scale was used as rating scale of the items in section B as follows: Strongly Agree, Agree, Disagree and Strongly Disagree was used for the questionnaire. In order to convert these ordinal scales to interval scale, a weighting was given to each point in the scale as follows: Strongly Agree (SA) 4 points; Agree (A) 3 points; Disagree (D) 2 points; Strongly Disagree (SD) 1 point.

The response of the biology teachers' perceptions were transformed to either positive or negative perception by summing up the four responses, strongly agreed, agreed, disagreed and strongly disagreed which was 10 divided four (4) Likert scale which gives 2.50. So, any biology teachers' response that is greater than ($>$) this was positive perception, while any response that was less than ($<$) 2.50 was negative perception. All the analyses were done with the aid of Statistical Package for Social Science (SPSS) Version 23 and the results were subjected to statistical analysis at 0.05 level of significance.

CHAPTER FOUR

DATA ANALYSIS AND RESULTS

This chapter presents the results of data collected in this study. Descriptive analysis of the number for senior secondary school biology teachers that were involved in the study was presented using frequency count and pie charts. The independent t-test and Analysis of Variance (ANOVA) were used for answering the thirteen research questions and five research hypotheses.

The Analysis of Variance (ANOVA) statistical technique was used to test hypotheses 1 and 2, while the t-test was used to test hypotheses 3, 4 and 5. Finally, findings from the analyses are summarised. The analyses and results are presented in tables 3 to 22.

Tables 3, 4, 5, 6, 7 and 8 describe personal information of senior school biology teachers that formed the sample for the study. The percentage was used to describe their personal characteristics.

Table 3 reveals that out of 720 Biology teachers sampled, 101 (14.0%) were B. Sc. holders; 80 (11.1%) were M. Sc holders while 539 (74.9%) were B.Sc (Ed) & B.Sc + PGDE holders. This implies that majority of the biology teachers involved obtained B.Sc (Ed) & B.Sc + PGDE. The report in table 4, further illustrated in the pie charts, figure 3.

Table 3:*Distribution of Biology Teachers Based on Academic Qualifications*

Qualification	Frequency	Percentage
B.Sc.Ed;B.SC+PGDE	539	74.9
B.Sc	101	14.0
M.Sc.	80	11.1
Total	720	100.0

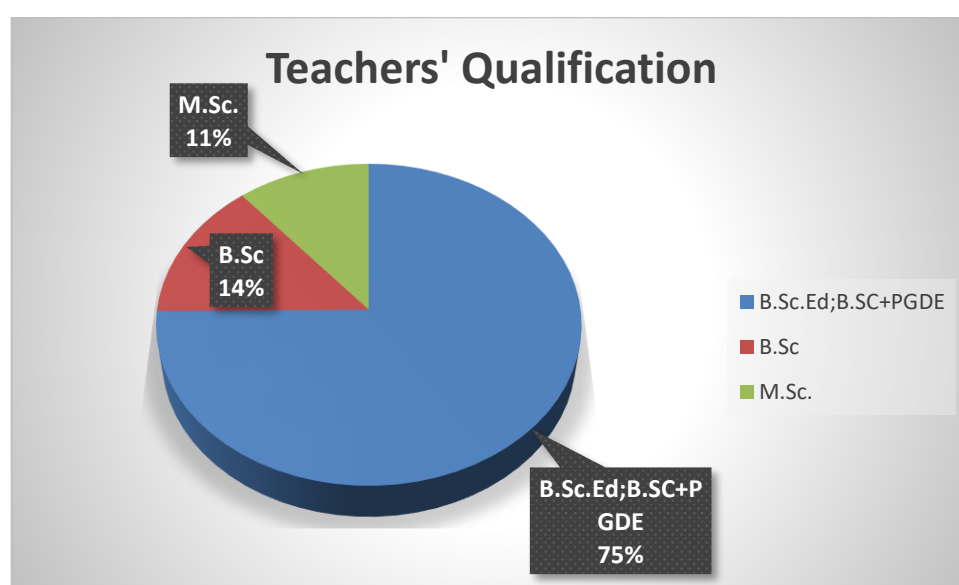


Figure 3: *Pie Chart Showing the Distribution of Senior School Biology Teachers Based on their Academic Qualifications*

Table 4 indicates that out of 720 senior school Biology teachers sampled, 254 (35.3%) were categorized as less experienced; 204 (28.3%) fell within moderately experienced, while the other 262 (36.4%) are categorised as well experienced. The pie chart showing the distribution of participants based on their years of teaching experience is Figure 3 where 35.3% of the

populations and less experienced, 28.3% were moderately experienced and 36.4% were experienced.

Table 4:*Distribution of Biology Teachers Based on Teaching Experience*

Experience	Frequency	Percentage
0-5	254	35.3
6-10	204	28.3
Above 10	262	36.4
Total	720	100.0

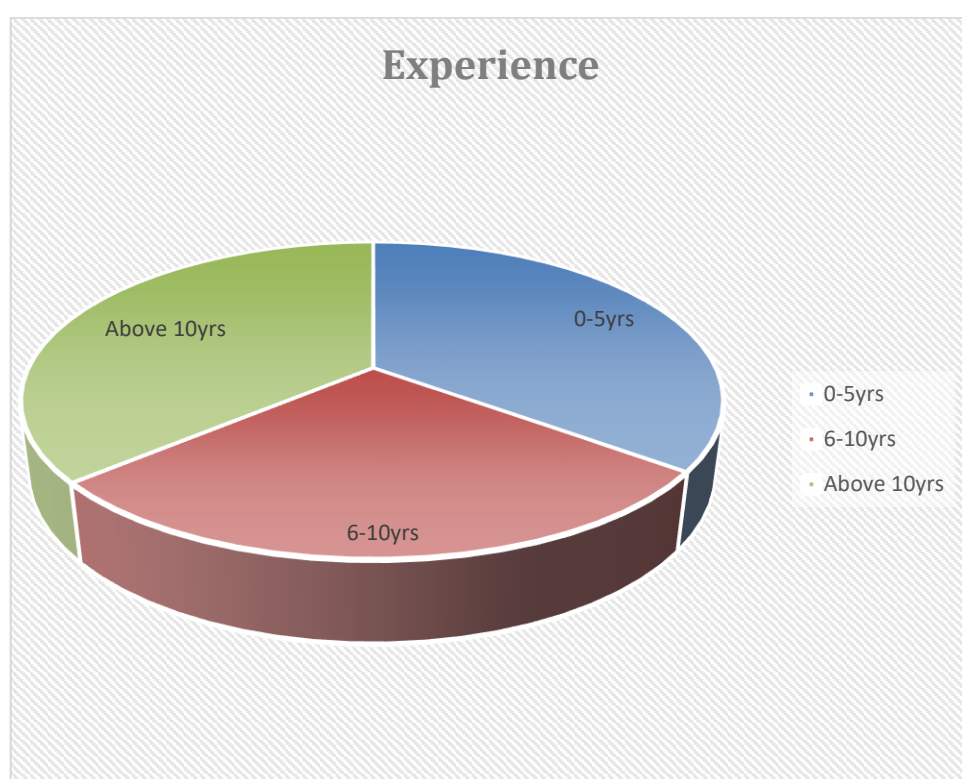


Figure 4: *Pie Chart Showing the Distribution of Biology Teachers Based on their Years of Teaching Experience*

Pie Chart Showing the Distribution of Senior School Biology Teachers Based on Their Years of Teaching Experience

Table 5 shows the distribution of the biology teachers based on gender. Out of 720 respondents who appropriately filled the questionnaire 339

(47.1%) were male Biology teachers, while 381 (52.9%) were female. This shows that female Biology teachers who participated in the study were more than their male counterparts.

The Pie chart showing the distribution of Biology teachers based on gender is Figure 5 where 47.1% of the population were male and 52.9% were female Biology teachers.

Table 5: *Distribution of Biology Teachers Based on Gender*

Gender	Frequency	Percentage
Male	339	47.1
Female	381	52.9
Total	720	100.0

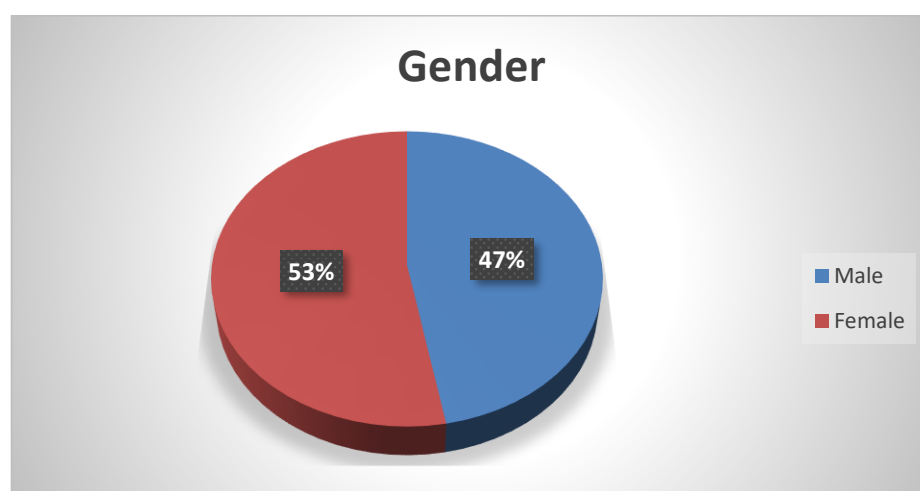


Figure5: *Pie Chart Showing the Distribution of Biology Teachers based on Their Gender*

Table 6 shows the distribution of Biology teachers based on the school type. 474 (65.8%) were selected from public schools, while 246 (34.2%) were selected from private schools.

The pie chart showing the distribution of participants based on the school type is shown in Figure 6 where 65.8% of the population was selected from the public schools and 34.2% of the population was selected from the private schools.

Table 6: *Distribution of Biology Teachers Based on School Type*

School Type	Frequency	Percentage
Public	474	65.8
Private	246	34.2
Total	720	100.0

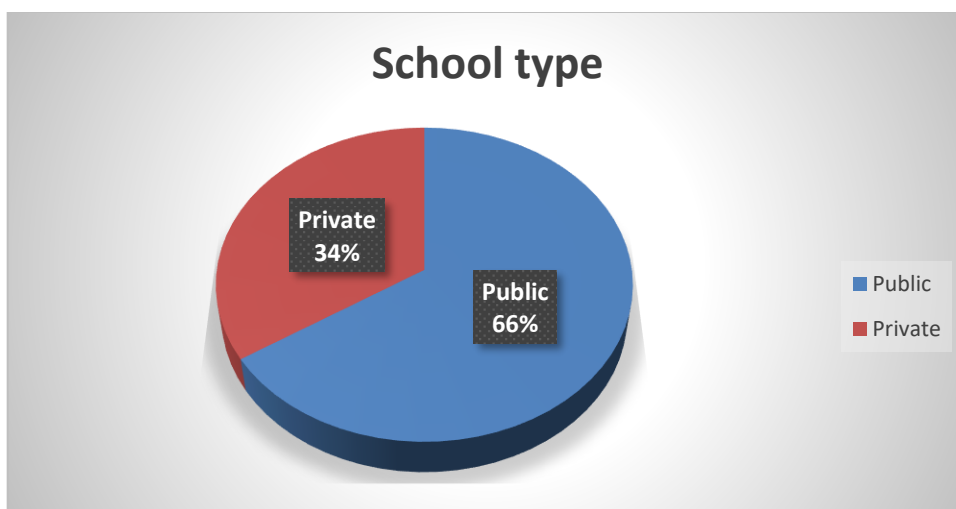


Figure 6: *Pie Chart Showing the Distribution of Biology Teachers Based on Their School Type*

Table 7 shows the distribution of senior school Biology teachers sampled based on school location. Where Biology teachers from schools in the rural areas were 220 (30.6%), those from schools in urban areas were 500 (69.4%). The pie chart showing the distribution of participants based on school location is shown in Figure 7 where the selected Biology teachers from schools in the rural areas were 30.6% of the population and 69.4% were teachers selected from schools in the urban areas.

Table 7: *Distribution of Biology Teachers Based on the School Location*

School Location	Frequency	Percentage
Rural	220	30.6
Urban	500	69.4
Total	720	100.0

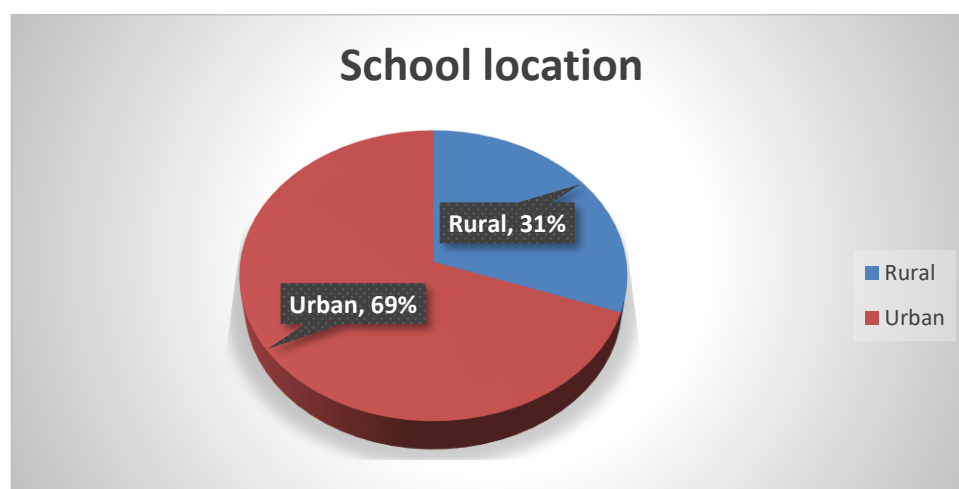


Figure 7: *Pie Chart Showing the Distribution of Biology Teachers Based on their School Location*

Research Question 1: What are the perceptions of senior school Biology teachers on application of study technology to instruction?

In analysing research question 1, the responses of the biology teachers (means) for all the twelve questionnaire items except one had positive perceptions (with the highest mean of 3.48) to the application of study technology to instruction, while the only questionnaire item with negative perception had a mean of 2.44

Table 8: *Biology Teachers' Perceptions on Application of Study Technology to Instruction*

S/N	ITEM	STUDY TECHNOLOGY	Mean	SD
1	Study technology is a unique programme which enables students to overcome the basic barriers to studying and learning but a new instructional strategy.		3.48	0.55
2	Study technology is a system of learning which is so difficult for teachers to apply in classroom situation.		2.44	0.83
3	Study technology is a research-based system of learning that requires more time than conventional method of learning.		3.02	0.78
4	Study technology entails active participation of the teachers.		3.27	0.71
5	Study technology enables learners to empower themselves by being able to take responsibility of their own learning processes.		3.39	0.62
6	Study technology is a learning strategy that students could embark on at their own leisure time.		3.16	0.72
7	Study technology causes attitudinal change in learners if properly utilised.		3.25	0.64
8	Study technology could liberate students from over-reliance on their teachers		3.29	0.63
9	Study technology produces self-regulated learners who possess ability to learn independently throughout their lives which encourages self-discoveries.		3.30	0.61
10	Study technology promotes self- discipline and academic abilities of learners.		3.21	0.70
11	The use of study technology encourages adequate coverage of the syllabus.		3.02	0.78
12	Users of study technology know how to cope when they feel disturbed and make them independent of their teachers.		2.91	0.75

Research question 2: What are the perceptions of senior school biology teachers on the application of checksheet to instruction?

Research question 2 indicated what the perceptions of Biology teachers' on the application of checksheet to instruction are. The Biology teachers had positive perceptions on application of use of checksheet to instruction. This was because all the means obtained were greater than (2.50). The highest mean was (3.18), while the lowest mean was (2.95).

Table 9: *Biology Teachers' Perceptions on Application of Checksheet to Instruction*

S/N	CHECKSHEET	MEAN	STD.
1	A checksheet is a form of information which sets out the exact sequence of items by items on a course but very difficult to form.	2.95	0.67
2	The use of checksheet requires teachers' commitment and dedication.	3.27	0.59
3	Checksheet are formed by making use of reference textbooks.	3.15	0.59
4	Students' use of checksheet requires teachers' guide.	3.13	0.63
5	A Checksheet is formed from the students' dictionary	2.58	0.73
6	Checksheet is a course guide in study technology which can bring about students' involvement in the classroom.	3.12	0.63
7	Checksheet includes the content of the course, which are progressively assigned to the learners to be studied in a measured manner.	3.13	0.61
8	A check out is a strategy used to find out how much a learner knows from an assigned work by the twin partner which involve the teacher.	3.04	0.63
9	A star-rated checkout occurs when it is carried out by a course instructor notifying the teacher on the next step of action.	2.97	0.65
10	The course guide contains all student-centred instructional strategies and resources for which study technology is noted, these should be kept by the teacher.	3.18	0.67

Research Question 3: Do Biology teachers have different perceptions on application of word clearing to instructions?

Table 10: *Biology Teachers' Perceptions on the Application of Word Clearing to Instruction*

WORD CLEARING			
1	Word clearing is the procedure used by learners to locate and clear up misunderstood words but it's time consuming.	3.19	0.67
2	A reference dictionary is a very good strategy that requires students to get for themselves for word clearing.	3.35	0.58
3	Students' inability to afford the purchase of dictionary could reduce its efficiency.	2.97	0.84

Research Question 4: Do Biology teachers have different perceptions on the application of demonstration kits to instructions?

Biology teachers had positive perceptions to the application of Demonstration kit to instruction, this was evidenced in the mean score of the teachers' responses to questionnaire items 1-6; except item one which has mean score less than (2.50) all other items have mean score greater than 2.50.

Table 11: *Biology Teachers' Perceptions on Application of Demonstration Kit to Instruction*

DEMO KIT			
1	Gathering of items of demonstration kit is a difficult task for the teachers.	2.18	0.83
2	Demonstration kits helps to concretize students' studying.	3.28	0.65
3	Objects can be moved about in relation to each other to show the mechanics actions of a given concept which arouse learners' interest.	3.26	0.59
4	Demonstrating a concept with various small objects encourages learners' participation.	3.31	0.64
5	Demonstration kit is one of the components of study technology that can cause inadequate coverage of the syllabus.	2.71	0.87
6	Demonstration kit is a suitable instructional strategy that could be use to teach large classes.	3.11	0.78

Research Question 5: Do Biology teachers have different perceptions on application of the Chinese school to instructions?

The Biology teachers had positive perceptions to application of the Chinese school to classroom instructions. Evidence in table 12 shows that all the means of their responses were higher than (2.50) having the highest mean of (3.28) and the lowest mean of (2.66) which is still greater than (2.50).

Table 12: *Biology Teachers' Perceptions on Application of Use of Chinese School to Instruction*

CHINESE SCHOOL				
1	A Chinese school is a strategy that is similar to the Quranic school strategy which promotes rote learning.	2.84	0.76	
2	Chinese school helps students to memorise important content in the course but may be difficult for them to understand.	2.90	0.73	
3	Procurement of projection equipment could hinder the effectiveness of Chinese school.	2.66	0.78	
4	The instructor is a trained person in study technology who could be regarded as the teacher.	3.28	0.66	
5	Projection equipment with a screen is required in a Chinese school, this requires more time.	2.89	0.71	

Research Question 6: Do Biology teachers have different perceptions on application of clay table training to instruction?

This shows that all the responses of the Biology teachers sampled were positive, this was because all the mean score obtained were greater than > (2.50) having the highest means of (3.26), while the lowest means is (3.23). This means that Biology teachers had positive perceptions on the application of clay table training to instruction.

Table 13: *Biology Teachers' Perceptions on the Application of use of the Clay Table Training*

CLAY TABLE TRAINING			
1	Clay table training is another section in the course room which enhance students' creativity.	3.26	0.63
2	Clay work will be given as assignment in the course guide so that learners will devote more time for it.	3.26	0.63
3	The instructor is required to check the learners out whether they are ready for the next topic.	3.23	0.62

Research Question 7: What are the perceptions of Biology teachers on the application of projection equipment to instructions?

All the mean obtained here are greater than (2.50) which indicated that the senior school Biology teachers had positive perceptions on the application of the use of projection to class instruction. The highest mean score is (3.17), while the lowest mean score is (2.89) which is greater than (2.50).

Table 14: *Biology Teachers' Perceptions on the Use of Projection Equipment to Instruction*

PROJECTION				
1	Twins partnership is a component of study technology, this could promote cooperative learning.	3.17	0.68	
2	The learner must have all recommended books for instruction which is not economical.	2.89	0.83	
3	Study technology uses a material- based instructional system whereby many schools may find it difficult to apply.	3.01	0.75	
4	A typical classroom for a material- based instruction has only 18 students per instructor.	2.86	0.79	
5	The duty of the instructor is to attend to the learners' instructional needs.	3.26	0.70	

Research Question 8: Do Biology teachers have different perceptions on application of communication skills in study technology?

Table 15 shows that Biology teachers had positive perceptions on the use of communication skills in study technology; this is because all their responses were greater than (2.50). The highest mean score is 3.52, while lowest mean score is 2.84 which is still greater than 2.50.

Table 15: *Biology Teachers' Perceptions on the application of use of Communication Skills in Study Technology to Instruction*

COMMUNICATION SKILLS				
1	Teachers need to learn to communicate well to promote effective teaching and learning processes.	3.52	0.61	
2	A two way communication system is important in study technology	3.34	0.67	
3	There should be mutual understanding between the teachers and a student in communicating process	3.47	0.61	
4	Learners must pay attention to the teachers' communication before it can be received	3.40	0.62	
5	It is important from the learners to be able to duplicate the communication from the teacher	3.22	0.70	
6	There is no verbal communication in Study Technology.	2.84	0.70	

Research Question 9: What are the perceptions of Biology teachers on the application of study technology principles to instructions based on their academic qualification?

Research Hypothesis 1: There is no significant difference in the perceptions of senior school biology teachers on the application of study technology principles to instruction based on academic qualification.

The research question had a correspondence hypothesis, research question 9 transformed to hypothesis 1. Tables 16 and 17 show the result of

data generated for research question 9 and hypothesis 1. The data generated were subjected to the Analysis of Variance (ANOVA).

The Table shows that there was no significant difference in the perceptions of biology teachers in senior secondary schools in Kwara State Nigeria based on academic qualifications. The mean scores ranged between 153.52 and 156.07 respectively. The p -value of 0.226 is greater than the alpha level of 0.05 ($p > 0.05$). Thus, the null hypothesis 1 (H_{01}), which states that there is no significant difference in the perceptions of senior school Biology teachers on the application of study technology to instruction based on their academic qualification, was therefore not rejected. Biology teachers with educational qualification were found to however have slightly higher perceptions than other categories of Biology teachers.

Table 16: *Descriptive Analysis of Biology Teachers' Perceptions based on Academic Qualification*

Academic Qualifications	N	Mean	Std. Dev.
B.Sc.Ed & B.Sc.+PGDE	539	156.0686	14.81060
B.Sc	101	154.4257	13.12200
M.Sc	80	153.5250	10.82306
Total	720	155.5556	14.20522

Table 17: *Analysis of Variance of Biology Teachers' Perceptions based on their Academic Qualifications*

Academic Qualifications	Sum of Squares	Df	Mean Square	F	P	Remark
Between Groups	600.675	2	300.337	1.490	0.226	NS
Within Groups	144485.103	717	201.13			
Total	145085.778	719				

Research question 10: Does Biology teachers' years of teaching experience influence their perceptions on the application of study technology principles to instruction?

Hypothesis 2: There is no significant difference in the perceptions of senior school Biology teachers on the application of study technology principles based on their years of teaching experience.

In providing answer to research question 10 which had a corresponding hypothesis 2, scores on perceptions of Biology teachers on the application of study technology principles to instruction based on their years of teaching experience in Kwara State, Nigeria is this. The data that was generated were subjected to the Analysis of Variance. The result of the analysis is presented in Tables 18 and 19.

Table 18 shows the mean scores range between 154.62 and 156.13 with moderately experienced having slightly higher positive perceptions. While table 19 reveals that there was no significant difference in the perceptions of Biology teachers on the application of study technology

principles to instruction based on their years of teaching experience in Kwara State, Nigeria since the p-value is $(0.411) > 0.05$. The null hypothesis which states that there was no significant difference in the perceptions of senior secondary school Biology teachers on the application on study technology principles to instruction based on their years of teaching experience is therefore, not rejected.

Table 18: *Descriptive Analysis of Biology Teachers' Perceptions based on Teaching Experience*

Teaching Experience	N	Mean	Std. Dev
0-5	254	156.0551	12,09600
6-10	204	156.1324	16,23131
above 10	262	154.6221	14,41418
Total	720	155,5556	14,20522

Table 19: *Analysis of Variance (ANOVA) of Biology Teachers' Perceptions based on their Years of Teaching Experience*

Teaching Experience	Sum of Square	df	Mean Square	F	Sig.
Between Groups	359.53	2	179.77	0.89	0.41
Within Groups	144726.25	717	201.85		
Total	145085.78	719			

Research Question 11: What are the perceptions of the senior school biology teachers on the application of study technology principles to instruction based on gender?

Hypothesis 3: There is no significant difference in the perceptions of male and female senior school biology teachers on the application of study technology principles to instruction.

In providing answer to research question 11 which was transformed to hypothesis 3, table 20 revealed the mean score of male and female Biology teachers' perceptions on the application of study technology principles to instruction in Kwara state, Nigeria. This shows that the mean scores of male Biology teachers is (157.11) and that of female is 154.18. The data was subjected to the t-test statistical analysis. The result of the analysis is presented in table 20, which shows that significant difference existed between the perceptions of male and female Biology teachers since the *p-value* (0.006) < 0.05. This is in favour of male Biology teachers with higher mean

score of 157.11. The null hypothesis (H_{03}), which states that there is no significant difference in the perceptions of male and female Biology teachers on the application of study technology principles to instruction, is therefore rejected.

Table 20: *t-test Analysis on Perceptions of Biology Teachers Based on Gender*

Gender	N	Mean	Std. Dev.	<i>t</i>	df	<i>P</i>	Remark
Male	339	157.11	13.36	2.78	718	0.006	Significant
Female	381	154.18	14.79				

Research Question 13: Is there any difference in the perceptions of senior school biology teachers on the application of study technology principles to instruction based on the school type?

Hypothesis 4: There is no statistically significant difference in the perceptions of senior school biology teachers on the application of study technology principles to instruction based on the school type.

Research question 13 which is corresponding with hypothesis 4, the result is shown in Table 21. In providing answer to research question 13 and hypothesis 4, the mean score of Biology teachers on the application of study technology principles to instruction was compared based on their school type. The data generated were subjected to t-test. The result of the analysis is presented in Table 21. This shows the mean scores and reveals that there was

a significant difference in the perceptions of Biology teachers on the application of study technology principles to instruction in Kwara state, Nigeria based on their school type. The mean scores are 154.78 and 157.05 for public and private schools respectively. The *p-value* (0.04) is less than 0.05($p\text{-value} < 0.05$). This is in favour of the private schools because this had high positive perceptions with the mean score of 157.05. The null hypothesis (H_{04}), which states that there is no significant difference in the perceptions of senior school biology teachers on the application of study technology principles to instruction based on their school type, is rejected

Table 21: *t-test Analysis of Perceptions of Biology Teachers Based on School Type*

School Type	N	Mean	Std. Dev.	<i>t</i>	<i>Df</i>	<i>P</i>	Remark
Public	474	154.78	14.06	2.03	718	0.04	Significant
Private	246	157.05	14.39				

Research Question 14: What is the influence of school location on the perceptions of the senior school Biology teachers on the application of study technology principles to instruction?

Research hypothesis 5: There is no significant difference in the perceptions of senior school Biology teachers on the application of the study technology principles to instruction based on the school location.

In providing answer for research question 14 which corresponded to hypothesis 5, the mean scores of the biology teachers' perceptions on the

application of study technology principles to instructions was compared based on their school location. The data generated were subjected to t-test. The result of the analysis is presented in Table 22.

The result in Table 22 shows the mean score and reveals that there was a significant difference in the perceptions of biology teachers on application of study technology principles to instructions in the senior secondary schools in Kwara State, Nigeria based on school location. This is because the p -value (0.02) is less than 0.05 ($p\text{-value} < 0.05$). This is in favour of rural secondary school teachers which had a higher mean score of 157.43. The null hypothesis 5 (H_{05}), which states that there is no significant difference in the perceptions of senior school Biology teachers on the application of study technology principles to instructions based on school location, is rejected. The result of school location had a significant influence on the perceptions of biology teachers on the application of study technology principles to instruction.

Table 22: *t-test Analysis of Perceptions of Biology Teachers Based on School Location*

School Location	N	Mean	Std. Dev.	t	df	P	Remark
Rural	220	157.43	11.75	2.36	718	0.02	Significant
Urban	500	154.73	15.10				

Summary of the Major Findings

Findings from this study as obtained from ANOVA and t-test based on the hypotheses are summarized as follows:

1. Biology teachers generally had positive perceptions on the application of study technology principles to instruction in Kwara State, Nigeria;
2. The perceptions of Biology teachers on the application of study technology principles to instruction was not significantly different based on teachers' academic qualification;
3. The perceptions of Biology teachers on the application of study technology principles to instruction based on their years of teaching experience were not significantly different;
4. The perceptions of Biology teachers on the application of study technology principles to instruction were significantly different based on their gender. This result was in favour of male Biology teachers;
5. The perceptions of Biology teachers on the application of study technology principles based on school type had a significant difference in favour of the private schools; and
6. There was a significant difference in the perceptions of senior school biology teachers on the application of study technology principles to instruction based on the school location. This was in favour of teachers located in the rural areas of Kwara State, Nigeria.

CHAPTER FIVE

DISCUSSION, CONCLUSION AND RECOMMENDATIONS

In this chapter, results are discussed; conclusion was drawn and relevant recommendations were made based on the research questions and hypotheses in this study with suggestions for further studies.

Discussion

This study sought to find out the senior school biology teachers' perceptions on the application of study technology principles to instruction in Kwara State, Nigeria. Thirteen research questions were formulated and five hypotheses were raised and tested. The research questions were answered using mean and standard deviation to determine Biology teachers' perceptions of the application of study technology principles to instruction. Hypotheses 1 and 2 were tested using the Analysis of Variance (ANOVA), while hypotheses 3, 4 and 5 were tested using the t-test statistics.

Based on the findings, it was discovered that Biology teachers' perceptions on the application of study technology were positive based on their responses. This result was anticipated due to the readiness of the biology teacher to teach the subject. They are the role models of students' success because they play an important role in imparting knowledge and equipping the students to be useful to themselves and the society. This could be as a result of Biology teachers that were favourably disposed to application of study technology principles as an integral whole which could be attributed to

teachers' tendency to use every avenue to eliminate all barriers to learning using strategies they considered to be effective and efficient. However, as far as this study is concerned, studies on perceptions of teachers on the application of study technology has not been conducted in the field of study; few ones conducted were based on students.

The finding on the perceptions of senior school biology teachers on application of study technology to instruction revealed that biology teachers generally had positive perceptions on the application of study technology to instruction in Kwara State, Nigeria; This finding is in agreement with the study of Oladipo, Olawoye and Adenaike (2012) who found out that the use of study technology greatly reduced the failure rate and increased the distinction level of students exposed to the techniques. The researchers observed the students during the course to identify and remove the barriers to learning. With this finding, teachers were not left out in the study because their duty was to serve as instructors during the course of study.

This finding is also in agreement with the report from Applied scholastics International (2017) that, with study technology techniques, students of all ages have gotten outstanding improvement in various discipline of knowledge which could be as a result of their teacher serving as an instructor to guide them on learning how to learn which would help the students to apply what they learnt in their day- to- day activities.

In a similar vein, the findings reveal that the perceptions of Biology teachers on the application of checksheet to instruction were higher. This means that Biology teachers were found to be resourceful by embracing this strategy. This could be as a result of this instructional method to be course guide- oriented which gives room for learning how to learn by the students. The finding is in agreement with the work of Abdulkadri (2011) who found out that, with the use of checksheet as an instructional strategy, students discovered and learned by themselves with the availability of other course guide.

In addition, the findings also revealed that the Biology teachers have higher perception on the application of word clearing to instruction which is an integral part of study technology principles that gives room for learners to clear any misunderstanding that could result to lack of mass with the use of subject or reference dictionary. This was in agreement with the work of Abimbola (2015) that no doubt that there would be no misunderstood words in the field of study, especially where a material-based instruction is employed. The duty of the instructors (teachers) is to assist learners to be able to remedy the situation by themselves.

The finding also revealed that the application of Demonstration kit to instruction was perceived positive by the Biology teachers, this is one of the components of study technology which concretize the learning of any concept in the field of study. Learners easily remember what they see, as a result of

this, learning stays permanently in their brain. This is in agreement with the work of Adeoye and Abimbola, (2016) who concluded that the use of demonstration kits requires students to pick objects from the kits and assign them significance as symbolic representation of ideas, objects, inter relationships or how something works. This present study agreed with the study of Ahmed (2018) which revealed that there was a significant difference in the achievement of students who learned Ecology using study technology learning strategies and those who learned with conventional method of instruction which shows that the students who were taught using demonstration kit combined with learning on a gradient strategy performed better than other students in the control group.

Therefore, this study shows that there is a relationship between the teachers' perceptions on the application of Demonstration kits to instructions as an effective strategy.

Furthermore, the finding revealed that Biology teachers' perceptions on application of a Chinese school to instruction promote the teaching and learning of any concept. It helps students in memorization of Biology concepts and affords learners the opportunity to recall whatever they learnt. This finding is in agreement with Abimbola (2015) which reveals that Chinese school helps students to memorise definition of concepts. The finding revealed that clay table training also contribute to the effective teaching and learning of Biology. This is in agreement with the study of

Oyelekan, Igbokwe and Olorundare, (2016) which revealed that clay models has been identified as an innovative strategy of permitting students to physically construct and label ideas in order to represent concepts.

The finding revealed that communication skills used in study technology contribute positively to the application of study technology principles, though non-verbal communication is employed in the use of some principles like checksheet, clay table training among others, between the instructors and the learners, which gives room for students to be self-reliant, and affords them the opportunity to learn by themselves. This is in agreement with the findings of Abimbola (2015) which stated that if instructors study the facial expressions, language of the eye, body language, sound symbols, symbolic code languages of learners, they can be used to gauge what learners are communicating among themselves. In turn, the instructor can communicate back his/her approval, disapproval to the understanding of both parties, without uttering words.

More so, the finding of this study also revealed that teachers' academic qualification does not influence their perceptions on the application of study technology to instruction. This is because there was no significant difference in the perceptions of senior school Biology teachers on the application of study technology principles to instruction based on their academic qualification. This implies that irrespective of the Biology teachers' qualification, whether qualified or less qualified biology teachers, they all had

positive perceptions on the application of study technology principles to instruction. Both qualified and less qualified biology teachers might be aware of study technology principles at the same time whereby affording them the opportunity to apply some of these principles like the use of reference dictionary for basic word clearing which could help the students to clear any misunderstood word. More so, the use of demonstration kit as an instructional strategy could be helpful in providing mass of some concepts in biology to give room for better understanding by the students. Also, qualified and less qualified biology teachers may be working collaboratively so as to improve students' academic performance using study technology principles.

This finding is in line with the finding of Okobia (2012) who revealed that the level of qualification of Biology teachers did not influence their attitudes towards the use of improvised instructional materials. A highly qualified Biology teacher is one who can completely achieve the objectives of science education, and affect students' performance positively. Outcome of this study is also in line with the work of Abimbola and Abidoye (2013) who examined the effect of qualification of Biology teachers on the status of ecology teaching and their results indicated that the views of Biology teachers based on their academic qualification did not have any effect on the performances of students.

This study is contrary to the work of Melisa (2019) who reported that school location of service teachers, their gender and their academic qualification have no significant influence in the biology curriculum.

On the perceptions of Biology teachers in relation to the application of study technology principles to instruction based on their years of teaching experience, the finding shows that there was no significant difference in the perceptions of Biology teachers based on their years of teaching experience. This may be due to the collaborative effort of experienced and less experienced biology teachers in the schools which can bring about creativity and critical thinking which in turns promote effective teaching and learning.

The preceding finding is in agreement with the study of Atotileto (2017) whose worked was on the science process skills perceived difficult to teach by Upper Basic Science teachers, the study revealed that teachers' teaching experience had no influence on the perception of less experienced, moderately experienced, and experienced Upper Basic Science teachers. The finding of this present study is in contrast with that of Yunus (2019) whose study was on senior school chemistry teachers' perception on utilization of improved laboratory materials in Abeokuta. The study revealed that teachers' years of teaching experience significantly influenced their perceptions on the extent at which the chemistry teachers utilized improvised materials.

The result on the analysis of the perceptions of Biology teachers on the application of study technology principles to instruction based on gender

showed that there was a significant difference in the perceptions of Biology teachers based on gender .The male Biology teachers had more positive perceptions on the application of study technology principles to instruction than their female counterparts, this shows that male Biology teachers can easily apply study technology principles to classroom instruction than their female counterparts. The reason alluded to this finding is that Biology is a practical-oriented subject as a result of that; the male teachers devote more time in teaching it. It could also be that male biology teachers prefer biology teaching because they feel that it acquaints them with the wealth of knowledge in different areas of life.

The outcome of this study is in line with the study of Ahmed *et al* (2017) who carried out a study on senior secondary school Biology teachers' perception of their academic needs based on gender. The findings revealed a significant difference between the perception of Biology teachers on their academic needs based on gender and that male Biology teachers want more of academic needs than their female counterparts but her findings was in favour of female biology teachers.

Also, this present study agreed with the findings of Odogwu *et al* (2011) who examined gender differences amongst science, mathematics and technology teachers with regards to the school environment.

Finding of the study revealed that there was a statistically significant gender difference in science, mathematics and technology teachers'

perceptions of work pressure and principal leadership persisted after controlling for teachers' background and characteristics. This is contrary to the work of Babalola and David (2011) whose study was on Biology teachers' perceptions of difficulty level. The study showed that there was no significant difference in the teachers' perception of difficult topics based on their gender.

Finding on the perceptions of senior school biology teachers on the application of study technology principles to instruction based on school type shows that there was a significant difference in the perception of biology teachers and their school type. This may be due to the advantages that private schools have over public schools in terms of infrastructural facilities, small class size, thorough supervision and rigorous academic environment by the school proprietors and their teachers, the teachers work in a conducive environment with small class sizes compared to a large population class size in the public schools. It is easier for teachers to control the smaller population of students in private schools than in the public schools.

In addition, findings from the study of Gamze (2018) agreed with the findings of the present study which revealed that there was a significant difference in the perceptions of Biology teachers about fieldtrip and related pre-service preparation based on their school type. The result of the findings also revealed that private school teachers had higher confidence levels and considered fieldtrips more beneficial while public school teachers focused more on the challenges. The finding of the present study is contrary with the

study of Adigun and Yusuf (2010) who observed the influence of school type, sex and location on students' academic performance. They reported that there was no significant influence of the variables on academic performance.

Findings on the perceptions of Biology teachers to the application of study technology principles to instruction based on the school location revealed that there was a significant difference in the perceptions of senior school Biology teachers on the application of study technology principles based on the school location. It shows that the rural school Biology teachers had positive perceptions to the application of study technology principles to instruction. This finding may be due to the fact that majority of the biology teachers working in the rural area reside in urban areas, meaning that they are also exposed to what the urban teachers are exposed to, such as infrastructural facilities.

In addition, the Biology teachers from rural schools have the advantages of using life specimen for practical aspect of biological concepts like ecology unlike teachers in urban schools.

Students can also be taken out from their classrooms to observe some life specimen which makes them more active in the practical classes than the students from urban schools. Since, study technology principles emphasise the use of concrete object as demonstration (demo) kit for effective learning; this is thought to be part of the reason for the difference in the perceptions of the Biology teachers based on their school location. The study is in agreement

with the study of Oyedeki (2005) who conducted a study on analysis of Biology teachers' views on the problems of teaching ecology in Nigeria secondary schools. The finding from this study revealed that there was a significant difference in the views of Biology teachers from rural and urban schools. Also, this study is contrary to the work of Onah (2010) which revealed that schools in urban areas achieved more than the schools in the rural areas in science subjects though his finding was in favour of the teachers of schools in urban areas. Also, this study is contrary with the work of Melisa (2019) who reported that the school location of service teachers, their gender and their academic qualification have no significant influence on the Biology curriculum.

Conclusion

Based on the findings of the study, the following major conclusions could be drawn. It was concluded that biology teachers had high perceptions on the application of study technology in class instruction irrespective of their academic qualification and teaching experience. This implies that biology teachers were favourably disposed to the use of study technology.

Also, it was concluded that school location, school type and biology teachers' gender had influence on their perceptions on the application of study technology in the class instruction.

Recommendations

On the basis of the findings and the conclusions drawn, this study suggested the following:

1. Teachers need to be encouraged by the Federal/State Government schools and schools' proprietors to enhance the application of study technology principles to instruction on all school subjects.
2. Both qualified and unqualified Biology teachers should be given equal opportunity in the acquisition of knowledge of study technology principles through workshops.
3. Professional bodies such as science teachers association of Nigeria (STAN) should organize conferences for science teachers on study technology awareness irrespective of their years of teaching experience.
4. The female Biology teachers should emulate their male counterpart in attending seminars and workshops to update their knowledge of study technology principles.
5. Concerted efforts should be made by the Government and school authorities to provide public school Biology teachers with adequate knowledge of study technology principles like their private school counterparts through sponsorship of seminars and workshops on study technology principles.

6. Educational stake holders should promote schools in urban area as regard their knowledge of study technology principles for them to meet up with the standard of knowledge of study technology principles of the rural school Biology teachers.
7. Curricular planners should be more acquainted with study technology principles to broaden their knowledge on these concepts through conferences.
8. Study technology awareness workshop should be extended to the textbook writers by the Federal and State government so as to be acquainted with the principles.
9. Biology teachers should be encouraged by both State/Federal Government and school proprietors to adopt/use study technology principles as instructional strategies for effective teaching and learning of the subject. Also, provision of course guides, projection equipment should be provided for Biology teachers to boost their morale in using study technology principles to teach, for better understanding of the subject.

Suggestions for further studies

The following are suggestions made for further researches:

- (1) This study could also be carried out on perceptions of Biology students on learning of biology concepts with the application of study technology principles.

(2) This study could be replicated in colleges of Education and Universities.

(3) A larger sample including all the six geo-political zones of Nigeria could be considered for a research on this topic so as to widen the scope of the study.

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APPENDIX I

**DEPARTMENT OF SCIENCE EDUCATION,
FACULTY OF EDUCATION,
UNIVERSITY OF ILORIN,
ILORIN, NIGERIA**

**SENIOR SCHOOL BIOLOGY TEACHERS' PERCEPTIONS ON
THE APPLICATION OF STUDY TECHNOLOGY PRINCIPLES TO
INSTRUCTION IN KWARA STATE, NIGERIA**

Dear Sir/Ma,

The purpose of this teachers' questionnaire is to investigate the perceptions of senior school biology teachers on the application of study technology to instruction in Kwara State. Consequent upon the above, you have been selected to participate in the investigation. This is in respect of a doctoral research being conducted in the Department of Science Education, University of Ilorin.

All information collected will be used strictly for research purpose and will be treated confidentially. However, you are requested to respond to the items given in this questionnaire as honestly as possible.

Thank you.

SaadatAbdulkadri

(Researcher)

SECTION A (PERSONAL INFORMATION)

This section is intended to help the researcher to arrive at reasonable conclusion. You are therefore required to fill or tick as applicable, please.

School.....

Area of specialization.....

Gender: Male () Female ()

Highest Academic Qualification:M.Sc&PGDE ();M.Ed. ();M.Sc ();

B.Sc&PGDE ();B.Sc ED.();B.Sc();NCE()

Others(please specify).....

Biology Teaching Experience: 0-5 years (); above 5 years (); 10 years and above () at the Secondary Schools level.

School Type: Public () Private ()

School Location: Rural () Urban ()

SECTION B

Please tick as appropriate the column that reflects your perceptions on the applicationof Study Technology principles to instruction in Senior Secondary Schools in Kwara State.

KEY: SA=Strongly Agree; A=Agree; D=Disagree; SD= Strongly Disagree

ITEMS	STUDY TECHNOLOGY	SA	A	D	SD
1.	Study Technology is a unique program which enables students to overcome the basic barriers to studying and learning but a new instructional strategy.				
2.	Study technology is a system of learning which is so difficult for teachers to apply in classroom situation.				
3.	Study technology is a research- based system of learning that requires more time than conventional method of learning.				
4.	Study technology entails active participation of the teachers.				
5.	Study technology enables learners to empower themselves by being able to take responsibility of their own learning processes.				
6.	Study technology is a learning strategy that students could embark on at their own leisure time.				
7.	Study technology causes attitudinal change in learners if properly utilized.				
8.	Study technology could liberate students from over reliance on their teachers				
9.	Study technology produces self-regulated learners who possess ability to learn independently throughout their lives which encourage self discoveries.				
10.	Study Technology promotes self- discipline and academic abilities of learners.				
11.	The use of Study Technology encourages adequate coverage of the syllabus.				
12.	Users of study technology know how to cope when they feel disturbed and make them independent of their teachers.				
ITEMS	CHECKSHEET	SA	A	D	SD
1.	A checksheet is a form of information which sets out the exact sequence of items by items on a course but very difficult to form.				
2.	The use of checksheet requires teachers' commitment and dedication.				

3.	Checksheet are formed by making use of reference textbooks.				
4.	Students use of checksheet requires teachers' guide.				
5.	A Checksheet is formed from the students' dictionary				
6.	Checksheet is a course guide in study technology which can bring about students' involvement in the classroom.				
7.	Checksheet includes the contents of the course, which are progressively assigned to the learners to be studied in a measured manner.				
8.	A check out is a strategy used to find out how much a learner knows from an assigned work by the twin partner which involve the teacher.				
9.	A star-rated checkout occurs when it is carried out by a course instructor notifying the teacher on the next step of action.				
10.	The course guide contains all student centred instructional strategies and resources for which study technology is noted, these should be kept by the teacher.				
ITEMS	WORD CLEARING	SA	A	D	SD
1.	Word clearing is the procedure used by learners to locate and clear up misunderstood words but it's time- consuming.				
2.	A reference dictionary is a very good strategy that requires students to get for themselves for word clearing.				
3.	Students' inability to afford the purchase of dictionary could reduce its efficiency.				
	DEMO KIT	SA	A	D	SD
1.	Gathering of items of demonstration kit is a difficult tasks for the teachers.				
2.	Demonstration kits helps to concretize students' studying.				
3.	Objects can be moved about in relation to each other to show the mechanics actions of a given concept which arouse learners' interest.				
4.	Demonstrating a concept with various small objects encourages learners' participation.				

5.	Demonstration kit is one of the components of study technology that can cause inadequate coverage of the syllabus.				
6.	Demonstration kit is a suitable instructional strategy that could be use to teach large class.				
ITEMS	CHINEESE SCHOOL	SA	A	D	SD
1.	A Chinese school is a strategy that is similar to the Quranic school strategy which promotes rote learning.				
2.	Chinese school helps students to memorize important content in the course but may be difficult for them to understand.				
3.	Procurement of projection equipment could hinder the effectiveness of Chinese school.				
4.	The instructor is a trained person in study technology who could be regarded as the teacher.				
5.	Projection equipment with a screen is required in a Chinese school, this requires more time.				
ITEMS	CLAY TABLE TRAINING	SA	A	D	SD
1.	Clay table training is another section in the course room which enhance students creativity.				
2.	Clay work will be given as assignment in the course guide so that learners will devote more time for it.				
3.	The instructor is required to check the learners out whether they are ready for the next topic.				
ITEMS	PROJECTION	SA	A	S D	D
1.	Twins partnership is a component of study technology, this could promote cooperative learning.				
2.	The learner must have all recommended books for instruction which is not economical.				
3.	Study technology uses a material- based instructional system whereby many schools may find it difficult to apply.				
4.	A typical classroom for a material- based instruction has only 18 students per instructor.				
5.	The duty of the instructor is to attend to the learners' instructional needs.				
ITEMS	COMMUNICATION SKILLS	SA	A	S D	D

1.	Teachers need to learn to communicate well to promote effective teaching and learning processes.				
2.	A two way communication system is important in study tech				
3.	There should be mutual understanding between the teachers and a student in communicating process				
4.	Learners must pay attention to the teachers' communication before it can be received				
5.	It is important from the learners to be able to duplicate the communication from the teacher				
6.	There is no verbal communication in Study Technology.				

APPENDIX II



UNIVERSITY OF ILORIN, ILORIN, NIGERIA

DEPARTMENT OF SCIENCE EDUCATION

HEAD OF DEPARTMENT
DR. A. O. AKANBI
B.Sc.Ed., M.Ed., Ph.D. (Ilorin)

P.M.B. 1515, ILORIN, NIGERIA
Cable of Telegram: UNILORIN
Telex: 33144 UNILORIN NG
Website: www.unilorin.edu.ng
Phone: 08033882477
E-mail: hodsciedu@unilorin.edu.ng

Our Ref: _____

Your Ref: _____

Date: _____

LETTER OF INTRODUCTION

The bearer of this letter MRS. Abdulkadri Saadat Abike is a Postgraduate student in the Department of Science Education, University of Ilorin, Ilorin Nigeria. He/She is conducting a research study as part of the requirements for the award of Ph.D. in Science Education Degree.

The title of the Study is Senior School Biology Teachers' Perceptions of the Application of Study Technology Principles to Instruction in Kwara State, Nigeria

Kindly allow your students/teachers to participate in the study. Be assured that the researcher has addressed all ethical issue arising from the research design.

Thank for your usual cooperation.

Thesis Supervisor

Head of Department

APPENDIX III

NUMBER OF BIOLOGY TEACHERS IN PRIVATE SCHOOLS IN KWARA STATE

S/ N	LOCAL GOVERNMENT	NO OF BIOLOGY TEACHERS	NO OF BIO.TCHS' THAT PARTICIPATED	NO OF SCHOOLS THAT PARTICIPATED
1	Asa	22	14	10
2	Barutean	20	08	08
3	Edu	15	05	04
4	Ekiti	06	02	02
5	Ifelodun	26	20	18
6	Ilorin East	32	19	18
7	Ilorin West	108	63	55
8	Ilorin South	100	40	38
9	Irepodun	18	10	10
10	Isin	10	04	04
11	Kaima	16	12	12
12	Moro	16	14	10
13	Offa	21	18	15
14	Oke-ero	06	03	03
15	Oyun	04	04	04
16	Patigi	30	10	08
	Total	450	246	219

Source: Quality Assurance Bureau, Headquarters Min of Education and HCD, Kwara State, Ilorin (2019).

APPENDIX IV

KWARA STATE TEACHING SERVICE COMMISSION, ILORIN NUMBER OF BIOLOGY TEACHERS (PUBLIC SCHOOLS) BY ORIGIN (2019)

S/N	LGA	NO OF BIOLOG Y TEACHE RS	NO OF BIO.TCH S' PARTICI PATED	NO OF SCHOO LS PARTICI PATED
1.	Asa	20	18	11
2.	Baruten	16	13	15
3.	Edu	17	15	14
4.	Ekiti	09	07	03
5.	Ifelodun	56	53	19
6.	Ilorin East	79	75	24
7.	Ilorin South	65	63	59
8.	Ilorin West	104	101	37
9.	Irepodun	32	29	13
10.	Isin	07	05	04
11.	Kaima	10	08	09
12.	Moro	19	18	13
13.	Offa	25	23	27
14.	Oke-Ero	10	08	04
15.	Oyun	30	27	03
16.	Patigi	13	11	06
Total		512	474	259

APPENDIX V

	UNIVERSITY OF ILORIN, ILORIN, NIGERIA DEPARTMENT OF SCIENCE EDUCATION	P.M.B. 1515, ILORIN, NIGERIA Cable of Telegram: UNILORIN Telex: 33144 UNILORIN NG Website: www.unilorin.edu.ng Phone: 08033882477 E-mail: hodsciedu@unilorin.edu.ng
HEAD OF DEPARTMENT DR. A. O. AKANBI B.Sc.Ed., M.Ed., Ph.D. (Ilorin)		
Our Ref: _____		
Your Ref: _____		Date: _____

APPENDIX IV

5th Marth, 2018

The Chairman,
Nigerian Union of Teachers,
Kwara State Chapter,
Ilorin.

Dear Sir,

Proposal for a Study Technology Awareness Workshop for the Biology Teachers in the Sixteen (16) Local Government Areas of Kwara State

I wish to formally propose a Study Technology Awareness workshop for all the Biology teachers in both public and private senior secondary schools in the sixteen (16) Local Government Areas of kwara state. Study technology is a new research-based system of learning how to learn, which includes basic principles and workable methods for application in the field of study. It is the Applied Scholastics Internationals collective name for its teaching and learning methods. It is based on the works of L.Ron Hubbard, an author and educator.

The end results of the application of study technology are students who know how to learn, how to apply and are motivated independent lifelong learners. The immediate results are unbelievably high scores in traditional examinations in their various subjects.

Teachers who know how to use this method become lifelong learners and teachers who are capable of learning anything and teaching anything and anybody.
Title: Study Technology Awareness workshop for the Biology teachers in both public and private senior secondary schools in the sixteen (16) Local Government Areas in Kwara State, Nigeria.

Title: Study Technology Awareness workshop for the Biology teachers in both public and private senior secondary schools in the sixteen (16) Local Government Areas in Kwara State, Nigeria.

Rationale:

The following are some general problems of secondary school education in Nigeria that a study technology awareness workshop would seek to address:

1. Students lack of knowledge of how to study.
2. Incomplete understanding of contents by students.
3. Inability of students to apply knowledge.
4. Teachers do not require students to understand materials fully.
5. Inadequate and outdated instructional materials and facilities.
6. Lack of material-based instruction.
7. Teachers do not assess students' full understanding of materials – assessment does not usually cover all contents.
8. Inadequacy or lack of feedback from teachers to students.
9. Inappropriate and outdated methods of teaching.
10. Poverty of ideas and funds.

The Workshop seeks to achieve the following:

Objectives:

1. Knowledge of types of barriers to study.
2. Ability to identify physical and mental reactions to barriers to study.
3. Knowledge of remedies to barriers to study
4. Application of knowledge gained by participants in improving their teaching.
5. Ability to prepare and use checksheets for instruction.
6. Ability to manage a material-based instruction.
7. Knowledge of effective communication skills for teachers
8. Drills in effective communication skills.
9. Ability to handle student discipline problems.
10. Knowledge of the fundamental principles of human relations.
11. Appreciation of the need to function happily in any environment.

Contents:

1. Barriers to study.
2. Preparation and practice in the use of checksheets
3. Communication skills.
4. The way to happiness.

Duration:

One day, of three sessions- (morning + opening), afternoon and evening, with two 15-minute breaks in the morning and evening, and a lunch in the afternoon.

No of participants: 900

Public Schools: 427 Biology Teachers

Private Schools: 450 Biology Teachers

Total Numbers of Biology Teachers in Kwara State: 877

Others: 23 People

Instructors: Prof. Isaac Olakanmi Abimbola-Applied Scholastics

International instructor

Assistant Instructors:-

- | | | |
|----|-------------------------|----------------------|
| 1. | Saadat Abdulkadri (Mrs) | Assistant Instructor |
| 2. | Abdulraheem Gbigbadua | Assistant Instructor |
| 3 | Rihanat Ahmed (Mrs) | Assistant Instructor |
| 4 | Gabriel Adeoye | Assistant Instructor |

Venue: A hall that can accommodate 1,000 persons sitting in pairs

Date: 11th April, 2018.

At the convenience of the Ministry of Education and Human Capital Development

Compulsory Requirements:

1. Each participant is expected to bring his/her own dictionary, such as Advanced Learners' Dictionary of Current English
2. A recommended textbook used by each participant for his or her students.

We want you to assist us in mobilizing the principals to sponsor one of their biology teachers to attend this workshop.

Yours Sincerely,

Saadat Abdulkadri

Coordinator

08035216685/08127680266

APPENDIX VI

BUDGET PROPOSAL

1.0 Personnel Cost/Allowances	180,000:00
1.1 Research assistant(6)	200.00
1.2 Research information	30,000:00
1.3 Technical assistant	210,000:00
Subtotal (not>20% of budget)	
2.0 Equipment (list & specify)	
2.1 Laptop	150,000:00
2.2 printers	85,000:00
(1 color and 2 black and white)	
2.3 Flash/modem	15,000:00
2.4 Generators	40,000.00
(Alternative power supply)	
Subtotal(not>20%of budget)	295,000:00
3.0 Supplied consumables	
3.1 papers/Toners	120,000:00
3.2 Purchase of textbooks and pen	5,000:00
3.3 Monthly subscription of	75,000:00
Modem at 2500 per month x30	
Subtotal	200,000:00
4.0 Data collection & analysis	
Study Technology Awareness Workshop	300,000.00
4.1 Analysis	100,000:00
4.2 Cost of administering the	100,000:00
the questionnaire	
Subtotal	500,000:00
5.0 Travels	
5.1 Researcher	120,000:00
Sub total	
6.0 Dissemination	
6.1 Seminar 1 (proposal)	40,000:00
6.2 Seminar 2 (Protocol)	25,000:00
6.3 Seminar 3 (Mock Defence)	40,000:00
6.4 Seminar 4 (Oral Defence)	260,000:00
Subtotal	335,000:00
7.0 Others/ Miscellaneous	
7.1 Accommodation on research trip	135,000:00
7.2 Miscellaneous	120,000:00
Subtotal	250,000:00
GRAND TOTAL	2,480,000:00

APPENDIX VII

Postgraduate Research Plan

	11/01/16	11/02/16	11/03/16	11/04/16	11/05/16	11/06/16	11/07/16	11/08/16	11/09/16	11/10/16	11/11/16	11/12/16	11/01/17	11/02/17	11/03/17	11/04/17	11/05/17	11/06/17	11/07/17	11/08/17	11/03/18	11/04/18	11/05/18	11/06/18	05/07/18	05/08/18	05/09/18	27/11/18	13/02/2020	
M O N T H	1	2	3	4	5	6	7	8	9	10	1	2	3	4	5	6	7	8	9	20	21	22	3	4	5	6	7	8		
T A S K																														
Survey of Literature																														
Write Proposal (Programmes Without Coursework)																														
Write Proposal (Programmes With Coursework)																														
Gather Data (Programmes with Coursework)																														
Thesis Writing																														
Write Introduction																														
Revise Introduction																														
Write Methodology																														
Revise Methodology																														
Approval for proposal S e m i n a r																														
Awaiting schedule for proposal seminar																														
Proposal presentation																														
Effecting proposal corrections for protocol																														
Protocol presentation																														
Analyses, Results and Discussion																														
Write Conclusions																														
Revise conclusions																														
Acknowledgements, Appendices, etc.																														
Preliminary Defense																														
Proof reading																														
Oral Defence																														
C o r r e c t i o n																														
Printing and Binding																														

APPENDIX VIII (A)



CROSS SECTION OF REPRESENTATIVE OF HONORABLE
COMMISSIONER FOR EDUCATION KW/ST, ILORIN



STUDY TECHNOLOGY AWARENESS WORKSHOP AT QUEEN
ELIZABETH SCHOOL HALL 'A'

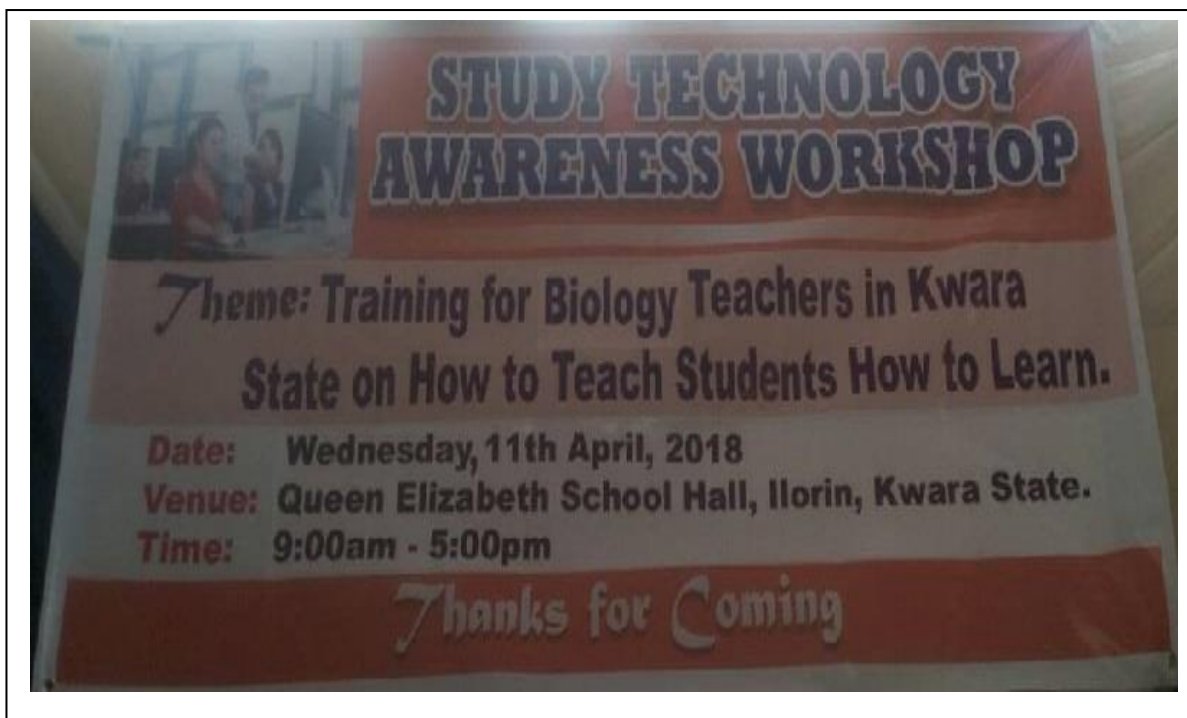
APPENDIX VIII (B)



APPENDIX VIII (C)



APPENDIX VIII (D)



APPENDIX IX (A)



MINISTRY OF EDUCATION AND HUMAN CAPITAL DEVELOPMENT (MOEHCD) HEADQUARTERS

P.M.B. 1391, ILORIN, KWARA STATE
Telegrams: SECEDUC. Telephone: 031 221161, 220401, 220351, 223101, 220373, 221549
Website: www.kwaraeducation.com

DE/S&T/CSW/122/VOL.I/59
9th March, 2018

The President,
National Association of Proprietors of Private Schools,
Kwara State Chapter,
Ilorin.

LETTER OF INVITATION

I am directed to inform you that Biology Teachers in all Private Schools in the State have been invited to a one-day workshop on Technology Awareness.

It is aimed at enhancing the teaching skills of the teachers. It is borne out of a new research which will foster the attainment of high scores of their students in traditional examinations.

The National Association of Proprietors of Private Schools (NAPPS) is therefore enjoined to inform all members to send one (1) of their biology teachers to the workshop with the sum of Two Thousand Five Hundred Naira (N2, 500.00) only payable at the venue as registration fee.

R E S T R I C T

APPENDIX IX (B)



MINISTRY OF EDUCATION AND HUMAN CAPITAL DEVELOPMENT (MOEHCD) HEADQUARTERS

Telegrams: SECEDUC P.M.B. 1391, ILORIN, KWARA STATE
Telephone: 031 221161, 220401, 220351, 223101, 220373, 221549
Website: www.kwaraeducation.com

DE/S&T/CSW/122/VOL.I/59
9th March, 2018.

The Chairman,
Association of Nigerian Confederation of Principals of Secondary Schools,
Kwara State Chapter,
Ilorin.

LETTER OF INVITATION

I am directed to inform you that Biology Teachers in all Public Schools in the State have been invited to a one-day workshop on Study Technology Awareness.

It is aimed at enhancing the teaching skills of the teachers. It is borne out of a new research which will foster the attainment of high scores of their students in traditional examinations.

The Association of Nigerian Confederation of Principals of Secondary Schools (ANCOPSS) is therefore enjoined to inform all members to send one (1) of their biology teachers to the workshop with the sum of Two Thousand Five Hundred Naira (N2,500.00) only payable at the venue as registration fee.

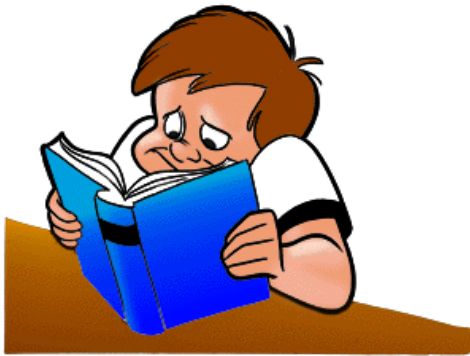
R E S T R I C T

APPENDIX X (A)

The First Barrier to Study: Lack of Mass

Studying about something without having the mass of what you are studying can give you trouble. It can make you feel different ways.

**It can make you feel squashed
bent**



It can make you feel



**You can wind up with your
stomach feeling funny
headaches.**



You may get

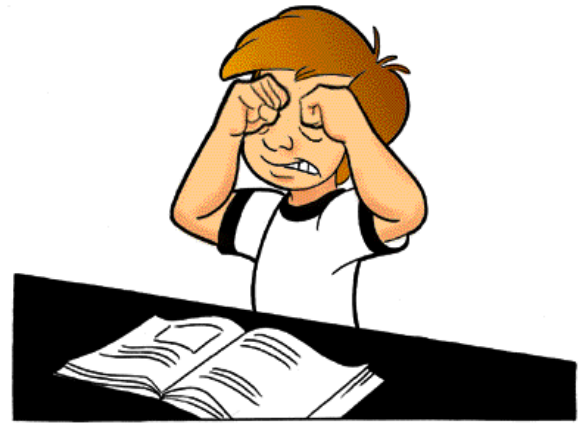


**You will feel dizzy from time to time.
will hurt.**

very often your eyes



angry



bored



sort of lifeless



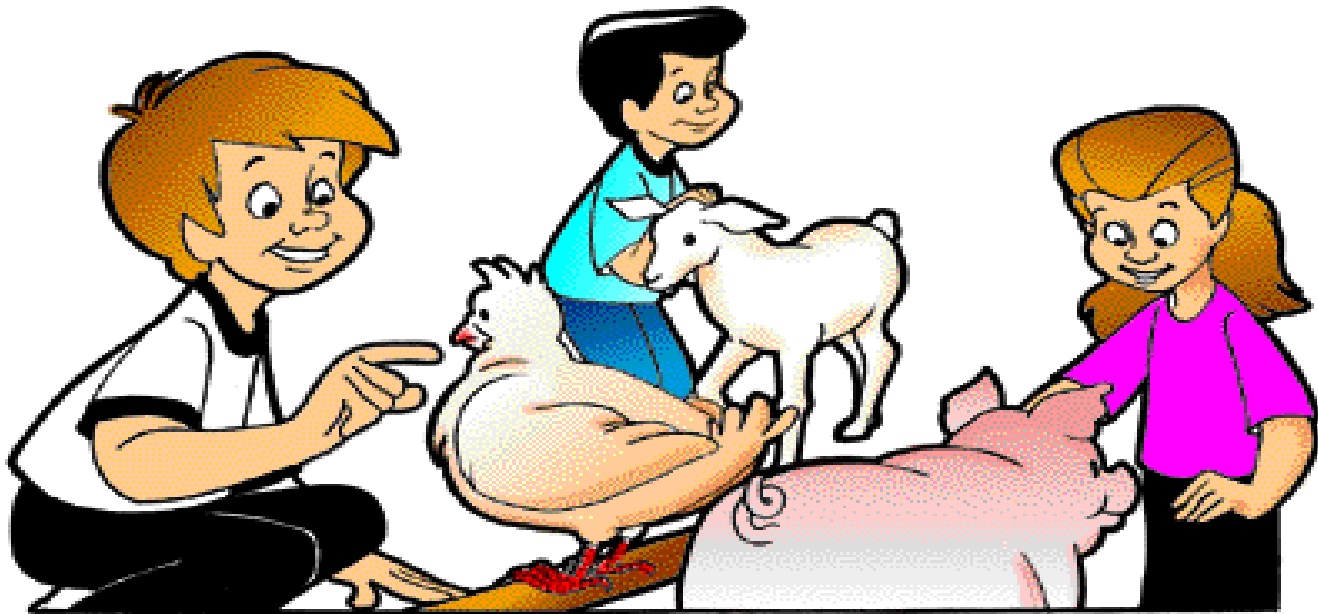
sort of spinny,



**The way to stop this from happening is to
get the mass of what**



If you were reading about animals, you could get the mass of animals by going to a zoo or a farm.



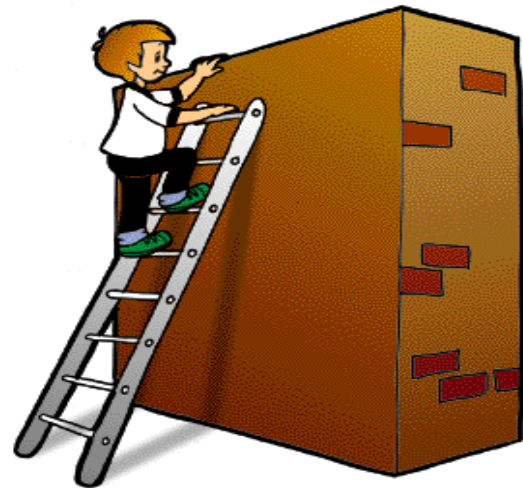
Source: <http://www.studytechnology.org/special/lackmass.html>



APPENDIX X (B)

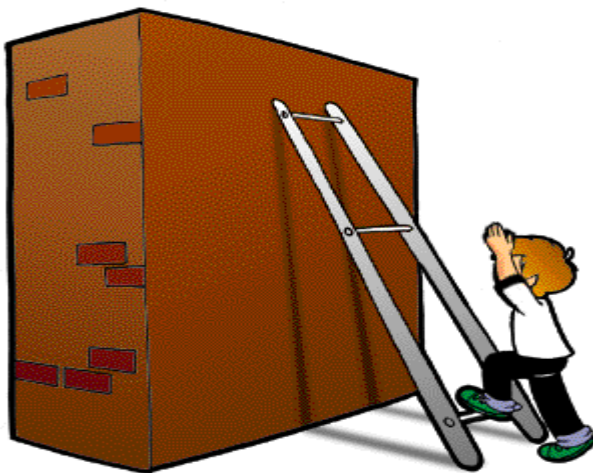
The Second Barrier to Study: The Skipped Gradient

is a way of learning or doing something step by step. A gradient can be easy



A gradient

**Or a gradient can be hard
and each step is difficult to do**



Learning something step by step is called learning on a gradient



If you hit a step that seems too hard to do or you feel you can't understand it, you have skipped a gradient.

"Skipped" means *left out* or *missed*.

If you don't fully understand a step of something you are learning or miss a step, you will have a skipped gradient.

Skipping a gradient is a barrier to study



There was too much of a jump because he did not understand what he was doing, and he jumped to the next thing and that step was too steep.



Then you go to the next step and learn how to do that



**learn how to do something learning to do each part of it by step.
You go through the first and learn how to do it.**

**You
by
step
step**

**ylearn how to do each
step
well and then you can do
the
whole thing**

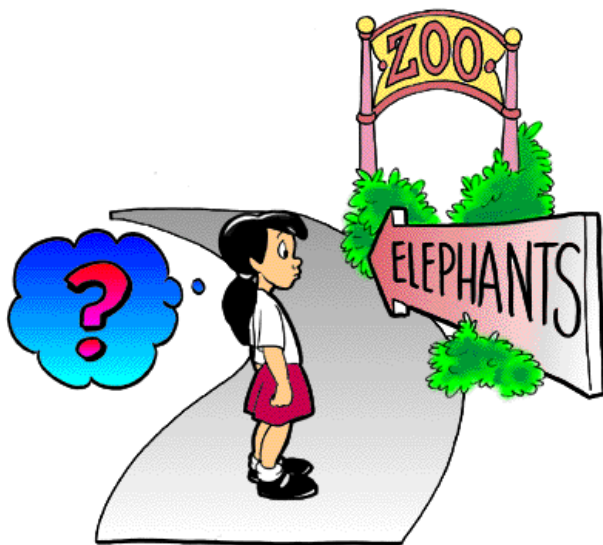
Source: <http://www.studytechnology.org/special/steepgradient.html>

APPENDIX X (C)

The Third and Most Important Barrier to Study: The Misunderstood Word

The third and most important barrier to study is the misunderstood word.

The misunderstood word is the most important of the barriers to study because it is the one that can stop you from learning anything at all.



"Mis" means *not* or *wrongly*.

"Misunderstood" means *not understood* or *wrongly understood*.

A misunderstood word is a word which is *not understood*,



Have you ever come to the end of a page and realized that you did not remember what you had read?

If you come to the end of a page and do not remember what you have read then there was a word on the page that you did not understand.



Going past a word that you do not understand can make you feel blank or tired,



A misunderstood word can

make you seem silly.



The way to handle this barrier is to look earlier in what you were reading for a misunderstood word.

Go back to before you got into trouble, find the misunderstood word and look it up in a dictionary.

A dictionary is a word book. A dictionary contains the meanings of words and other information about them. A dictionary can be used to find out what a word means, how to say a word, how to spell a word, how to use a word and many other things about words.



Source: <http://www.studytechnology.org/special/wordclearing.html>

APPENDIX XI

UNIVERSITY OF ILORIN, ILORIN, NIGERIA

FACULTY OF EDUCATION,

DEPARTMENT OF SCIENCE EDUCATION.

PRINCIPAL'S INFORMED CONSENT FORM

Dear Sir/Ma

I am ABDULKADRI, Saadat Abike, a postgraduate student of the department of Science Education, University Of Ilorin, Nigeria, is currently embarking on a Ph.D. research work entitled: Senior School Biology Teachers' Perceptions on the Application of Study Technology Principles to Instruction in Kwara State, Nigeria.

The purpose of this study is to seek for the perceptions of the biology teachers on the application of study technology principles to instruction. On this note, the purpose of this form is to seek your consent for the participation of your biology teachers in this study, which will be conducted in your school during the free periods of the school hours. Any information obtained will be treated with maximum confidentiality and used for research purpose only.

Principal's Respondent Agreement: I hereby voluntarily consent the participation of my biology teachers in the research. I have clear understanding that for any enquiry about the research, I may contact the

Department of Science Education, University of Ilorin, Ilorin, Nigeria or call the researcher through this number 08035216685.

.....

Principal

Signature and date

.....

.....

Researcher

Signature and date