

**BIOLOGY TEACHERS' AWARENESS AND UTILIZATION OF
INNOVATIVE TEACHING STRATEGIES IN SENIOR
SECONDARY SCHOOLS IN SOUTH WEST, NIGERIA**

Ph.D. ORAL DEFENCE

BY

KAYODE, Olufunke Olayinka

05/68ON005

DEPARTMENT OF SCIENCE EDUCATION

FACULTY OF EDUCATION

UNIVERSITY OF ILORIN

ILORIN, NIGERIA

SUPERVISOR: PROF. A. S. OLORUNDARE

VENUE:

DATE:

TIME:

CERTIFICATION

This is to certify that this study entitled “Biology Teachers’ Awareness and Utilization of Innovative Teaching Strategies in Senior Secondary Schools in South West, Nigeria” was carried out by KAYODE Olufunke Olayinka (05/68ON005). The thesis has been read and approved as meeting part of the requirements for the award of Doctor of philosophy in Science Education, in the Department of Science Education, Faculty of Education, University of Ilorin, Ilorin, Nigeria.

.....
Prof. A. S. Olorundare
Supervisor

.....
Date

.....
Dr A. O Akanbi
Head of Department and Chief Examiner

.....
Date

.....
Prof. S.A. Onasanya
Internal/External Examiner

.....
Date

.....
Prof. Mednat F. Salman
Dean, Faculty of Education

.....
Date

.....
External Examiner

.....
Date

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KAYODE, Olufunke Olayinka

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DEDICATION

This research work is dedicated to the Lord Almighty, the giver of life, the source of all wisdom, the all sufficient one who has given me the grace and strength to do all things through Christ Jesus.

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ABSTRACT

Various innovative teaching strategies have been developed by educators and found to positively influence students' academic performance when utilised. Unfortunately, students continue to perform below expectation in Biology, hence, the assumption of teachers not using varied forms of teaching strategies to cope with difficulties associated with its teaching and learning. This study investigated biology teachers' awareness and utilisation of selected innovative teaching strategies in senior schools in South-west, Nigeria. The objectives of the study were to determine: (i) the level of Biology teachers' awareness of innovative teaching strategies; (ii) level of utilisation of innovative teaching strategies in Biology classroom and, the influence of (iii) gender (iv) academic qualification (v) year of teaching experience on Biology teachers' level of awareness and utilisation of the teaching strategies; and (vi) problems facing the utilisation of selected teaching strategies.

A descriptive research of the survey type was adopted for the study. The population consisted of all science teachers in senior secondary school, South-west of Nigeria. The target population was all biology teachers in senior secondary school, South-west of Nigeria, while the sample comprised 622 biology teachers purposively selected from Ekiti, Osun, Oyo and Lagos States. A researcher designed questionnaire with reliability coefficient of 0.84 was used to collect data from the respondents. Frequency and percentage, *t*-test and Analysis of variance were used to test the hypotheses at 0.05 level of significance.

The findings of the study were that:

- i. Biology teachers (98.0%) are highly aware of the selected innovative teaching strategies;
- ii. less than half (44.0%) of the teaching strategies were frequently utilized by Biology teachers;
- iii. the least utilised strategies were the Z-A approach (15%), Jigsaw (15.5%), Mnemonic-word-words approach (21.5%) and Mind map (25.3%);
- iv. gender had no significant influence on either the Biology teachers' level of awareness or on their utilisation of teaching strategies;
- v. academic qualification had no significant influence on Biology teachers' level of awareness but significantly influenced the level of their utilisation of teaching strategies ($F_{(1,560)}=2.142, p<0.05$);
- vi. there was a significant difference among less experienced, experienced and highly experienced Biology teachers on their level of awareness of innovative teaching strategies, in favour of the highly experienced teachers $F_{(2,549)}=4.639, p<0.05$;
- vii. years of teaching experience had no significant influence on Biology teachers' level of utilisation of teaching strategies; and
- viii. problems associated with inadequate utilisation of the innovative teaching strategies include: non-availability of teaching resources, strategies being demanding and stressful, poor motivation for teachers, absence of in-service training for teachers, and students' non-commitment to extra effort needed.

The study concluded that Biology teachers' level of awareness of innovative teaching strategies was high, however, utilisation was low. This implies that the Biology students will be denied the benefits attached to the use of innovative teaching strategies. The study recommended that utilisation of innovative teaching strategies should be encouraged.

Word count: 467

CHAPTER ONE

INTRODUCTION

Background to the Problem

The primary purpose of education is to make citizens of any country self-reliable, literate, increase their knowledge, and capacity to think rationally. Education is a tool for growth and progress in life because it impacts knowledge, skills and right type of value as well as build human capital (Khurshid & Zahur, 2013). The driving force of change towards sustainable development in any nation is education. Besides providing skills such as scientific and technological know-how, it provides the motivation, justification and social supports for pursuing and utilizing them. Through education, the values, behaviours and ways of living necessary for sustaining a given community can be inspired (Sachou, 2013).

Science has been defined as a body of knowledge which can be rationally explained but reliably applied. In this wise, science has been seen as the knowledge about the structure and behaviour of the natural and physical mind based on facts that can be verified (Hornby, 2015). Science as a body of knowledge, examines the method, as well as way of thinking in the quest to understanding the nature. Hence, it is a structured method of building and

organising knowledge in the form of testable explanations and predictions about the world (Abimbola & Omosewo, 2012).

As an ever changing human activity, science is interested in the working of the world. It is the bedrock on which modern day technological breakthrough is built. (Akinwumi & Bello, 2015). This is why developing countries like Nigeria are working hard to develop scientifically and technologically since the world is a scientific and technological global village where all proper functioning of lives largely depends on science (Agommuo & Ifeanafo, 2013). Science and Technology have become major ingredients of economic and national advancement (Olaniyan, Omosewo & Nwankwo, 2015).

Science Education consist of learning science by acquiring and developing conceptual and theoretical knowledge through scientific inquiry and problem solving (Obeka, 2011). Science Education is one of the areas in the wider world, which shapes and moulds the character of the 21st century especially in technologies which has greatly influenced the way we think and live.

There has been much concern expressed about the obvious inconsistency in the standard of science education at the Secondary School level in Nigeria. Gbadamosi (2014) opined that there are several problems associated with the

teaching of science, especially biology, some of which are: inactiveness, misrepresentation, passive learning, over dependent of students on teachers and books, low performance, lack of skills and right scientific attitudes, falling interest and low enrolment in science. It is not just enough to teach science for the sake of knowledge, but for acquisition of skills. Factors which contribute to the preceding situation are many but the most important of them is the method of teaching. Working separately, Omotere (2013), Omoifo (2012) have lamented on the rise and fall in the standard of science teaching in Nigeria. Oludipe (2012) observed that a major flaw in our system of education is that science is presented dogmatically in most schools as fragmented facts and concepts which students find difficult to relate to the real world.

There is a persistent unsatisfactory performance in the sciences especially biology at School Certificate level (Ogbeba, 2010; Samba, Achor & Ogbeba, 2010). This has generated an assumption that most secondary schools' biology teachers in Nigeria possibly do not make use of diverse forms of teaching strategies to be able to cope with some specific difficulties associated with the teaching and learning of biology by both the teacher and the student respectively. Corroborating this, Oyelekan, Igbokwe and Olorundare, (2017) affirmed that science teachers barely utilised innovative teaching strategies in their lessons. This suggest that they are knowledgeable

in science content but not in instructional aspects. This problem needs to be addressed so that the desire to equip students with skills to operate efficiently in this modern age of science and technology as well as their acquisition of appropriate skills, development of mental, physical and social abilities to fit in and contribute meaningfully to the advancement of the nation as specified in Nigerian National Policy on Education (FRN, 2013), is achieved.

Table 1 shows a rise and fall in the total number of students' enrolments and their performance in SSCE/WASSCE between the years 2007-2019. The total enrolment of biology student shows a progressive increase in the years 2007-2013 (1,238,163-1,648,363) but with a significant decrease between the years 2014-2019 (1,365,384-1,033,304). The percentage credit pass of students in biology is not yet 100% and so unsatisfactory. Even though, there was an improvement in the performance of students between the years 2014-2019. Percentage credit pass in biology rose from 51.73% to 68.03% in the year 2017, dropped from 68.03% to 62.48 in the year 2018 but rose to 75.01% in the year 2019

Table 1:

Candidate Enrolment and Performance in May/June Senior School Certificate Examination in Biology, Chemistry and Physics in Nigeria 2007-2019

		Biology		Chemistry			Physics		
	Total	Credit	% Pass	Total	Credit	% Pass	Total	Credit	% Pass
	Entry	Passed		Entry	Passed		Entry	Passed	
		(A1-C6)			(A1-C6)			(A1-C6)	
2007	1,238,163	413,211	33.37	424,747	196,063	46.16	409,449	180,797	44.16
2008	1,259,964	427,644	33.94	456,980	202,762	44.37	408,237	200,345	49.08
2009	1,259,964	453,928	33.87	456,980	203,365	43.49	444,236	222,722	50.14
2010	1,300,418	427,644	32.88	465,643	263,059	50.70	463,755	237,756	51.27
2011	1,505,199	79,432	38.50	565,692	280,280	49.54	563,161	360,096	63.94
2012	1,646,150	587,044	35.66	627,302	270,570	43.13	624,658	429,415	68.74
2013	1,648,363	852,717	51.73	639,296	462,517	72.34	637,023	297,988	46.77
2014	1,365,384	766,971	56.17	636,268	397,649	62.49	635,729	386,270	60.76
2015	1,390,234	798,246	57.42	680,357	412,323	60.60	684,124	410,543	60.01
2016	1,200,367	740,345	61.68	706,873	408,122	57.74	705,125	415,655	58.95
2017	580,449	394,898	68.03	377,970	320,635	84.83	377,851	205,757	54.45
2018	1,087,063	679,299	62.48	728,551	424,231	58.22	728,354	571,687	78.49
2019	1,033,304	775,103	75.01	726,132	566,156	77.96	725,853	565,746	77.94

Source: West African Examination Council, Yaba Lagos. 2019

Figure 1 shows a continuous rise and fall in the percentage pass of students in biology between the years 2007-2019 as shown below.

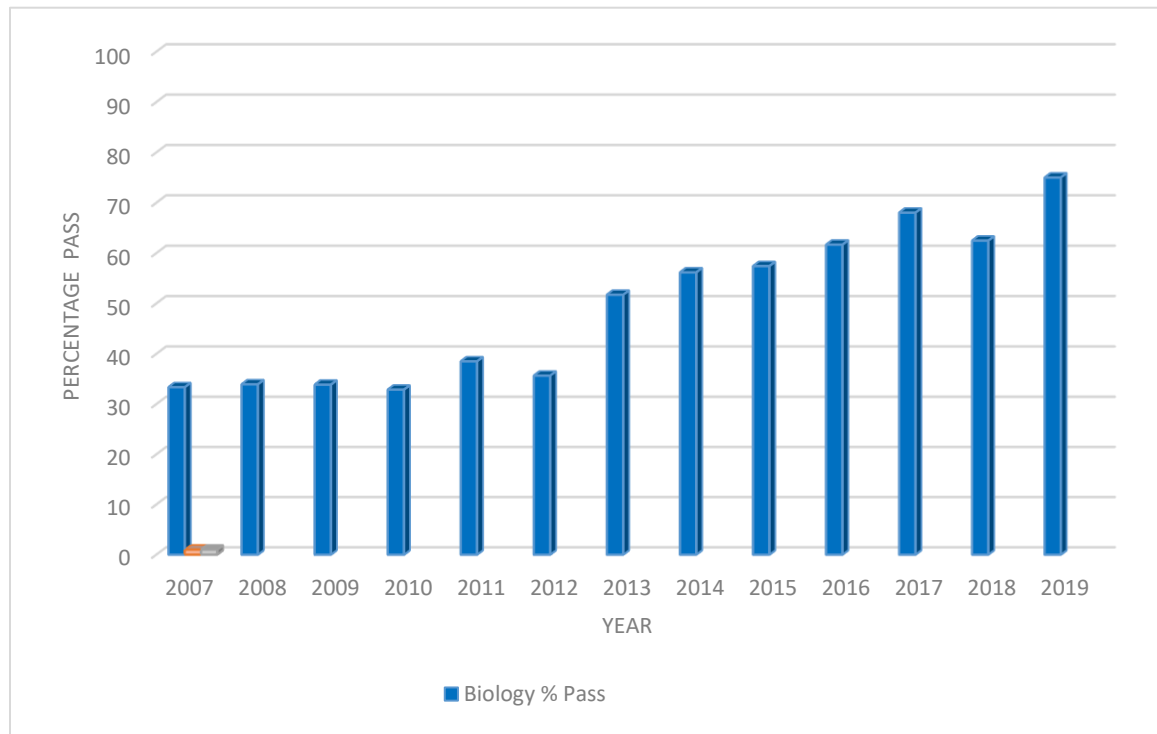


Figure 1: Candidates' percentage pass in Biology; 2007-2019

Biology, a subjects taught at the senior secondary school level is a natural science concerned with the study of life and living organisms including their evolution, distribution, structures, functions, growth, characteristics and classification. Adejoh and Itokyaa (2012), Nasr and Asghar (2011), noted that biology which is a science of life, occupies a central position in the scientific and technological development of any nation. It is referred to as the gate way to disciplines such as Medicine, Agriculture, Pharmacy, Nursing, Dentistry

and so on. Biology is an important factor in ending poverty, with biology, maternal and child health is improved, (ERIM, 2014). It is therefore the power house for growth and progress of any society. In modern time, information and knowledge stand out as very important and critical input for growth and survival. Instead of viewing biology merely as a means of achieving social upliftment, the society must look at it as a means of advancement in an information age propelled by knowledge and research leading to development. Biology is a light that shows mankind the right direction to follow. Khairnar (2015) affirmed that biology plays major roles in creating new knowledge, economic development and wealth creation. This guarantees social wellbeing by wiping out poverty and providing better health care which improves the quality of human living in numerous ways.

Biology finds its application in all facets of life such as agriculture, medicine, biotechnology, biomedical engineering, genetic engineering and so on. This means that the understanding of biology helps man to know more about him/herself and the world around us. The role of biology in eradicating poverty, combating hunger, improving the health and well-being of the citizen and in the national development cannot be over emphasised; the knowledge of biology is used tremendously in solving diverse problem of humanity and providing solution to natural and artificial problems in the world at large.

Biology is important to the technological development of any nation because of its numerous benefits (Watkins and Mazur 2013). Many developed nation of the world are not taking biology education with levity but invest heavily on it and hence maintain their development.

The teaching of biology like any other science subjects demands active student's participation and the use of innovative teaching strategies. Oyekefi and Nzewi (2012) affirmed that biology is activity- based and student-centred and as such requires learner-focused activities so as to encourage student's participation during the teaching and learning process.

The recommended method of implementing the Senior School Curriculum for Biology placed emphasis on guided discovery, laboratory techniques and skills, field study and critical thinking. Other methods include: use of model, field trip, discussion, project work demonstration, team work, and resource individuals. These methods are prescribed in pursuance of the stated objectives, the content and context of the curriculum (Nigerian Educational Research and Development Council, 2009).

Innovation in biology classroom is inevitable in order to meet man's present needs. Innovation in biology classroom would involve change in both methodology and content of the subject matter. Such a change influences the essence and method of performance of learning activities. This change must

be monitored and assessed to ensure that it is achieving the goals specified and that the effect of the change meets the expectation of both the designers and users (Abidoye & Ogunlowo, 2019).

Okoye (2009) regarded curriculum innovation as ideas, approaches and materials introduced into education to improve the content of the curriculum in order to make it more relevant to the varying need of the learner and to every changing need of the society, it improves instructional strategies and techniques in order to help learners to learn faster and better improve organization of learning experience thereby making teaching-learning activities more meaningful and less tedious.

Innovation must be tailored towards enhancement of education. This is because the essence of introducing innovation in the biology classroom is to effect some changes that are expected to improve on the present educational practices that have been judged as deficient and incapable of meeting the aspiration of the ever-changing society of today. Olorundare (2014) maintained that innovation in the classroom is vital as it enables educational practices to change from time to time so as to reflect the consequent changes in the society. Innovation provides the means of trying new research findings. It enables the teacher to solve some instructional problems that they occasionally encounter in the teaching learning setting, it also enables them to

acquire new knowledge that will make them more effective and productive in teaching. In general, innovations in biology classroom should be directed towards improving performance of the students.

Teaching is largely a process by which a person helps other people to learn. It is an active process in which a person shares information with others to provide them with information to make behavioural changes. On the other hand, learning is the process of assimilating information with a resultant change in behaviour and hence teaching- learning process is a planned interaction that promotes behavioural change that is not a result of maturation or coincidence (Iyiola & Madu, 2013; Surajo & Rislan, 2013).

Teaching strategies can be referred to as the ways teachers choose to achieve the goals they have set in their lesson. A strategy can be an approach, method or a combination of carefully designed classroom interactions that could be followed meticulously to teach a topic, concept, idea or a way the teacher chooses to implement goals of the curriculum (Darda, 2014). Teaching strategy could also mean the use of instructional or assessment methods which are different from traditional ‘talk and chalk’ lecture methods. This could also mean using new or reconstructed already existing ideas, methods, which often may not be brand new but rather are new applications of existing approaches and appear novel to others because they have not yet

been widely adopted. These strategies may be used to teach a topic, a collection of concepts, theme, idea or some specific science subjects. To make teaching more effective or to tackle pedagogical problem or challenge, teachers often make use of innovative teaching strategies with an overall desire to improve students' learning.

Innovation, as described by Hornby (2015), is the introduction of fresh ideas, concepts or other positive ways of doing things. According to Gbadamosi(2014), innovation can be defined as the implementation of new and improved knowledge, ideas, methods, processes, tools, equipment and machinery, which leads to new and better products, services and processes. An innovative approach for example has to do with the use of knowledge, methods, and equipment which do not have to be new but its use in that precise concept or topic may be novel (Samba, Achor & Ogbeba, 2010).

Innovative teaching strategies as used in this study is a good way of reaching all the students, it entails plans or patterns that can be used to impart knowledge such that students are more engaged, lessons more interesting, understanding easily facilitated and students' learning and retention improved. Innovative teaching strategies in biology classroom can be manifested as the use of new teaching methods, addition of new ideas either in the curriculum content, learning experiences or introducing new or modern

instructional materials. It can also be the adoption of a new change in evaluating the outcomes of teaching and learning.

Khairmar (2015) outlined the need to shift emphasis from teaching to learning and to embrace the numerous ways in which students can learn instead of relying on traditional methods. Innovative teaching strategy encourages contact between students and learning materials, develop reciprocity and cooperation among students, encourage active learning, give prompt feedback which can be used to evaluate the teaching and learning process, emphasize time on task, communicates teachers expectation of the learning process as well as respects diverse talents in the student and their individual ways of learning (Zundel and Deane, 2010) .

The need for innovative teaching strategies in teaching science subjects arise from the fact that different situations such as teaching topics, learner's cognitive readiness, concept being taught, skills intended to be developed in learning, demand for different teaching approaches. Hence a teacher who is not aware of a variety of such strategies would not use them let alone use them effectively (Khurshid & Ansari, 2012).

The effect of difficulties in learning upon a learner may be very obvious, as anxiety builds up around the student's area of weakness (Oyelekan, Igbokwe and Olorundare, 2017). The student may therefore be unable to meet

up with the expectation or standards set by the teacher, parents and school administration, this problem can be resolved through the use of varied form of teaching strategies of which teachers should be aware of. Any innovation calls for knowledge, understanding technique and abilities. When these are lacking, the knowledge gap will be a challenge, and this will make the teacher unable to implement the curriculum. Olumorin (2008), affirms that awareness of policies usually forms the backbone of the utilization and productivity level of any programme. The author further emphasized that it is when an individual is aware of the principles and content policy that such an individual can cultivate right type of attitude that will result in improved productivity. Teachers' decision to utilize innovative teaching strategies depends mainly on their awareness of the existence of such strategies, therefore teacher who is not aware of the innovative teaching strategies will neither attempt to use them in the first place or use them appropriately and adequately.

Ige, Tella and Kareem, (2010), emphasized that very little of what science teachers teach will be directly used by their students in real life situation. Based on this affirmation, researchers encourage science teachers to go beyond the utility argument of the subject but teach the aspects of science needed to enrich the lives of the society. Only the use of appropriate strategies

can bring these into realization and these should be put into consideration when developing the senior school science curriculum.

Ajaja (2013), described teaching as the transfer of knowledge between the teacher and the learners. For teaching and learning to be successfully done in a classroom setting, a two-way communication channel must exist between the teacher and the students. The students are expected to improve on their cognitive and practical skills, this will enable them to apply the knowledge gained to explain phenomena happening around them and to solve day to day challenges. These desired goals are yet to be achieved among students, as the teaching-learning situation has largely ignored the higher objectives of education, which are the development of the cognitive critical thinking skills and the affective domain. The effect of this is that students would be deficient in cognitive and critical thinking skills, when they are faced with real life situations where they are expected to apply what they have learnt to solve specific problem.

Omotere (2013), opined that there are several problems associated with the teaching of science, some of which are: development of passivity, misrepresentation, docile learning, dependence on teachers and books, poor performance, absence of skills and right scientific attitudes, dwindling interest and low enrolment in science. It is not enough to teach science for the sake of

knowledge, but also for the gaining of skills. Factors that contribute to the preceding situation are many but the most important of them is the method of teaching (Gbadamosi, 2014). There have been different studies on methods of teaching and their effect on students' performance. Several of these studies emphasized the need to shift from the formal method to informal method of teaching sciences. For an instance, Ajaja (2013) pointed out the method adopted for teaching and learning science as one of the factors contributing to this low interest in science and hence advocate for an alternative instructional strategies that could arouse students' interest and improve their academic success. Okoro (2011) had earlier noted that several methods are available for lesson presentations the choice of which for instance depends on several other factors such as learners' age, nature of the topics, class size, resources available and the period of the day when a particular lesson is to be taught.

Oyelekan, Igbokwe and Olorundare (2017) listed teaching strategies that are used to impart knowledge in the classroom. These are: the lecture method, demonstration method, discovery method, project method, laboratory investigation method, field trips, discussion method, inquiry method, play-way and cooperative method, competitive method and the computer assisted instructions. Other innovative teaching strategies that could be used in teaching science include inquiry- based learning strategies, quick response

(QR codes) project-based learning, wisely managed classroom technology, jigsaw, Team teaching and collaborative learning strategies and so on.

Teachers' years of experience is a measure of quality and thus becomes vital in the achievement of students' academic performance (Akinsolu, 2010). Teachers are said to gain extensive experience of successful and unsuccessful performance throughout their years of teaching (Kini & Podolsky 2016), this assumption has generated in-depth research into how teachers who have been involved in teaching for different periods of time perceive their teaching (Fives, 2010). Ibe, Nworgu and Anyaegbunam (2016) examined the influence of teachers' teaching experience on academic achievement of secondary school biology students in Nsukka local government area of Enugu state. Findings revealed that teachers' teaching experience positively influenced students' academic success in subject like Biology.

Kosgei, Mise, Odera and Ayugi (2013) undertook a study on the relationship between teacher characteristics and students' academic achievement in Nandi District, Kenya with teachers from 26 public secondary schools forming the target population. Findings from the study revealed that there was a noticeable relationship between teacher teaching experience and student academic achievement. It has been argued upon that experiences

improve teaching skills while pupil learn better at the hands of teachers who have taught them continuously over a period of years (Temitope and Olabanji, 2015).

Academic qualification is considered one of the factors that enhance teachers' ability to understand and teach a subject effectively. Furthermore, academic or professional qualifications have been affirmed to be an important aspect of teachers' perception of area of difficulty in teaching (Abimbola and Abidoye 2013). This suggests that the academic qualification of a teacher matters when it comes to effective teaching. Akinfe, Olofinniyi and Fashiku (2012) affirmed that the role of professionally qualified biology teacher or trained teachers is an important teacher's quality which enhances students' academic achievements in Biology.

Akinsolu (2010) buttress the above statement with the findings of the study which showed that teachers' qualification was significantly related to students' academic performance. The availability of adequate and qualified science teachers cannot be debated for when it comes to success of any science programme. It does not matter how good a programme is, however valid the theory that underlies it and whatever the objectives of the plan are, the success of such programme lies in the nature, quality, attitudes, motivation and convictions of the subject teacher (Obomanu & Akporehwe, 2011).

Gender differences have become an issue of concern around the world most especially to educators and researchers. Gender has been reported to have an essential influence on vocational and educational options as well as the level of perception of scientific concepts (Edu, Edu & Kalu 2012).

Findings on teaching strategies and teachers' gender revealed that the gender disparity in science may not be affiliated to ability but on variables such as motivation, culture, environmental factor and personal factors such as religious and moral beliefs. Jones and Dindia (2004) opined that teachers have different expectations from boys and girls in the classroom. Olagunju and Abiona (2008) revealed that the male teachers utilize instructional materials in their teachings more than female teachers whereas Khurshid and Zahur (2013) found that female teachers have greater awareness and also utilize innovative teaching strategies more than the male science teachers.

It could be deduced from the previous studies that the sources of gender differences in educational outcomes have long been the subject of study and debate as there are no conclusive statements on influence of gender and teacher's teaching experience related issues.

Differences in the teachers/learners' gender, learners' background, abilities, and aptitudes, learning styles, the circumstances or learning environments may have effect on the outcome of the teaching and learning

process, if teaching is to be effective, a number of options in terms of teaching strategies to be utilized must be considered (Ilime 2013). This means that no single teaching strategy can be said to be the most effective at all time. Many teaching methods show poor results because sometimes teachers are not fully aware of them or teachers apply wrong strategy at the wrong time. The present research examined biology teachers' awareness and utilization of innovative teaching strategies in senior secondary schools in south western zone of Nigeria.

Statement of the Problem

Science education is a suitable and faster vehicle for an intentional transformation of the society and because of this, different studies have been carried out on how to improve its teaching in Nigerian Secondary Schools. Despite this effort by different researchers, students continue to perform below expectation especially in subject like biology. This observable problem has been blamed on a number of factors. Chief of which is the possibilities of teachers not using varied forms of teaching strategies to be able to cope with some specific difficulties associated with the teaching and learning, (Ajaja 2013, Gbadamosi 2014, Oyelekan, Igbokwe & Olorundare 2017) identified the method adopted for teaching and learning any science subject as a major factor contributing to the low interest and poor performance in those subjects.

There is therefore the need for other instructional strategies that may arouse students' interest and enhance their performance.

Researchers like Abdulwahab, Oyelekan and Olorundare (2016), Lamidi, Oyelekan and Olorundare (2015), Danjuma (2015), Khairnar (2015), Khurshid and Ansari (2012), Udeani and Okafor (2012), Olatoye and Adekoya (2010), Yusuf and Adedeji (2010), Olatoye and Adekoya (2009) among others, all emphasized the effectiveness of learner-centered teaching strategies that could produce better results in terms of students' learning. These author recommended such strategies in biology, chemistry, physics or math's teaching. The problem of biology teachers not been aware of the existence of these innovative strategies is an area which need further investigation.

Khurshid and Zahur (2013), examined teachers' awareness and utilization of 16 innovative teaching strategies in private and public secondary schools in Islamabad, 100 secondary school teachers were randomly sampled, result of their study revealed that level of teachers' awareness and utilization of innovative strategies was high. This result was however contrary to that of Samba, Achor & Ogbeba (2010) who reviewed the extent to which senior secondary school science (biology, chemistry and physics) teachers in Benue State were aware and utilize 19 innovative teaching strategies. The present

study was thus carried out specifically to determine the awareness and possible utilization of selected innovative teaching strategies by biology teachers in public senior secondary schools.

Oyelekan, Igbokwe and Olorundare (2017) worked on biology, chemistry and physics teachers' utilisation of innovative teaching strategies in senior school in Ilorin, Nigeria, results revealed that, out of the thirty six (36) selected innovative teaching strategies, most science teachers frequently used only two (2), while others were rarely used. The study did not investigate the teachers' awareness of the innovative teaching strategies neither were reasons of their non-used focused on. Consequently, the present research was carried out to examine the biology teachers' awareness of innovative teaching strategies and also to find out reasons why biology teachers fail to utilize innovative teaching strategies.

Purpose of the Study

The main purpose of this study was to determine biology teachers' awareness and utilization of innovative teaching strategies in senior secondary schools in south west, Nigeria. Specifically, the study;

1. determined the level of teachers' awareness of innovative teaching strategies in biology classroom;

2. determined teachers' level of utilization of the innovative teaching strategies in their biology classroom;
3. examined the influence of gender on biology teachers' level of awareness of innovative teaching strategies;
4. examined the influence of gender on biology teachers' level of utilization of innovative teaching strategies;
5. investigated the influence of biology teacher's academic qualification on their level of awareness of innovative teaching strategies;
6. determined the influence of teachers' academic qualification on their level of utilization of innovative teaching strategies;
7. investigated the influence of biology teachers' years of teaching experience on their level of awareness of innovative teaching strategies;
8. investigated the influence of biology teachers' years of teaching experience on their utilization of innovative teaching strategies and
9. examined the problems facing the utilization of the carefully chosen innovative teaching strategies .

Research Questions

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

1. What is the level of awareness of innovative teaching strategies in biology classroom?

2. How often do biology teachers utilize innovative teaching strategies in their classes?
3. Do male and female biology teachers differ in their awareness of innovative teaching strategies?
4. What difference exists between male and female biology teachers in their utilization of the innovative teaching strategies?
5. Do biology teachers differ in their' level of awareness of innovative teaching strategies based on their academic qualification?
6. Do secondary school biology teachers differ in their utilization of the innovative teaching strategies based on their academic qualification?
7. Do biology teachers differ in their level of awareness of innovative teaching strategy based on their year of teaching experience?
8. What is the difference in biology teachers' level of utilization of innovative teaching strategies based on year of teaching experience?
9. What are the problems facing the utilization of some selected teaching strategies by biology teachers?

Research Hypotheses

H₀₁: There is no significant difference in the level of awareness of innovative teaching strategies by male and female biology teachers.

H₀₂: There is no significant difference in the level of utilization of innovative teaching strategies by male and female biology teachers.

H₀₃: There is no significant difference in the level of awareness of innovative teaching strategies by qualified and unqualified biology teachers.

H₀₄: There is no significant difference in the level of utilization of innovative teaching strategies by qualified and unqualified biology teachers.

H₀₅: There is no significant difference in the level of awareness of innovative teaching strategies among less experienced, experienced and highly experienced biology teachers.

H₀₆: There is no significant difference in the level of utilization of innovative teaching strategies among less experienced, experienced and highly experienced biology teachers.

Scope of the Study

The study was a descriptive research of the survey type. The content scope was biology teachers' awareness and utilisation of innovative teaching strategies. The sample scope were all biology teachers in selected senior secondary schools in Oyo, Ekiti, Ogun and Lagos states. The moderating variables were biology teachers' gender, their years of teaching experience and academic qualification. Twenty (20) innovative teaching strategies out of a total of 1,271 instructional strategies listed by Kelly (2010) were selected

and used for the study. The selection of the 20 teaching strategies were based on the following criteria; they are activity based as an individual or group, learner-centred, ability to encourage creativity, critical reasoning, provide active environment to facilitate interest, encourage class attendance, test performance, reduction of anxiety and stress in dealing with difficult topics and concepts, improve the psychomotor, cognitive and affective domain of the learner and also on their relevance to the prescribed method for implementing the senior school science curriculum.

Significance of the study

The findings of this study could be of benefit to biology teachers, students, curriculum developers, curriculum planners, policy makers, teachers' education, curriculum development process, educational researchers and professional bodies.

The findings of this study could stimulate the awareness of biology teachers to different innovative teaching strategies that could be used for teaching biology at the senior secondary school level. Knowing different innovative teaching strategies will help teachers to handle different situations, topics, learner's cognitive readiness and concept being taught. It could help the biology teachers to develop positive attitude towards the utilisation of

innovative teaching strategies for teaching and learning purposes which in turn could improve their professional competences in teaching the subject.

The results of this investigation could be of great help to students in learning and acquiring knowledge or skills in biology since it focuses on modern methods of teaching what could ordinarily be abstract ideas. Student's performance may thus be improved through the use of innovative teaching strategies for learning purposes. The findings of this study could assist curriculum developers to identify educational programmes that require the use of innovative teaching strategies for effective productivity. It may assist them in particular to re-plan and include aspects that could enhance the process of teaching and learning difficult concepts in biology. Curriculum planners, policy makers may find the findings of the study useful with respect to future decision making to improve biology teaching in secondary schools.

The findings of the study could provide relevant information (to policy makers) such as the extent to which biology teachers in Oyo, Ogun and Lagos state utilized innovative teaching strategy which could serve as a basis for planning and organising seminars, workshops, and conferences to train the in-service biology teachers on the use of innovative teaching strategies. Schools, administrators and proprietors who may attend these seminars, workshops and

conferences may allocate more funds to their schools to purchase relevant teaching/instructional materials.

Teachers' education could benefit from this study in training biology teachers on the use of innovative teaching strategies. The findings therefore may help teachers, trainers to improve on their teaching strategies and adequate utilisation of innovative teaching strategies. Consequently, the findings from this study would assist the institutions to review their micro teaching and teaching practice assessment format so as to make biology student teachers demonstrate positive classroom behaviour using innovative teaching strategies.

Findings of this study would provide useful information to educational policy makers on the need for a better orientation of the utilisation of innovative teaching strategies in the teaching and learning of biology in secondary schools. This could improve biology teaching; make biology interesting and more understandable to students. This study could also be beneficial to educational researchers as it could be a useful empirical reference in the field of science education especially in biology as well as educational technology in the area of educational processes and products for designing befitting educational programme for the nation.

The findings from the research work could also be useful to professional bodies such as Teachers Registration Council of Nigeria (TRCN), National Education and Research and Development Council (NERDC), Science Teachers Association of Nigeria (STAN), Nigerian Union of Teachers (NUT), Colleges of Education among others by providing members with necessary workshop and seminars on innovative teaching strategies utilization to upgrade their professional standard.

Clarification of Major Terms and Variables

The following terms and variables have been operationally defined as used in the study.

Awareness: is the biology teachers' conscious knowledge on the existence of an innovative teaching strategy.

Utilization: refers to teachers' classroom use of acquired knowledge on innovative teaching strategies for effective teaching and learning of biology.

Teaching Strategies: are the plans laid down by the biology teacher to achieve the set goal of instruction which is to pass on knowledge or educational experience to the students.

Innovation: is a better way of reaching all the students which may be through the use of already existing or reconstructed ideas, methods, material

or equipment which do not have to be new but its use in that particular concept or topic been new.

Innovative Teaching Strategies: are carefully selected approaches used to integrate new teaching strategies and methods into science class room such that students are more engaged, creativity enhanced, lessons are interesting, understanding easily facilitated, knowledge retained and students' learning is improved.

Qualified Teacher: A biology teacher in secondary school with relevant academic qualification that must include at least; Bachelor of Education (B.Ed.), Bachelor of Science Education (B.Sc. (Ed)); Master of Education (M.Ed.) or Bachelor of Science (B.Sc.), Master of Science (M.Sc.), with a PGDE.

Unqualified Teacher: A biology teacher in secondary school who does not have professional qualifications such as: Bachelor of Education (B.Ed.), Bachelor of Science Education (B.Sc. (Ed)); Master of Education (M.Ed.) or Bachelor of Science (B.Sc.), Master of Science (M.Sc.), with a PGDE.

Highly Experienced Teachers: These are biology teachers that have been teaching biology for more than 20 years in senior secondary schools.

Experienced Science Teachers: These are Biology teachers that have been teaching biology for more than 10 years in senior secondary schools.

Less Experienced Teachers: are those teachers in senior secondary school that have been teaching Biology for less than 10 years.

CHAPTER TWO

REVIEW OF RELATED LITERATURE

This chapter presents a review of related literature to this study under the following subheadings:

- Theoretical Framework for the Study
- Objectives and Content of the Senior Secondary School Biology Curriculum
- Nature of Biology Teaching and Learning
- The Teacher's Role in Biology Teaching and Learning
- Meaning and Concepts of Innovative Teaching Strategies in Biology
- Teaching Strategies and Students' academic Performance
- Teacher's Experience and Innovative Teaching Strategies
- Teacher's Academic Qualification and Innovative Teaching Strategies
- Teacher's Gender and Innovative Teaching Strategies
- Teachers Awareness and Utilization of Innovative Teaching Strategies
- Appraisal of Reviewed Literature

Theoretical Framework for the Study

Learning is a concept that cuts across all human endeavours. It is a long life process that starts from birth and continues till death. In education, there are many learning theories which include: Behaviourism, cognitive and social

learning theories and so on. The views and perceptions of these theories on knowledge construction acquisition vary, depending on the outcome of the learning.

Adeoye and Ayanda (2019) suggested that behaviourists perceived learning as habit formation. On the other hand, the social learning theorists understand learning simply as imitation while cognitive theorists view learning as change in perception that involves active mental processes.

Bello and Abimbola (2012) stated that the newer idea of cognitive psychologists about learning is that, learning is an active internal process of construction where learners' prior knowledge plays a significant role in further conceptual learning. These 'newer' ideas of the cognitive psychologists and the constructivists' epistemological views form the cornerstone upon which innovative teaching strategies are built and are linked to the works and philosophies of Dewey, Vygotsky, Bruner and Piaget to mention but a few.

Constructivist's view on Learning

Constructivism according to Razia (2015) is not a teaching theory but rather a theory of learning which argues that human beings generate knowledge and meaning from interaction between their experience and ideas.

Thus to the constructivists, learning is experience gained by learner's interaction with the environment.

Constructivists view a learner as an active creator of his own knowledge. In order to construct knowledge, Akanbi (2013) noted that learners must ask questions, explore and assess what are known. The basis of teaching is to help the students to construct their knowledge in an active way while working cooperatively with classmates, so that their talents and competencies are developed'' (Olorundare 2014). Characteristics of the constructivism are: focus on the learner, flexible pace of instruction rather than fixed, encouragement for searching for implications of actions, encouragement at generating multiple concessions and justification of methods for problem solving by students.

John Dewey a philosopher, psychologist and educational reformer contributed and influenced education and social reforms especially in the area of inquiry teaching and learning. Dewey (1998) explained that knowledge comes only from situations in which learners have to bring them out of meaningful experience. He claimed that education and learning are social and interactive processes and that the school as a social institution should provide suitable environment in which social reforms can and should take place. Dewey (1998) perceives the classroom as a social environment where students

can take part in active learning and thus form a community of learners who build their knowledge together. Dewey recognized one lasting frame of reference; namely the organic link between education and personal experience. Dewey ascertained that every experience gained modifies further experience and results in positive attitude and growth of understanding. Dewey explained that learning succeed in an environment where learners are allowed to experience and interact with the curriculum. He stressed that all learners should have the opportunity to take part in their own learning.

Dewey (1998) was of the view that the primary responsibility of teacher is to assist in shaping the experience of students by providing conducive environment for learning. This will help students to utilize their surroundings to build up experiences that interact with their personal desire, thereby facilitating learning. Dewey advocates for active learning and explained that it is impossible to gain knowledge without the use of objects which inspire the mind. As a constructivist, Dewey believed that the teachers/instructor is a partner in the learning process whose guidance and assistance help learners to construct their learning and independently discover meaning within the subject area (Hsu & Chang, 2011).

The apparent implication of Dewey's theory to this study is that, in any learning process, students must be meaningful engaged in activities that will

motivate them to apply the concepts they are trying to learn. The teacher's role should be to provide enabling environment for active learning to take place.

Vygotsky (1978), is a social constructivist who submitted that learning takes place through social interaction. He believed that, the effect of learning is determined by independent problem solving ability of a child and the level of his/her potential development under the supervision of the teacher or with joint effort of one or more capable peers. In view of this, Vygotsky sees teaching and learning as what cannot be judged by what the child can do when working alone but rather how far ahead the learner can go when offered some assistance by a more experienced person who happens to be the teacher (Nwagbo & Chukelu 2011).

As stated by Blake and pope (2008), Vygotsky suggested that as children grow, they learn from their inner maturation promptings and active curiosity but the knowledge gained cannot take them very far. So, for a child to fully develop, he needs intellectual teachings and assistance that will guide him towards maturing. Vygotsky submitted that through proper support and guidance a learner can go beyond the limitations of physical maturation to the extent that the developmental process lags behind the learning process (Singh &Yaduvanshi 2015). Vygotsky further maintained that instruction in

scientific concepts is very helpful because it provides children with broader frame work in which they place their day to day learning process.

The implication of Vygotsky's theory for this study is that it is the teacher's duty to move the child forward in the academic process by exposing the child to different learning environment. Through innovative teaching strategies, the child's zone of proximal development can be reached as the teacher provides assistance and structures the content of instruction.

Jerome Bruner a cognitive theorist and a developmental Psychologist conducted an in-depth study in areas such as human perceptions motivation, learning and thinking (Nnachi, 2007). Bruner (1990) viewed human beings as information processors, thinker and creator of ideas, whose cognitive developments occur through the interaction and exploitation of the environment. Bruner submitted that learning is effective when learners are given the opportunity to discover facts by themselves and in this, he laid emphasis on discovery learning.

Bruner (1990) affirmed the acquisition of knowledge as an active process and thus encouraged learner's autonomy and personal involvement in the learning process. He also asserted that learner's independence become stronger through encouraging students to discover new principles on their own and this should be the goal of any effective education. Bruner was in support

of a spiral curriculum that can enable students to build upon what they have already learnt in the order of these principles:

Teaching must correspond to the experiences that make students willing and able to learn (readiness), teaching must be patterned in such a way that students can easily assimilate what is taught (spiral organization), instruction should be planned to facilitate deduction (going beyond the information given). The implication of Bruner's theory to teaching strategies is that teachers should create an environment that would help learners to discover facts by themselves.

Jean Piaget (1972) suggests that the basis of all learning is the child's own experience as the child interacts with the physical and social environment. In his views, informed knowledge can never replace one's personal experience but instead has adaptive function. Piaget recognized that human beings are born as active fact-finding organisms and keenly pattern their own ways of thinking about things based on their current level of maturation, actual experiences with objects, people and ideas (Atomatofa 2014).

Piaget claims that the child's mental activity is organized into a structure called 'schema' or pattern of behaviour which develops as the child passes through stages of mental development, through the sensory motor,

preoperational concrete and formal operational stages (from early childhood to maturation). Thus, as children grow and develop, they go through stages in which they accept as correct ideas that they may later discard as wrong. Understanding is therefore built up step by step through active participation and involvement. Piaget used the term assimilation, accommodation and reorganization to explain his views about the learning processes in children. The child assimilates new objects by making accommodation that build new cognitive structures.

Jean Piaget, as observed by Atomatofa (2014), recognized the importance of environment in child development as much emphasizes is laid on the role of cognitive structure which helps the child to build experience from important event which is much higher than environmental influences. In Piaget's views, true learning is not something learned from the teacher, but something that comes from the child through the process of active invention and discovery. Piaget asserted that the basic principle of learning is discovery, therefore to understand is to find out or recreate by rediscovery. The relevance of Piaget's theory to this study is that Piaget sees learning as an active process in which learner should be given freedom to understand and construct meaningful knowledge at their own pace through personal experience, with the teacher as a facilitator or a guide in the teaching and learning process, The

teacher provides a rich environment for spontaneous exploration of the learners. In support of Piaget's view, Okebukola (2005) stated that a science classroom filled with materials to explore inspire students to become active constructor of their own knowledge. Ausubel however is concerned with how individuals learn large amounts of meaningful material from verbal or written presentations in a school setting.

According to Kumagai (2013), learning is based on subsumption in which new learning is related to relevant ideas in the existing cognitive structure on a substantive, non-verbatim basis. Ausubel ascertained that meaning is made, from some forms of representational equivalence between language and mental context. Ausubel's theory relates to reception (expository) learning in school settings. Ausubel differentiates reception learning from memorization and discovery learning; the former because it does not involve meaningful materials and the latter because the learner must discover information through problem solving.

According to Flok (2010), Ausubel advocates the use of advance organizers as a mechanism to help link new learning material with existing related ideas. He emphasized that advance organizers are different from overviews and summaries which simply point out key ideas and present them at the same level of abstraction and generality as the rest of the material.

Organizers help in incorporating new learning material into the old related ideas. Advance organizers are helpful as they aid the process of learning particularly when difficult and multi-tasking instructions are presented. Materials learned that have relation to experiences or memories that are firm in the person's memory are more likely to be retained, whereas, materials that are learned through memorization may tend to be forgotten quickly (Adama, 2014).

Ausubel's learning theory also acknowledged the significance of learner's eagerness, cognitive drive, success motivation, self-development internal driving force and other personal motivating force. Cognitive drive is a student's desire for knowledge, understanding and mastery of how to solve problem. The inner motivation makes student to be curious, leading to greater tendency to explore, manipulate, understand and cope with his psychological environment. The duty of the teacher is to act as instructional designer who facilitate meaningful verbal learning (Kumagai, 2013).

Ausubel's learning theory focused on how students learn meaningfully through verbal learning other than experimental learning. The implication of Ausubel's theory to teaching strategies is that, since learning process depends on teachers significantly, teachers' most crucial role in meaningful learning is

how the new information passed to the students is integrated into the old or existing knowledge structure (Kumagai, 2013)

The implication of the constructivist' learning theories to the present study is that since learners are seen as the active creators of their knowledge, teaching strategies should be diversified in such a way that learners are helped to construct their own knowledge in an active way while working together with other learners so that students' talents and competencies are developed. The obligation of the teacher is to provide rich learning environment where learners can integrate new knowledge into the existing ones, assess what are known and ask questions. These are the elements of innovative teaching strategies. There are many teaching strategies which show poor results because sometimes teachers are not fully aware of them nor were able to apply the correct strategy at the right time.

Nature of Biology Teaching and Learning

Biology which is a branch of science, is interested in the study of life and living organisms. Adejoh and Itokyaa (2012) described biology as the natural science which is concerned with the study of structures, functions, growth, origin, evolution, distribution, and taxonomy of living things.

The nature of biology is a multifaceted concept that defies simple definition. It includes aspects of evolution, genetics, cell structure and

function, ecology and philosophy of science (Okwara, Anyagh & Ikyaan 2017). The easiest way to understand the nature of biology is to first comprehend scientific literacy. Recent science education reform efforts emphasize scientific literacy as the main goal of science education. Scientific literacy is the ability to understand media accounts of science, to identify and acknowledge the contributions of science, and to be able to use science in decision-making on both every day and socio-scientific issues. The Programme for International Student Assessment (PISA, 2015) describes scientific literacy as the way a person will participate in science-related issues and with the ideas of a patriotic citizen. In recent days, science education has introduced lot of changes in our world and will continue to do so in the future (Orukotan, 2007). Accomplishment in science education will go a long way in reducing illiteracy and poverty which are obstacles to national development.

In modern science, biology teaching should be such that will enable young people have access to new knowledge to expect change, behave rationally and creatively towards the problems generated by such changes (Gbadamosi 2014). Biology is investigative in nature and that is the reason why the teaching and learning of biology is concerned with the systematic procedure involved in scientific process, these scientific process includes the

scientific facts, concepts, theories, and laws typically presented in biology textbooks.

The teaching of biology is tentative as it is subject to change in light of new evidence and new ways of thinking thereby making scientific laws to change. New ideas in biology are often received with a degree of scepticism, especially if they are contrary to well-established scientific concepts. On the other hand, knowledge, once generally accepted, can be robust and durable. Lots of ideas in biology have survived repeated challenges, and have remained mostly unchanged for hundreds of years. Thus, it is reasonable to have confidence in biological knowledge, even while realizing that such knowledge may change in the future (Bell 2009). Atomatofa (2014) opined that students understanding of scientific knowledge is bound to change when they are actively involved or engage in scientific inquiry.

Biology teaching relies heavily upon quantitative and qualitative data. All biological ideas must conform to observational or experimental data to be considered valid. Observation involves the use of the five senses to gather information which is often augmented with technology. Conclusions are made from observations and often involve entities that are not directly observable. From the conclusion, laws and theories are formulated. Laws are often expressed in mathematical terms.

There is no single, world-wide way of teaching biology. Biology teachers employ a wide variety of teaching strategies to generate knowledge, including observation, demonstration, experimentation, and even chance discovery which brings about creativity which is a source of innovation and inspiration in biology. Biology teachers and learners use creativity and imagination throughout their investigations and these lead to acquisition of knowledge. Biologists tend to be sceptical and apply self-checking mechanisms such as peer review in order to improve objectivity. On the other hand, intuition, personal beliefs, and societal values all play significant roles in the development of biological knowledge. Thus, subjectivity can never be (nor should it be) completely eliminated from the biological enterprise.

According to Daramola (2005), the implication of the nature of biology on biology teaching and learning is that it will enable biology teachers to present instructions in a manner that reflect the true nature of biology. It will be wrong for biology teachers to use teaching strategies that will present biology to students as a bundle of facts in isolated bits.

THE NATURE OF BIOLOGY TEACHING AND LEARNING IS:

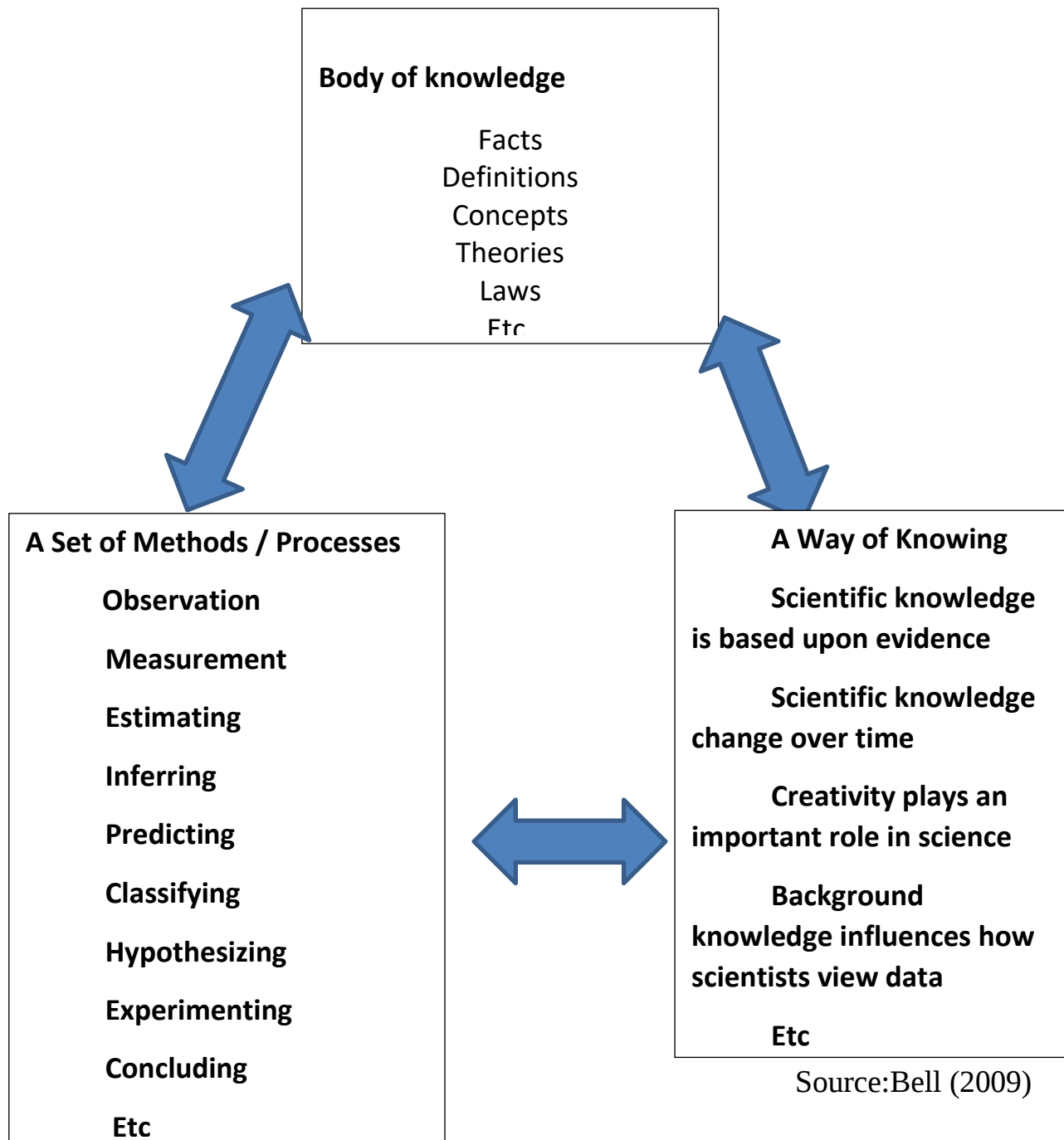


Figure 2. Three domains of biology

Objectives and Content of the Senior Secondary School Biology Curriculum

According to Great School partnership (2014), the term curriculum refers to the lessons and academic content taught in a school or in a specific course or program. Ebert, Ebert and Bentley (2013) defined curriculum as the way and resources with which students interact with in order to achieve a set educational goals. An effective curriculum has a definite and dynamic purpose or goals based on the values of the society and the needs of the child as a citizen and a skilled individual (Abidoye and Ogunlowo, 2019). Gbamanja (2000) defined curriculum as the totality of learning experiences provided to students so they can attain general skill and knowledge at a variety of learning sites. Erinoshio (2013) viewed curriculum as representing a set structured series of intended learning outcomes. Alade (2011) stated that curriculum is a broad term and may include the complete experience of the learner whole under the guidance and direction of the school.

The Biology curriculum was derived from a draft developed by CECAC and presented to a National critique Workshop in 1984. The objectives of the senior secondary school biology curriculum were derived from the National policy of education (2013) and the main objectives are to prepare students to acquire:

Sufficient laboratory and field skills in Biology, meaningful and relevant knowledge in Biology, ability to apply personal, community health and agricultural knowledge, Reasonable and useful scientific attitude. Some instructional strategies such as field trip, laboratory technique and skills, guided inquiry and conceptual thinking were prescribed to take care of the themes in the curriculum. The themes are organisms and their environment, organization of life, continuity of life, organisms at work.

The aims and objectives of the National Examination Council (NECO) and the West African examination council (WAEC) syllabus for biology are derived from the (FRN, 2015) specified objectives. In accordance with the specified objectives of both WAEC and NECO syllabuses, the contents and contexts of the syllabus placed emphasis on field studies, guided discovery, laboratory technique and skills coupled with conceptual thinking. The two syllabuses intended to provide modern biology course as well as meet the needs of the society through relevant and functional contents, method, processes and application. The two syllabuses cover the major concept of nutrition, energy production, cell behaviour and ecology. The content was organised to fit the three years period of secondary school system of education in Nigeria (NERDC, 2009).

Topics are sub-divided into instructional units which are sequenced in spiral forms. In this approach, the content to be taught is arranged in such a way that they run throughout the three year course. The concept being discussed in greater depth as the course progresses over the years. Some of the themes that recur in the course are; form and function of the cell, ecological relationship, conservation of matter / energy and metabolism. Each unit is organised under teaching topics, performance objectives, content, teacher and student activities and notes.

Teachers' Role in the Teaching and Learning of Biology

Science plays vital role in all human endeavors. This ranges from everyday living in order to cope and adapt to the demands of the environment. Okwara, Anyagh and Ikyaan (2017) opined that biology and indeed the entire discipline of science will continue to play an increasingly important role in every individual's life whether the individual may have chosen science profession or not. Hence, the government through its science education program focuses on achieving the goal of "science for all" (Nworgu, 2005).

Nworgu (2005), explained that the government has demonstrated commitment to the inculcation of scientific literacy among all Nigerians not only for those pursuing scientific professions or career through making science compulsory (a core subject) to our primary and junior secondary

schools. Nevertheless, the challenge of having inadequate manpower would always be because of the practice of insufficient motivation and provisions to study science and technology in our educational system (Ajewole, 2005).

It is recognized worldwide that the teacher is the mainstay of any educational system because knowledge is usually transferred from teachers to the learners. Every country gives utmost importance to the quality of teachers and national policies have been influenced by the growing realization that teachers have a principal role to play in determining the quality of output of educational institutions. The secret of quality education lies in the quality of teachers. According to Akinsolu (2010), the quality of students depends upon the quality of teachers either highly qualified or have high professional development.

Teachers ensure that teaching and learning process take place smoothly and efficiently as planned. Once a class period starts and students and teachers enter the classroom, teachers exercise control on the activities going on in the classroom by taking up the role of a manager. Effective management is especially important in the early sessions

Teachers are concerned about whether teaching emphasis is placed primarily on course content, interpersonal relationship, or on classroom discipline and control. They take into consideration the kind of learning being

promoted, i.e. whether the emphasis is on the acquisition of skills, facts or understanding. They look at the pattern of communication in the classroom; keep an eye on the way in which educational tasks are organized and supply educational materials. The role played by teachers in any educational system is enormous. They are responsible for overall achievement of the child through the interpretation and implementation of the educational policies and curriculum.

Teaching has to do with assisting individuals to obtain knowledge, skills and attitudes in different areas of Learning. Teaching is guiding, facilitating and motivating learners. The aim of teaching is not only to transfer information but also to make the passive students to become active receptors of knowledge and constructors of their own knowledge. Khurshid and Zarur (2013) stated that individuals or groups of learners that may be involved in learning obviously vary in their background, abilities, aptitudes and learning styles. The circumstances or learning environments in which teaching and learning take place may also incorporate a wide array of challenges. These factors therefore suggest that for teaching to be effective, a number of options in terms of approaches, strategies and skills to be utilized must be considered if optimal teaching and learning must be achieved. That means, no single approach or method can be said to be the most effective at all times.

Teaching is a concept central to education and any academic setting. There are various definitions of teaching just as there are different activities involved in the teaching and learning process. Sam, Owusu, &Anthony-Krueger (2018) defined teaching as conscious and deliberate effort by a mature or experiences person to impact information, knowledge, and skills to an immature or less experienced person, with the intention that the latter will learn or come to believe what is taught. Gengle, Abel, &Mohammed (2016) defined teaching as a systematic activity designed by a teacher or instructor to facilitate learning in order to enable learners constructs worthwhile knowledge and skills.

Teaching as an educational practice, involves two sets of people: the teacher/instructor and students/learners. According to Gengle, Abel, & Mohammed (2016) teaching and learning are considered as two sides of a coin, because teaching is worthless without learning. Hence, teaching without learning is considered mere talking. For teaching to be meaningful, it must be effective in promoting knowledge, skills and values. Kudryashova, Gorbatova, Rybushkina and Ivanova (2016), stated that the accepted criterion for measuring good teaching is the amount of learning outcomes demonstrated by the school age learners and also through the perspective of learner's engagement in the teaching and learning process. Kudryashova et. al. (2016)

characterized effective teaching as teaching in ways that help learners understand ideas and perform proficiently and diversified i.e. teaching in ways that would assist different learners to gain knowledge and become a constructive member of the society.

Onojah, (2016) stated that the role of a teacher in teaching and learning should be inquiry-based as teachers should build the subject program around inquiry process by selecting content and adapting curricula to address students learning needs, interests and prior knowledge, he/she should develop activities and assessments that promote students depth of understanding by working together as colleague across discipline. According to Kudryashovva et. al. (2016), teachers are to guide and enhance learning with different strategies that will assist students to focus on their inquiries and ideas, initiate student discussion; they are to help students to share responsibility for their own learning by demonstrating curiosity, scepticism and the skills of inquiry. Biology teachers would therefore need to create and manage learning environments, provide enough time for extended inquiries, which are safe but flexible and should be supportive of students' activities and actions by encouraging the use of materials, tools and resources in and outside school.

Cox (2017) stated that the role of teachers in teaching any of the sciences is to help students apply the concept such as mathematics, English and science

through classroom instruction and presentation. Hence biology teachers should produce groups of learner with each member respecting the ideas and diverse experience of others, work together and make good decisions about the contents and context of their work, embrace the intellectual, rigor and attitudes that make learning interesting and be involve in on-going formal and informal conversation. They should also engage in on-going, assessment of instruction and learning by using multiple methods to determine student's understandings, guide students in self-assessment.

Based on the preceding claims, accomplished teachers of Biology are constructors, organizers, open-minded and critical independent professionals. They are active co-operators and collaborators, intermediaries between learners and what they need to know, providers of platform for easy understanding, coaches and designers of learning environments. Experienced biology teachers have great understanding of their subject matter and appreciate how knowledge in other disciplines help learners to acquire greater knowledge in biology. Such teachers are those who engage students in higher cognitive skills, who promote information literacy and encourage collaborative classroom practices among students or indirectly influence the students 'attitude toward biology which in consequence can influence student's achievement (Adeoye & Ayanda, 2019).

Teachers are therefore, invariably, role models whose behaviours are easily mimicked by students. What teachers like or dislike, appreciate and how they feel about their learning or studies could have a significant effect on their students (Umar, 2011). By extension, how teachers teach, how they behave and how they interact with their students can be more paramount than what they teach. There is no doubt that teachers are the most important person in the curriculum implementation process (Cox, 2017). Irrespective of which philosophical belief the education system is based on, there is no doubt that teachers influence students' learning. Teachers are well-vested with the necessary and requisite knowledge about the practice of teaching and are responsible for introducing the curriculum in the classroom. According to Olorundare (2014) teachers are the key curriculum decision-makers who need to be extended professionals. This means that teachers are not only skilled in dealing with the classroom situation, but with issues wider than that. The easiest way to get teachers to be devoted to an innovation is to enrich their knowledge of the programme.

The Meaning and Concepts of Innovative Teaching Strategies in Biology

An innovative strategy is a design that is full of new or purposively reconstructed existing ideas, methods, and equipment, for example to combine various teaching strategies and develop a new one. Innovation is

useful in any educational system because it is man's means of survival in a rapidly changing environment. Hence, the strength of any society depends to a large extent on its curriculum and the teaching methods used in implementing such curriculum. The technological strength of Nigeria depends mainly on the school science curriculum knowing that science and technology are tools for sustainable national development.

Innovative teaching strategies are activity-based and characterized by students sharing some degree of responsibility for making decision in the learning process. In the innovative teaching strategies, the teacher is often described as a partner and a facilitator in the teaching and learning process and not the possessor of knowledge hence the innovative teaching strategies are referred to as student-centred approach to learning (Abida & Muhammad, 2012). Active learning generates and sustains motivation and a student who is so motivated learns more easily (Abba & Ubandoma, 2008). Students have a sense of achievement as active learning encourage creativity and reduce conformity. This statement is affirmed by Achor (2008) who stated that some teaching methods are activity-based, learner centered interest arousing and activity oriented.

Teaching strategy is linked to one or more of the three categories - pedagogy, organization and non-academic. Pedagogy refers to any strategy

that requires teachers to adopt teaching methods or practices in order to implement it. Organization refers to the need for support from the school administration, educational establishment or other governmental or constituent group to implement the strategy. Also, Non-Academic refers to strategies that do not have any academic gains (supporters of new model schools agree that these benefits are just as vital, if not more important, than the academic benefits of school). Humans face diver problems in their lives and they try to find particular ways to solve these problems. Based on this, it is important for students to be prepared for the future by facing real-life problems in their learning environment and proffering appropriate solutions to these problems. Education should enable individuals to become an effective problem solver in real life situation (Abimbola, 2015).

Abida and Mohammad (2012), explained in their work that the individual needs of the students cannot be attained with convectional method of teaching as every child has different home background, with different question about things being taught on their mind, they have different focus towards the environment around them and unless the things get clearer in the mind of the students, learning cannot be achieved.

For the purpose of this study, 20 innovative teaching strategies were considered and these are as follows: Activity based Learning, Mind map,

Teaching with sense of humour, Personalized system of instruction, Wisely managed classroom technology, Think-pair- share, Jigsaw team work / puzzle, Z-A approach, Mastery Learning, Concept Formation, Mnemonic-word- Words approach, Online Virtual Laboratories, Peer tutoring/learning, Hands on Learning approach, Brain based strategy, Experiential Learning, Reciprocal Learning Strategy, Integrating debate into course assignment, Blended Learning, Inquiry based learning. The biology teachers' awareness and the utilization of the listed teaching strategies were investigated because the selected teaching strategies are activity – based and learner centred.

Activity based Learning Strategies

Activity based Learning Strategy is an instructional strategy with focus how learner relates with the subject matter content of a course through active participation, generating of ideas, rather than be a passive listener and a receiver of knowledge (Pane, 2018). Abimbola (2017) opined activity based learning/active learning technique as a means of involving students in practicing important skills and applying new knowledge. Also, Audu (2018) described active learning technique as a process of involving students in the learning process through writing, discussing, reading, acting, movies, and problem solving. Active Learning means engaging students with the learning material (subject matter), participate in the class, and collaborate with each

other, demonstrate a process, analyse an argument, or apply a concept to a real world situation (Eison , 2010).

Mintz (2014) affirmed that students learn best when learning is active: students are mentally involved, when they engage in hands-on activities, when they are involved in a process of inquiry, discovery, investigation, and analysing. Thus, learning is enhanced when students repeat the information in their own words or when they give examples or are able to process the information given to arrive at a conclusion. The active learning is a learning process in which the learner takes the responsibility of his/her learning and he/she is given the opportunity to make decisions on the various aspects of the learning process and to perform self-assessment (Singh & Yaduvanshi, 2015). In active learning process, learning is no longer a standard process, but is transformed into a personalized process. Here, the skills of problem-solving, critical thinking and learning to learn are developed (Abimbola, 2015).

Active Learning Strategies is said to be very effective, motivating and interactive by several researchers. Salman (2009) did an assessment of Nigerian primary School Teachers on Active Learning Technique (ALT) in the North Central geopolitical zone of Nigeria. At a Mathematics workshop organised by the United Nations Educational, Scientific and Cultural organisation (UNESCO), a sample of 120 primary school teachers were

involved in the assessment. Findings from the study indicated that participants found ALT interactive, interesting, motivating, participating and highly innovative.

Active learning can be achieved by applying strategies at the base of the cone of learning shown below, using direct, purposeful learning experiences that stimulates “doing the real thing” (Davies & Summers, 2015).

The Cone of Learning

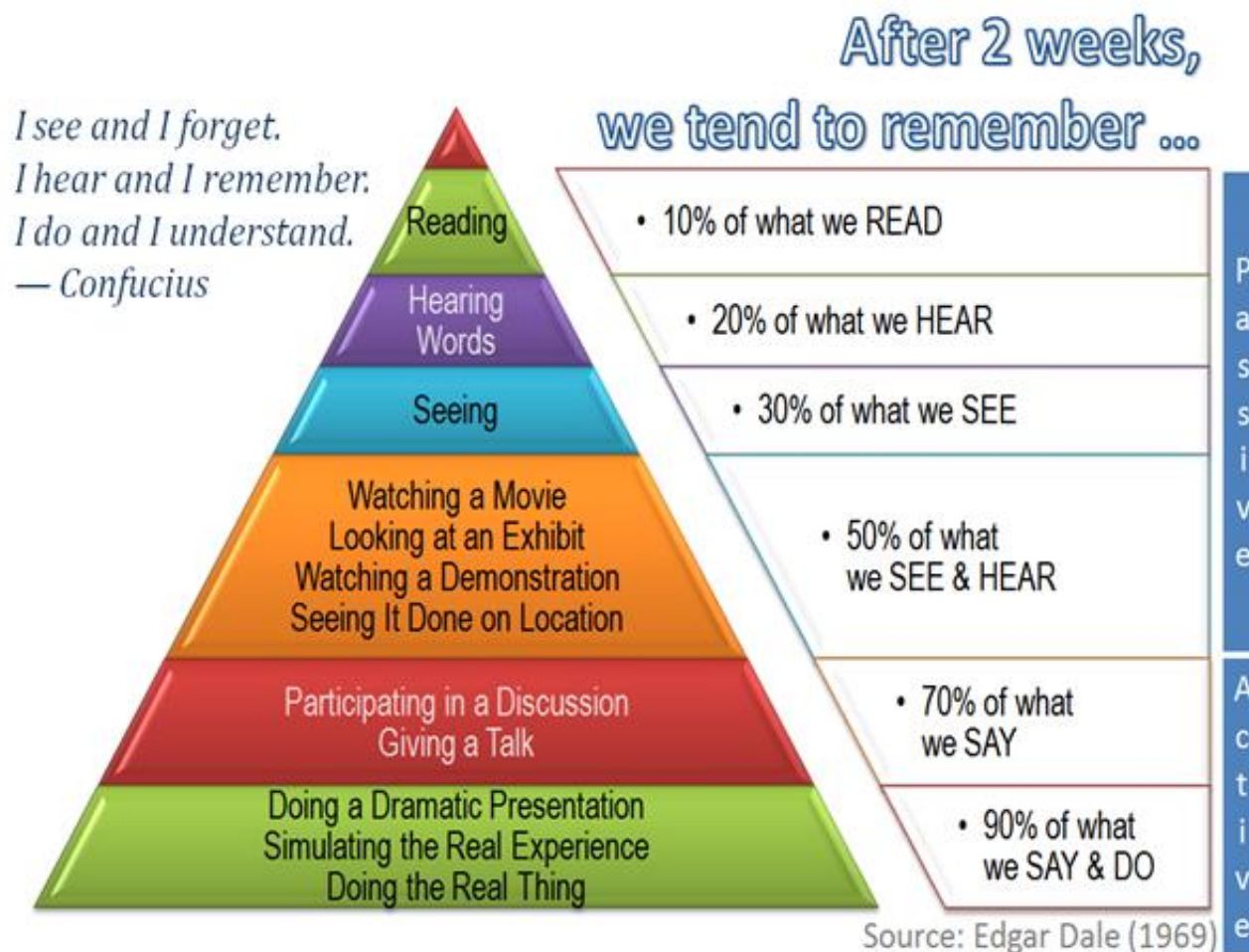
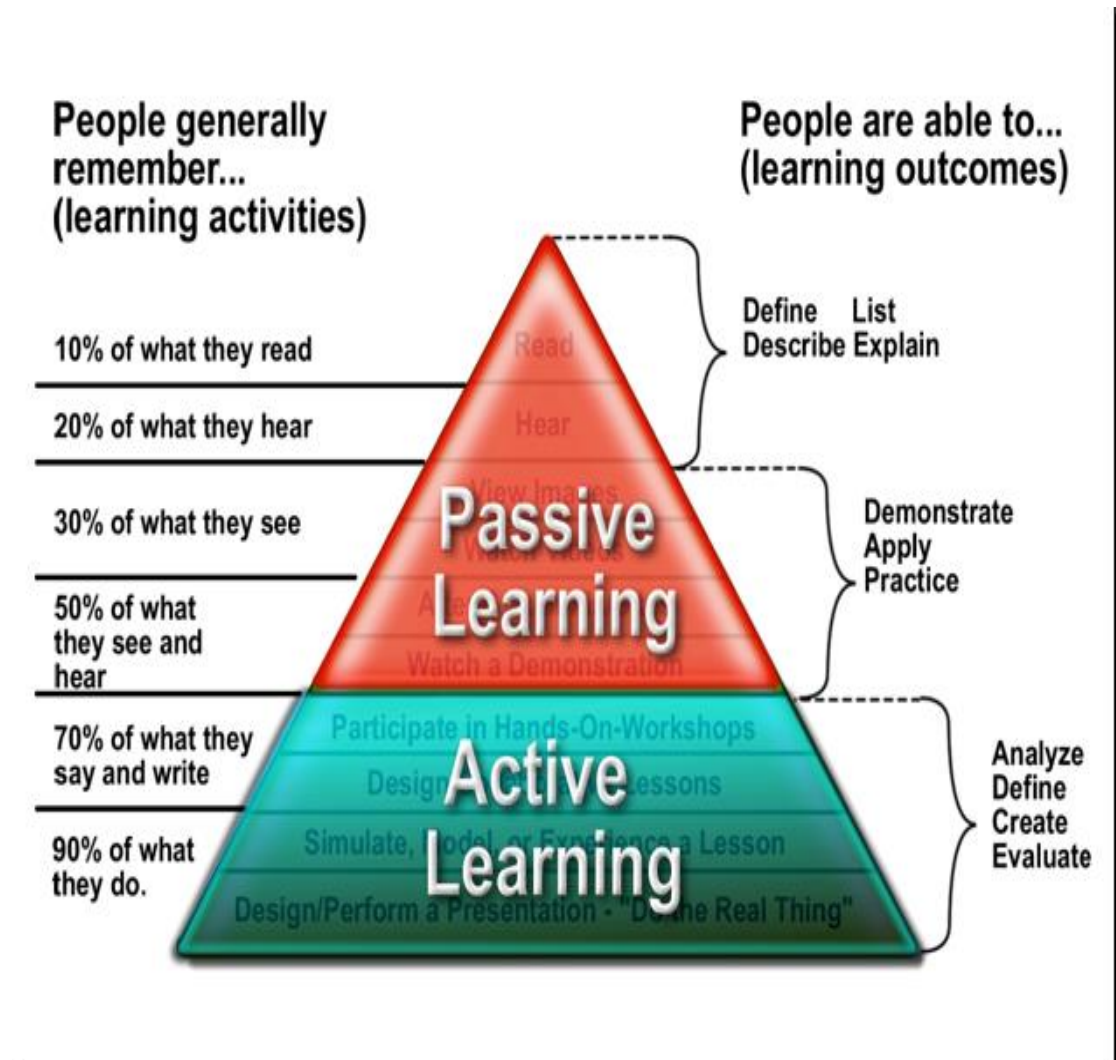


Figure 3: Cone of Learning 1.



Source: Edger Dale (1969)

Figure 4: Cone of Learning 2

The importance of active learning as highlighted by Eison (2010), are that; It facilitates independent, critical and creative thinking (case-based problem solving exercises, debate and puzzles, encourages effective

collaboration (small-group discussions, peer instruction exercises), increases students' investment, motivation and performance (computer assisted instruction, puzzles, models and explores personal attitudes and values.

Mind map as an innovative teaching strategy

Mind mapping originated from the theory of radiant thinking or the full Brain actively thinking of association driven from a central concept (Rosciano 2015). Mind maps were developed in the late 60s as a way of helping students make notes that used only key words and images, which is a simple technique for drawing information in diagrams, instead of writing it in sentences. The diagrams usually take the basic format of a tree, with a point starting from the middle, then branches out and divides again and again. The tree consists of words or short sentences connected by lines. The lines that connect the words are part of the meaning (Spencer, Anderson & Ellis 2013) Mind map can be used by biology teachers to explain concepts in an innovative way. They can be drawn quickly and much easier to go through and recall because of their visual quality. The nonlinear feature of mind maps enables it to be much easier to relate to and cross-reference with diverse elements on the map.

Mind maps can be review easily and quickly as information in one's mind can be refreshed just by glancing once. It can also be an effective mnemonics. Remembering shape and structure in mind map can provide the cues necessary

to remember the information within it. Mind map engages the brain in the process of assimilating and connecting facts than the conventional notes. The good thing about mind mapping is that, one can learn and remember more effectively just by making use of visual and sensory tools at ones disposal. Models, pictures, charts, music, colour, shapes, even touch and smell can help to facilitate learning, and this helps to retain information for a longer period. The key to building a good mind maps lies on one's creativity, thinking and cross linking between ideas that exist in one's mind. Nwagbo and Obiekwe (2010) pointed out that any particular information explained with the help of graph charts makes a high impact in the minds of the people.

Teaching with sense of humour

Students always like lively and delightful personalities. If one for an instance teaches whatever he/she wants in a humorous, delightful and entertaining way, he/she can easily achieve target. Everyone loves a teacher with a good sense of humour. Considering the positive side of life, not only promotes a good or cordial relations between teacher and students, but also provides great relief when trying to explain difficult topics or a complicated subject matter (Damodharan & Rengarajan, 2012). There is always hope for improvement in any field when there is a willingness to change. Teaching and learning are not always easy, combining both successfully is a challenge.

Being humorous is a greater work. However, laughing is stress-free. There are various strategies with which one can teach effectively. It is easy to create a humour in the classroom by reading books of jokes, watching scientific base cartoon and listening to professional comics, using techniques such as exaggeration, pauses, and timing. Observing reality and exaggerate it. Much humour lies in observing real life and truthful situations. Individual experience and various researches proves that using humour in teaching is a very effective tool for both the teacher and student. Humour strengthens the relationship between student and teacher, reduces stress, makes a course more interesting and if relevant to the subject, may even enhance recall of the material (Elangovan, 2018). Humour has the ability to make one relax, lessen tension, and thereby create an environment conducive for learning and communication. Invariably, humour not only plays an important role in the healing process but is also very important in education.

Personalized system of instruction /Individualize learning

Personalized teaching is an innovative strategy in which instruction is responsive to learners' need and values, the learners have a choice in choosing the teaching strategy, deciding the choice of subject matter and time for learning, selection of goals and criteria for evaluation (Adeoye, 2018). Personalized system of instruction is an important underpinning of the whole

New Paradigm model of education. It commence with the notion that learners are not products that can be mass-produced by schools. If one accepts the undisputable truth that no two children are exactly alike, then it reasonably means no one teaching strategy can work for all students (Nair 2008) therefore, a good educational model will "personalize" each student's learning experience.

The impression that each student has an "Individualized Education Program" is not novel to those who specialize in educating children with learning disabilities. Now, the principle of Personalization includes not only what will be taught in school, but also how it will be taught. While it is possible and perhaps even desirable to postulate certain "standards" which define the kind of skills and knowledge that constitutes robust learning in any given discipline, each student must have adequate and individualized preparation to master these standards (Nair 2008). Further, a school that promotes personalized teaching will make every effort to deliver education using different teaching strategy in an attempt to involve all students. Personalized teaching is therefore compatible with the idea of Howard Gardner' "Multiple Intelligences Theory" which identifies eight different intelligences whose development is essential for success in a variety of today's professions (Applied Scholastics International, 2018).

Personalized teaching environment improves not only an individual's cognitive and analytical skills, but is also concerned with the development of other intelligences skills thereby building learner to be responsible citizen.

Wisely managed classroom technology

Information and communications technology has made available a range of computer based multimedia which is able to integrate voice video and computer technologies. Such faculties include computer, tablets, digital cameras, video conferencing technology and GPS devices which can all enhance student's learning experiences and play useful roles in distance education (Concordia University, 2018).

With access to the internet increasing, individual schools and organizations are linking up and opening up more possibilities for learners to gain full advantage of the networked world. Distance learning has indeed been greatly enhanced by the internet and its associated service (Ige, Tella & Kareem, 2010) To enhance student's skills in the use of information and communications technology, assignments requiring the use of the internet can be given to the students from time to time. There is the tendency for teachers to overemphasize the limited availability of these facilities but many young learners have shown that their interest in the internet and motivation constitute

a strong force in overcoming the limitations associated with availability (Damodharan, and Rengarajan, 2012).

|Think-Pair-Share

Think-pair-share begins with information that was provided initially through a reading assignment, a short lecture, a videotape, etc. The instructor then poses a single question and students are instructed to reflect (i.e., think) about the question and to note their response in writing. Students then turn to a partner and share their responses. This can terminate the sharing or the pair may turn to another pair and share again in groups of four. (ED Glossary 2015). Using think-pair-share as a strategy, teacher are to provide sufficient time for each participant to speak with his or her partner; the teacher however, can determine the total time required for the activity by limiting the number of pairs invited to share their responses with the whole class.

Think-Pair-Share is a collaborative teaching strategy that is effective in very large classes, it encourages students to be reflective about course content, allows students to privately formulate their thoughts before sharing them with others, and is good in developing higher-order thinking skills. (Damodharan, and Rengarajan, 2012).

Jigsaw Team Work/ Puzzle

Jigsaw is an active (cooperative) learning strategy in which a broad topic is shared into smaller, interrelated pieces, after which each member of a group is assigned to read and become proficient on a different piece of the puzzle. Once an individual becomes knowledgeable on their piece of the puzzle, he/she teaches the other group members that puzzle piece. After each person is done teaching, the puzzle will be reassembled and everyone in the group knows something important about every piece of the puzzle (Aronson, 2000). Functioning as a successful team requires the integration of many different activities.

Z to A approach

This approach attempts to explain the application part of a particular concept first. The teacher explains the application of a particular concept first after which he/she explains the effects of such applications. This type of teaching method is useful in teaching laws, principles, generalization and theories. For example, the teacher demonstrates the shrinking of an animal cell when left in a hypertonic solution for a while before explaining the concept of plasmolysis to the students (Damodharan, and Rengarajan, 2012).

Mastery learning

As developed by Benjamin Bloom (Wikipedia, 2019), mastery learning applies the principles of individualized teaching and tutoring to whole class learning. In this strategy, rather than waiting till the end of lesson to check on progress, teachers design on going checks to use during the process of teaching which provides individual feedback, identify learning needs/difficulties, recommend specific remediation or enhancement strategies, and re-evaluates with a parallel assessment. Mastery learning is fundamental to many textbook programs and has brought about formative evaluation as a routine in classrooms. Mastery learning works on the principle that students learn at different paces or levels. A number of research shows that compared to traditional classrooms, learners in well-implemented mastery classrooms reach higher levels of achievement (Lamidi, Oyelekan, and Olorundare 2015).

Concept Formation

In concept formation, learners are provided with information about a specific concept. These information may be provided by the teacher or by the students. Learners are then instructed to classify or group the information and give descriptive labels to their groupings. By connecting the examples to the

labels and by supporting their reasoning with explanation, the students form their own understanding of the concept.

Concept formation provides learners with an opportunity to discover new ideas by making connections and seeing relationships between items of information (Transforming Learning Environments through Global and STEM Education 2013). This strategy can help in developing and improving learners' ability to recall and discriminate among new ideas, see similarities and identity relationships, formulate concepts and generalizations, organize information and to explain the rationale behind the new information gained. Concept formation lessons can be highly motivational because students are provided with opportunity to participate in their own learning (Ajaja 2013). It helps students to exploit and manipulate information from other lessons and contexts in new ways.

Mnemonics words- words –words approach

In this type of teaching method, the teacher is not expected to comment on a specific concept for quite a while. Nevertheless he/she goes on saying only mnemonics or its associated meaning in words instead of sentence, and once the students come to a basic understanding of the meaning of a particular concept then the teacher will explain in sentences. For example in teaching concepts like characteristic of living things, cell and its environment, genetics,

ecology, this technique can be used as an effective medium by the teacher to develop the ability of the learner to recall, synthesize, organize and deduce meaning of terms and word power (ED Glossary 2015).

Peer Tutoring as an innovative teaching strategy

The best way to learn is to teach. In schools across the world, students become better learners as they take on the role of teachers and mentors to their peers and younger children (Nguyen, 2013) When using peer teaching as an innovative teaching strategy, different topics may be allotted to individual members of the class to teach to the whole class. To do this effectively, individual student needs adequate preparation. Experience has shown that a lot more permanent learning can be gained in the course of this preparation. In addition to this; many students appear to gain substantially from learning from their peer teachers. As much as possible the selection of subjects they want to teach should be left for them for greater efficiency.

Peer tutoring is valuable because students can often forge stronger bonds with other students than with adults and are more easily able to develop interest and motivation in the younger learner (Uzuner & Aktaş, 2016). There are many advantages to peer tutoring as set forth by Irfan, Rabia & Muhammad (2018) where they concluded that peer teaching Involves students

directly involved in the teaching and learning process. The act of teaching others enhances student's own learning, encourages collaboration between learners, enriches learning environment by sharing responsibility for teaching between teacher and learners while using expertise in the learning group. The problem with this method is that not all students are good teachers. In addition to this, the quality of teaching may not be as standard as desired. Peer tutoring can be viewed as a strategy for dealing with individual differences in the classroom.

Hands-on learning

Hands-on learning strategy is an educational programme that directly engage learners, by encouraging them to do something in order to learn about it. It is learning through doing. Science subjects like physics chemistry and biology practical are basically hands-on; others like higher levels of mathematics are more abstract. However, all learners can benefit from activities that stimulate different regions of the brain. The younger learners, those with learning disabilities, thoughtful hands-on teaching strategies are their keys to learning (ED Glossary 2015).

Problem Based Teaching

In problem-based teaching strategy, problem can be presented to the class/group. The problem needs to be based on an authentic situation that the participants could actually encounter ED Glossary (2015). Partners or small groups must apply the presented information to address the problem. They may address the problem by determining what is causing the problem (deductively) or by analysing the issues and identify the problem. (Inductively).

Hybrid/Blended learning

Hybrid learning can be described as a school education program in which a teacher teaches part of the lesson through online delivery of content and instruction. In this type of strategy, students have control over time, place, path or pace of learning (Adeoye 2018). This means the combination of face to face teaching and online teaching. Hybrid teaching facilitates simultaneous independent and collaborative teaching experience which contributes hugely to student satisfaction and success in subjects/courses. (Bath & Bourke 2010)

Cooperative learning as an innovative strategy

Cooperative learning is a method of instruction that encourages students to work in small groups with learning material, then presenting what they have learned to other small groups. Through this, they become responsible for their own learning as well as their classmates'. Invariably, cooperative learning is a system in which students become both motivated and motivators. By shifting responsibility for learning from teachers to students, cooperative learning remove the "us vs. them" mentality that the usual school organization naturally tends to encourage and creates in its place a new dynamic where students feel empowered and eager to succeed on their own terms and not only to please their teacher (Achor, 2008). Using cooperative learning strategy, small groups, each with students of diverse levels of learning ability, employ varied learning activities to enhance the understanding of the students. Each member of a team is expected not only to learn what is taught but to also help team mate to learn, therefore, creating an atmosphere of achievement. In cooperative learning laboratory, students work together to achieve goals that cannot be obtained by working as an individual. According to Kingdom-Aaron, Etokeren and Okwelle (2019), cooperative learning experience promote more positive attitude towards instructional experience than competitive or individualistic methodology.

Team teaching as an innovative strategy

Team teaching can be said to be an approach to teaching which leads to the departure from the traditional one teacher per one class or one teacher per subject set up commonly practiced in Nigeria. Olorundare (2005) described Team teaching as a systematic arrangement in which several teachers with a leader cooperatively instruct students with an optimum use of technology. In this practice, the sizes of students' groups and procedures are usually varied so as to provide an optimum instruction which each of the teacher makes the best use of their respective competencies for the benefit of the students. Goetz (2000) illustrated team teaching as an effective way of learning new teaching skills and that it often contributes to professional development. Bess (2000) defined team teaching as a process where all team members are equally involved and accountable for students' instruction, evaluation and meeting learning objectives. It exposes student to varieties of teaching styles and approaches which increases the potential for the team to meet various learning styles of the students.

Achor, Imoko & Jimin (2011) conducted a study of the way of improving some Nigeria Secondary Students' Achievement in geometry. The sample was 288 students from four schools' in Benue State. Two schools serve as the experimental group while the other two served as the control group. The

experimental group taught geometry using team approach while the control group was taught using their subject teacher. The result showed that there was a significant difference between the mean achievement of the group taught geometry using team approach and the group that interacted with their subject teacher.

Strategies such as Project Based Learning can work in secluded classrooms with a good teacher, but they are most effective when teachers of different interests and abilities work together as a team to provide a multidisciplinary program for the students. Team teaching is also advantageous because it makes teaching a less lonely profession than it has traditionally been. By working closely with their mates, teachers themselves stand to gain through cooperative learning. Students' learning from team teaching curricula is not usually distorted by a teacher's weakness in any given area because that might be strength another teacher in the group possesses.

Music and songs

Music is a powerful teaching tool that can be integrated into most learning situations. It has a direct physical, emotional, and psychological effect on students. Music and songs can generate a heightened awareness, motivate students to be fully involved, and create a sense of safety. Each of these factors considerably improves the development of a favourable learning

environment. Furthermore, music can serve as a medium to teach curriculum content, in this context; music offers a multi-sensory approach to enrich learning and retention of academic knowledge and skills. Research supports the use of music as a mnemonic device for learning and recalling information (ED Glossary, 2015).

Teaching Strategies and Students' Academic Performance

Teaching is an act of impacting knowledge. Ayeni (2011) refers to teaching as a non-stop process that involves bringing out desirable changes in learners through the use of appropriate teaching strategies. Adunola (2011) explained that in order to obtain desirable changes in students, teaching strategies used by instructors should be best suited to the subject matter. In addition, Bharadwaj & Pal (2011) explained that teaching strategy work effectively, mainly if they suit learners' needs; since every learner interprets and responds to questions in a different ways (Chang 2008, Ganyaupfu 2013).

A teaching strategy refers simply to a combination of cautiously designed classroom interactions that could be carefully followed to teach a topic, concept or idea. Strategy of teaching is a psychological or systematic way of imparting knowledge so as to obtain the set objectives in learners. Darda (2014) referred to teaching strategies as the way teachers choose to achieve the goals they have set in their lesson. A good teaching strategy should

not only be centred on the instructional skills, but also on the learning materials which must meet the personal needs of the students. It should make students to be aware of why they are working so that they are able to relate to other students and receive help if required.

The use of innovative strategy may not be totally new, but its' implementation may be vital in the field of study. It is not just using new technologies; but rather, an approach to teaching that results in a transformation and educational experiences for the students. It occurs by the design of using methods, practices and techniques beyond the use of new technology and above and beyond normal pedagogical practices resulting in teaching and learning excellence.

Most biology teachers teach biological concepts and topics using wrong strategy which is the 'Teacher-Centred Methods'. Under this method, students simply obtain information from the teacher without building their engagement level with the subject being taught (Atomatofa, 2014). Teacher-Centred Method is least practical, more theoretical and memorizing (Teo & Wong, 2000). It is not activity based, therefore does not encourage students to acquire knowledge that will be useful in solving real life problems. Since the teacher is in charge of transmission and sharing of knowledge, the teacher may try to maximize the delivery of information while minimizing time and effort. As a

result, students may lose both interest and understanding. Zakaria, Chin and Daud (2010) specified that for a teacher to implement the biology curriculum successfully, teaching should not merely focus on dispensing rules, definitions and procedures for students to memorize, but should also engage students actively as key participants.

Oludipe and Oludipe (2010), employ teachers to understand that changes in the students' outcomes must be supported by parallel changes in method of instruction. They made it clear that many teachers are not professionally prepared for changes in educational system, so all they do in their classroom is to teach students to memorize information, conduct well-regulated experiments, and were tested on their ability to repeat the tasks or remember the main points. In such situations where the teacher controls the instructional process, delivers content to the entire class emphasizing factual knowledge while student listen, thus, making learner to play little part in the learning process has limited effectiveness in the teaching and learning of biology in schools.

This statement was buttress by the research carried out by Colburn, (2000) on undergraduates in a large lecture hall setting. In the research, it was discovered that only 20% of the students retained what they were taught, as they were too busy taking notes to internalize the information given by the

instructor. From this research, one can infer that, some teaching methods could be more facilitative than others in teaching, but this depend on the subject and topic to be taught. This statement was also supported by Yusuf and Adedeji (2010), who said most biology teachers handle their teachings using wrong methods such as lecture method or chalk and talk method, instead of active learning like laboratory or discovery method, which is more suitable for teaching science subject like biology.

Achor (2008) buttressed the above statement by saying that some teaching methods are learner centred, interest arising and activity oriented and in most cases teachers are required to use a number of them while teaching. The effectiveness of a method and its' suitability in certain situation is what should compel a teacher to use it or not. Different circumstances, topics and concepts to be taught, skills to be developed, demand for diverse teaching methods to be used.

Ali, Toriman and Gasim (2014) researched on Academic Achievement in Biology with Suggested Solutions. 100 respondents who were randomly selected from five senior secondary schools in Kano State Nigeria were sampled. Data was collected through questionnaire, observations, interviews and documentary analysis of SSCE results for five years, the result of the study revealed that teachers' inability to use different innovative teaching

strategies in their classroom, adversely affect the level of students' academic achievement in biology.

Audu, (2018) carried out a research on the influence of teaching styles on students' achievement and interest among biology students in secondary schools using survey and quasi experimental designs. Stratified sampling technique was used to select a sample of 336 senior secondary two students from ten secondary schools. The instrument used for data collection were the Biology Achievement Test (BAT) and Biology Interest Inventory developed by the researcher. Biology teachers in the selected schools were observed and their teaching method were identified either as students centred or teacher centred using teaching style check list. The treatment lasted six weeks during which data were collected at various intervals using the BAT and BII and the data collected were analyzed. The findings revealed a significant difference in the mean achievement scores in favour of students' taught Biology using student centred teaching styles. Also, students taught biology using student centred teaching methods had a higher interest rating than those taught using the teacher centred teaching methods.

In the research carried out by Yusuf and Adediji (2010) on the effect of computer assisted instruction on senior secondary school student in Biology. Using pre-test post-test control group design, one hundred and twenty first

year secondary school student from three private schools in Oyo State were sampled. The result of the finding showed that performance of student exposed to the computer assisted instruction either individually or collectively were better than those exposed to conventional class room instruction, they recommended the need of computer assisted instruction packages for the teaching of Biology in Nigeria secondary schools.

Jiya (2011) investigated the effect of teaching with analogy and academic performance and retention of evaluation and concepts among NCE biology students. The sample was 280 students randomly selected from FCE, Kontagora and FCE, Minna. The study adopted the pre-test, post-test, post-post-test quasi experimental and control group design. The topics taught were evolution concepts. It was make known from the result of the study that the students taught using analogy performed quite better than those taught using lecture method. Furthermore, a noticeable difference exists in the retention ability of students' tutored using analogy and those tutored using lecture method of instruction in favour of experimental group.

Ariyo and Monogbe (2018) worked on the effects of two innovative teaching strategies i.e. Kolawole's Problem Solving and the use of Labless Kit strategies on the academic performance of secondary school students in Biology in Ekiti-State. The sample comprised of 209 biology students. The

research design adopted for the study was Quasi–pre-test/post-test experimental design. Kolawole’s Problem Solving strategy and Lab-less kits were used as treatment, while Biology Achievement Test was used as instrument for the study. The study showed that significant difference exists between the mean pre-test and post-test score of the experimental groups and the control group in favor of the experimental groups.

Khurshid and Ansari (2012) investigated the effects of innovative strategy on the performance of 50 grade 1 students in Islamabad. The experiment was done on the teaching of science subject. A pre-test on general science was given to the students and the score was recorded. The students were then divided into two groups, one group was used as control group and was exposed to conventional method, the second group was taught by teachers who used innovative strategies such as Team projects, Individual project, field trip, Role play, Computer Assisted Aids Multimedia, and mind maps etc. After a period of one month, a post test was conducted, it was discovered that the students taught using innovative strategies achieved significantly higher scores than those taught using lecture method.

Udeani and Okafor (2012) studied the comparative effectiveness of expository and concept mapping instructional strategy. Through a duration of two weeks, secondary school biology concepts was presented to slow learners

in their respective biology lesson. The sample for the study were divided into two groups. The first group was taught using expository method while the second group was taught using concept mapping method. The group were post-tested after two weeks. Analysis of post-test scores showed that the group taught using concept mapping instructional strategy performed significantly ($p < 0.05$) better than their expository group counterpart. This suggest that biology teacher should adopt various effective methods of tackling problems encountered when teaching.

Teacher's Teaching Experience and Innovative Teaching Strategies.

Researchers like Jiya, 2011; Ariyo and Monagbe (2011); Yusuf and Adedeji 2010, all gave different opinions about teaching experience and students' learning outcomes in schools. In their own point of view, experience improves teaching skills while students learn better at the hands of teachers who have taught them uninterruptedly over a period of years (Ijaiya, 2000). A teacher's years of academic experience is a yard stick to measure quality and thus becomes vital in the achievement of students' academic performance (Akinsolu, 2010).

Fives (2010), explained that, most teachers develop their classroom abilities early in their teaching career, teachers entering the profession may realise teaching is very demanding, but with experience, they acquire a range

of teaching strategies that they make use of throughout their teaching. Akinleye (2001), Ijaiya (2000), and Ogundare (2001) in different research works highlighted the importance of experience teachers in schools, one of which is that, experience enhances teaching skills and students learn more successfully in the hands of teachers who have taught them continuously. The importance of experienced teachers in schools has been argued as being necessary for school effectiveness (Akinsolu 2010).

Ewetan and Ewetan (2015) observed that experienced teachers are more reluctant to change as they use different types of teaching strategies than teachers with less experience. Other researchers like Ibe, Nworgu and Anyaegbunam (2016), suggested that, although less experienced teachers preferred implementing new methods of instruction, experienced teachers are more concerned about classroom management and organization of instruction and their impact on the students. Oyelekan, Igbokwe and Olorundare (2017)) in a study revealed that science teachers' experience (biology teachers inclusive) did not influence their utilisation of innovative teaching strategies. Studies by Samba et al. (2010), Khurshid and Zahur, (2013), on the other hand, affirmed that experienced teachers are more aware and utilize the innovative teaching strategies more than the less experienced ones.

Adeyemi (2008) worked on teachers' teaching experience and students' achievement in secondary schools in Ondo State Nigeria. Out of the population of 257 schools, a sample of 180 schools was drawn through the process of stratified random sampling technique. An inventory and a semi-instructed interview were conducted with selected principals and education officers. Analysis from their responses showed that teachers' teaching experience surely influence students' learning end result as shown by the students' performance in Senior Secondary Certificate examination. Schools having more teachers with five years and above teaching experience achieved better result than schools having more teachers with less than five years teaching experience.

In a research carried out by Ibe, Nworgu and Anyaegbunam, (2016). 326 SS2 biology students and all the biology teachers of SS2 were purposively sampled from 19 schools. Ex-post facto design was take on. Using a researcher developed observational schedule of 35 items divided into two sections, data was gathered on teachers' years of teaching experience and interpersonal relationship with students and knowledge of subject matter. Students' end of term performance for 3 terms were collected from the 19 teachers. Using mean and standard deviation, answers were sought to the research questions and hypotheses were tested at 0.05 level of significance

using t- test and ANOVA. The study revealed that teacher's teaching experience, influenced students' achievement in Biology.

Kosgei, Mise, Odera and Ayugi (2013) also examined the relationship between teacher's years of teaching experience and students' academic achievement. The study took place in Nandi District, Kenya and teachers from 26 public secondary schools formed the sample. Data was collected using questionnaire and was analysed using descriptive and inferential statistical techniques. The study revealed that there was a noticeable relationship between teachers' teaching experience and student academic outcome.

Teachers' Qualification and Innovative Teaching Strategies

Obomanu and Akporehwe (2011) opined that the importance and availability of adequate and qualified biology teacher cannot be over stressed for the success of any biology programme and that however well-convinced a programme is, however valid the theory that underlies it, and whatever the objectives of the plan are, its success will ever be influenced by the nature, quality, attitudes, motivation and convictions of the subject teacher. Darling-Hammond (2000) stated that certificate or licencing status is a measure of teacher qualifications that combines aspect of knowledge about subject matter and about teaching & learning. Akinfe, Olofinyi and Fashiku (2012) affirmed that students learn more from teachers with strong academic skills. According

to these researchers, teacher's assignment depends on their qualification of the subject(s) being taught. Students from junior and senior secondary school are better taught by teachers with educational qualification in addition to bachelor's or master's degree in the subject they teach and by experienced teachers than they do from less experienced ones (Darling-Hammond, 2000).

Akinsolu, (2010), worked on the relationship between teachers' qualification and students' academic performance. Twenty-One (21) public secondary schools were sampled from all the Local Government Area (LGA) of Osun State. The senior secondary school certificate examination results from 2000/01 to 2004/05 academic session were used to analyse students' academic performance. The study revealed that the academic outcome of students taught by qualified and more experienced teachers was far better than those taught using unqualified and less experienced teachers.

Oyelekan *et al* (2017), carried out a research on biology, chemistry and physics teachers' utilisation of innovative teaching strategies in teaching senior school science subjects in Ilorin, Nigeria. Using stratified random sampling technique, a sample of two hundred and fifty six (256) science teachers were carefully chosen from secondary schools in Ilorin East, South and West Local Government Areas. Data was gathered using a researcher-designed questionnaire. Results revealed that out of the thirty six (36) selected

innovative teaching strategies, greater number of the science teachers frequently used only two (2), while the rest of the teaching strategies were rarely used. The results nonetheless showed no significant difference in science teachers' level of utilisation of the innovative teaching strategies based on teachers' experience and qualifications.

Khurshid, and Zahur (2013), worked on the extent of teachers' awareness and utilization of innovative teaching strategies in private and public secondary schools, they further aimed at identifying differences in the responses of teachers based on teaching experience and professional background. They sampled 100 secondary schools teachers from various private and public sector schools in Islamabad. In the study 16 selected teaching strategies were used to analyse teachers' awareness and their 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; moreover teachers with more teaching experience and professional qualifications are more aware of innovative teaching methodologies.

Ibe, Nworgu and Anyaegbunam, (2016), determined the influence of teachers' qualification on academic achievement of secondary school biology students. Ex-post facto design was adopted. 326 SS2 biology students from

19 schools and all their biology teachers were purposively sampled. Instrument for data collection was a researcher developed observational schedule of 35 items divided into two sections which was used to elicit information on teachers qualifications, teachers' interpersonal relationship with students and knowledge of subject matter. Students' results for 3 terms were also collected from the 19 teachers. Data collected was analysed. Findings reveal that teachers' qualification influenced their method of teaching and subsequently students' achievement in biology.

Abimbola and Abidoye (2013) investigated the effect of qualification and experience of Biology teachers on the status of ecology teaching in Kwara State. Random sampling technique was used to sample one hundred and forty two (142) Secondary School. A validated researcher designed questionnaire was used to gather information from four hundred and fifty (450) teachers selected from eight (8) local government areas of Kwara state. Three research questions and two hypothesis were answered and analyzed respectively using Frequency counts and chi-square statistics. Finding of the research declared that both qualified and unqualified teachers viewed ecology teaching the same way in Kwara State.

Akinfe, Olofinyi and Fashiku (2012) worked on teacher's quality as correlates of students' academic performance in Biology in senior secondary

schools in Ondo State. A multi-stage sampling technique was used to solicit data from two hundred biology teachers. The instrument used for the study was a validated questionnaire titled: Teachers Quality as Correlates of Student Academic Performance. Data was analyzed using simple frequency counts and percentage. Data analysis revealed that the role of professionally qualified or trained teachers is an important teacher quality which enhances students' academic achievements in Biology.

Teachers Gender and Innovative Teaching Strategies

Gender has to do with a range of physical appearance relating to, and differentiating between masculinity and femininity. Depending on the situation, these characteristics may include biological sex. The word gender and sex have been used interchangeably. Sex is a biological term whereas gender is a psychological or cultural construct. Gender is the division of people into two categories, 'male' and 'female'. Through interaction with care-givers, child's interaction with the society, peer pressure in adolescence, gendered work and roles in the family, men and women are socially raised to be different in behaviour, attitudes and emotions. The issue of gender differences is of great importance to educational researchers these days. There had been different views and report as to the comparative ability of male and female in Human endeavours, especially in education

Khurshid and zahur (2013) affirmed that women have been found to be more concerned than men about the academic achievement of students and are more involved in professional growth activities. The literature on the relationship between teachers' gender, teachers' use of innovative teaching strategies, and students' outcome offers almost every possible conclusion. Ibrahim, Sabiu and Mogaji (2016) revealed that, despite the cry against gender differences, men dominate science (chemistry and physics) and engineering subjects while women dominate biology, arts and humanities. The study showed that the population of male teachers and students still surpass that of the female teachers and students in the engineering field. Thomas Dee (2006) examined the effect of teachers' gender using national education longitudinal survey (NELS) data on 8th graders from the US and discovered that same-gender teachers had a positive influence as female students do better in school when taught by female teachers and male students do better when taught by male teachers. Dee also found that the effect of teacher-gender differs depending on the subject. As observed by Okoye (2016), male teachers are likely to select a more aggressive disciplinary approach towards boys' disruptive behaviour than that of girls when the behaviour was not aggressive, such a teacher's disposition could affect the class learning environment.

Ibe, Nworgu and Anyaegbunam (2016) study the effect of teachers' gender on secondary school biology students' academic achievement. Ex-post facto design was employed for the study. Sample comprised 19 biology teachers and 326 SS2 students purposively sampled and selected for the study. Instrument for data collection was a researcher developed observational schedule of 35 items divided into two sections. Findings reveal that teachers' gender, influenced students' achievement in biology. They discovered that male teachers are more likely to believe that boys are better visual learners while girls are ever ready to lend a hand in the classroom. However, female teacher do not show these differences in belief but tend to reason that boys are with quantitative skills. It will be normal for a male teacher, who learned through this experience, to engage in visual teaching leading to better performance of the boys in the class.

Nabwire, Toili, Ong'unya and Songok (2014) worked on the influence of teacher's gender on student performance in biology in secondary schools in kenya. The study adopted a descriptive survey design. 384 eleventh grade students; 10 biology teachers; 10 heads of science department and; 10 directors of studies making a total of 414 respondents were drawn from 10 co-educational secondary schools in the sub-County. Data collection was done through interview schedules and questionnaires. Frequencies and percentages

as well as means was used to establish the distribution of opinions of the respondents on study variables. The means were thereafter used to compare the students' performance. Pearson's Product-Moment correlation was used to determine the degree of association between the teacher's gender and the students' performance while Chi-square was employed in testing whether the teacher's gender had effect on students' performance. Study revealed that female students performed better when they are taught by women while boys performed better when taught by men.

Odagboyi (2015), studied the effect of gender on the achievement of students in biology using the jigsaw method. 39 males and 49 females SS 1 students in an intact class of a secondary school form the sample for the study. Biology Achievement Test (BAT) constructed from past WAEC questions was administered as pre-test, and the results were collated by gender. Result of the analysis using t- test revealed that there was no substantial difference between the mean scores of male and female students. The students were taught, topics in microorganisms for 12 weeks, after which the students were post-tested using BAT. The results were once more analysed using t-test at 0.05 level of significance. Outcome of the study revealed that there was a significant difference between the mean scores in support of the boys. This implies that the males gained more from the jigsaw method compared with

the females. It was recommended that in order to get the best out of instruction, several methods, or a combination of them must be employed in biology classroom.

The study by Olagunju and Abiona (2008) on the production and utilization of material resources in biology education in secondary schools south-west Nigeria, revealed that the male teachers' awareness of utilisation of instructional materials in teaching is higher than that of the female teachers.

In a research carried out by Khurshid and Zahur (2013) it was discovered that female teachers are more aware and utilize innovative teaching strategies than the male teachers. However, the study were inconclusive, hence, this study will investigate the influence of gender on biology teachers' awareness and utilization of innovative teaching strategies.

Teachers Awareness and Utilization of Innovative Teaching Strategies

Several innovative teaching strategies have been developed in the field of science education with a view to involving learners more in the teaching learning process. Biology teacher's awareness of innovative teaching strategies form the basis for its utilization. In a study conducted by Gbadamosi (2014) on biology teachers' awareness and utilization of innovative teaching strategies in Oyo south senatorial District of Nigeria. 25 teaching strategies were deliberated upon. The sample for the study comprised of three hundred

biology teachers randomly and purposively selected. Data was collected using a researcher designed questionnaire. Data collected from the sample were analysed using the percentage, Spearman Rho Rank Order Correlation Coefficient and mean statistics. The study revealed that, majority of the biology teachers in Oyo South Senatorial District were aware of the selected innovative teaching strategy and the level of utilization of the teaching strategies was also high.

Samba, Achor & Ogbeba (2010) reviewed the extent to which science (biology, chemistry and physics) teachers in Benue State were aware of 19 innovative strategies and their utilization at secondary schools. The sample included 160 science teachers. It was discovered that teachers in Benue state were aware of these strategies but only few of them were effectively put to use. The strategies identified included discussion, demonstration, cooperative, project conceptual, problem solving, drama, constructivism, analogy and so on.

Khurshid, and Zahur (2013) examined the extent to which teachers are aware and utilize innovative teaching strategies in both private and public secondary schools. 100 secondary schools teachers from various private and public sector schools in Islamabad were randomly sampled. In the study 16 selected teaching strategies were used to analyse teachers' awareness and its

utilization in classrooms settings. Finding asserted that level of teachers' awareness and utilization of innovative strategies was high.

Oyelekan, Igbokwe and Olorundare (2017) worked on science teachers' utilisation of innovative teaching strategies in instructing senior school science subjects. An aggregate of two hundred and fifty six biology, chemistry and physics teachers were selected from secondary schools in East, South and West Local Government Areas of Ilorin, Nigeria to form the sample for the study, using stratified random sampling technique. Data was obtained using a researcher-designed validated questionnaire. Results showed that out of the thirty six selected teaching strategies, most science teachers frequently utilized only two, while the rest were rarely used.

Appraisal of Reviewed Literature

The teaching of biology should be such that enabled young people have access to new knowledge. This means that for teaching to be effective, a number of options in terms of approaches, strategies and skills to be employed must be considered if quality teaching and learning must be achieved. Researchers affirmed that many teaching strategies exist and that teacher needs to be aware of a lot of them that arouse students' interest, activity based and give learner the opportunity to construct their own knowledge. Since the individuals or groups of learners that may be involved obviously vary in their

background, abilities, aptitudes, learning styles, environments in which the teaching and learning take place, no single approach or method can be said to be the most effective always. Knowing different innovative teaching strategies will help biology teachers to handle different situations, topics, learner's cognitive readiness and concept being taught.

Researchers like Oludipe and Oludipe (2010), Yusuf and Adededeji (2010), Jiya (2011), Khurshid & Zahur (2013) all in separate work concluded that even though many teachers were aware of different innovative teaching strategies, only few of these strategies were utilized effectively. This statement was buttressed by Abimbola (2013), who stated that the performance level for individual science subjects did not show any significant rise for a twenty year period between 1991 and 2011, except occasionally for chemistry and physics which were above 50%. Hence, more innovative teaching strategies should be considered to see if there would be significant rise in student performance in science subject.

Teachers' teaching experience has been highlighted by many researchers such as Yusuf and Adededeji (2010); Jiya (2011); Gbadamosi (2014); Ariyo and Monogbe (2018); Audu (2018); and other as necessary for school effectiveness. It is debated on that experience promote teaching skills and that students learn and retained knowledge better from teachers who have been

teaching uninterruptedly over a period of time. Gbadamosi (2014) concluded that experienced teachers gain lot of teaching strategy that they draw on throughout their teaching. Researcher like Goetz, K. (2000), stated that, although less experienced teacher preferred implementing new method of instruction, experienced teachers are more concerned about classroom management and organisation of instruction and impact on students. Studies by Samba et al. (2010); Adeyemi, (2008); Akinsolu, (2010); Khurshid & Zahur, (2013), supported that experience improves teachers skills, students achieve better when taught by experienced teachers and that experienced teachers use innovative teaching strategies more than less experienced teachers. This is contrary to the findings of Gbadamosi (2014) and Oyelekan *et. al.* (2017) that revealed that there was no significant difference in the level of utilisation of the innovative teaching strategies between experienced and less experienced science teachers, the present study was therefore aimed at investigating the extent to which science teachers' year of teaching experience influence their level of awareness and utilization of innovative teaching strategies particularly in South West, Nigeria.

In the review of teachers' qualification and innovative teaching strategies, researchers such as Darling Hammond (2000); Akinsolu (2010); Obomanu & Akporehwe (2011); Khurshid, and Zahur (2013); Gbadamosi

(2014) , support that students learn better from teachers with good academic qualification. Oyelekan, Igbokwe and Olorundare (2017) however reported that there was no significant difference in the level of utilisation of the innovative teaching strategies between qualified and unqualified teachers. Hence, the present study examined the relationship that exists between teachers' academic qualification and their level of awareness and utilization of innovative teaching strategies in implementing senior secondary biology curriculum.

In the review of teachers' gender and innovative teaching strategy, the study reported have contradicting findings as Dee (2006) stated that the same gender teachers had a positive effect while the study conducted by Olagunju and Abiona (2008), review that most male teachers' perception of utilisation of instructional materials in teaching is higher than that of the female teachers. Khurshid and Zahur (2013) declared that female teachers are more aware and make use of innovative teaching strategies than male teachers. Studies by khurshid, and Zahur (2013), Ibrahim, Sabitu and Mogaji (2016) noted that women are more concerned than men about the academic performance of students and participate more in professional growth activities.

In the review on teacher's awareness and utilization of innovative teaching strategies, researchers like Samba, Achor & Ogbeba (2010) reported

that teachers are aware of different innovative teaching strategies but only few of them were effectively put to use. This was supported by Oyelekan, Igbokwe and Olorundare (2017) who reported that the level of utilization of innovative teaching strategies was low among science teachers. Findings from Khurshid, and Zahur (2013) and Gbadamosi (2014) were however different as their studies revealed that level of teachers' awareness and utilization of innovative teaching strategies was high.

Much work has been done by different researchers to improve science teaching and learning as different teaching and learning strategies and models were postulated; however there were no conclusive findings on the level of awareness and utilization of these innovative teaching strategies by biology teachers. Hence, this study was hoped to fill the gap by examining the extent to which biology teachers' academic qualification, their year of teaching experience and gender influence their level of awareness and utilization of innovative teaching strategies. The study also examined factors that influence the utilization of selected teaching strategies by biology teachers of senior secondary schools particularly- in South West, Nigeria.

CHAPTER THREE

METHODOLOGY

The methodology that was adopted in carrying out the research has been discussed under the following sub-headings: research type, population sample and sampling technique, research instrument, validation of research instrument, procedure for data collection and data analysis technique.

Research Type

The study was a descriptive research of the survey type. A normal descriptive study is concerned with the assessment of attitudes, opinions, demographic information, conditions and procedures.

This study fits into a descriptive survey method because it solicited information from biology teachers on their awareness and utilization of innovative teaching strategies in senior Secondary schools in South west, Nigeria.

Population, Sample and Sampling Technique

The population for the study were all biology teachers in the public senior secondary schools in South-west, Nigeria. The South-west of Nigeria comprises Ogun, Osun, Oyo, Ekiti, Ondo and Lagos states. Each state of this zone has three senatorial districts.

Multi-stage sampling technique was employed in the course of the study. Simple random sampling technique was used at the first stage to select four states out of the six states in the South-west zone. The states selected were Osun, Ekiti, Oyo and Lagos. Since each state has three senatorial districts, the sample for the study comprised of biology teachers from the 12 senatorial districts.

Records from the Osun, Ekiti, Oyo and Lagos State ministry of education as at 2017/2018 session show that there were 456, 311, 484 and 455 public senior secondary schools in each of the states respectively. Using “Research Advisor” at a significance level of 0.05 (appendix VI), proportionate sampling techniques was employed to select twenty percent (20%) of the total number of public senior secondary schools in each of the sampled states. In all a total of 322 schools were selected from 1706 public senior secondary schools in the four states to participate in the study. The selection cut across each senatorial district of each selected state (Singh & Masuku, 2014)). The public senior secondary schools were selected based on availability of biology teacher.

Since the researcher was mainly interested in the biology aspect of the senior secondary school science curriculum, purposive sampling technique was used to select only biology teachers while convenient sampling technique

was used to select biology teachers that were available in each of the sampled senior secondary school. In all, a total of 652 biology teachers were sampled.

Research Instrument

The research instrument for the study was a researcher-designed questionnaire entitled Biology Teachers' Awareness and Utilisation of Innovative Teaching Strategies" questionnaire (BTAUITS) (Appendix I). The instrument was adapted from related research work which were reviewed by the researcher. The questionnaire was divided into four sections A, B C and D. Section A dealt with the biology teacher's personal data such as respondent's school, gender, subject area, teaching experience and educational qualifications. Section B elicited information on the biology teacher's awareness of the twenty (20) identified innovative teaching strategies, having a 2 – option rating scale of aware and not aware. Section C elicited information on the extent of utilisation of the innovative teaching strategies by the biology teachers. It had a respond mode of frequently used, sometimes used, rarely used and never used. While section D examined the problem(s) facing the utilization of innovative teaching strategies. It had response mode of resources not available; the strategy is time consuming, teacher not familiar with the teaching strategy and an open ended question where biology teachers were asked to express any other problem faced in the

utilization of innovative teaching strategies. The characteristic features of the selected instructional strategies that were examined in the course of the study were shown in Appendix IX.

Validation of Research Instrument

The instrument was subjected to both content and face validity by three lecturers all from the Department of Science Education, University of Ilorin, Nigeria. A researcher designed validation form (Appendix V) was used by these lecturers to rate the different item on the questionnaire. Aspects of the questionnaire such as the relevance of the instrument to the research work, suitability of the instrument to the research work, comprehension level of the instrument to the respondents, emotional and psychological effect of the instrument on the respondents, suitability of the instrument to the age level of the respondents was rated between 1 and 5, with 5 being the highest. These lecturers scrutinized, identified and corrected the mistakes on the questionnaire and also ensured that the instrument measures what it is expected to measure. The correction made by the lecturers and the suggestion from the researchers' supervisor were used to produce the final draft of the instrument.

The reliability of the instrument was determined by administering the instruments to twenty (20) biology teachers in Kwara state. These teachers

were not part of the sample for the study but have similar characteristics as those in the study. Cronbach Alpha formula was used to analyse the data collected with the aid of Statistical package for the Social Sciences at 0.05 level of significant and the value was calculated to be 0.86, which showed high internal consistency in the research instrument. Hence the instrument was adjudged to be reliable for the study.

Procedure for Data Collection

The researcher obtained an official letter of introduction from the Head of Department of Science Education, University of Ilorin. The researcher then proceeded to the selected schools to present the introductory letter to secure permission to conduct the study. The researcher employed the service of three research assistants in three of the states under investigation while the researcher covered a state. Proper orientation on how to fill and administer the questionnaires was given to the research assistants. Copies of the introductory letter, as well as the consent forms for school principals and biology teachers were also given to the research assistants. Sampled schools' principals and biology teachers that took part in the study were asked to complete the informed consent form. The completion of the informed consent form was used to document their willingness to participate in the study. Ethical issues relating to participation in the study was properly addressed. The consent

forms were endorsed and returned to the researcher by the participants (Appendixes II, III and IV). With the help of the research assistants, the biology teachers in the sampled schools were orientated on the characteristic features of the selected innovative strategies (Appendix IX) after which the questionnaires were administered to them.

Data Analysis Technique

Descriptive and inferential statistics was used to analyse the data collected from the study. Percentage, frequency and charts were used to answer research question 1 to 9. t-test was used to test hypotheses 1, 2, 3 and 4 because there was one categorical (independent) variable and one continuous (dependent) variable. Analysis of variance (ANOVA) was used to test hypotheses 5, and 6. All hypotheses were tested at 0.05 level of significant. The qualitative aspect of the instrument (open ended question) was answered, the response were categorised and expressed using descriptive statistics.

CHAPTER FOUR

DATA ANALYSIS AND RESULTS

This chapter presents the analysis of data collected through the administration of questionnaire, hypotheses testing as well as summary of finding from the study. Descriptive and inferential statistics were employed to answer the research questions earlier raised in the study, while the hypotheses were tested using analysis of variance (ANOVA) and t-test statistics at 0.05 level of significance

Descriptive Analysis of Results

A total of 652 biology teachers were sampled however only 622 of the questionnaire were properly and completely filled. The respondents involved in this study were therefore 622 biology teachers, 47.6% were male while 52.4% were female. This is shown in table 2 below.

Table 2:

Frequency and percentages of respondents based on gender

Gender	Frequency	Percentage (%)
Male	296	47.6
Female	326	52.4
Total	622	100

Table 3 shows that qualified biology teachers were 518 (83.0%), while unqualified biology teachers were 104 (17.0%) of the respondents in the study

Table 3:

Frequency and percentages of respondents based on qualification

Qualification	Frequency	Percentage (%)
Unqualified	104	17.0
Qualified	518	83.0
Total	622	100

Table 4 shows that the distribution of the respondents by years of teaching experience were, less experience 298 (47.9%), experienced 178 (28.6%) and highly experienced teachers 146 (23.4%).

Table 4:

Frequency and percentages of respondents based on year of teaching experience

Years of teaching experience	Frequency	Percentage (%)
Less experienced	298	47.9
Experienced	178	28.6
Highly experienced	146	23.4
Total	622	100

Research Question 1: What is the level of awareness of innovative teaching strategies in biology classroom?

Table 5 reveals that the respondents were highly aware of the innovative teaching strategies with the percentage of awareness being 98%

Table 5:

Frequency and percentages of Biology teachers' level of awareness of the innovative teaching strategies

Level of Awareness	Frequency	Percentage (%)
Not Aware	10	1.60
Aware	612	98.40
Total	622	100

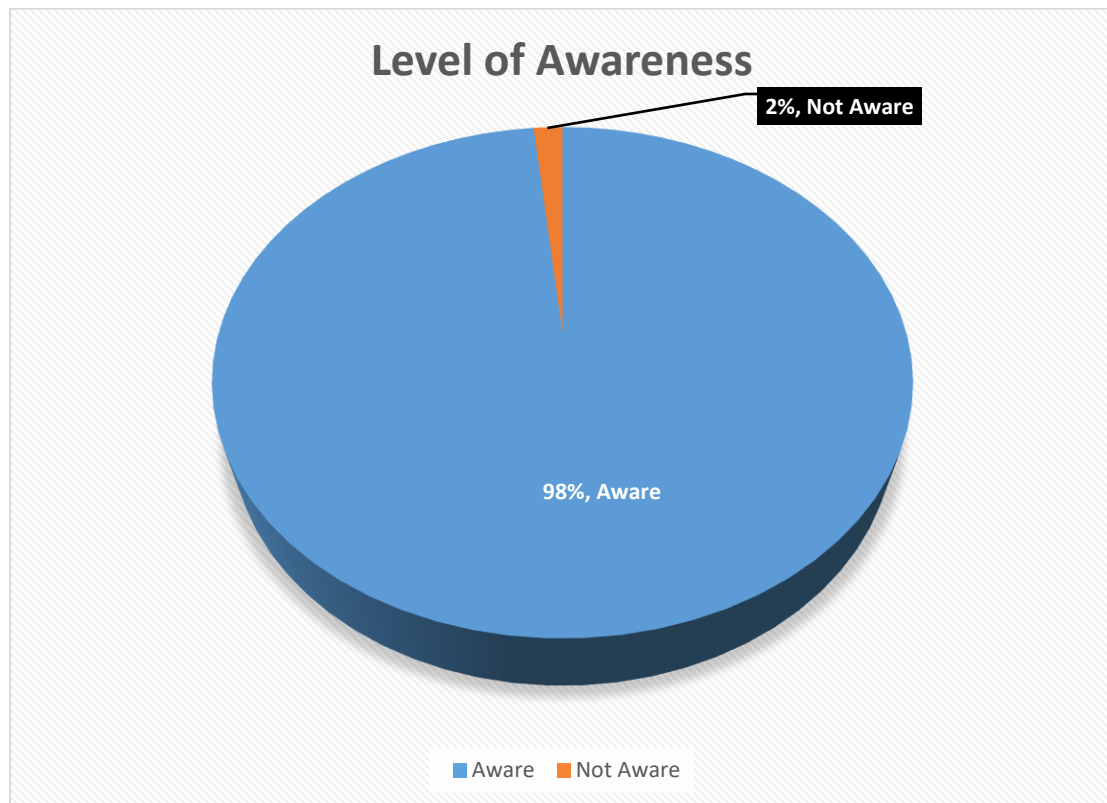


Figure 5: A pie chart showing the percentages of Biology teachers' level of awareness of the innovative teaching strategies

Table 6 shows Biology teachers' level of awareness of each of the selected innovative teaching strategies. This shows that biology teachers were aware

of activity based instructional strategy, mind map, teaching with sense of humour, personalized system of instruction, wisely managed classroom technology, think-pair- share, mastery learning/instructional strategy, concept formation, Mnemonic-word-Words approach, online Virtual Laboratories, peer tutoring, hands on Learning/instructional strategy, brain based strategy, experiential Learning/instructional strategy, reciprocal, learning/instructional Strategy, integrating debate into course assignment, blended Learning/instructional strategy, inquiry based learning/instructional strategy which has a higher percentage of 88.1%, 62.7%, 86.8%, 77%, 83%, 53.7%, 78.6%, 75.2%, 54.8%, 66.0%, 81%, 79.2%, 72.1%, 81.5%, 66.9%, 74.6%, 68% and 80.5% respectively. The table also reveals that most biology teachers were not aware of Jigsaw team work instructional strategy and Z-A approach with higher percentage of 55.7% and 57.1% respectively.

Table 6:

Frequency counts and percentages of Biology teachers' level of awareness of the selected innovative teaching strategies

S/N	INNOVATIVE TEACHING STRATEGY	AWARE (%)	NOT AWARE (%)
1	Activity based instructional strategy	548 (88.1)	74 (11.9)
2	Mind map	390(62.7)	232(37.7)
3	Teaching with sense of humour	538(86.8)	82(13.2)
4	Personalized system of instruction	470(77)	140(23)
5	Wisely managed classroom technology	516(83)	106(17)
6	Think-pair- share	330(53.7)	284(46.3)
7	Jigsaw team work instructional strategy	274(44.3)	344(55.7)
8	Z-A approach	260(42.9)	346(57.1)
9	Mastery Learning / instructional strategy	486(78.6)	132(21.4)
10	Concept formation	460(75.2)	152(24.8)
11	Mnemonic-word-Words approach	332(54.8)	274(45.2)
12	Online Virtual Laboratories	404(66.0)	208(34.0)
13	Peer tutoring	494(81)	116(19)
14	Hands on Learning/instructional strategy	480(79.2)	126(20.8)
15	Brain based strategy	440(72.1)	170(27.9)
16	Experiential Learning/instructional strategy	502(81.5)	114(18.5)
17	Reciprocal Learning/instructional Strategy	408(66.9)	202(33.1)
18	Integrating debate into course assignment	458(74.6)	156(25.4)
19	Blended Learning/ instructional strategy	420(68)	198(32)
20	Inquiry based learning/instructional strategy	496(80.5)	120(19.5)

Research Question 2:

How often do biology teachers utilize innovative teaching strategies in their classes?

Table 7 shows the level of utilization of the innovative teaching strategies by biology teachers. The table shows that 44.10% of the respondents frequently used the teaching strategies, 45.30% sometimes used the teaching strategies, 9.30% of the respondents rarely used the teaching strategies while only 1.30% of the respondents do not use any of the strategies.

Table 7:

Frequency and percentages of Biology teachers' level of utilization of the selected innovative teaching strategies

Level of Awareness	Frequency	Percentage (%)
Not used	8	1.30
Rarely used	58	9.30
Sometimes used	282	45.30
Frequently used	274	44.10
Total	622	100.00

Table 8 revealed that 53.80% of the biology teachers frequently use activity based instructional strategy, 50.60% used teaching with sense of humour, 45.80% used personalized system of instruction, and 56.00% used wisely managed classroom technology. Those with mastery learning / instructional strategy were 51.20%, Hands on Learning/instructional strategy were 42.80%, brain based strategy were 40.10%, experiential learning/instructional strategy

were 49.00%, while 36.50% of the teachers frequently used blended learning/instructional strategy. The table also shows that only 21.10% of the biology teachers utilized jigsaw team work while Z-A approach was rarely used with 21.80% utility.

Table 8:

Frequency and percentages of biology teachers' level of utilization of each selected innovative teaching strategies

INNOVATIVE TEACHING STRATEGY	FREQUENTLY USED (%)	SOMETIMES USED (%)	RARELY USED (%)	NOT USED (%)
Activity based instructional strategy	328(53.8)	222(36.4)	28(4.6)	32 (5.2)
Mind map				
Teaching with sense of humour	152(25.3)	206(34.3)	92(15.3)	150(25.0)
	362(60.5)	142(23.7)	56(9.4)	38(6.4)
Personalized system of instruction				
	272(45.8)	188(31.6)	82(13.8)	52(8.8)
Wisely managed classroom technology				
Think-pair- share	344(56)	156(25.4)	72(11.7)	42(6.8)
Jigsaw team work instructional strategy	132(21.9)	220(36.5)	128(21.3)	122(20.3)
Z-A approach	94(15.5)	186(30.7)	122(20.1)	204(33.7)
Mastery Learning / instructional strategy	88(15)	144(24.5)	128(21.8)	228(38.8)
Concept formation	310(51.2)	186(30.7)	54(8.9)	56(9.2)
Mnemonic-word-Words approach				
	200(33.6)	258(43.3)	72(12.1)	66(11.1)
Online Virtual Laboratories	124(21.5)	220(38.1)	84(14.5)	150(26.0)
Peer tutoring				
Hands on Learning/instructional strategy	142(23.7)	198(33.1)	144(24.1)	114(19.1)
	222(37.8)	248(42.2)	78(13.3)	40(6.8)
	260(42.8)	218(35.9)	74(12.2)	56(9.2)
Brain based strategy				
Experiential Learning/instructional strategy	238(40.1)	204(34.3)	88(14.8)	64(10.8)
	296(49)	196(32.5)	78(12.9)	34(5.6)
Reciprocal Learning/instructional Strategy				
	186(30.8)	246(40.7)	90(14.9)	82(13.6)
Integrating debate into course assignment				
Blended Learning/ instructional strategy	200(32.9)	224(36.8)	134(22.0)	50(8.2)
Inquiry based learning/instructional strategy	224(36.5)	200(32.6)	104(16.9)	86(14.0)
	278(45.3)	212(34.5)	86(14.0)	38(6.2)

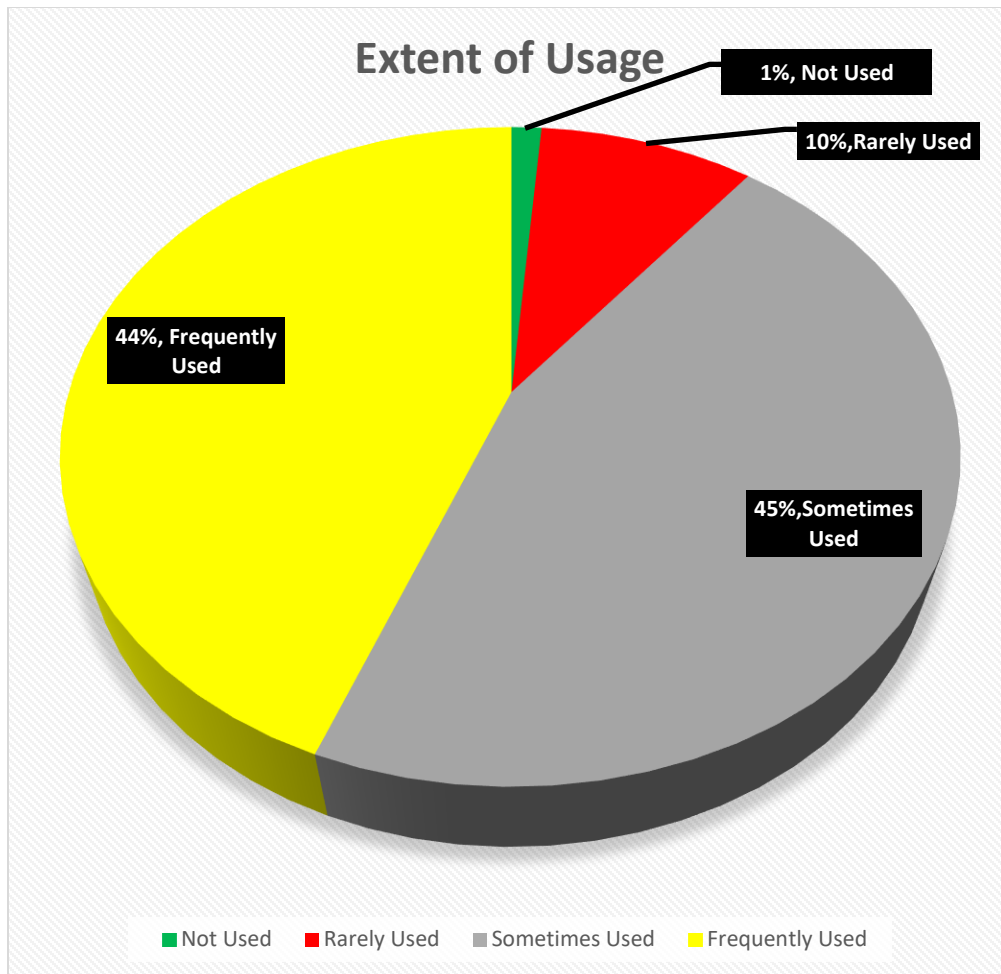


Figure 6: A pie chart showing percentages of Biology teachers' level of utilization of the selected innovative teaching strategies

Research Question 3: Do male and female biology teachers differ in their awareness of innovative teaching strategies? The corresponding hypothesis is hypothesis 1.

Hypothesis 1: There is no significant difference in the level of awareness of innovative teaching strategies by male and female biology teachers.

A t-test analysis was carried out to find out the difference between male and female biology teachers in their level of awareness of innovative teaching strategies. The findings are presented in table 9.

The result as shown in table 9 revealed that the difference in awareness level for female and male yielded a t-statistics of 0.907 and a significant value of 0.365 at 0.05 level of significance. Since the significant value 0.365 is greater than 0.05, it implies that the null hypothesis is not rejected that is there was no significant difference between male and female biology teachers in their level of awareness of innovative teaching strategies.

Table 9:

t-test Analysis Output for Significant Difference in the Awareness of the Innovative Teaching Strategies on the Basis of Biology Teachers' Gender

Variables	Mean	Std. Deviation	df	t	Sig.
Female	34.12	4.45	560	0.907	0.365
Male	33.78	4.60			

p>0.05

- Research Question 4:** What difference exists between male and female biology teachers in their utilization of the innovative teaching strategies?

The corresponding hypothesis is hypothesis 2.

Hypothesis 2: There is no significant difference in the level of utilization of innovative teaching strategies by male and female biology teachers.

The t-test analysis as shown in table 10 displays the cal t-value of 0.171, cal dif (1,560) computed at 0.05 with p value of 0.864. Since the p value is greater than alpha value of 0.05, the null hypothesis was not rejected that is, there was no significant difference between male and female biology teachers in their level of utilization of innovative teaching strategies.

Table 10:

t-test Analysis Output for Significant Difference in the Utilization of the Innovative Teaching Strategies on the Basis of Biology Teachers' Gender

Variables	Mean	Std. Deviation	df	t	Sig.
Female	56.95	13.24	560	0.171	0.864
Male	57.15	14.07			

p>0.05

Research Question 5: Do biology teachers differ in their level of awareness of innovative teaching strategies based on their academic qualification? The corresponding hypothesis is hypothesis 3

Hypothesis 3: There is no significant difference in the level of awareness of innovative teaching strategies by qualified and unqualified biology teachers.

The t-test analysis displayed in table 11 revealed the cal t-value 1.305, cal dif (1,560) computed at 0.05 with p value of 0.192. Since the p value is greater than alpha value 0.05, hypothesis three was not rejected hence there was no

significant difference between un-qualified and qualified biology teachers in their level of awareness of innovative teaching strategies, although there was a difference in the mean score values of unqualified (34.45) and qualified (33.69).

Table 11:

t-test Analysis Output for Significant Difference in the awareness level of innovative teaching strategies based on their academic qualification

Variable	Mean	Std. Deviation	df	t	Sig.
Unqualified	34.45	4.83	560	1.305	0.192
Qualified	33.69	4.70			

p>0.05

Research Question 6: Do secondary school biology teachers differ in their utilization of the innovative teaching strategies based on their academic qualification? The corresponding hypothesis is hypothesis 4

Hypothesis 4: There is no significant difference in the level of utilization of innovative teaching strategies by qualified and unqualified biology teachers. The t-test analysis displayed in table 12, shows the difference in utilization of unqualified and qualified biology teachers. The t-statistics shows a t-value of 2.142 and a sig. value of 0.033 computed at 0.05 level of significance. Since the sig. value 0.033 is lower than 0.05, it implies that the null hypothesis was rejected that is there was significant difference between qualified and

unqualified biology teachers in their level of utilization of innovative teaching strategies.

Table 12:

t-test Analysis Output for Significant Difference in the awareness level of qualified and unqualified biology teachers in their level of utilization of innovative teaching strategies.

Variable	Mean	Std. Deviation	df	t	Sig.
Unqualified	60.13	10.99	560	2.142	0.033
Qualified	56.62	13.62			

$P < 0.05$

Research Question 7: Do biology teachers differ in their level of awareness of innovative teaching strategy based on their year of teaching experience?

The corresponding hypothesis is hypothesis 5

Hypothesis 5: There is no significant difference in the level of awareness of innovative teaching strategies among less experienced, experienced and highly experienced biology teachers. In response to this, an Analysis of Variance (ANOVA) test was conducted to determine whether the level of utilization of innovative teaching strategies significantly differs for respondents based on their teaching experience. As shown in Table 13. The statistics shows an f -value of 4.639 and a significant value of 0.01. Since the significant value 0.01 is lower than 0.05, it implies that the null hypothesis is

rejected, that is there is significant difference among less experienced, experienced and highly experienced biology teachers on their level of awareness of innovative teaching strategies. The post-hoc test showed that the significant difference between the groups falls only between less experienced and highly experienced. $F_{(2, 549)} = 4.639$, $P < 0.05$

Table 13:

Analysis of Variance (ANOVA) for the Significant Difference in the Awareness of the Innovative Teaching Strategies on the Basis of Biology teachers' experience

Variable	Sum of Squares	Df	Mean Square	F	Sig.
Between Groups	202.558	2	101.279		
Within Groups	11986.717	549	21.834	4.639	0.01
Total	12189.275	551			

$P < 0.05$

Tukey HSD Post-Hoc Test in table 14 showed that there is a significant difference between the less experienced and the highly experienced with the sig. value of 0.008 which is less than 0.05 while the sig. value between the less experienced and the experienced as well as the experienced and highly experienced are not significant since their values are greater than 0.05.

Table 14:

Tukey HSD Post-Hoc Test showing the Direction of the Significant Difference in the level of awareness of the Innovative Teaching Strategies on the Basis of Biology teachers' experience

Awareness (I) Classification of Teaching	(J) Classification of Teaching	Mean Difference (I-J)	Std. Error	Sig	95% Confidence Interval	
					Lower Bound	Upper Bound
Less Experienced	Experienced	.744	.475	.262	-.37	1.86
	Highly Experienced	1.497*	.502	.008	.32	2.68
Experienced	Less Experienced	-.744	.475	.262	-1.86	.37
	Highly Experienced	.753	.566	.379	-.58	2.08
Highly Experienced	Less Experienced	-1.497*	.502	.008	-2.68	-.32
	Experienced	-.753	.566	.379	-2.08	.58

Research Question 8: What is the difference in biology teachers' level of utilization of innovative teaching strategies based on year of teaching experience? The corresponding hypothesis is hypothesis 6

Hypothesis 6 There is no significant difference in the level of utilization of innovative teaching strategies among less experienced, experienced and highly experienced biology teachers. To answer this, an Analysis of Variance

(ANOVA) test was conducted to determine whether the level of utilization of innovative teaching strategies significantly differs for respondents based on their teaching experience. As shown in Table 15. The statistics show an f -value of 1.291 and a sig. value of 0.276

Since the significant value 0.276 is greater than 0.05, it implies that the null hypothesis was not rejected that is there was no significant difference among less experienced, experienced and highly experienced biology teachers in their level of utilization of innovative teaching strategies. $F_{(2, 549)} = 1.291$, $p > 0.05$

Table 15:

Analysis of Variance (ANOVA) for the Significant Difference in the Utilization of the Innovative Teaching Strategies on the Basis of Biology Teachers' Teaching experience

Variable	Sum of Squares	Df	Mean Square	F	Sig.
Between Groups	444.736	2	222.368	1.291	0.276
Within Groups	94559.090	549	172.239		
Total	95003.826	551			

$p > 0.05$

Research Question 9: What are the problems facing the utilization of some selected teaching strategies by biology teachers? Table 16 and 17 show the

likely reasons why biology teacher failed to utilize each of the selected innovative teaching strategies. The reason varies from lack of knowledge of the innovative teaching strategies, non-availability of resources to time constrain. Other reasons include: strategies been demanding/stressful, student not ready for proper learning, lack of motivation for teachers/ by students, financial constraint, time frame to cover syllabus not always enough, poor location of the school environments, failure of government to provide more training for teachers, instability of school calendar, inadequacy in teachers' training, less time given to practical aspect of biology syllabus, obsolete science equipment, inaccessibility of available resource by student, inexperience of teachers, Influence of the community on school, large population of students in a class, inadequate monitoring of teachers by school management board / government, non-challant attitude of teachers, school policies, lack of maintenance of school properties, teacher to student ratio.

Table 16:

Reasons (1) expressed by biology teachers for non-utilizing the selected innovative teaching strategies

	Frequency	Percent
Unfamiliar with strategies	94	15.2
Non-availability of facilities and infrastructures	37	6.0
Strategies are demanding/stressful	27	4.4
Student not ready for proper learning	29	4.7
Lack of motivation by teachers/ students	23	3.7
Financial constraint	43	7.0
Time frame to cover syllabus	48	7.8
Poor location of the school environment	21	3.4
Failure of government to provide more training for teachers	51	8.3
Instability of school calendar	15	2.4
Inadequacy in training of teacher	17	2.8
Less time given to practical aspect	44	7.1
Obsolete equipment	15	2.4
Inaccessibility of available resource by student	13	2.1
Inexperience of teacher	17	2.8
Community influence	20	3.2
Population of students in a class	15	2.4
Inadequate monitoring from authority	14	2.3
Non-challant attitude of teacher	16	2.6
School policies	26	4.2
Lack of maintenance of school properties	19	3.1
Teacher to student ratio	15	2.4
Total	619	100

Table: 17

Reasons (2) expressed by biology teachers for non-utilizing the selected innovative teaching strategies

INNOVATIVE TEACHING STRATEGY	RESOURCES NOT AVAILABLE	STRATEGY IS TIME CONSUMING	I AM NOT FAMILIAR WITH THE STRATEGY
Activity based instructional strategy	202 (38.8)	280 (53.8)	38 (7.3)
Mind map	146 (26.7)	244 (44.7)	156 (28.6)
Teaching with sense of humour	146 (29.9)	268 (54.9)	74 (15.2)
Personalized system of instruction	148 (30.7)	274 (56.8)	60 (12.4)
Wisely managed classroom technology	232 (46.4)	220 (44.0)	48 (9.6)
Think-pair- share	116 (21.7)	268 (50.2)	150 (28.1)
Jigsaw team work instructional strategy	164 (29.4)	182 (32.6)	212 (38.0)
Z-A approach	126 (22.5)	216 (39.1)	210 (38.0)
Mastery Learning / instructional strategy	152 (30.9)	274 (55.7)	66 (13.4)
Concept formation	136 (27.3)	290 (58.2)	72 (14.5)
Mnemonic-word-Words approach	132 (25.2)	238 (45.4)	154 (29.4)
Online Virtual Laboratories	234 (44)	204 (38.4)	94 (17.7)
Peer tutoring	92 (18.3)	350 (69.4)	62 (12.3)
Hands on	162 (32.7)	266 (53.6)	68 (13.7)
Learning/instructional strategy			
Brain based strategy	96 (19.4)	322 (64.9)	78 (15.7)
Experiential	146 (28.9)	298 (58.9)	62 (12.3)
Learning/instructional strategy			
Reciprocal	142 (26.4)	286 (53.2)	110 (20.4)
Learning/instructional Strategy			
Integrating debate into course assignment	110 (21.2)	332 (64.1)	76 (14.7)
Blended Learning/ instructional strategy	148 (28.1)	262 (49.6)	118 (22.3)
Inquiry based learning/instructional strategy	146 (28.5)	308 (60.2)	58 (11.3)

Summary of Findings

The following are the findings from the study:

1. Biology teachers are highly aware of the selected innovative strategies with a percentage of awareness of 98%.
2. Innovative teaching strategies with the highest level of awareness by biology teachers were activity based instructional strategy (88.1%), teaching with sense of humour (86.8%), wisely managed classroom technology (83%), Experiential Learning/instructional strategy (81.5%) Peer tutoring (81%), Inquiry based learning/instructional strategy (80.5%) while the innovative teaching strategies with the lowest level of awareness were Jigsaw team work instructional strategy (44.3%) and Z-A approach (42.9%).
3. Forty-four percent (44.0%) of the innovative teaching strategies were frequently utilized and most utilized teaching strategies were teaching with sense of humour (60.5%), wisely managed classroom technology (56.0%), activity based instructional strategy (53.8%) and mastery Learning / instructional strategy (51.2%).
4. A few of the innovative teaching strategies (10%) were rarely utilized while the least utilized strategies were Z-A approach, Jigsaw team work instructional strategy, Mnemonic-word-Words approach and Mind map.

5. There was no significant difference between male and female biology teachers in their level of awareness of innovative teaching strategies.
6. There was no significant difference between male and female biology teachers in their level of utilization of innovative teaching strategies.
7. There was no significant difference between qualified and unqualified biology teachers in their level of awareness of innovative teaching strategies.
8. There was significant difference between qualified and unqualified biology teachers in their level of utilization of innovative teaching strategies.
9. There was significant difference among less experienced, experienced and highly experienced biology teachers on their level of awareness of innovative teaching strategies with the significant difference between the groups falling only between less experienced and highly experienced with significant value of 0.008.
10. There was no significant difference among less experienced, experienced and highly experienced biology teachers in their level of utilization of the innovative teaching strategies.
11. Some of the reasons for less utilization of the selected innovative teaching strategies by biology teachers are; non-availability of

resources, strategies been demanding/stressful, students not ready for proper learning, lack of motivation for teachers, time consuming, lack of in- service trainings for teachers.

CHAPTER FIVE

DISCUSSION, CONCLUSION AND RECOMMENDATIONS

This chapter presents a discussion of findings that emanate from the study as well as conclusion and recommendations. Suggestions were also made for further studies.

Discussion

The findings from this study show that most of the biology teachers (98%) of the four state in South West Geo-political zone of Nigeria were aware of the 20 selected innovative teaching strategies. However, only forty-four percent (44.0%) of the innovative teaching strategies were frequently utilized by them, forty-five percent (45%) of the teaching strategies were sometimes utilized, ten percent (10%) were rarely utilized while one percent (1%) was not used. Teaching strategies that were frequently used were sense of humour, wisely managed classroom technology, activity based instructional strategy and mastery Learning / instructional strategy.

Instructional strategies like, think-pair-share, online virtual laboratory, peer tutoring, which reduces anxiety and stress in dealing with difficult concept and encourages class attendance are only used occasionally in biology classroom. The least utilized strategies were Z-A approach, Jigsaw team work instructional strategy, Mnemonic-word-Words approach and Mind map. This

means biology students will be constantly denied benefits such as; self-motivation, divergence thinking, improvement on the psychomotor, cognitive and affective domain of the learner and many more which are associated with the use of most of these innovative teaching strategies.

Findings from this study also show that biology teachers (respondents) did not fully utilized all these innovative teaching strategies that arouse students' interest and give learner the opportunity to construct their own knowledge. This findings concur with the previous study of Oludipe and Oludipe (2010), Yusuf and Adedeji (2010), Jiya (2011), Samba, Achor and Ogbeba (2010), whose study concluded that even though many teachers were aware of different innovative teaching strategies, only few of these strategies were effectively put to use. This study contradicted the previous study of Gbadamosi (2014) whose study reported that most biology teachers use varying strategies to handle difficulties associated with the teaching of biology. The noticeable difference between the finding of the present research and that of Gbadamosi (2014) may be due to difference in geographical location as well as the novelty of the innovative teaching strategies that was been investigated in the present research work.

In this study, male and female biology teachers were not significantly different in their level of awareness as well as their level of utilization of

innovative teaching strategies. Contrary to this findings, Olagunju and Abiona (2008), review that most male teachers' perception of utilisation of instructional materials in teaching is higher than that of the female teachers while Khurshid and Zahur (2013) found that female teachers are more aware and utilize innovative teaching strategies than male teachers. Difference that existed between this study and the previous ones may be due to the obvious reason that the strategies in the present study are more innovative hence both male and female biology teachers were not used to them and so did not utilize them.

Findings in the present study also show that there was no significant difference between qualified and unqualified biology teachers in their level of awareness of innovative teaching strategies. However, a significant difference existed in the level of utilization of innovative teaching strategies between qualified and unqualified biology teachers. This present finding agrees with previous works of Darling Hammond (2000); Akinsolu (2010); Obomanu & Akporehwe (2011); Khurshid, and Zahur (2013); Gbadamosi (2014), who concluded that students learn better from teachers with good academic qualification. It is however contradicted by the findings of Oyelekan, Igbokwe and Olorundare (2017) who claimed that teachers' academic qualification has no influence on their level of utilisation of innovative teaching strategies.

In respect to teaching experience, the study revealed that there was a significant difference among less experienced, experienced and highly experienced biology teachers on their level of awareness of innovative teaching strategies. The significant difference between the groups fell only between less experienced and highly experienced teachers in favour of the highly experienced biology teachers. Nevertheless, the difference in their level of awareness does not affect the level of their utilization because the findings show that there was no significant difference among less experienced, experienced and highly experienced biology teachers in their level of utilization of innovative teaching strategies. This implies that the level of utilization of innovative teaching strategies is the same among respondent irrespective of the difference in their year of teaching experience. This findings is in support of Gbadamosi (2014) and Oyelekan, Igbokwe and Olorundare (2017) but contradicts those of Adeyemi, (2008); Samba et al. (2010); Akinsolu, (2010); Khurshid & Zahur, (2013), who affirmed that experienced teachers utilized innovative strategies more than the less experienced ones. The reason for this result may be due to the findings of Ewetan and Ewetan (2015), which opined that effect of experience is more pronounce during the first few years of teaching and after which marginal returns diminish and there is little evidence that improvement continues after

the first three years. The justification for the findings may also be attributed to the differences in geographical locations in which the studies were conducted.

Findings from this study revealed that the respondents did not make use of the innovative teaching strategies because of non-availability of resources, lack of in- service trainings for teachers, lack of motivation, strategies too demanding/stressful due to lack of expertise, while some (38.3%) biology teachers complained of time constrain.

Conclusions

The focus of the research was to determine biology teachers' awareness and utilization of innovative teaching strategies in senior secondary schools in south west, Nigeria. The data collected were analysed using frequency counts, percentage, t-test and ANOVA statistics. Variables considered were teachers' awareness, teachers' utilization and reasons for non-utilization, teachers' gender, teachers' teaching experience and teachers' academic qualification.

The result of the study shows that biology teachers' level of awareness was high, even though the teachers barely utilized the innovative teaching strategies they were aware of. There was no significant difference between male and female biology teachers in their level of awareness and utilization

of innovative teaching strategies. This means that both male and female biology teachers' level of awareness and utilization were the same. With respect to teachers' qualification, it was concluded that the academic qualification of biology teachers had no effect on their level of awareness. This notwithstanding, their qualification had some positive effect on their utilization of innovative teaching strategies. Teachers with educational qualification have been found to utilize the selected strategies more than those without any educational qualification.

This study also concluded that there was a significant difference among less experienced, experienced and highly experienced biology teachers in their level of awareness of the teaching strategies. However, the difference in their level of awareness did not significantly influence their level of utilization as there was no significant difference among less experienced, experienced and highly experienced biology teachers in their level of utilization of innovative teaching strategies. It was concluded that biology teachers' underutilization of innovative teaching strategies was due to: non-availability of instructional resources, financial constraint, lack of in-service trainings to teachers, lack of motivation both to teachers and students, strategies too demanding/stressful due to lack of expertise, students not ready for proper

learning and because most innovative teaching strategies consume more time than the usual convectional method that is not activity-based.

Recommendations

The following recommendations were made based on the findings of this study:

1. The state governments, relevant professional bodies such as Teachers' Registration Council of Nigeria (TRCN), Nigeria Education Research and Development Council (NERDC), Science Teachers Association of Nigeria (STAN), and schools should frequently organise workshops, seminars and conferences for in-service biology teachers to sensitize them on the effectiveness of teaching with innovative teaching strategies especially those strategies like Z-A approach, Jigsaw team work instructional strategy, Mnemonic-word-Words approach and Mind map with lowest level of awareness and utility. Inter-state program and trainings should be organised by States Ministry of Education so as to update teachers on instructional strategies that might be new to them. Biology teachers should also familiarize themselves with the internet so as to keep themselves up to date with the innovative teaching strategies.

2. State Ministry of Education and other policy makers should enforce that only professionally qualified teachers are employed to teach sciences in senior secondary schools. Provision should be made for the professionally unqualified teachers (who are already in school) on how to obtain post graduate diploma in Education. This will help to bridge the gap between the qualified and the unqualified biology teachers' level of utilization of innovative teaching strategies.
3. The government and non-government bodies should provide innovative instructional resources such as modern computer laboratories, electronic interactive devices to schools. Teachers should be trained on how to use such resources so as to enable them to introduce novel ideas into biology classroom which eventually motivate students to learn.
4. Since the study revealed that the use of most innovative teaching strategies consumed more time than the regular "talk and chalk" method, school managements should allocate more periods on the time table to practical classes so as to give room for coverage of the syllabus.
5. Authors of biology text book should carefully illustrate in their revised text books several innovative teaching strategies and demonstrate how to effectively utilize the strategies especially the rarely used innovative teaching strategies.

Suggestions for Further Studies

For further research in this area, the following are suggested:

1. Studies of this type could be carried out in the other Geo-political zones of the nation so as to give the findings of the research a nationwide acceptance and total coverage to the point of adoption by the federal government of Nigeria.
2. Related studies should be carried out in other subjects such as chemistry, physics and mathematics in order to determine how conversant those subject teachers are with innovative teaching strategies and how effective they put into utilization those strategies they were aware of.
3. A further study could also be carried out with focus on private school biology teachers. This may provide the biology teachers the opportunity of having broader knowledge on innovative teaching strategies. It will also increase productivity and better performance. This is because, students of private secondary schools in Nigeria sit for the same external examination with students in public schools who were involved in the present study.

REFERENCES

- Abba, I. & Ubandoma, Y. (2008). Global challenges in the science technology and mathematics education (STME) curriculum. *49th Proceeding of the Annual Conference of STAN 15-17. Nigeria: Author.*
- Abdulwahab, N., Oyelekan, O. S. & Olorundare, A. S. (2016). Effects of cooperative instructional strategy on senior school students' achievement in electrochemistry. *Eurasian Journal of Physics and Chemistry Education*, 8(2), 37-48.
- Abida, K., & Muhammad, A. (2012). Constructivist vs traditional: Effective instructional approach in teacher education. *International journal of Humanities and social science*, 2(5), 170-177.
- Abidoye, F. O., & Ogunlowo, S. O. (2019). *Effect of curriculum review on biology teachers' variables and performance of their senior school students in Ogbomosho, Nigeria.* Ilorin: Chemistry Education Group, Department of Science Education, University of Ilorin, Nigeria.
- Abimbola, I. O. (2015). *Learning how to learn for perfect understanding.* Ilorin: Bamitex Printing & Publishing.
- Abimbola, I. O. (ED). (2017). *Biology teaching methods.* Ilorin: Haytee Press and Publishing Company Nigeria Ltd.

- Abimbola, I. O. & Abidoye, F. O. (2013). Effect of qualification and experience of biology teaching in Kwara State. *Journal of Education and Practice*, (4),24-29
- Abimbola, I. O. & Omosewo, E. O. (2012). Views of Nigerian science teacher educators on the American minimum professional knowledge standards for science teacher educators. *European Scientific Journal*, 8(5), 200-208.
- Abimbola, I. O. (2013). *The misunderstood word in science: Towards a technology of perfect understanding for all. The One Hundred and Twenty-Third (123rd) Inaugural Lecture*. Ilorin: Unilorin Press.
- Abimbola, I. O., & Abidoye, F. O. (2013). Effect of Qualification and Experience of Biology Teaching inKwara State. *Journal of Education and Practice* 15(4), 24-29.
- Achor, E. E. (2008). Repositioning physics teaching and learning in secondary schools in Benin state: Focus on strategies for teaching difficult concepts. *Workshop material on retraining for maximum efficiency in secondary schools by Benue State Ministry of Education*, 178-187.
- Achor, E. E., Imoko, B. I., & Jimin, N. (2011). Improving some Nigerian secondary students' achievement in geometry: A field report on team teaching approach. *New York Science Journal*, 4(12), 43-49.

- Adama, M. (2014). *Effects of collaborative constructivism on academic performance in biology among students of different cognitive styles in colleges of education, North-east, Nigeria* (Master's dissertation). Ahmadu Bello University, Zaria, Nigeria.
- Adejoh, M. J., & Itokyaa, F. M. (2012). An assessment of the provision of the material resources for implementing biology programme in secondary schools in Benue State. *STAN proceedings of 53rd Annual Conference Aug, 2012*, 246-252.
- Adeoye, G. A., & Ayanda, M. O. (2019). Nexus between learning theories and the classroom teaching of biology. *Joint Schools' Journal of Kwara State College of Education Oro*, 3(1), 137-142.
- Adeoye, O. O. (2018). *Effects of blended learning on biology students' attitude and achievement in colleges of education in Kwara State, Nigeria* (Unpublished Ph.D thesis). University of Ilorin, Ilorin, Nigeria.
- Adeyemi, T. O. (2008). Teachers teaching experience and students learning outcomes in secondary schools in Ondo state, Nigeria. *Educational Research and Review*, 3(6), 204-212.

- Adunola, O. (2011). *The impact of teachers' teaching methods on the academic performance of primary school pupils in Ijebu-Ode local government area of Ogun state*. Ogun State, Nigeria: Ego Booster Books.
- Agommuo, P. C & Ifeanacho, A.O. (2013). Secondary school students' assessment of innovative teaching strategies in enhancing achievement in physics and mathematics *journal of research & method in education* 3(5), 06-11
- Ajaja, O. P. (2013). Which strategy best suits biology teaching? Lecturing, concept mapping, cooperative learning or learning cycle? *Electronic Journal of Science Education*, 17(1), 1-37.
- Ajewole, A. G. (2005). Science and technology education in secondary schools: Need for manpower development. *Journal of Science Teachers Association Nigeria*, 40, 63-67.
- Akanbi, A. A. (2013).Teacher-directed, student-directed instructional strategies and gender as predictors of students' entrepreneurship knowledge in biology in Oyo State, Nigeria. *Journal of Education and policy review*. 5(2), 62-74.
- Akinfe, E., Olofinyi, O. E., & Fashiku, C. O. (2012). Teachers' quality as correlates of students' academic performance in biology in senior

- secondary school in Ondo state. *Online journal of Education Research*, 6(1), 33-45
- Akinleye , G. A. (2001). Early childhood education: Guide for parents and teachers. *University of Ado Ekiti Journal of Education*, 2(1), 45.
- Akinsolu, A.O. (2010). Teachers and students' academic performance in Nigerian Secondary Schools: Implication for planning. *Florida Journal of Educational Administration and policy*, 3(2), 86-103
- Akinwumi m. o & Bello t. o (2015) Relative Effectiveness of Learning-Cycle Model and Inquiry-Teaching Approaches in Improving Students' Learning Outcomes in Physics *Journal of Education and Human Development*, 4(3), 169-180 .
- Alade, I. A. (2011). Trend and issues on curriculum review in Nigeria and need for paradigm shift in educational practice. *Journal of Emerging Trend in Educational Research and Policy Studies (JETERAPS)*, 2(5), 325-333.
- Ali, A. R., Toriman, M. E., & Gasim, M. B. (2014) Achievement in Biology with Suggested Solutions in Selected Secondary Schools in Kano State, Nigeria *International Journal of Education and Research* Vol. 2(11),117-121.

Applied Scholastic International. (2018). Breakthrough in learning. Retrieved from <http://www.appliedscholastic.org/study-tech/a-breakthrough-in-learning>

Ariyo, B. O. & Monogbe, T. G. (2018). Two Innovative Teaching Strategies and Academic Performance of Senior Secondary School Students in Biology in Ekiti State. *American Journal of Educational Science Vol. 4(4)*, 127-135.

Aronson, E. (2000): *Nobody left to hate developing the Emphatic Classroom, the Humanist* 60.

Atomatofa, R. O. (2014). Effects of instructional strategies on basis-science students' achievement in Nigeria. *Academic journal of physiological studies*, 3(3), 207-217.

Audu, C. T. (2018). Influence of Teaching Styles on Students' Achievement and Interest among Biology Students in Secondary Schools in Taraba State Nigeria. *Advances in Social Sciences Research Journal*, 5(5) 164-172.dio:14738/assrj.55.4506.

Ayeni, A. J. (2011). Teachers' professional development and quality assurance in Nigerian secondary schools. *World Journal of Education*, 1(2), 143-149.

- Ayinla, J.O. (2015). *Effect of curriculum-based measurement on students' performance in Kwara south senatorial district, Nigeria* (Unpublished Ph.D. Thesis). University of Ilorin, Ilorin, Nigeria.
- Bath, D. & Bourke, J. (2010) Getting started with blended learning; *Griffith Institute for Higher Education*. www.griffith.edu.au/gihe
- Bell, R. L. (2009) Teaching the nature of science: Three Critical Questions. *Journals of Best Practices in Science Education* 22-49
- Bell, R. L. (2009). Teaching the nature of science: Three critical questions. Retrieved 10th April, 2018 from http://ngl.cengage.com/assets/downloads/ngsci_pro0000000028/am_bell_teach_nat_sci_scl22-0449a_.pdf
- Bello, G., & Abimbola, I. O. (2012). Gender influence on biology students' concept mapping ability and achievement in evolution. *Journal of Science Teaching and Learning*, 3(2), 8-17.
- Bess, J. L. (2000). *Teaching alone, teaching together: Transforming the structure of team for teaching*. San Francisco CA: Jossey-Nass.
- Bharadwaj, B. K., & Pal, S. (2011). Mining educational data to analyse students' performance. *International Journal of Advanced Computer Science and Applications*, 2(6), 63-69.

- Blake, B., & Pope, T. (2008) Developmental psychology: Incorporating Piaget's and Vygotsky's theories in classrooms. *Journal of Education*, 5(3), 51-59
- Bruner, J. (1990). *Acts of meaning*. Cambridge, MA: Harvard University Press.
- Calma, A., & Eggins, M. (2012). Enhancing the quality of tutorials through peer-connected tutor training. *Issues in Educational Research*, 22(3), 213-227.
- Casmir, N. E. (2011). Influence of gender on students' attitude towards biology in Enugu East Local Government Area of Enugu State. *The Nigerian journal of Research and Reviews*, 10(3), 256-273.
- Chang, Y. (2008). Gender differences in science achievement, science self-concept and science values. *The Proceedings of IRC 2008*, pp. 1-11.
- Colburn, A. (2000). Constructivism: Science education's "grand unifying theory". *Clearing House*, 74(1), 1-6.
- Concordia University - Portland (2018) *Three Innovative Methods of Teaching for High School Educators* Retrieved from <https://education.cu-portland.edu/blog/classroom-resources/3-innovative-methods-of-teaching-for-high-school-educators/>

- Cox, J. (2017). *What is the role of a teacher?* Retrieved from <https://www.thoughtco.com/what-is-the-role-of-a-teacher-208151>
- Damodharan, V. S., & Rengarajan, V. (2012). Innovative methods of teaching. Retrieved from: http://math.arizona.edu/~atpmena/conference/proceedings/Damodharan_Innovative_Methods.pdf
- Danjuma, B. (2015). *Effects of computer assisted instruction on academic achievement among NCE physics students of different abilities in Niger state, Nigeria* (Unpublished M.Ed. Thesis). Ahmadu Bello University, Zaria, Nigeria.
- Daramola, S. O. (2005). Philosophical foundation of science teaching. In I. O. Abimbola, & A. O. Abolade (Eds.). *Fundamental principles and practice of instructions* (2nd Ed.). Ilorin:
- Darda, R. (2014). *Handbook on advanced pedagogy*. Monarch: Monarch University Publications.
- Darling–Hammond, L. (2000). Teacher quality and student achievement: A review of state policy evidence. *Educational Policy Analysis Archives*, 8(1), 1-3.
- Davies, B., & Summers, M. (2015). Applying Dale’s cone of experience to increase learning and retention: A study of student learning in a

foundational leadership course. *Proceedings of the Engineering Leaders Conference, 2014* (pp. 1-7). Lafayette, USA: QScience.

Dee, T. S. (2006). The Y chromosome: How a teacher's gender affects boys and girls. The free Library. Retrieved from <http://www.thefreelibrary.com/The+Y+chromosomes%3a+how+a+teacher's+gender+affect+boys+and+girls.php>

Dewey, J. (1998). John Dewey's experience and education: Lessons for museums. *The Museum Journal*, 41(1), 36-50.

Ebert, E. S., Ebert, C., & Bentley, M. L. (2013). *Curriculum definition*. Retrieved from <https://www.education.com/reference/article/curriculum-definition>

ED Glossary (2015). *Curriculum*. Retrieved from <http://edglossary.com/curriculum>

Edsys. (2018, January 5), 50 Innovative Teaching Methods in Science Retrieved from <https://www.edsys.in/innovative-science-teaching-methods/>

Edu, D. O., Edu, G. O., & Kalu, I. M. (2012). Influence of academic qualification and gender on teachers' perception of difficult concept in primary science in Ikom Educational Zone of Cross River State, Nigeria. *Greener Journal of Educational Reseach*, 2(2) 021-026

- Eison, J. (2010). Using active learning instructional strategies to create excitement and enhance learning. Retrieved from <https://www.cte.cornell.edu>
- Elangovan, T. (2018). Cartoonic and non-cartoonic simulations in reducing biology students' misconceptions in cell division. *International Journal of Academic Research in Business and Social Sciences*, 8(4), 962-975. doi:10.6007/IJARBSS/v8-i4/4237
- Erinosho, S. Y. (2013). How do students perceive the difficulty of physics in secondary school? An exploratory study in Nigeria. *International Journal of Cross-disciplinary Subjects in Education (IJCDSE)*, 3(3), 1510-1515.
- Ewetan, T. O., & Ewetan, O. O. (2015). Teachers' Teaching Experience and Academic Performance in Mathematics and English Language in Public Secondary Schools in Ogun State, Nigeria. *International Journal of Humanities, Social Sciences and Education*, 2(2), 123-134.
- Federal Republic of Nigeria (2015). *National policy on education*. Lagos: FME/NERDC.
- Fives, H. (2010). Examining the factor structure of teachers' sense of efficacy scale. *Experimental Education*, 78, 118-134.

- Flok, W. (2010). *Ausubel: Meaningful Learning Theory, Subsumption Theory & Motivational Theory*. Retrieved from [https://cimtprelims.fandom.com/wiki/Ausubel: Meaningful Learning Theory, Subsumption Theory, %26 Motivational Theory](https://cimtprelims.fandom.com/wiki/Ausubel:_Meaningful_Learning_Theory,_Subsumption_Theory,_%26_Motivational_Theory)
- Gambari, I. A., Yusuf, M. O. & Thomas, D. A. (2015). Effects of computer-assisted STAD, LTM and ICI cooperative learning strategies on Nigerian secondary school students' achievement, gender and motivation in physics. *Journal of Education and Practice*, 6(19), 16-28.
- Ganyaupfu, E. M. (2013). Teaching methods and students' academic performance. *International Journal of Humanities and Social Science Invention*, 2(9), 29-35.
- Gbadamosi, A. F. (2014). *Biology teachers' awareness and utilization of innovative teaching strategies in Oyo, south senatorial district, Nigeria* (Unpublished M.Sc Thesis). University of Ilorin, Ilorin, Nigeria.
- Gbamanja S. P. T. (2000). *Essentials of curriculum and instruction: Theory and practice*. Port-Harcourt: Paragraphics.
- Gengle, H. I., Abel, M. I., & Mohammed, B.K.,(2016) Effective Teaching and learning in science and mathematics to improve students' academic

- performance in Nigeria. *British journal of Education, society and Behavioural Science*, 19(1), 1-7.
- Goetz, K. (2000). Perspectives on team-teaching. *A Peer Reviewed Journal*, 1(4),
- Great school partnership (2014) Glossary of educational reform. Retrieved from <http://edglossary.org/greatschoolpartnership>
- Hornby, A. S. (2015). *Oxford advanced learner's dictionary of current English* (9th Ed.). Oxford: Oxford University Press.
- Hsu C. M., & Chang, I. H. (2011). The Relationship between computer based concept mapping and creative performance. *Asian Journal of Arts and Sciences*, 2(1), 16-36.
- Ibe, E., Nworgu, N. L., & Anyaegbunam, J. N. (2016). Influence of teachers' characteristics on academic achievements of secondary school biology students. *British Journal of Science*, 13 (2).
- Ibrahim, S. T., Sabitu, A., & Magaji, Y. M. (2016). Comparative analysis of Gender performance in biology, chemistry, and physics among pre-degree students of Federal University Dutsin-ma *international journal of Educational Benchmark*, 5(1), 108-118
- Ige, T. A; Tella A and Kareem, A.A. (2010) Effect of computer assisted instruction on senior secondary school students' academic achievement

- in Chemistry in Osun State. *Nigeria Journal of Computer Literacy* (NJCL), 11(1).
- Ijaiya, N. Y. (2000). Failing schools and national development: Time for reappraisal of school effectiveness in Nigeria. *Nigeria Journal of Education, Research and Evaluation*, 2(2), 37-44.
- Ilime C. S. (2013). Impacts of the demonstration method in the teaching and learning of hearing impaired children. *Journal of Humanities and Social Science* 12(1) 48-54.
- Irfan, U., Rabia, T., & Muhammad, K. (2018) Effects of Peer Tutoring on the Academic Achievement of Students in the Subject of Biology at Secondary Level *Education Science*, 122(8), 1-3. doi:10.3390/educsci8030112.
- Iyiola, F. B., & Madu, B. C. (2013). NEEDS assessment of Nigeria senior secondary school science teachers for improvement of science instruction in Taraba state, Nigeria. *Developing Country Studies*, 3(9), 14-24.
- Jiya, A. (2011). *Effects of teaching- with- analogy on academic performance and retention of evolution concepts among Nigeria Certificate in Education biology students* (Unpublished M.Ed. Thesis). Ahmadu Bello University, Zaria, Nigeria.

- Jones, S. M., & Dindia, K. (2004). A meta-analytic perspective on sex equity in the classroom. *Review of Educational Research*, 74(4), 443-471.
- Kelly, J. R. (2010). Glossary of Instructional Strategies. Retrieved from <http://www.bugbee.com>
- Khairmar C. M. (2015). Advance pedagogy: Innovative methods of teaching and learning. *International Journal of Information and Education Technology*, 5(11), 869-872.
- Khurshid, F., & Ansari, U. (2012). Effects of innovative teaching strategies on students' performance. *Global Journal of Human Social Science linguist & Education*, 12(10), 47-53.
- Khurshid, F., & Zahur, B. (2013). Comparison of teacher's awareness and utilization of innovative teaching strategies in private and public sectors secondary schools. *Elixir Phycology*, 54(2013), 12242-12245.
- Kini, T., & Podolsky, A. (2016). *Does Teaching Experience Increase Teacher Effectiveness? A Review of the Research*. Washington DC: Learning Policy Institute.
- Kingdom-Aaron, G. I., Etokerin, I. S., & Okwele P. C. (2019). Effect of cooperative learning strategy on biology students' academic performance in senior secondary school in Rivers State. *Journal of Scientific research and reports*, 23(6), 1-11

- Kosgei, A., Mise, K. J., Odera, O., & Ayugi, E. M. (2013). Influence of teacher characteristics on students' academic achievement among secondary schools. *Journal of Education and Practice*, 4(3), 207-212.
- Kudryashova, A., Gorbatoa, T., Rybushkina, S., & Ivanova, E. (2016). Teacher's roles to facilitate active learning. *Mediterranean Journal of Social Sciences*, 7(1), 460-466.
- Kumagai, S., N. (2013) Ausubel's subsumption theory: The role and nature of advance Organizers. California State University Monterey Bay. Retrieved from http://www.academia.edu/4865184/ausubels_subsumption_theory._The_role_and_nature_of_advance_organizers
- Lamidi, B. T., Oyelekan, O. S., & Olorundare, A. S. (2015). Effects of mastery learning instructional strategy on Senior School students' achievement in the mole concept. *Electronic Journal of Science Education*, 9(5), 1-20.
- Mintz, S. (2014). Active Learning. Retrieved 24th November, 2014 from <http://www.columbia.edu/cu/tat/pdfs/active%20learning.pdf>
- Nabwire, J. L., Toili, W. W., Ong'unya, R.O. & Songok, J. R (2014). Influence of teacher's gender on student performance in biology in secondary schools in Kenya. *International Journal of Advanced*

- Research*, 2(2), 178-186. Retrieved from http://www.journalijar.com/uploads/18_IJAR-2653.pdf.
- Nair, P. (2008). *30 strategies for education innovation*. Retrieved from <http://www.designshare.com>
- Nasr, A. R., & Asghar, S. K. (2011) Attitude towards biology and its effects on students' achievement. *International Journal of Biology*, 3(4), 100-104.
- National Centre on Educational Outcomes (2002). *Glossary of teaching strategies*. Retrieved July 3, 2015 from <http://education.umn.edu/neco>
- NERDC. (2009). *Senior secondary education curriculum: Biology curriculum for senior secondary schools 1-3*. Abuja: Nigerian Educational Research and Development Council.
- Nguyen, M. (2013). Peer tutoring as a strategy to promote academic success. *Duke University Research Brief*, 1-8.
- Nnachi, R. O. (2007). *Advanced psychology of learning and scientific enquiry*. Enugu, Nigeria: John Jacob's Classic Publishers Ltd.
- Nwagbo, C., & Chukelu, U. (2011). Effects of biology practical activities on students' process skill acquisition. *Journal of Science Teachers' Association of Nigeria*, 46(1), 58-70.

- Nwagbo, C., & Obiekwe, C. (2010). Effects of constructivist instructional approach on students' achievement in basic ecology concept in biology. *Journal of Science Teachers Association of Nigeria*, 45(1&2), 26-35.
- Nworgu, L. N. (2005). Effect of gender sensitization package on students' achievement in integrated science. *Journal of Science Teachers Association of Nigeria*, 40, 74-79.
- Obeka, S. S. (2011). Panacea for science education research. Zaria: Ahmadu Bello University Press.
- Obomanu, B. J., & Akporehwe, J. (2011). Resources for teaching secondary school biology in Bayelsa state of Nigeria. *Information and Knowledge Management*, 1(2), 28-35.
- Odagboyi, I. A. (2015). The effect of gender on the achievement of students in biology using the jigsaw method. *Journal of Education and Practice*, 6(17), 176-179.
- Ogbeba, J. A. (2010). *Effect of prior knowledge of instructional objectives on senior secondary school students' motivation and achievement in biology* (Unpublished Ph.D. Thesis). Benue State University, Makurdi.
- Ogundare, S. F. (2001). Purposes and problems of recess in Nigerian primary schools. *University of Ado Ekiti Journal of Education*, 2(1), 4-8.

- Okebukola, P. A. (2005). Quality assurance in teachers education: The role of faculties of education. *Address presented to the Deans of Education, Ilorin, 30th July.*
- Okoro, A. U. (2011). *Effects of interaction patterns on achievement and interest in biology among secondary school students in Enugu state, Nigeria* (Unpublished M.Ed. Thesis). University of Nigeria, Nsukka.
- Okoye, N. S. (2009). *Theory and practice of curriculum development for Nigeria Students*. Abraka: Delsu Investment Ltd.
- Okoye, P. O. (2016). Influence of gender and cognitive styles on students' achievement in biology. *International Journal of Science and Technology*, 5(1), 59-65. [dio:org/10.4314/stech.v5i1.6](https://doi.org/10.4314/stech.v5i1.6)
- Okwara, O. K., Anyagh, P. I., & Ikyaan, G. S. (2017). Effect of projected instructional medium on senior secondary school students' achievement in biology. *International Journal of Scientific Research in Education*, 10(2), 137-147.
- Olagunju, A. M., & Abiona, O. F. (2008). Production and utilization of resources in biology education: A case study of south west Nigerian secondary schools. *International Journal of African and African American Studies*, 7(2), 49-56.

- Olaniyan, A. O., Omosewo, E. O., & Nwankwo, L. J. (2015). Effect of Polya problem solving model on senior secondary school student performance in current electricity. *European Journal of Science and Mathematics Education*, 3(1), 97-104.
- Olatoye, R. A., & Adekoya, Y. M. (2009). Effect of four teaching strategies on senior secondary school students' achievement in an aspect of agricultural science. *African Journal of Education Studies in Mathematics and Science*, 7, 1-6.
- Olatoye, R. A., & Adekoya, Y. M. (2010). Effect of project-based, demonstration and lecture teaching strategies on senior secondary students' achievement in an aspect of agricultural science. *International Journal of Educational research and Technology*, 1(1), 19-29.
- Olorundare, A. S. (2010). Best practices in the teaching of Science in Secondary Schools in Nigeria. *Lead paper presented at the Nigerian Educational Research and Development Council, (NERDC) Capacity Building Workshop, Kwara State.*
- Olorundare, A. S. (2005). Team teaching and departmentalization. In I. O. Abimbola & A. O. Abolade (Eds.), *Fundamental principle and practices of instruction (2nd Ed.)*. Ilorin:

- Olorundare, A. S. (2011). Correlates of poor academic performance of secondary students in the science in Nigeria. *Paper presented at the national institute of Capacity Building in Higher Education, Virginia state University, Petersburg Virginia, USA, June, 20-31, 2011).*
- Olorundare, A. S. (2014). *Theory into practice: Beyond surface curriculum in science education. The One Hundred and Forty-Seventh (147th) Inaugural Lecture Series.* Ilorin: Unilorin Press.
- Oludipe, B., & Oludipe, I. D. (2010). Effect of constructivist-based teaching strategy on academic performance of students in integrated science at junior secondary school level. *Educational Research and Reviews*, 5(7), 347-355.
- Oludipe, D. I. (2012). Gender difference in Nigerian junior secondary students' academic achievement in basic science. *Journal of Educational and Social Research*, 2(1), 93-101.
- Olumorin, C. O. (2008). *Lecturer's attitude to competence in and use of computer in tertiary institution in Kwara State, Nigeria* (Unpublished Ph.D. Thesis). University of Ilorin, Ilorin, Nigeria.
- Omoifo, C. N. (2012). *Dance of the limits: Reversing the trends in science education in Nigeria.* One hundred and twenty-fourth inaugural lecture delivered at the University of Benin City: University of Benin Press.

- Omosewo, E. O., Akanmu, A. M., & Asebiomo, A. M. (2013). Evolution of functional basic and senior secondary education curriculum in Nigeria: Implications for effective implementation. *Journal of Education and Practice*, 4(22), 73-79.
- Omotere, T. (2013). *Influence of school environment on academic performance of secondary school students in Lagos State*. <http://egoboosterbooks.files.wordpress.com>
- Onojah, A. O. (2016). *Undergraduate students' awareness readiness and motivation towards the adoption of study technologies for learning in Kwara state, Nigeria* (Unpublished master's dissertation). University of Ilorin, Ilorin, Nigeria.
- Orukotan, A. F. (2007). Curriculum enrichment of STM education as a basis for sustainable development. *50th Annual Conference Proceed 32-35*. Nigeria: Author.
- Oyekefi, Q. O., & Nzewi, U. M. (2012). Assessment of ICT competencies possessed by biology teachers in Nsukka education zone. In O. Abonyi (Ed.), *Meeting the challenges of UBE through STM Education, STAN 53rd Annual Conference (300-305)*. Ibadan: HEBN Publishers Plc.
- Oyelekan, O. S., Igbokwe, E. F. & Olorundare, A. S. (2017). Science teachers' utilisation of innovative strategies for teaching senior school science in

- Ilorin, Nigeria. *Malaysian Online Journal of Educational Sciences*, 5(2), 49-65.
- Pane, J. F., (2018). Strategies for implementing personalized learning while evidence and resources are underdeveloped. Retrieved from <https://www.rand.org/pubs/perspectives/PE314.html>
- Piaget, J. (1972). The epistemology of interdisciplinary relationships. Paris: Organization for Economic Cooperation and Development
- Razia , B. (2015). Study Habits of secondary school students in relation to their socio-economic status and gender. *International Journal of Social Sciences and Management*, 2(1), 68-73.
- Resurreccion, J. A. & Adanza, J. (2015) Spiral Progression Approach in Teaching Science in Selected Private and Public Schools in Cavite. *Proceedings of the DLSU Research Congress 3, 2015*
- Rosciano, A. (2015). The effectiveness of mind mapping as an active learning strategy among associate degree nursing students. *Teaching and Learning in Nursing*, 10, 93–99.
- Sachou, M. E. (2013). *Innovative methods of teaching*. Retrieved from <https://www.semanticscholar.org/paper/Innovative-Methods-of-Teaching-Sachou/7bc9e1e7480c09f71d6d191b633d658d8f246a76/abstract>

- Salman, M. F. (2009). Active learning techniques (ALT) in a mathematics workshop: Nigerian primary school teachers' assessment. *International Electronic Journal of Mathematics Education*, 4(1), 23-35.
- Sam, C. K., Owusu, K. A., & Anthony-Krueger, C. (2018). Effectiveness of 3E, 5E and conventional approaches of teaching on students' achievement in high school biology. *American Journal of Educational Research*, 6 (1), 76-82
- Samba, R. M., Achor, E. F., & Ogbeba, J. A. (2010). Teachers' awareness and utilization of innovative teaching strategies in secondary school science in Benue state, Nigeria, *Educational Research*, 1(2), 32-38.
- Singh, A. S., & Masuku, M. B. (2014). Sampling Techniques and Determination of Sample Size in Applied Statistics Research: An Overview. *International Journal of Economics, Commerce and Management*, II(11), 1-22. Retrieved June 26, 2018, from <http://ijecm.co.uk/>
- Singh, S., & Yaduvanshi, S. (2015). Constructivism in science classroom: why and how. *International Journal of Scientific and Research Publications*, 5(3), 1-5.

- Spencer, J. R., Anderson, K. M., & Ellis, K. K. (2013). Radiant thinking and the use of mind map in nurse practitioner education. *The Journal of Nursing Education*, 52(5), 291-293.
- Surajo, A. M. R., & Rislán, A. K. (2013). Integrating ICT in teaching and learning process in Nigeria: The pros and cons. *A Paper Presented at 1st International Conference of Arts and Social Sciences at Sa'adatu Rimi College of Education, Kumbotso, Kano, Nigeria.*
- Temitope, O. E., & Olabanji, O. E. (2015) Teachers' teaching experience and academic performance in mathematics and English language in public secondary schools in Ogun State, Nigeria. *International Journal of Humanities Social Science and Education*, 3(3) 123-134.
- Teo, R., & Wong, A. (2000). Does problem based learning create a better student: A reflection? *A Paper Presented at the 2nd Asia Pacific Conference on Problem Based Learning: Education Across Disciplines, 4th – 7th December, 2000.* Singapore: EAD.
- Thomas, S. D. (2006). *How teachers gender affect boys and girls.* Washington: Associated Press.
- Tofade, T., Eisner, J., & Haines, S. T. (2013). Best practice strategies for effective use of questions as a teaching tool. *American Journal of Pharmaceutical Education*, 77(7), 1-5.

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(2013) Getting the Big Idea: Concept-Based Teaching and Learning;

Retrieved at [https:// worldview.unc.edu](https://worldview.unc.edu).

Udeani, U., & Okafor, P.N. (2012). The effect of concept mapping instructional strategy on the biology achievement of senior secondary school slow learners. *Journal of Emerging Trends in Education Research and Policy Studies (JETERAPS)*, 3(2), 137-142.

Umar, F. (2011). *Role of science teacher. Study Lecture Notes*. Retrieved from <http://www.studylecturenates.com/social-sciences/education/> 248-role-of-science-teacher

Universal access to education, ERIM (2014): *A study of innovative strategies*
Retrieved from <https://www.yumpu.com/.../universal-access-to-education-a-study-of-innovative-strate...14/2/19>

Uzuner Yurt, S., & Aktaş, E. (2016). The effects of peer tutoring on university students' success, speaking skills and speech self-efficacy in the effective and good speech course. *Educational Research and Reviews*, 11(11), 1035-1042.

Vygotsky, L. (1978). Interaction between learning and development. In Gauvin & Cole (Eds.), *Readings on the development of children* (pp. 34-40). New York: Scientific American Books.

- Washoe Council School District (2015). *Student learning objectives: Instructional strategies list*. Retrieved from <https://www.washoeschools.net>
- Watkins, J., & Mazur, E. (2013). Retaining students in science, technology, engineering, and mathematics (STEM) majors. *Journal of College Science Teaching*, 42(5), 36–41.
- Wikipedia, the free encyclopaedia (2019). Mastery Learning. Retrieved from https://en.wikipedia.org/wiki/Mastery_learning
- Yusuf, M. O., & Adedeji, O. A. (2010). Effect of computer assisted instruction on secondary school students' performance in biology. *The Turkish Online Journal of Educational Technology*, 9(1), 62-69.
- Zakaria, E., Chin, C. L., & Daud, Y. (2010). The effect of cooperative learning on student mathematics achievements and attitude towards mathematics. *Journal of Social Sciences*, 6(2), 272-275.
- Zundel, P. & Deane, P. (2010). It's time to transform undergraduate education. *Final Report of task force on Innovative Teaching Practice to Promote Deep Learning at the University of Waterloo*. University Affairs Press.

APPENDIX I
DEPARTMENT OF SCIENCE EDUCATION
FACULTY OF EDUCATION
UNIVERSITY OF ILORIN, ILORIN, NIGERIA
QUESTIONNAIRE ON
BIOLOGY TEACHERS' AWARENESS AND UTILIZATION OF
INNOVATIVE TEACHING STRATEGIES IN SENIOR
SECONDARY SCHOOLS, SOUTH WEST, NIGERIA

Dear Teacher,

This questionnaire is designed to elicit response on your perception of the above subject matter. Any information provided will only be used for the purpose of this research work and will be treated confidentially.

Thank you for your participation in this study.

Kayode, O. O.

Researcher

SECTION A: PERSONAL INFORMATION

Instruction: Please kindly fill or tick () as appropriate in the following information

1. Name of school:
2. Gender: Male () Female ()
3. Academic Qualification: Ph.D. (Sc. Ed) () M.Sc. Ed () M.Sc. with
P.G.D.E. / NCE () B.sc (Ed.) () B.Sc. with P.G.D.E /NCE () HND ()
OND () NCE. () Others, please specify
.....
4. Area of specialization: Physic () Chemistry () Biology ()
5. Years of Teaching Experience
 - a. 0-10 years () b. above 10-20 years () c. above 20years ()

Section B: This section examines the extent to which you as a Science Teacher is aware of innovative teaching strategies, please tick as appropriate.

S/NO	INNOVATIVE TEACHING STRATEGY	AWARE	NOT AWARE
1.	Activity based instructional strategy		
2.	Mind map		
3.	Teaching with sense of humour		
4.	Personalized system of instruction		
5.	Wisely managed classroom technology		
6.	Think-pair- share		
7.	Jigsaw team work instructional strategy		
8.	Z-A approach		
9.	Mastery Learning / instructional strategy		
10.	Concept formation		
11.	Mnemonic-word-Words approach		
12.	Online Virtual Laboratories		
13.	Peer tutoring		
14.	Hands on Learning/instructional strategy		
15.	Brain based strategy		
16.	Experiential Learning/instructional strategy		
17.	Reciprocal Learning/instructional Strategy		
18.	Integrating debate into course assignment		
19.	Blended Learning/ instructional strategy		
20.	Inquiry based learning/instructional strategy		

Section C: This section measures the extent to which you as a Science

Teacher utilizes innovative teaching strategies, please tick as appropriate.

S/NO	INNOVATIVE TEACHING STRATEGY	FREQUENTLY USED	SOMETIMES USED	RARELY USED	NOT USED
1.	Activity based instructional strategy				
2.	Mind map				
3.	Teaching with sense of humour				
4.	Personalized system of instruction				
5.	Wisely managed classroom technology				
6.	Think-pair- share				
7.	Jigsaw team work instructional strategy				
8.	Z-A approach				
9.	Mastery Learning / instructional strategy				
10.	Concept formation				
11.	Mnemonic-word-Words approach				
12.	Online Virtual Laboratories				
13.	Peer tutoring				
14.	Hands on Learning/instructional strategy				
15.	Brain based strategy				
16.	Experiential Learning/instructional strategy				
17.	Reciprocal Learning/instructional Strategy				
18.	Integrating debate into course assignment				
19.	Blended Learning/ instructional strategy				
20.	Inquiry based learning/instructional strategy				

Section D: This is to examine the reason(s) for non-utilization of some selected innovative teaching strategies, please tick as appropriate.

S/NO	INNOVATIVE TEACHING STRATEGY	RESOURCES NOT AVAILABLE	STRATEGY IS TIME CONSUMING	I AM NOT FAMILIAR WITH THE STRATEGY
1.	Activity based instructional strategy			
2.	Mind map			
3.	Teaching with sense of humour			
4.	Personalized system of instruction			
5.	Wisely managed classroom technology			
6.	Think-pair- share			
7.	Jigsaw team work instructional strategy			
8.	Z-A approach			
9.	Mastery Learning / instructional strategy			
10.	Concept formation			
11.	Mnemonic-word-Words approach			
12.	Online Virtual Laboratories			
13.	Peer tutoring			
14.	Hands on Learning/instructional strategy			
15.	Brain based strategy			
16.	Experiential Learning/instructional strategy			
17.	Reciprocal Learning/instructional Strategy			
18.	Integrating debate into course assignment			
19.	Blended Learning/ instructional strategy			
20.	Inquiry based learning/instructional strategy			

Kindly state two (2) other reasons responsible for your not utilizing the listed innovative teaching strategies.

1.....
.....
.....
.....

2.....
.....
.....
.....

APPENDIX II
UNIVERSITY OF ILORIN, ILORIN, NIGERIA
DEPARTMENT OF SCIENCE EDUCATION
INFORMED CONSENT FORM FOR SCHOOL PRINCIPAL

Dear Sir/Ma,

Please be informed that you have been selected to participate in a research study in which your consent of participation is required. Detailed information about the research is provided below. Kindly endorse this consent form if you volunteer to participate in the study after reading about the research.

Purpose of the Research: This study aims at examining biology teachers' awareness and utilization of innovative teaching strategies in senior secondary schools, south west, Nigeria

This is part of an effort to promote meaningful teaching and learning in our secondary schools.

Procedure: Teacher participants will be required to respond to questions on their level of awareness and utilization of innovative teaching strategies as well as their bio data.

Confidentiality: All information provided by you will be treated with utmost confidentiality and used for the purpose of the research only.

Risks: Response to questions on the questionnaire will be administered in a small office within your school premises, hence no risk is envisaged to you during the research.

Benefits: The likely benefits to you include having factual information with respect to students' meaningful learning of the sciences and this can be used to properly plan for effective teaching and learning.

Right of volunteers (Teachers Participants): Your participation in this research is voluntary. If you decide not to take part or stop your participation in the research at any time, you will not lose anything. If you have any question about this research, you may contact the Department of Science Education, University of Ilorin, Ilorin, Nigeria or call the researcher on cell phone number: 08060392780

Principal's Respondent Agreement: I hereby voluntarily consents to participation of my biology teachers in the research. I understand that I may refuse my teachers' participation or stop their participation in the research at any time.

..... Principal	 Signature	 Date
..... Researcher	 Signature	 Date

APPENDIX III
UNIVERSITY OF ILORIN, ILORIN, NIGERIA
DEPARTMENT OF SCIENCE EDUCATION
INFORMED CONSENT FORM FOR BIOLOGY TEACHERS

Dear Teacher,

Please be informed that you have been selected to participate in a research study in which your consent of participation is required. Detailed information about the research is provided below. Kindly endorse this consent form if you volunteer to participate in the study after reading about the research.

Purpose of the Research: This study aims at examining biology teachers' awareness and utilization of innovative teaching strategies in senior secondary schools, south west, Nigeria

This is part of an effort to promote meaningful teaching and learning in our secondary schools.

Procedure: Teacher participants will be required to respond to questions on their level of awareness and utilization of innovative teaching strategies as well as their bio data.

Confidentiality: All information provided by you will be treated with utmost confidentiality and used for the purpose of the research only.

Risks: Response to questions on the questionnaire will be administered in a small office within your school premises, hence no risk is envisaged to you during the research.

Benefits: The likely benefits to you include having factual information with respect to students' meaningful learning of the sciences and this can be used to properly plan for effective teaching and learning.

Right of volunteers (Teachers Participants): Your participation in this research is voluntary. If you decide not to take part or stop your participation in the research at any time, you will not lose anything. If you have any question about this research, you may contact the Department of Science Education, University of Ilorin, Ilorin, Nigeria or call the researcher on cell phone number: 08060392780

Teacher Respondent Agreement: I hereby voluntarily consent to participate in the research. I know that I may refuse to participate or stop my participation in the research at any time.

.....		
Teacher participant	Signature	Date

.....		
Researcher	Signature	Date

APPENDIX IV

UNIVERSITY OF ILORIN, ILORIN, NIGERIA

DEPARTMENT OF SCIENCE EDUCATION

INFORMED CONSENT FORM FOR RESEARCH ASSISTANTS

Dear Sir/Ma,

Please be informed that you have been selected to participate in a research study in which your consent of participation is required. Detailed information about the research is provided below. Kindly endorse this consent form if you volunteer to participate in the study after reading about the research.

Purpose of the Research: This study aims at examining biology teachers' awareness and utilization of innovative teaching strategies in senior secondary schools, south west, Nigeria

This is part of an effort to promote meaningful teaching and learning in our secondary schools.

Procedure: Teacher participants will be required to respond to questions on their level of awareness and utilization of innovative teaching strategies as well as their bio data.

Confidentiality: All information provided by you will be treated with utmost confidentiality and used for the purpose of the research only.

Risks: Response to questions on the questionnaire will be administered in a small office within the school premises, hence no risk is envisaged to you during the research.

Benefits: Remuneration of five hundred per school visited (N500/selected school visited) will be given to each research assistance for the period of training and administering the questionnaire.

Right of volunteers (Research assistant Participants): Your participation in this research is voluntary. If you decide not to take part or stop your participation in the research at any time, you will not lose anything. If you have any question about this research, you may contact the Department of Science Education, University of Ilorin, Ilorin, Nigeria or call the researcher on cell phone number: 08060392780

Research assistant Participants Respondent Agreement: I hereby voluntarily consent to participate in the research. I know that I may refuse to participate or stop my participation in the research at any time.

.....
Teacher participant

.....
Signature

.....
Date

.....
Researcher

.....
Signature

.....
Date

APPENDIX V

SCIENCE TEACHERS' AWARENESS AND UTILIZATION OF INNOVATIVE TEACHING STRATEGIES (STAUTS) QUESTIONNAIRE VALIDATION FORM

Name of validator

Department

As a validator, kindly rate the various section of this questionnaire between 1 and 5, with 5 being the highest

Item		validator's rating
1.	Relevance of the instrument to the research work	
2.	Comprehension level of the instrument to the respondent	
3	Emotional / psychological effect of the instrument on the respondent	
4.	Suitability of the instrument to the research work	
5.	Suitability of the instrument to the age level of the respondent	
	Total Score	/25

Validator's General Comment &
Recommendation.....

.....
I hereby acknowledge that I have gone through various sections of this research work and I attest that the research instrument "STAUTS" has attained a good standard to measure content and face validity of the research work.

Name/Signature and Date

.....

APPENDIX VI

RESEARCH ADVISORS

Required Sample Size

Confidence = 95%

Confidence = 99%

Population Size	Margin of Error				Margin of Error			
	5.0%	3.5%	2.5%	1.0%	5.0%	3.5%	2.5%	1.0%
10	10	10	10	10	10	10	10	10
20	19	20	20	20	19	20	20	20
30	28	29	29	30	29	29	30	30
50	44	47	48	50	47	48	49	50
75	63	69	72	74	67	71	73	75
100	80	89	94	99	87	93	96	99
150	108	126	137	148	122	135	142	149
200	132	160	177	196	154	174	186	198
250	152	190	215	244	182	211	229	246
300	169	217	251	291	207	246	270	295
400	196	265	318	384	250	309	348	391
500	217	306	377	475	285	365	421	485
600	234	340	432	565	315	416	490	579
700	248	370	481	653	341	462	554	672
800	260	396	526	739	363	503	615	763
1,000	278	440	606	906	399	575	727	943
1,200	291	474	674	1067	427	636	827	1119
1,500	306	515	759	1297	460	712	959	1376
2,000	322	563	869	1655	498	808	1141	1785
2,500	333	597	952	1984	524	879	1288	2173
3,500	346	641	1068	2565	558	977	1510	2890
5,000	357	678	1176	3288	586	1066	1734	3842
7,500	365	710	1275	4211	610	1147	1960	5165
10,000	370	727	1332	4899	622	1193	2098	6239
25,000	378	760	1448	6939	646	1285	2399	9972
50,000	381	772	1491	8056	655	1318	2520	12455
75,000	382	776	1506	8514	658	1330	2563	13583
100,000	383	778	1513	8762	659	1336	2585	14227
250,000	384	782	1527	9248	662	1347	2626	15555
500,000	384	783	1532	9423	663	1350	2640	16055
1,000,000	384	783	1534	9512	663	1352	2647	16317
2,500,000	384	784	1536	9567	663	1353	2651	16478
10,000,000	384	784	1536	9594	663	1354	2653	16560
100,000,000	384	784	1537	9603	663	1354	2654	16584
300,000,000	384	784	1537	9603	663	1354	2654	16586

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APPENDIX VII

BUDGET PROPOSAL

DESCRIPTION OF ITEM	TOTAL
1.0 Equipment(list & specification)	
1.1 HP Laptop	175,000
1.2 HP Laser jet printer	85,000
1.3 Flash drive	2000
1.4 Universal Modem	8,000
SUB-TOTAL	270,000
2.0 Supplies/ Consumables	
2.1 Papers/ toners	52,000
2.2 Purchase of textbooks and writing materials	50,000
2.3 monthly subscription of modem per month × 30	8000
SUB-TOTAL	110,000
3.0 Data Collection and Analysis	
3.1 Photocopies of materials	260,000
3.2 Analysis of data	60,000
SUB-TOTAL	320000
4.0 Travels	
4.1 Loca1 Run Around	110,000
SUB-TOTAL	110,000
5.0 Disseminations	
5.1 Seminar 1(proposal)	45,000
5.2 Seminar 2(protocol)	25,000
5.3 Seminar 3(mock defence)	20,000
5.4 Seminar 4 (oral defence)	310,000
SUB –TOTAL	40,000
6.0,Others/ Miscellaneous	
6.1 Publication and conferences	
6.2 Accommodation / Feeding on research Trip	50,000
6.3 Miscellaneous	100,00
	50,000
SUB-TOTAL	200,000

GRAND TOTAL 1,420,00

APPENDIX VIII
Postgraduate Research Plan

	01/11/15		01/12/15		05/01/16		01/02/16		01/03/16		01/04/16		01/05/16		01/06/16		01/07/16		01/08/16		01/09/16		01/10/16		01/11/16		01/12/16		01/01/17		01/02/17		01/03/17		01/04/17		01/05/17		01/06/17		01/07/17		01/08/17		01/09/17		10/11/17		08/11/18		01/12/18		01/01/19		05/01/19		12/01/19		15/01/19		01/05/19		01/07/19		10/07/19		24/07/19		30/07/19		10/10/19																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																	
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APPENDIX IX

FEATURES OF THE SELECTED INNOVATIVE TEACHING STRATEGIES

	INSTRUCTIONAL STRATEGIES	CHARACTERISTIC FEATURES
1.	Activity based learning strategy is an instructional strategy which focus on how learner relates with the subject matter content of a course through active participation, generating of ideas, writing, discussing, reading, acting, movies, inquiry and problem solving situation, rather than be a passive listener and a receiver of knowledge	a. Learner centered b. Encourages creativity c. Encourages working in groups
2.	Mind map is a way of helping students make notes that used only key words and images, which is a simple technique for drawing information in diagrams, instead of writing it in sentences. The diagrams usually take the basic format of a tree, with a point starting from the middle, then branches out and divides again and again The tree is made up of words or short sentences connected by lines. The lines that connect the words are part of the meaning	a. Learner centred b. Motivation of student c. Reduction of anxiety and stress in dealing with difficult concept
3.	Teaching with sense of humour involves the use many devices with the help of which one can teach effectively. It is easy to create a humour in the classroom by reading books of jokes, watching scientific base cartoon and listening to professional comics, using techniques such as exaggeration, pauses, and timing. Observing reality and exaggerate it. Much humour lies in observations about real life and truthful situations.	a. Activity based b. Active learning environment to facilitate interest c. Reduction of anxiety and stress in dealing with difficult concept
4.	Personalized system of instruction is an innovative strategy in which instruction is tailored to the particular needs, aptitudes and abilities of the learner who works at his or her own pace. In this type of strategy, instructions is responsive to learners' need and values, the learners have a choice in choosing the teaching strategy, deciding the choice of subject matter and time for learning, selection of goals and criteria for evaluation	a. Learner centred b. Improved learning / self-motivation c. Encourages interest, best performance and class attendance
5.	Wisely managed classroom technology involves the use of wide range computer based multimedia which is able to integrate voice video and computer technologies. Such faculties include computer, tablets, digitals cameras, internet, video conferencing	a. Activity based b. Encourages working as individual and in groups

	technology and GPS devices which can all enhance student's learning experiences and play useful roles in distance education	c. Increases emotionally stable and social learning environment
6.	Think-pair- share begins with information that was provided initially through a reading assignment, a short lecture, a videotape, etc. The instructor then poses a single question and students are instructed to reflect (i.e., think) about the question and to note their response in writing. Students then turn to a partner and share their responses.	a. Activity based b. Divergence thinking c. Encourages creativity
7.	Jigsaw team work / puzzle is a cooperative learning strategy in which a broad topic is shared into smaller, interrelated pieces, after which each member of a group is assigned to read and become proficient on a different piece of the puzzle. Once an individual becomes knowledgeable on their piece of the puzzle, he/she teaches the other group members that puzzle piece. After each person is done teaching, the puzzle will be reassembled and everyone in the group knows something important about every piece of the puzzle. The strategy is often used for the purpose of team building or quickly managing a large task in a short time	a. Activity based b. Improvement on Psychomotor, cognitive and affective domain of the learner c. Encourages working in pairs
8.	Z-A approach attempts to explain the application part of a particular concept first after which he/she explains the effects of such applications. This type of teaching method is useful in teaching laws, principles, generalization and theories. For example, the teacher demonstrates the falling of any object throw up before explaining the concept of force of gravity to the students.	a. Learner centred b. Critical thinking c. Ability to invent
9.	Mastery Learning applies the principles of individualized instruction and tutoring to whole class learning.), In this strategy, rather than waiting till the end of lesson to check on progress, teachers design an ongoing test to use during the process of teaching which provides individual feedback, identify learning needs/difficulties, recommend specific remediation or enhancement strategies, and re-evaluates with a parallel assessment. Mastery learning encourages students to learn at different levels or paces	a. Activity based b. Improves self-motivation c. Encourages creativity

10.	Concept Formation: In concept formation, learners are provided with information about a specific concept. These information may be provided by the teacher or by the students. Learners are then instructed to classify or group the information and give descriptive labels to their groupings. By connecting the examples to the labels and by supporting their reasoning with explanation, the students form their own understanding of the concept. Concept formation provides learners with an opportunity to discover new ideas by making connections and seeing relationships between items of information	a. Activity based b. Encourages critical thinking c. Encourages creativity
11.	Mnemonic-word-Words approach is a type of innovative teaching method, in which the teacher goes on saying only words instead of sentence, and once the students come to a basic understanding of the meaning of a particular concept then the teacher will explain in sentences. For example the teaching of characteristics of living things using acronyms like 'MR NIGER D'. This technique can be used as an effective medium by the teacher to develop the ability of the learner to recall, synthesize, organize and deduce meaning of terms and word power.	a. Activity based b. Reduction of anxiety and stress in dealing with difficult concept c. Encourages interest, test performance and class attendance
12.	Online Virtual Laboratories is a teaching and learning environment where participants can interact, communicate, view and discuss presentations, and engage with learning resources while working in groups. Just like in a real-world classroom, a student in a virtual classroom participates in synchronous instruction, which means that the teacher and students are logged into the virtual learning environment at the same time.	a. Increases emotionally stable and social learning environment b. Encourages working as individual or group c. Activity based
13.	Peer tutoring/learning is a type of collaborative learning that involves students working in pairs or small groups to discuss concepts, or find solutions to problems. It enables learners to take responsibility for reviewing, organizing, and consolidating existing knowledge and material; understanding its basic structure; filling in the gaps; finding additional meanings; and reformulating knowledge into new conceptual frameworks. Learning from peers increases	a. Activity based b. Improved leadership skills c. Encourages working as a team

	learning both for the students being helped as well as for those giving the help.	
14.	Hands on Learning instructional strategy is an educational strategy that directly involves learners by encouraging them to do something in order to learn about it. It is learning by doing. For example, construction of teaching models.	a. Learner based b. Critical thinking c. Improves creativity
15.	Brain based strategy is a form of pause procedure with an extremely easy and effective approach to promoting greater student engagement with minimal modification to one's traditional lecture presentations. This strategy has the instructor pausing for approximately two minutes on three occasions during a forty-minute lesson (i.e., every 12-15 minutes). During the pauses, students work in pairs to discuss and rework their notes without teacher-student interaction. The teacher shares information for ten minutes and then stops for two minutes to encourage listeners to pair and share their ideas, fill in any gaps or misunderstandings, and allow each other to clarify information.	a. Lively atmosphere to facilitate interest b. Ability to work in pairs c. Increases creativity
16.	Experiential Learning, is a strategy in which educators purposefully engage with students in direct experience and focused reflection in order to increase knowledge, develop skills, and clarify values. A students in experiential learning situations cooperate and learn from one another in a more semi-structured approach. Instruction is designed to engage students in direct experiences which are tied to real world problems and situations in which the instructor facilitates rather than directs student progress.	a. Encourages working as individual or group b. Activity based c. Divergence thinking d. Encourages creativity
17.	Reciprocal Learning Strategy is an instructional approach in which students become the teachers in small group reading (or other content) sessions. Teachers model, then help students learn to guide group discussions using strategies such as summarizing, question generating, clarifying, and predicting. Once students have learned the strategies, they take turns assuming the role of teacher in a dialogue about what has been read. In another version, students take the roles of predictor, summarizer, questioner, and clarifier.	a. Activity based b. Improved leadership skills c. Encourages working as a team
18.	Integrating debate into course assignment	a. Activity based

	Debate is a structured form of argumentations that requires participants to engage in research, develop listening and oratory skills, and think critically. Debating can be employed as an instructional strategy wherever the learning material and circumstances are open to opposing points of view. Debates may be viewed or read to contribute additional perspectives on a classroom topic.	b. Reduction of anxiety and stress in dealing with difficult concept c. Encourages interest, test performance and class attendance
19.	Blended Learning is a formal education program in which a student learns at least in part through online delivery of content and instruction with some element of student control over time, place, path or pace. This means the combination of face to face teaching and online learning. Hybrid learning facilitates simultaneous independent and collaborative learning experience which contributes hugely to student satisfaction and success in subjects/courses	a. Increases emotionally stable and social learning environment b. Encourages working as individual or group c. Activity based
20.	Inquiry based learning works on the principle that knowledge is “constructed” from experience and process. It covers a range of approaches, including: field work, case studies, investigations, individual and group projects, and research projects. Specific learning processes that students engage in during inquiry include: developing questions, seeking evidence to answer questions, explaining evidence, and justifying or laying out an argument for the evidence.	a. Learner based b. Encourages creativity c. Encourages working in groups